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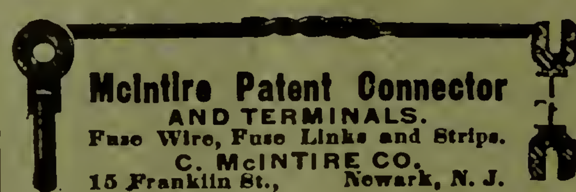

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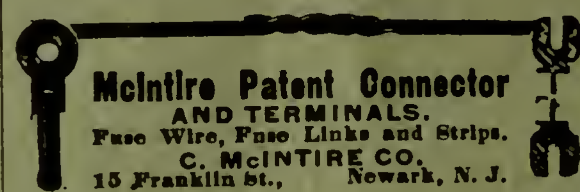

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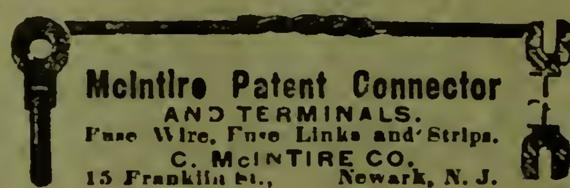

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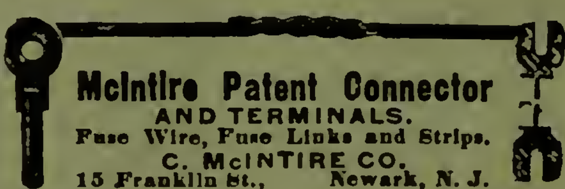

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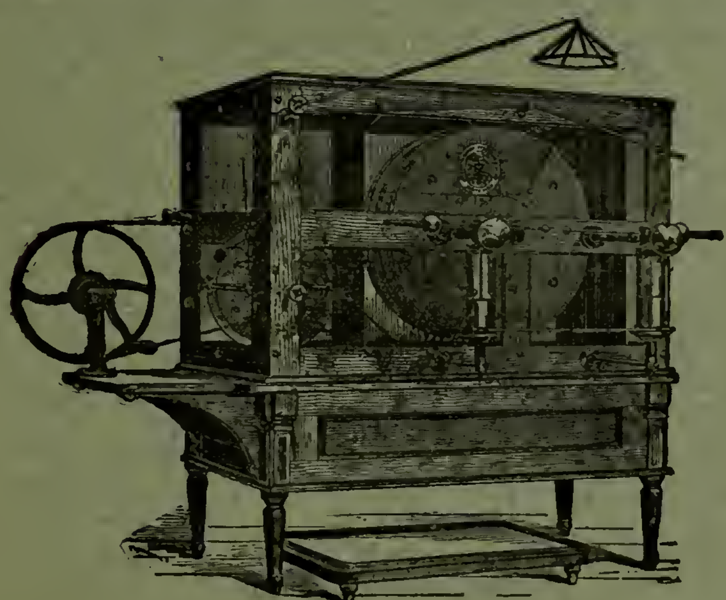

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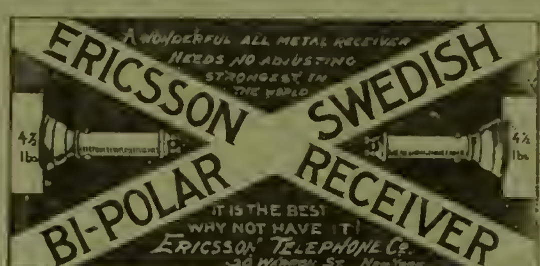

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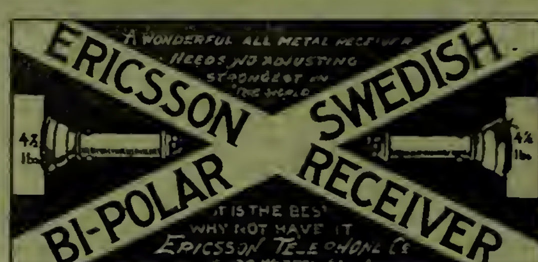

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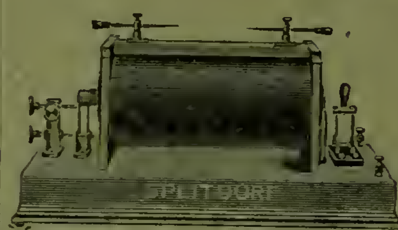

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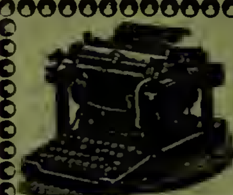

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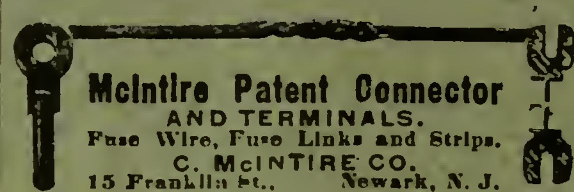

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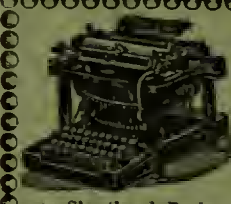

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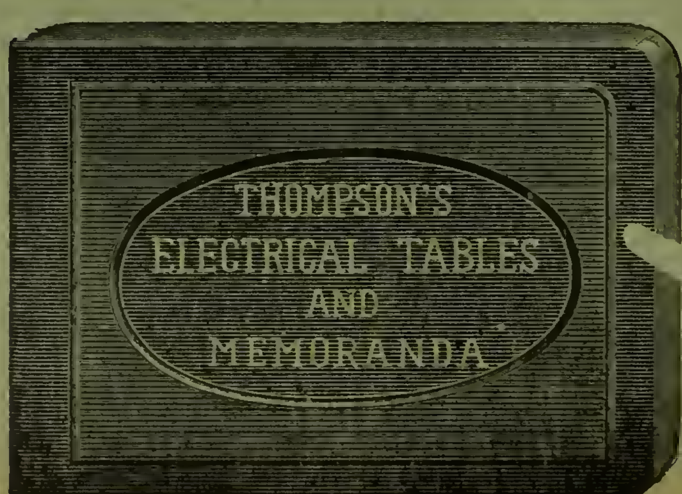

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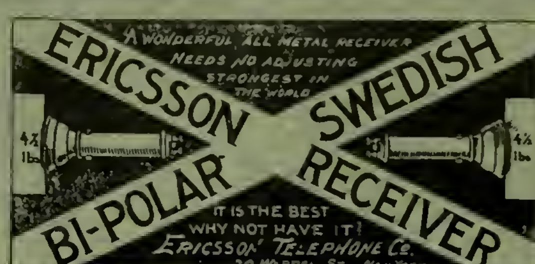

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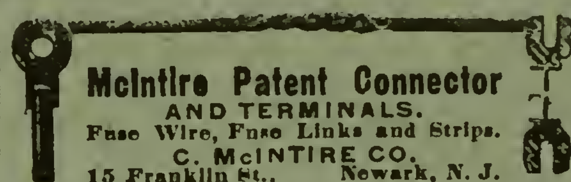

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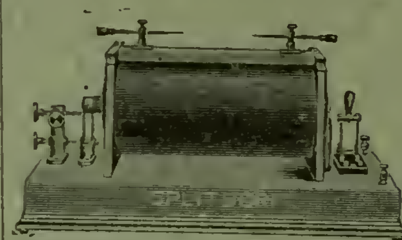

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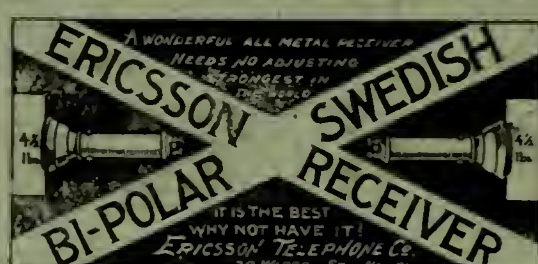

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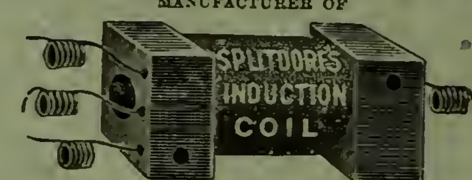

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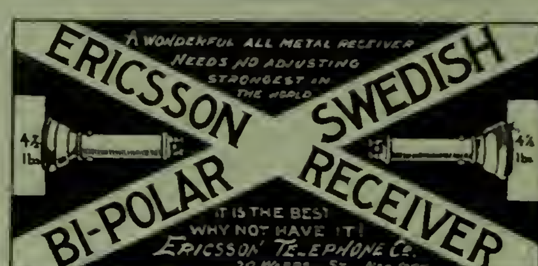

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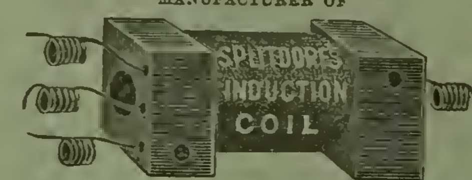

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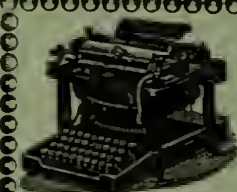

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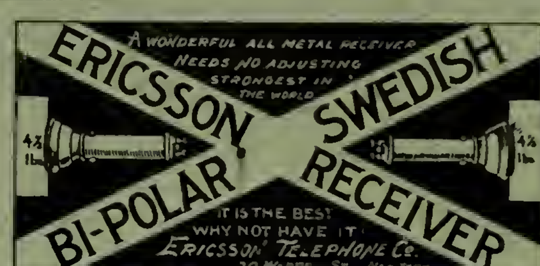

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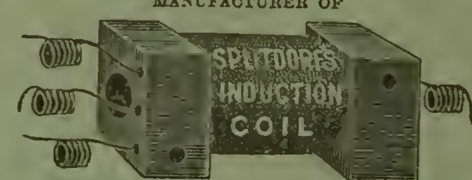

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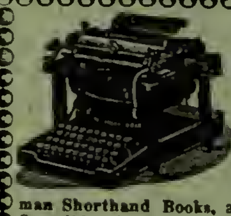

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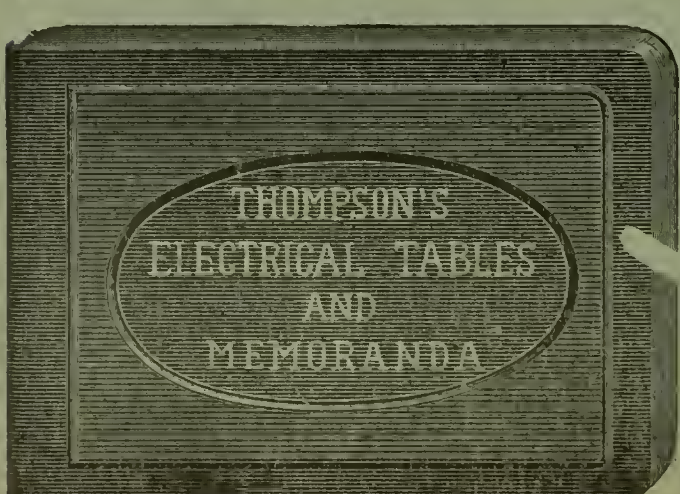

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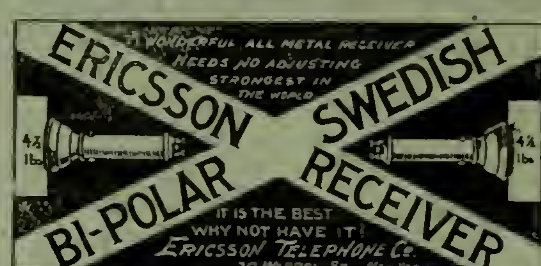

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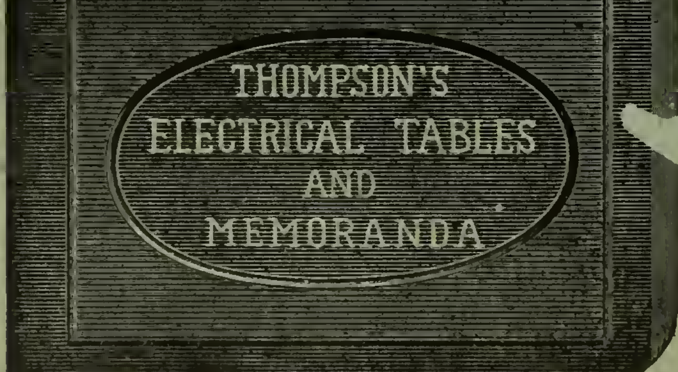

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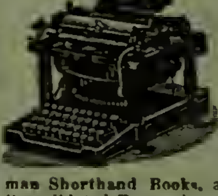

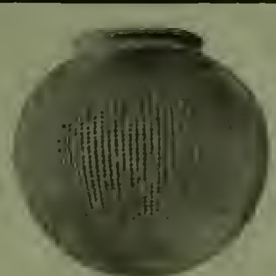

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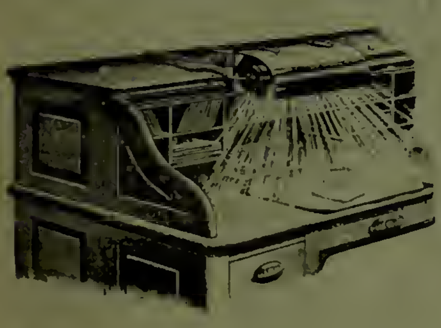

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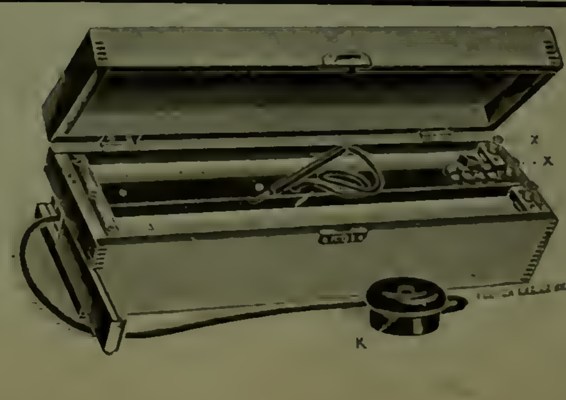

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The Electrical Age.

VOL. XXIV—No. 1 NEW YORK, JULY 1, 1899 WHOLE No. 633

LIGHT AND ITS MANIFESTATIONS.

Fig. 1

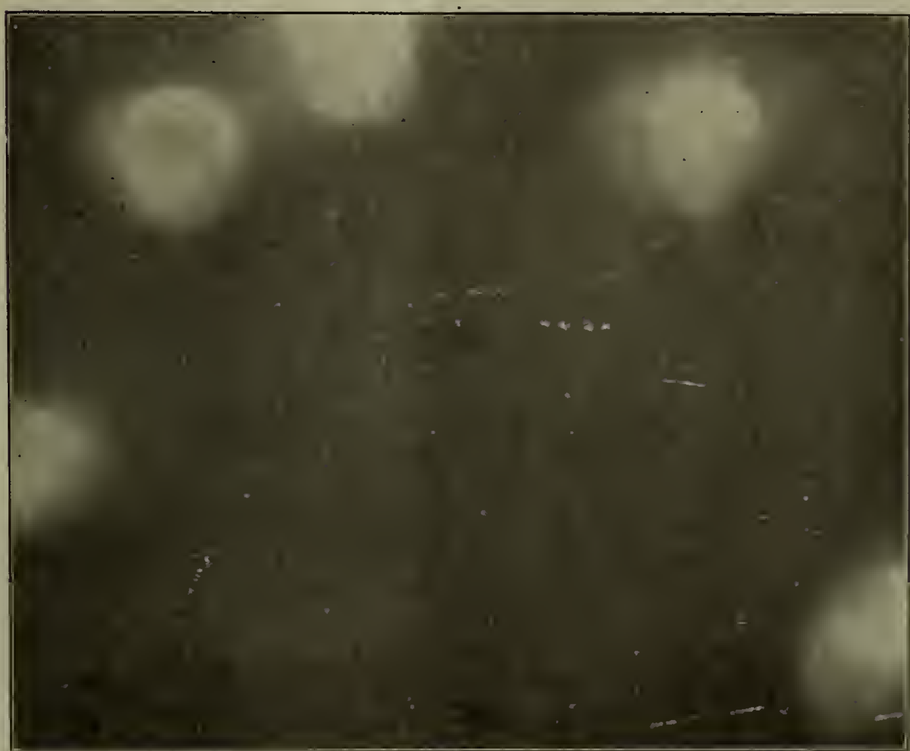

Fig. 2.

Human Rays.

*HUMAN RAYS.

(By Ottokar Hofmann.)

I have discovered the very interesting fact that the human body emits rays which act on a sensitive photographic plate. There is a distinct difference in the property of these rays and that of light. They pass through certain opaque substances, while to others they impart their vibration; and these substances in this condition then act on the photographic plate. Before giving a description of my experiments I will mention that it seems that not all persons emit rays of the same chemical energy. Some persons whom I tried produced a strong, while others only a faint impression on the film and others even none at all. But it may be that, had I tried these same persons the next day, the result would have been an entirely different one, because I made the observation on myself that at different times there was much difference in the chemical energy of the rays emitting my fingers. What causes these differences I do not know, but these rays being produced by the functions of our organic system, it is not improbable that these differences occur in connection with the regularity and irregularity of these functions. However, my experience in this direction is too limited to justify the expression of a positive opinion.

I filled a developing tray a little over half with developing solution and placed a sensitive photographic plate in it with the film up. This was done in perfect darkness without the use of a developing lamp. (The developing

*Through the courtesy of "The Engineering and Mining Journal."

solution consisted of: Metol, $\frac{1}{4}$ oz.; hydrochinon, $\frac{1}{4}$ oz.; water, 80 oz.; sulphate of soda, crystals, 4 oz., and carbonate of soda, crystals, $2\frac{1}{2}$ oz.) Then I put the tips of my fingers into the solution and kept them for 10 minutes as close as possible to the film. After this the plate was put as usual into the "hypo" solution. When taken out the negative showed five distinct black spots on the plate, See Fig. 2. In this case the reaction on the silver compounds of the film was apparently produced through the glass, still the possibility was left that hydrogen sulphide may have been absorbed by the liquid, and being so very diluted, may have acted only on those parts of the film which were warmed by the touch of the fingers.

Next I soaked a plate for 5 minutes in the developing solution, then took the plate out, held it in one hand and pressed the fingers gently against the glass side of the plate. There was again the image of the fingers impressed on the film. This was nearly conclusive that the reaction took place through the glass, but there was still the faint possibility left that hydrogen sulphide emitted into the air acted more readily on the warmer places of the film.

Fig. 4.

Fig. 1. This showed that a chemical reaction took place, but it did not give any information as to the nature of this reaction, whether it was caused by a chemical reagent like hydrogen sulphide, which the body emitted, or by rays, especially as it was difficult to keep the fingers close to the plate without touching the film occasionally.

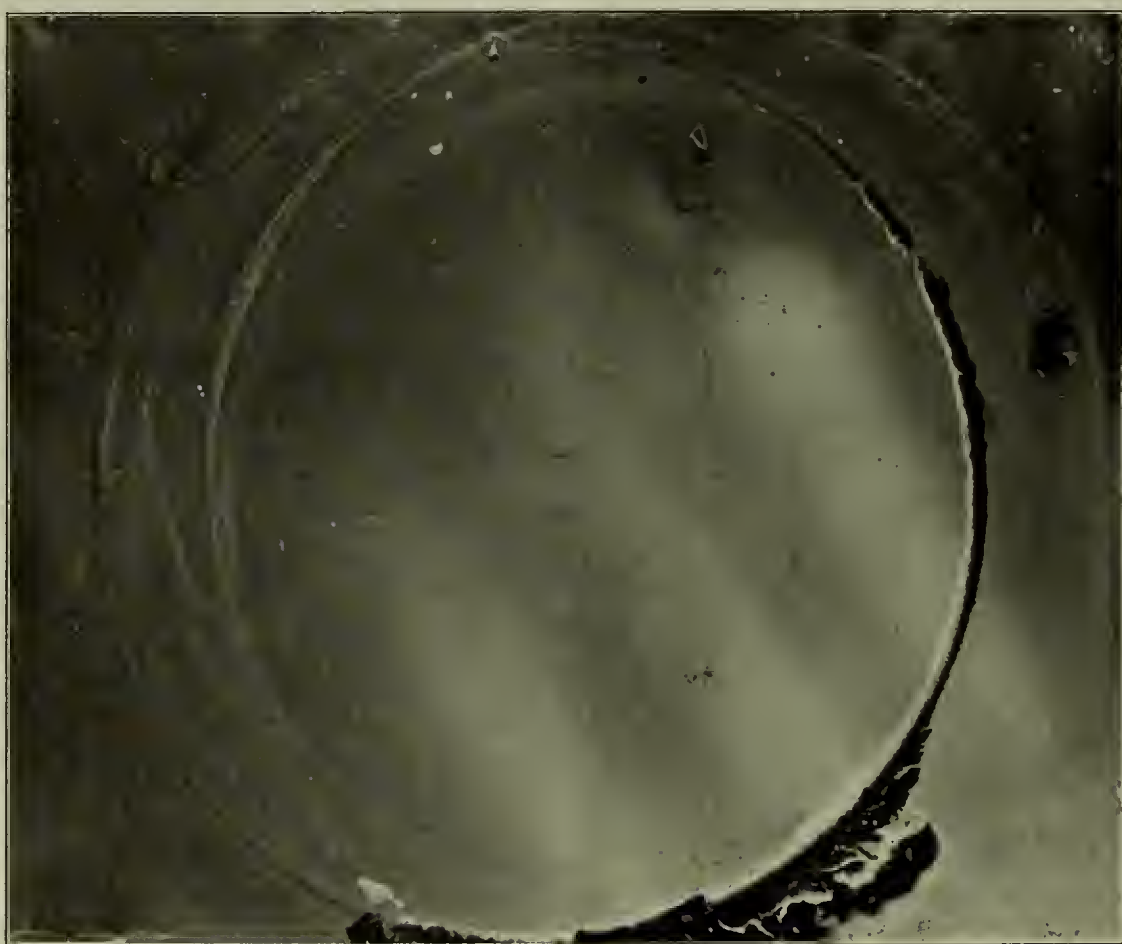

Fig. 3.

In my next experiment I put the plate in the tray with the film down and resting on the four little buttons with which the bottom of the tray was provided. Then I pressed the back of my four fingers gently against the plate and kept them in position for 10 minutes. The result was a quite distinct image of my fingers on the film.

I now soaked again a plate for 5 minutes in the developing solution and pressed the plate with the film against the rim of a cut glass vase. The soft film closed the vase hermetically. Then I placed the fingers on the back of the plate for 10 minutes, and obtained a very distinct imprint of the fingers. See Fig. 3. During the operation the plate was sliding a little on the rim of the vase, as can be seen by the photograph, but nevertheless the inside of the vase remained perfectly closed, so that no air could enter the same while the experiment was performed. It can be seen that the part of the fingers within the rim of the vase is just as plainly imprinted as the part outside of it.

The result of this experiment convinced me that the reaction on the silver compounds of the film was caused by rays and not by any chemical reagent.

Then I tried the effect of the rays when intersected by different substances. I placed a silver dollar on the glass side of the plate, the dollar being covered by the developing solution, and held two fingers during ten minutes on the metal. The result was a distinct impression of the dollar without giving any detail of the stamp of the coin. The fingers touching the coin were not imprinted on the film. See Fig. 4. This indicates that the rays did not pass through the metal, but that their vibration was imparted to the metal, which then acted on the film. Then I placed, also on the glass side of a plate, two silver dollars and touched one of them. The result showed that the image of the dollar which I touched was imprinted on the film, while the other did not act at all. Next I tried a plate of fine silver 1.32 in. thick, 2 in. wide and 3 in. long and touched the same with three fingers. Though the silver plate was thin, the tips of my fingers were not impressed on the film, but an imprint of the whole plate was plainly visible. The impression, however, was not as strong as that obtained with the dollar, indicating that the force of the rays may be in proportion to the surface of the metal. Then I experimented with a round plate of lead of the size and thickness of a silver dollar. The result was the same as obtained with the coin, only that the imprint was fainter, suggesting that not all metals are equally affected by the rays. In order to investigate if these rays can be conducted for some distance through the metal, I had soldered with lead to the center of the round lead plate a lead rod $\frac{1}{4}$ in. thick and 10 in. long. The soldering was done with lead to avoid the formation of a galvanic current by the contact of two different metals. I bent the rod about 4 in. above the lead plate, held the bent part of the rod in my hand and kept the metal 10 minutes on the glass side of the photographic plate. The shape of the metal was not imprinted on the film, only a few irregular spots where the metal rested were visible, but it could be plainly seen that an action took place over the whole film. The negative became dark.

In my next experiment I placed again a photographic plate in the tray with the film down. Then I took the hard rubber tray in my hand and placed my fingers on the outside of the bottom of the same and held them in position the usual time. The result of the experiment was a plain imprint of my fingers on the film. As the plate rested on the four little buttons of the bottom of the tray, the rays therefore passed through $\frac{1}{8}$ in. thick hard rubber and a sheet of solution.

Comparing the results of the experiments, we find that by placing the fingers on the rubber or glass we obtain the image of the fingers, while if we place them on a metal we do not obtain the image of the fingers, but that of the metal we touched. Though the information obtained by these few experiments is very limited, the results seem to indicate that the human rays have the property of passing undisturbed through a material which is a non-conductor of electricity (rubber, glass), while they communicate their vibration to a conductor of electricity (silver, lead), which then acts as such on the film.

During my experiments I observed some phenomena which were rather puzzling on account of the irregularity with which they appeared. For instance, it happened sometimes that the film melted away from some of the places where the fingers touched the glass, leaving the same bare in the shape of the fingers. The gelatine was then found adhering to the bottom of the tray in exactly the same position as the fingers were touching the plate. This happened sometimes and not at others, even if I used in both cases developer of the same temperature and touched the plate during the same number of minutes. I attribute the melting away of the film to the effect of the temperature of my fingers. Still, I had it also happen when I placed the fingers on the outside of the bottom of the tray, and it is not easy to see how the heat of the fingers could have passed through such a non-conductor of heat as rubber and through the solution during the short time of 10 minutes.

Again I observed that occasionally the places touched with the fingers assumed on the film a metallic luster. In one instance it happened that the whole plate was converted into a mirror, while, if held against the light, the dark imprint of the fingers could be plainly seen.

Using distilled water instead of the developing solution, I did not succeed in getting an imprint on the film; nor did I when I touched a dry plate and then placed it in the developer. In experimenting it is well to change frequently the developing solution.

My discovery undoubtedly opens a very interesting field for investigation for the physiologist.

ELECTRIC LIGHT AND POWER.

ELECTRIC POWER FOR SHIPYARDS.

The shipyard, however, presents some new problems not encountered in the ordinary manufacturing plant, for power is required not only in the shops where regular machine work of all kinds is done, but also for the large derricks and traveling cranes in the yards, an extensive system of tramways, portable drills and other tools for use on the hulls, temporary lighting of the hulls, pumps for dry docks, and for various other purposes. Appliances, like those mentioned, must be ready for use at any and all times and in different parts of the yard. Furthermore, shipyards, with the exception of those on the Great American Lakes, are located on salt water, and as many of these appliances must operate out of doors, the motors and the conductors leading to them must be properly protected from salt air and from the weather.

While this necessitates special precaution in these cases, it cannot be said that such applications are experimental, for no service in a shipyard can equal in severity that imposed on a street car motor, for example, which is operated by a man who does not see it, and who knows little or nothing of its construction or care. It is, besides, necessarily exposed in its location under the car to all kinds of weather conditions under the most unfavorable circumstances. In spite of these difficulties, there are more street car motors in use to-day than motors of any other single type built. The distinguishing features of such a motor are its generally massive construction, ample bearings, large reserve capacity, and an enclosing steel case, itself a part of the structure, which protects the more delicate parts and renders the motor practically dust and water proof. Such a type lends itself readily to many of the out-of-door requirements of a shipyard.

Before the general introduction of electricity in shipyards it was customary to use compressed air for operating rivetters and drills, and for other out-of-door work. This not only necessitates an expensive plant for compressing and storing the air, but permanent pipes must be laid wherever the power is required, and flexible pipes must be used in the vicinity of the work. The system is cumbersome and expensive, both in first cost and in operation, while not over 10 to 15 per cent. of the power generated by the engines driving the compressors is realized in effective work.

With electricity, the operating-cost is greatly reduced, while an efficiency of from 60 to 70 per cent. is realized in the system. This, of course, means a smaller plant for a given amount of work, and, therefore, a lower first cost of installation.—S. Dana Greene in Cassier's Magazine for July.

MISCELLANEOUS.

STRAY CURRENTS.

TIDAL POWER AND ELECTRICAL ENERGY.

"Electricity" states that there is a scheme on foot at Bath, Maine, to utilize tidal power in the production of electrical energy. The scheme is to secure an old mill site where at one time 10 sawmills were run by tide power, to repair the dam there, and to generate electricity by the same force that in former years operated scores of saws.

HORSELESS CARRIAGES FOR THE U. S. SIGNAL CORPS.

Brigadier-General Greely, Chief of the United States Signal Corps, has invited proposals for furnishing the army with three electric horseless carriages, and experiments will be carried out with them near Washington.

Gen. Greely thinks it will be possible for these carriages to pay out wire promptly between two points so that telegraphic and telephonic communications can be readily opened. If the experiment is successful, carriages will be used for other purposes by the Signal Service.—"Scientific American."

ELECTRIC MOTORS IN SWEDEN.

The manufacture of electric motors in Sweden, more especially those of smaller dimensions, is becoming quite an important industry. The well-known electric company at Vesteros, in spite of large manufacturing facilities, is unable to keep pace with the orders; they have, therefore, arranged for co-operation with the De Laval Electric Company, in Stockholm, about te manufacture of a quantity of small electric motors of their model (under 3 horse-power), and this manufacture of small electric motors is expected to amount to 1,000 to 1,200 per annum.—"Eng. & Min. Journal."

THE ELECTRICITY BUILDING AT THE PARIS EXPOSITION.

The building which will be devoted to the electrical exhibits of the Paris Exposition will be a most remarkable structure. It is so florid and ornate that it resembles no other building ever constructed. It will undoubtedly be the most striking building which is seen on entering the grounds. The facade has a richly ornamented portico, and directly in the middle is an enormous fountain which masks three-quarters of the central part of the facade. It is what is known as a "Chateau d'Eaux," and consists of a deep niche with steps at various levels over which water will flow, and a group of sculpture will terminate it. The building will be made of staff and will be brilliantly treated in color.—"Scientifis American."

THE NERNST ELECTRIC LAMP.

The Allgenmeine Electricitats-Gesellschaft are about to undertake the manufacture of the Nernst lamp on a large scale. The standard sizes so far decided on are of 25, 50 and 100 candle-power, though some of 480 candle-power will also be supplied. The life is about 300 hours, and it is stated that the simpler type of lamp will be extremely cheap. Those arranged to light up automatically will naturally be somewhat more expensive, owing to the large amount of platinum used in them. The life of this platinum is, however, very much more than that of the Nernst rod which gives the light.—"Eng. & Min. Journal."

ALUMINUM FOR ELECTRIC WORK.

The Pittsburgh Reduction Company has received an order from the Chicago Northwestern Elevated Railway Company for 150,000 lbs. of aluminum to be used as feed wires on that road. This will be the first electric road in the country that has attempted the use of aluminum for feed wires. Three sizes of aluminum cable will be used. The largest feeder is about 1½ in. in diameter, and the railroad company is buying over 10 miles each of the two larger sizes. The feeders will be placed in a wooden box, or trough covered by the board walk between the tracks of the elevated. They will be supported on vitrified clay blocks, about 9 ft. apart and designed with an umbrella drip. Every 100 ft. a special malleable iron chair will be used, the cable being carried in split spool insulators to hold the slack. It is estimated that 47 lbs. of aluminum wire will answer the same purposes as 100 lbs. of copper wire, while the difference in cost considering the conductivity, will make the aluminum cheaper. The copper costs about 20c. a pound, while the aluminum can be had for about 36c. a pound. The installation in Chicago was caused by the rising price of copper.—Ex.

SULHATE OF COPPER IN FRANCE.

The approach of the wine-making season has caused the agriculturists in this part of France to unite in a movement for the repeal of the tariff on sulphate of copper, which is extensively used to protect the grapevines against black rot and mildew. In periods of heavy rains, the vines sometimes require five treatments, at an aggregate expense of from $2 to $2.50 per acre. The use of copper has increased, and is expected to further raise the cost of the sulphate; hence, the movement for a reduction of the duty.

As the United States is the largest copper-producing country in the world, a resume of what is said on this subject in France will not be without interest. The imports of the sulphate into France were:

	Tons
1895	24,641
1896	34,539
1897	30,909
1898	31,468

The metal base enters into the composition of the sulphate in the proportion of 26 per cent, the price of the sulphate being entirely governed by the price of copper.

When the proposition was made to remove the tariff of 3 francs (57 cents) per 220 pounds from copper, it was stated that an American syndicate had cornered the market and that the corner must soon break, with a resulting fall in prices. Wine growers influenced by this report, refrained from laying in a supply of sulphate, and as the demand for that article ceased, manufacturers stopped producing. A legislative commission appointed to investigate the subject reported the advance in price to be a legitimate result of the working of the law of supply and demand, to wit, the new and increased uses of copper in machinery, the extensions of telegraphs, telephones, electric lighting and electric tramways, and especially the building of the Metropolitan Trolley Railroad in Paris, which will consume 5,000 tons of copper. The opinion was expressed by the commission that the demand for consumption will continue in excess of production; that Japan and Spain can not increase their output; that Chile can increase hers, but that the possibility of equalizing the two factors—supply and demand—must depend upon the copper producers of the United States.

The consumption in France amounts, annually, to 60,000 tons—47,000 tons in block, bars, and plates; 8,000 tons of old metal, all imported; and 5,000 to 6,000 tons of old copper picked up at home

The committee of the Lower House of Parliament reported adversely that to a reduction of the customs duty. It declared that France was powerless to lower the price of copper, as it does not produce that metal. It is believed here that much of the copper that enters France from England is the production of the United States. It is entered as English goods, so as to escape the extra warehouse tax levied upon merchandise that is transshipped from the country of its origin to France. It was stated in the report of the commission that if the duty were abolished, English dealers would at once raise the price of copper.

The customs tariff on copper yields a revenue of 90,000 francs ($17,370) per year.

JOHN C. COVERT,
LYONS, April 5, 1899. Consul.

The Electrical Age.

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CONTENTS

THE DYNAMO AS A FACTOR OF CHEAP POWER.

When Watt immortalized himself by the invention of the steam engine, he stated that greater work than his would be done by a man who invented a rotary engine. As far as science is concerned, it would be impossible to build a more efficient piece of apparatus than the electric motor. The rotary engine of Watt appeared in its most modern form far better in construction and operation than he ever imagined. The motor or its converse, the dynamo, have played and will play a part in the world's history which may some day make them be regarded as indispensable props of civilization.

The dynamo is certainly a superior type of machine, and, in fact, the only imaginable type for certain purposes to which it has and will be put. In transforming water power into electrical energy and sending it along lines for purposes of distribution, a link was added to the chain of completed inventions which added enormous impetus to the industrial developments then occurring. The mining districts of the West, as well as the East, wherever water power was accessible, were equipped with electric power transmission systems. In fact, this idea of transforming the power which goes to waste all over the earth's surface has so taken possession of certain moneyed men that they have concluded to invest in wave power plants, one of which has been erected on the Pacific coast and another on the Atlantic. The rise and fall of the water operates a system of plungers which pump water into a tank against the air sealed up in it. By this means the water which is under pressure can be used to drive a water wheel, operate a dynamo, which gives light and power.

There is no question now as to whether wave power can or cannot be used. Practical experience has shown that a plant of this kind, when properly erected, will be sufficiently reliable to give a certain uniform output of power during the year. The well-known inventor, Chas. F. Brush, erected an automatic and self-contained wind power plant by means of which the dynamo was operated and storage batteries charged. This apparatus gives excellent satisfaction, and represents one of a type of which many could be erected with distinct advantages to the owners. In a land like Holland a proposition of this kind would receive the utmost consideration, windmills in that country being a most familiar part of a farm, some of them being enormously large and capable of developing considerable horse power.

Although Holland is a land of windmills, the same series of enterprises does not manifest itself as quickly there as in the United States. A large windmill constructed along modern lines might be of great service to farmers, small manufacturers, and, in certain cases, to mine owners. A windmill driving a dynamo would not be a more complex case to handle than that of a dynamo attached to the axle of a train such as is now used for electric lighting. Recent reports from abroad and a record of other experiments tried here show that attention has been directed to the use of the sun's heat for power purposes. From the data that is obtainable, we discover from a quarter to a half horse power square yard of surface is developed by the sun's rays.

Prof. L. G. Carpenter, of Fort Collins, Colo., presented at the late meeting of the American Association, in Boston, the results of some interesting observations, continued during ten years, of the amount of solar energy received on our Western plains. These observations, to quote from the "Journal of the Franklin Institute," show an intensity of from seven to seventeen calories per square metre from eight A. M. on sunny days. His conclusions seem to show that sun power is as reliable as the wind, and can be used to great advantage by those desiring large or small power at their disposal. Of course, in using the sun for lighting or power certain disadvantages would be met which are not present when either wind or water are utilized for the same purpose. There are no calms which last three or four days along the water's edge; no atmospheric quietness which prevents breezes and winds from blowing; but there are times when the sun, during stormy periods, is overcast for many days. The only provision which could be made against this contingency would be the erection of a larger plant than is actually required, and the use of enough accumulators to continue power distribution uninterruptedly. As far as cost is concerned, it is difficult to decide as to whether one method is cheaper than the other. In the winter the sun is cold, so to speak. In the summer the temperature may be torrid. Such varying conditions as these make it questionable as to whether sun power could ever be relied upon for the steady performance of any machinery. It seems, though, after a plant has been erected, that the expenses reduce down to a minimum. In the course of a few years the profits accruing from the sale of power would probably increase very rapidly.

BALM FOR THE STOCKHOLDERS OF THE ELECTROLYTIC SALTS COMPANY.

At last the Electrolytic Salts Company have received a report on the "process" of extracting gold from sea water. The professor whom the directors employed reports that the process was fraudulent. The directors are said to have recovered a considerable sum from the originator of the swindle, which, together with the sale of the machinery, etc., has realized enough to pay 20 per cent. dividend to the stockholders.—"Scientific American."

TELEGRAPHING WITHOUT WIRES.

TORPEDO STEERING BY ETHER WAVES.*

From the London "Electrician."

Now that wireless tdelegraphy is being so much talked about, a description of an invention for the wireless control of torpedoes might not be without interest for our readers. A representative recently had an opportunity of seeing in Glasgow a working model for effecting this purpose. The method is the joint invention of Mr. Walter Jamieson, of Greenock, and Mr. John Trotter, the well-known optician and electrician, of Glasgow. The idea of steering torpedoes without shore connections occurred to Mr. Jamieson in the Summer of 1896, but though several methods were thought of, including sound waves, these were not found satisfactory. However, on reading an account of the life of Hertz and his work, a probable solution suggested itself, and following this up, Prof. Lodge's now famoues lecture gave a key to the difficulty. A rough model was made and experimented with, and, on the strength of this, Mr. Jamieson went to London during the Summer of 1897, and visited many people interested in torpedo manufacture, but the idea of steering torpedoes without shore connections appears to have been too much for them to credit. The invention was shelved till the end of 1897, when Mr. Jamieson wrote an account of the experiments, with descriptions of the apparatus, intending to publish it and let any one who cared take up the matter. On showing the article to Mr. Trotter, however, the latter saw several points in the mechanical details that could be improved, and at once advised letters patent to be applied for, and co-operated in devising a large and improved model. The model was tried in June last, but, owing to a glass sight-hole breaking, it sunk and ruined the apparatus. A new and larger model was built, and has been an entire success, working without a hitch under all kinds of conditions.

The apparatus can take several forms, although the method of using the Hertz waves is more or less the same in the various models, the difference being in the method of applying the opposing currents controlled by the selector to the rudder of steering mechanism. This can be done, as shown diagrammatically in Fig. 1, by means of two solenoids into which are sucked cores attached to the rudder head; or, as shown in Fig. 4, by means of a motor attached to the rudder head by means of an electric coupling; or, again, a model has been tried with twin screws and two motors, the current being arranged to flow to one or other or to both, as needed, to effect the required direction. Two staffs, projecting about four feet above the surface of the water, receive the waves, and have a coherer of special type in circuit, and this affects a relay in the usual way. The relay—a most important part of the invention—was devised by Mr. Trotter, and most ingeniously gets over the difficulties which made ordinary relays useless, owing to the very great vibration. It has no loose contacts, and does not depend on an electromagnetic attraction for contact. There is no trembling during decohering, as in tapping arrangements. The steering mechanism consists of a peculiar form of switch, termed the "selector," the principle of which is shown in Figs. 1 and 2. The selector switch may take any suitable form of the ordinary commutator type of switch, such as a number of metallic studs arranged in a circle, with revolving contact-piece operated by an electro magnet and

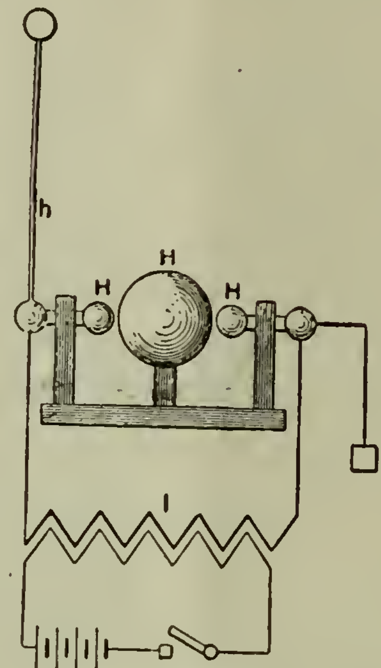


Fig. 2.—Torpedo Steering by Ether Waves.

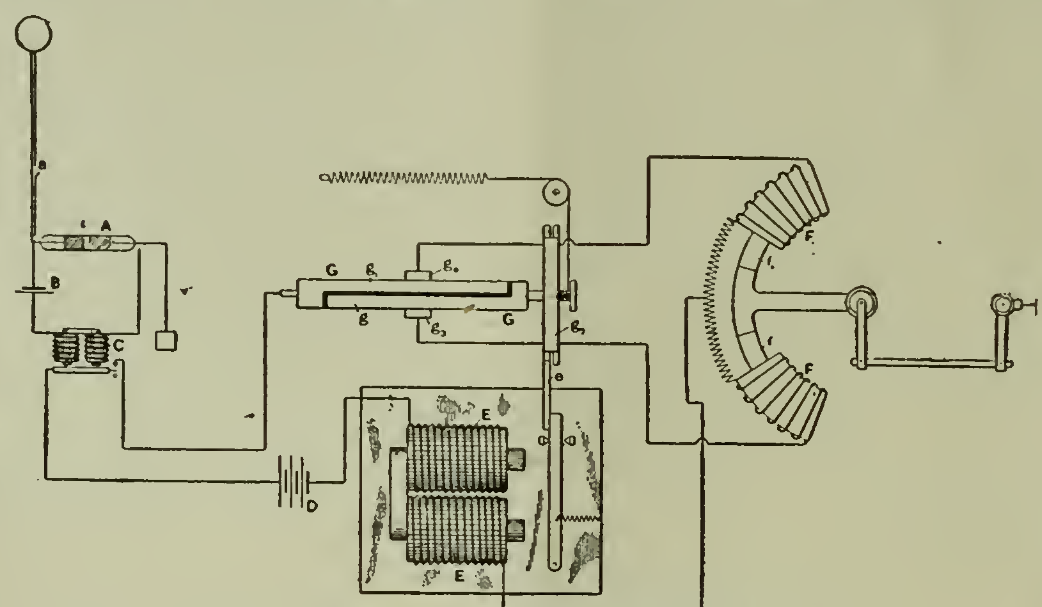
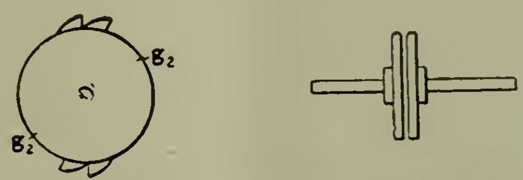


Fig. 1.—Torpedo Steering by Ether Waves.

so arranged that the contact-piece is shifted round one stud further by the electro-magnet immediately on the cessation of the current in the circuit, the studs being so arranged that at each shift round, the direction of the current, through the electro-magnetic apparatus and electro-magnet coupling, is reversed. It has been found most convenient to use for the selector switch a metallic tube split longitudinally (the two sections being insulated), mounted on a spindle and capable of rotating on bearings. On one end of the tube is fixed a disk with four teeth cut therein, in sets of two each at opposite diameters of the disk, one tooth in the set of two being a little ahead of the other and extending only half across the rim of the disk. This selector allows the current to pass to two solenoids alternately. In other forms the motor of the torpedo takes the place of the solenoids. On sending waves the helm is first pulled to port; on cessation of the waves it flies back to zero. The next impulse sends the nelm to starboard, but if it is desired to send to port again two waves are sent in quick succession. The first operates the selector but not the steering mechanism, the second steers to port again.

The transmitting apparatus has many forms. The best results have been got from two small dumb-bell, Hertz pattern oscillators with balls three-fourths-inch diameter, sparking in the middle. The oscillator has a wire extension about three feet long with duplex reflectors. Referring to Fig. 1, A is the coherer connected with one terminal to an insulated conductor, a, projecting outside the torpedo for receiving the electric vibrations and having the other terminal connected to earth. B is a battery in series with the coherer and with the relay C. The armature of the relay is in series with the battery D, electro-magnet E, two solenoids F and F1, and the selector switch G. The selector switch may be constructed in various ways. As shown in Fig. 1 it consists of a tube in two parts, g and g1, which are insulated from one another and capable of rotating on bearings. At one end of the tube their is a disk g2, having four teeth, two at each end of a diameter. The pair at each end of the diameter are placed one a little behind the other, as shown in Fig. 3. The tube is rotated by means of a spring. On either side of the tube there are brushes, g3, g4, connected respectively to the solenoids F and F1 as shown. The armature of the electro-magnet E has a catch e, which gears with the teeth on the disk g2 of the selector switch. The armature is kept back from the poles of the electro-magnet E by a spring, and in this position the catch e engages with one tooth of the disk and prevents the tube turning. When the current passes through the electro-magnet E the armature is attracted and the disk will rotate a little till the catch engages in the second tooth at that part of the circumference. When the current ceases the armature will spring back behind the first tooth and allow the disk to rotate nearly half a revolution, when one of the other pair of teeth will engage with the catch and the position of the sections of the tube will be reversed with regard to the brushes. The method of acting on the steering apparatus, shown in Fig. 1, is by means of two solenoids F and F1. From each of the brushes pressing on the tube of the selector switch a wire is taken to one or other of the two solenoids, and there is a common return wire to the electro-magnet E and battery D. The solenoids have each an iron core, f and f1, fixed to the rudder-head direct or to rods connected to the rudder. When an electric current traverses the coil of the solenoids the core will be sucked to the right or left, according as the current traverses the right or left coil.



FIGS. 3 AND 5.—TORPEDO STEERING BY ETHER WAVES.

The apparatus for generating the electric waves may take many forms. A convenient form is shown in Fig. 2, consisting of three metallic balls, H, highly polished, two small and one large, thoroughly insulated, and having a small space between each as a spark gap. To one of these small balls is connected a wire, h, projecting a short distance above it, while an earth connection is made to the other small ball, as shown. The two mall spheres are also connected to the terminals of a powerful induction coil, I, capable of giving large sparks. By means of a switch, i, an electric current may be supplied to the induction coil by a suitable battery of cells, when the high tension current thus generated will spark across the air gaps between the spheres and generate oscillations. These will travel in all directions from the point of generation.

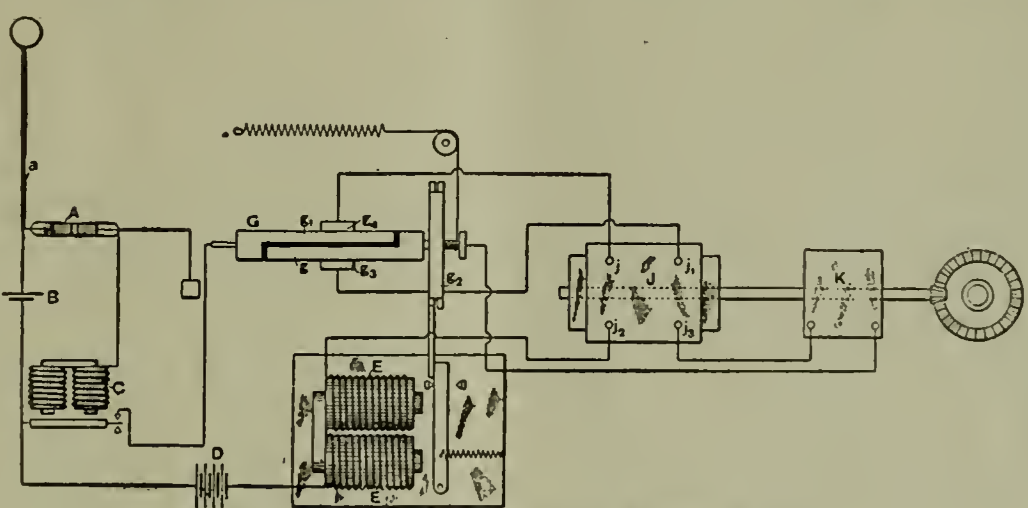


FIG. 4.—TORPEDO STEERING BY ETHER WAVES.

Having now described the apparatus in detail, let us examine the actual processes involved in steering and controlling a torpedo. Let a torpedo, containing a suitable combination of the apparatus mentioned, be launched, say, from a vessel containing the necessary sending apparatus as described. Suppose the torpedo goes off its course. Then, by means of the switch mentioned above, the induction coil is supplied with electric current, and waves or oscillations are generated, as already shown. These on reaching the torpedo, pass into the projection wire, and thence reach the coherer. As already mentioned, this operates the relay, closing its secondary circuit. An electric current now flows though the "selector" to one of the solenoids, F or F1, the iron core is sucked into right or left, and the helm is thus turned. When the torpedo has attained a proper course, the switch i is opened and the waves cease. The vibration in the neighborhood of the coherer restores it to the original resistance, the current passing through it becomes weaker and ceases to affect the relay coil, which therefore opens the secondary circuit and allows the helm to fly back to the midship position while the "selector" is turned one-half revolution. The torpedo is now ready to be steered in the opposite direction to its former one, or it may be steered in the same direction provided two waves be sent from the transmitting apparatus in quick succession. The first will operate the selector, but should be so short in duration as not to act on the solenoids; the second wave may be continued the necessary time.

As has already been mentioned, instead of the solenoids F and F1 for working the steering apparatus, as shown in Fig. 1, we may employ other means, as, for instance a motor. This is shown in Fig. 4. The coherer, relay circuit, selector switch, battery and electro-magnet are arranged as already described, but the wires from the terminals j and j1 of the field coils of an electric motor J, and the armature terminals j2 and j3 are connected respectively to the electro-magnet E and to one section g of the selector tube. The spindle of the motor is connected by an electric coupling K to the rudder. The electric coupling is provided to allow the rudder to fly back to midship position as soon as the current ceases. To accomplish this the steering shaft is in two pieces, as shown in Fig. 5, with flanges similar to ordinary shafting couplings. The two sections of the shaft are allowed some slight end play. Round these flanges, at a distance only sufficient to allow of free rotation, is placed a coil of wire of suitable guage and in series with the motor. When the electric current passes through, it will couple the flanges together, but on the cessation of the current the shafts will be uncoupled, and the pressure on the rudder will cause it to fly back to the natural position amidships.

The radius of control is evidently great, but as the highest authorities do not consider torpedoes of any great value beyond 2,000 yards, it will be seen how deadly a weapon of offence the Jamieson-Trotter torpedo can be.

Messrs Jamieson and Trotter have applied themselves of late to simplifying the coherer and relay circuits, so that the only electric part of the mechanism may be the coherer, coherer battery and selector magnet. In this they have met with much encouraging success and progress. Of course, the mode of effecting this is at present preserved a secret, as is also the mechanism of stopping, starting, altering the depth en route, and for exploding the weapon.

Toledo, Ohio.—Toledo Union Railway Co., incorporated by James King Duffey, Thaddeus S. Powell, Frank S. Mitchell, Scott H. Kelly and Benjamin F. James: electric railway in Lucas County. Capital stock $50,000.

ELECTRIC LIGHT AND POWER.

MEANS OF ATTAINING SAFETY IN ELECTRICAL DISTRIBUTION.

By
W. L. R. Emmet.

(Concluded from page 335.)

Figure 8 illustrates the principal of a circuit-breaker that has produced excellent results. Two terminals are placed side by side on a vertical board, and are separated both in front and behind the board, by high barriers. Into the metal surrounding these terminals stout fibre tubes are attached, which extend downward on either side of the barrier. Two copper rods, connected at the bottom by a crosshead, are inserted in these tubes, and forced upward until they make contact in the terminals; the circuit is thus established through the copper rods and the crosshead around the lower extremity of the barrier, and through the fibre tubes. The crosshead carries a piston, and this piston moves in a long, air dash-pot. To set the circuit-breaker, the rods are foced upwad, by means of a wooden rammer, until the contacts are made; in this position therods are held by a latch controlled by a selenoid. When the proper amount of current is put through this selenoid the latch is released; a spring starts the rods downward, so that the circuit is broken in both tubes, the gas produced by the arc expels the rods rapidly from the tubes, the acceleration being checked by the dash-pot. This device has been found very effective on the heavy circuits with which we have experimented. It occupies a small amount of space, and is simple in its mechanical construction.

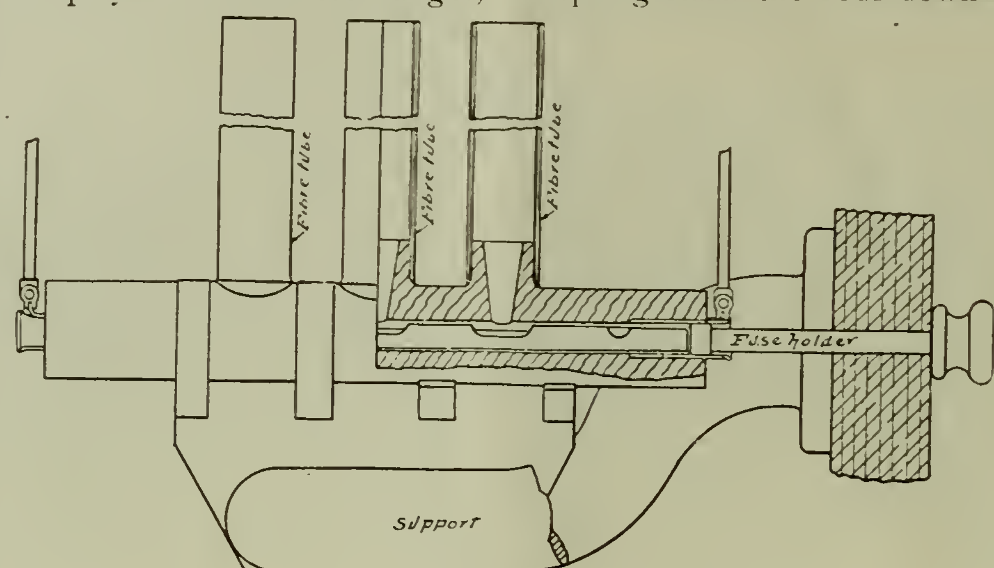


FIG. 10.

Figure 9 illustrates the construction of a switch or circuit-breaker somewhat similar in principle to that shown in Figure 8. In this case the terminals are at the lower end and are situated inside of vessels into which the fibre tubes project for a short distance. These vessels are partly filled with oil, the break occurring below its surface. In the switches of this type which we have designed the rods have been withdrawn from the tubes by a pneumatic cylinder. The presence of the oil materially increases the breakng power of the switch and reduces the violence of the explosive effect when the circuit is opened.

Figure 10 shows a shunt fuse device that has been used in connection with circuit-breakers at Niagara Falls and elsewhere. The object of the design is to produce a fuse that can be placed in shunt with the circuit-breaker, to open the circuit after the main contacts are broken. It is, of course, desirable so to design such fuses that they can be very easily replaced. The fuse is placed in a slot in a long, wooden rod; this wooden rod is covered by a paper tube, and part of the wood is cut away at three points, so as to form air chambers inside of the paper tube. The rod is inserted in a long wooden tube, provided with vents that come opposite to these air chambers when the fuse is in place. The fuse is a small copper wire and is attached to ferrules on the rod which make contact with springs at both ends of the tube. When the current is diverted into the tube, which immediately volatilizes, the pressure in the chambers bursts the paper opposite the vents and the gas escapes through chimneys provided above the vents. The paper covering of the rod prevents the hot gas from getting into the interior of the tube; consequently the device can be used over and over again without any deterioration. These

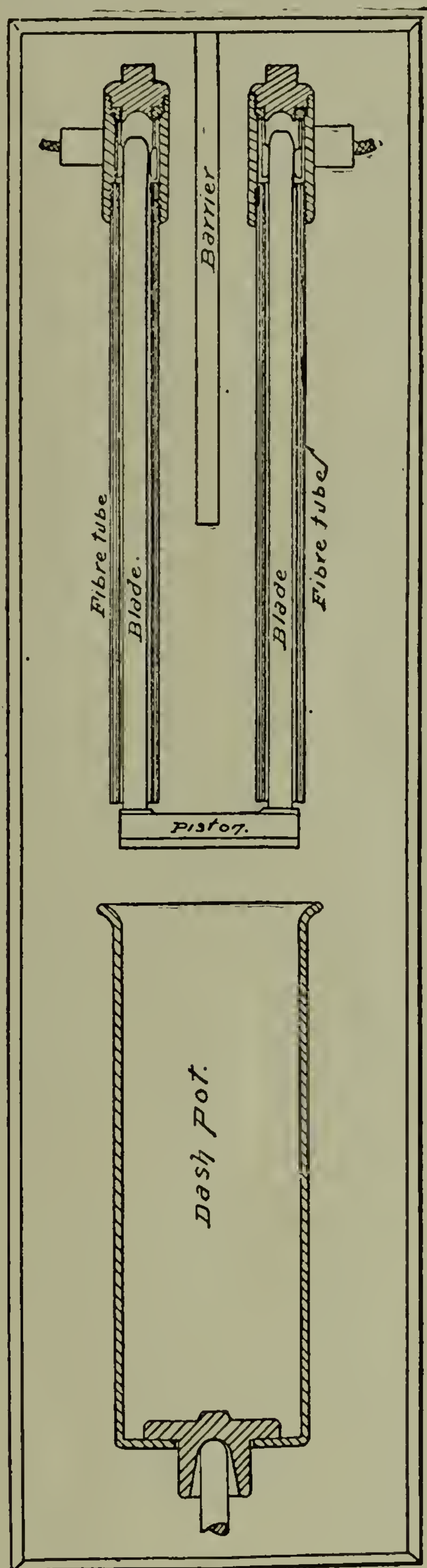


Fig. 8.

fuses have worked perfectly in parallel with circuit-breakers under the most difficult conditions that we have yet been able to produce.

Another form of fuse, which has been found very effective for difficult conditions, consists simply of a short piece of glass or porcelain tube with terminal at each end, and an asbestos lining to prevent burning of the porcelain. The objecton to this type is that the gas is blown with great violence from both ends of the tube, and must be diverted from surrounding conductors, or else short circuits are liable to be caused by it.

Many forms of fuses have been designed that operate inside of tubes with closed ends. Some of these fuses act very well with limited amounts of power. If, however, the capacity of the circuit is sufficiently large, the tube will be exploded with great violence. My experience is that the open-ended tube never explodes and never fails to open the circuit. It is, however, only practicable in certain cases, because of the heavy discharge of gas from its ends, on account of which it has to be given a good deal of room.

AUTOMOBILES.

OPERATING COSTS OF HORSE AND ELECTRIC DELIVERY WAGONS IN NEW YORK CITY.

By G. F. Sever and R. A. Fleiss.

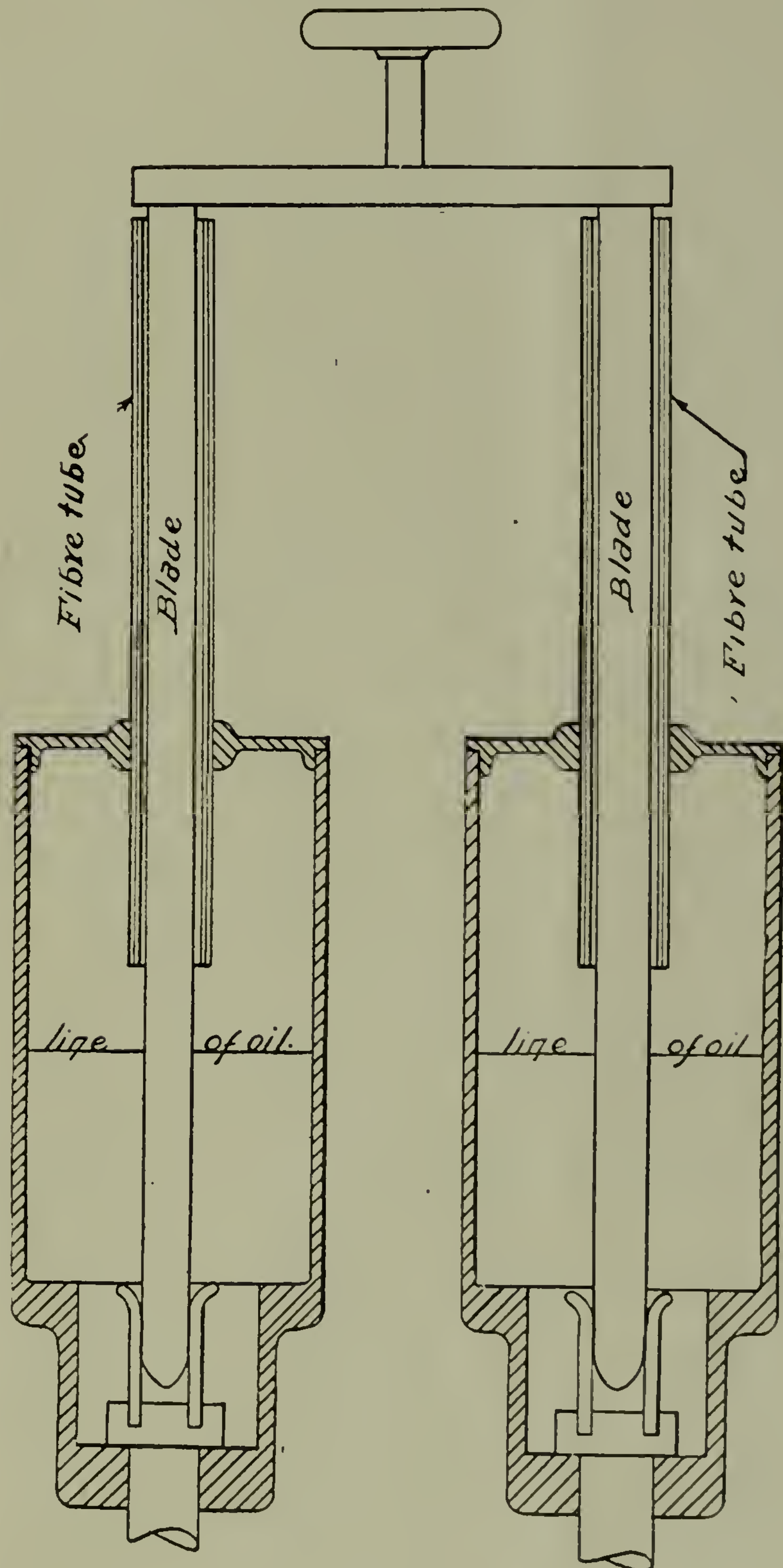


Fig. 9.

During the last three years many descriptive articles relating to the automobile, have appeared in the technical press, but up to the present time, there has been published no definite data which might be used to indicate whether or not electric operation posessed any advantages. Hence both the general as well as the technical public, could form no definite opinion as to the benefits to be derived from the use, in any particular class of service, of either an electric or a horse system.

Presented at the 16th General Meeting of the American Institute of Electrical Engineers, Boston, June 28th, 1899.

The purpose of this paper is to present the results of an investigation, carried on during the past year in the city of New York, of the operating costs of the horse and electric delivery service, as at present instituted by the large department stores. This investigation formed part ot a graduation thesis in the Electrical Engineering Department of Columbia University.

The present status of the art does not permit of an exhaustive comparison, as some of the data now presented will probably be entirely altered by the rapid developments which are taking place, the art progressing quite similarly to that of the electric railway. That which can be done most successfully is to compare the cost of maintenance of the two above mentioned systems, and if to-day, an electrical system costs less to operate and keep than a horse system, it is simply a question of a short time as to the repeplacement of the horse by the electrical method. Of course in considering the economy of any system, depreciation enters largely as a factor; but, in case of any new system such as is under consideration, the determination of the depreciation of any of the various parts or of the system as a whole, would be difficult and for its solution would require long continued service and close observation. Owing to the short time that the automobile has been in the field in commercial competition with the horse, it has been impossible to collect a sufficient amount of data on this point to make its introduction of value in drawing a comparison between the total operative cost of the two systems.

SECTION I.

Some Data on Horse Delivery Service.

The work done by a horse in moving a vehicle over level ground, consists in overcoming resistance to motion due to friction; it may be conviently expressed in foot-pounds. When grades are encountered, the number of foot-pounds of work performed in the same distance, will increase. This additional work is necessary to overcome the force of gravity. When on a dcending grade, the horse does work in resisting the tendency of the vehicle to accelerate. Hence when in motion, the horse is continually doing work. The exact amount of work performed by upon many factors, some of which are:

1. Kinds of road surface—macadam, asphalt, etc.
2. The conditions of roads traveled over.
3. Topography of the country passed through.
4. Nature of the load.
5. Distribution of the load on the wheels.
6. The horse itself.

The horse is not an automobile that can be designed to perform a given amount of work with a given efficiency. It is, on the contrary, a most variable, and at times, willful, source of motive power. The breed, state of health, temperament, environment, adaptation to the load, etc., affecting in a greater or less degree, the amount of work that can be performed in a day by any individual horse. The problem therefore, of determining the amount of work done by a horse, under any but very regular and systematic conditions, is one of great complexity. But under regular conditions, the amount of work performed may be quite closely approximated. It is proposed in this section to give the results obtained in an investigation which was undertaken to determine, as closely as possible, the average amount of work performed daily by a certain lot of horses engaged in the delivery service of a large dry goods store in New York City.

It may be well to explain in some detail the exact nature of the work required of this class of horses. The "large department stores," as they are now called, have to keep in operation winter and summer, irrespective of the weather, a delivery service which must be as regular in the fulfilment of its functions as the local steam railroads and street railway systems are in the execution of their obligations. The nature of the work necessitates a highly organized system of delivery by means of small units capable of carrying 700 to 800 lbs., over short distances and with considerable speed. This problem has been met and solved by these stores through the introduction of a horse delivery service composed of many small units, each one of which has its special district to cover and a certain time schedule to follow.

To illustrate more clearly the method pursued, we will follow one of these units through its daily routine. Let us consider the case of a wagon making three deliveries a day. The first delivery starts from the stable at 8 o'clock in the morning and arrives at the store a few minutes later—the stable in most cases bing not far from the stores. Arrived at the store the wagon receives its load, which varies from day to day, but which will average the year round, not over 800 lbs. This load may be taken as the average load on all trips as the wagon leaves the store. The load decreases as deliveries are made so that theoretically when the wagon has reached the store again, it should be without load. This however, seldom happens in practice, as there are many c. o. d. packages in each delivery that must be returned to the store as collection could not be made. Also packages sent out on approval are called for and brought back to the store on each trip. Hence, the load as a general thing, does not entirely disappear before the wagon reaches the store at the end of any one delivery. It may safely be assumed, however, that the average load carried throughout any trip will not be more than 500 lbs. The load having been received, the wagon starts out to deliver its packages.

The following table gives for a certain store, the division of the city into what may be called unit districts, each store having of course, its own peculiar scheme of subdivision—this depending upon the volume of its business.

Table 1

1	Canal St. to Battery, East and West.	2 deliveries a day.
2	Canal St. to 19th St., E. of Fifth Ave.	3 deliveries a day.
3	Canal St. to 19th St. W. of Fifth Ave.	3 deliveries a day.
4	20th St. to 40 th St. W. of Fifth Ave.	3 deliveries a day.
5	41st St. to 59th St. W. of Fifth Ave.	3 deliveries a day.
6	60th St. to 75th St. W. of Fifth Ave.	3 deliveries a day.
7	76th St. to 90th St. W. of Fifth Ave.	3 deliveries a day.

It will be observed that on the longer trips only two deliveries are made a day, while above 145th street only one delivery is made. This latter is an all day route and the horse that goes up one day comes back the next—horses being changed at the local stable of this particular store near 180th street.

Let us suppose that the wagon has started on trip No 7, then it will go from that store to 76th street without stopping, the first delivery being made in 76th street. To make it easier for the horse and to facilitate the delivery, the driver does what is called "backloading." This means giving a number of packages to his helper or delivery boy to distribute on foot, while he drives to another street, makes some deliveries and meets his boy again at some pre-arranged point. By this method the horse is saved a great deal of work and the time of delivery is much shortened. After the deliveries are all made on the way up, say, between 8th avenue and Amsterdam avenue as far as 90th street—the end of this route—then the wagon comes down delivering between Amsterdam avenue and Riverside Drive to 76th street. At this point deliveries stop, and the wagon proceeds to the store, there to deposit the money collected on C. O. D. packages and to return undelivered goods. By this time it is usually after 12 o'clock and the wagon goes to the stable to change horses and prepare for its second trip. The horse used on the morning trip is sent to his stall and a fresh one is harnessed to the wagon. The wagon starts out again at 1 o'clock to load up for another delivery. The same procedure as before is carried out, the wagon usually returning to the stable a few minutes before 5 o'clock. The horse used during the morning trip is harnessed to the wagon again and starts out on the 5 o'clock delivery. This horse returns about 7.30 or 8 o'clock. Hence we see that it takes two horses for every delivery wagon—the horse that makes only one trip on any one day, making two trips on the following day, on a route calling for three deliveries each day. On a route having two deliveries a day, each horse makes but one trip a day.

It has been found that the mileage per wagon per day is nearly a constant, irrespective of the number of trips made. The method pursued which led up to this conclusion was the following: An odometer was placed on the axle of a delivery wagon in the service of one of the large department stores in the city. This wagon was sent over each of the routes specified in table 1, an accurate record being kept of the number of miles covered by the wagon on each day. This wagon was kept on the various routes in regular delivery service for a period of some three weeks, and the results obtained indicate that approximately the same number of miles are covered by all the wagons in this service each day. This will be readily understood when one considers that a wagon, making a trip over an apparently short route, is in reality covering very much more ground than would at first be thought. The density of population in the district which the route covers materially affects the number of deliveries and consequently the mileage of the wagon. The explanation of the fact that the average mileage per day of the wagons is nearly the same, is that experience extending over many years of service, has taught those in charge the best method of district subdivision which will produce such a proportioning of the work that it shall be equally distributed among the units.

In determining the amount of work done per day by one of these delivery horses, it is essential to know the number of miles traveled by the horse, the average draw-bar pull of the wagon, and the average speed of the horse while in motion. To determine these factors one of the authors spent a number of days on his wheel following delivery wagons of many firms, under varying conditions of load and in many different streets. Attached to the wheel ridden, was an accurately tested cyclometer and an equally accurately tested tachometer. A notebook, pencil and watch completed the outfit, and the following is an illustration of the method pursued in determining the amount of work done by horses attached to delivery wagons in New York city.

The draw-bar pull of the wagon was determined by the use of a traction dynamometer. For the wagons under consideration it was found that the average pull per ton was 60 lbs. on ordinary cobblestones at a speed of seven miles per hour. On asphalt the draw-bar pull was found to be 40 lbs. per ton at 7 miles per hour. The unit under consideration was composed of a wagon weighing 1,300 lbs. drawn by a horse weighing 1,100 lbs. Each wagon is provided with a driver and a delivery boy. The average weight of the driver may be taken at 150 lbs. and that of the boy at 125 lbs. Hence the total weight of the unit without load was 2,675 lbs. To this must be added the average load, which may be considered as being 500 lbs. Adding this to 2,675 lbs. we have as the total weight of the unit 3,175 lbs. The weight causing the draw-bar pull, however is 2,075 lbs. The test recorded was approximately one-half on cobblestones and one-half on asphalt. The true average draw-bar pull may then be taken as having been 50 lbs. per ton during the test.

(To be continued.)

BUSINESS NEWS

SPECIAL EXPORT COLUMN.
TOTAL AMOUNT OF ELECTRICAL EXPORTS FOR WEEK ENDING JUNE 20, 1899, $82,157.00.

New York, N. Y., June 20, 1899.—The following exports of Electrical Material are from the port of New York for the week ending this date:—

Antwerp:—39 cases electrical material, $1,829.

Bremen:—9 cases electrical material, $50

British Australia:—8 packages electrical material $348. 71 packages electrical machinery, $14,890.

British West Indies:—12 packages electrical material, $333.

British East Indies:—8 cases electrical material, $401. 9 cases electrical material, $534.

Berlin:—1 case electrical material $15.

British Possessions in Africa:—27 packages electrical material, $731.

China:—47 cases electrical machinery, $2,505. 5 cases electrical material, $130.

Chili:—3 cases electrical material, $47.

Central America:—19 packages electrical material, $347.

Cuba:—9 cases electrical material, $188.

Dutch West Indies:—1 case electrical material, $23.

Dutch East Indies:—1 case electrical material, $22.

Genoa:—6 cases electrical material, $197.

Hamburg:—37 cases electrical material, $2,949.

Hong Kong:—15 cases electrical material, $470. 3 cases electrical machinery, $160.

Havre:—13 cases electrical material, $1,586. 4 cases electrical machinery, $310.

Japan:—21 cases electrical material, $1,324. 35 cases electrical machinery, $1,882.

Liverpool:—11 packages electrical material, $3,975.

London:—24 packages electrical material, $1,115. 5 packages electrical material, $300.

Mexico:—35 packages electrical material, $1,613. 1 case electros, $32. 32 packages electrical machinery, $13,788.

Manchester:—70 cases electrical machinery, $350.

Marseilles:—283 cases electrical machinery, $25,000.

Newfoundland:—2 cases electrical material, $24.

Nova Scotia:—1 case electrical material, $50.

Naples:—2 cases electrical material, $50.

Odessa:—43 packages electrical material, $925.

Peru:—10 packages electrical material, $533.

Porto Rico:—25 packages electrical material, $433.

NEW INCORPORATIONS.

Ford City, Pa.—Ford City Electric Light, Heat & Power Co. Capital stock, $1,000.

Chicago, Ill.—The Ray Co., incorporated under the laws of West Virginia by M. F. Sullivan, C. A. Ross, C. F. Morse, A. A. Goodrich, and R. S. Badler; transmission of light, heat, power and electricity. Capital stock, $1,000,000.

West Bethlehem, Pa.—The West Bethlehem Light Co., incorporated by E. W. Mulligan, L. Flick, J. Flanigan and others. Capital stock, $1,000.

El Paso, Tex.—The International Light & Power Co., incorporated by J. P. Dieter, J. J. Kyler, W. S. McCutcheon and others. Capital stock, $25,000.

Portland, Me.—Electrical Association, incorporated by C. H. Newhall, J. S. Bartlett, M. P. Clough and others; manufacturing and dealing in electrical plants. Capital stock, $300,000.

Chelsea, Vt.—Chelsea Electric Light & Power Co., incorporated by W. F. Davis, E. D. Burnes, Viola Davis, H. M. Dufur and C. F. Smith; producing electricity and furnishing same for heat, light and power. Capital stock, $10,000.

Cavendish, Vt.—Vermont Electric Light & Power Co., incorporated by E. G. White, C. E. Ongley and others. Capital stock, $100,000.

Trenton, N. J.—Gas & Electric Appliance Co., has been incorporated by Fred P. Auten, Theodore Backus, and Henry McMillan; deal in electric appliances. Capital stock, $10,000.

Spencer, Mass.—Citizens' Gas & Electric Light Co., has been incorporated by E. Jones, F. A. Drury and N. Sagendorpt. Capital stock, $60,000.

Camden, N. J.—Wildwood Holly Beach & Anglesea Electric Light, Heat & Power Co., has been incorporated by Spencer Simpson, Peter W. Wiltbanks and John M. Mays. Capital stock, $30,000.

TELEPHONE CALLS.

Mooresville, Tex.—The Mooresville & Waco Telephone Co., incorporated by J. E. Brown, Robert Brown and others; for the construction of a telephone system from Mooresville to Waco. Capital stock, $1,000.

Littleton, N. C.—The Henderson Telephone Cò., will construct a telephone exchange at Littleton.

Attalla, Ala.—The Citizens' Telephone Co., incorporated by J. W. Wood and others; for the erection of a telephone system. Capital, $2,000.

Fernandina, Fla.—Mayor John G. McGiffin is endeavoring to organize a $10,000 company for the construction of a telephone system.

Owingsville, Ky.—The Owingsville Telephone Co., incorporated, with a capital stock of $2,500, for construction of telephone system.

Carrollton, Ky.—The Carrollton Telephone Exchange Co., incorporated by R. M. Parker and others. Capital stock, $5,000.

Millersburg, Pa.—Susquehanna Telephone & Telegraph Co., incorporated by J. E. Kahler, and others. Capital stock, $5,000.

Elizabeth, Pa.—The Elizabeth Telephone Co., incorporated by E. P. Van Kirk, W. P. Wylie; telephone and telegraph. Capital stock, $5,000.

Glen, N. Y.—Glen Telephone Co., has been incorporated by J. S. G. Edwards, A. M. Burt, A. A. Turnboul, J. W. Shelp and others; telephone line. Capital stock, $10,000.

Blountsville, Tenn.—Holston Telephone Co., incorporated by J. C. Henry, J. B. Wolf, W. E. Wolf, E. J. Burkey and W. C. Webb; constructing and operating a telephone system. Capital stock, $1,000.

Duluth, Minn.—Duluth Telephone Exchange Co., incorporated by Edw. Lomasney, C. M. Mansean, James Wanless and others; operating telephone lines. Capital stock, $500,000.

Jersey City, N. J.—United States Telephone Co., incorporated by Oscar L. Lefferts, Oscar A. Enholm and John W. Hutchinson, Jr.; manufacture electrical apparatus, etc. Capital stock, $125,000.

Milwaukee, Wis.—The Wisconsin Telephone Co., meeting of directors and stockholders held recently, and capital stock increased from $1,200,000 to $3,000,000.

Pulaski, Va.—The Virginia and Tennessee Telephone Co., has been incorporated, with George M. Holstein president, D. D. Hull, Jr., vice-president and treasurer, B. F. Garnett secretary, and B. Langhon manager. Capital stock, $200,000.

Diller, Neb.—Diller Telephone Co., has been incorporated by E. L. Osborne, T. P. Price, T. Nelson and J. A. Price; telephone business. Capital stock, $1,000.

Decatur, Ill.—Macon County Telephone Co., incorporated by H. M. Whitmer, C. S. Hankins and W. P. Shade. Capital stock $20,000.

Kankakee, Ill.—Hamlin Telephone Co. has certified to an increase in capital stock from $15,000 to $20,000.

Butler, Ind.—Butler Telephone Co., incorporated by L. E. Gardner, W. W. Morrison, Sam G. Stone and L. C. Harding. Capital stock $10,000.

Hamburg, N. Y.—Hamburg Telephone Co., incorporated by Jacob Peffer, John Schoefflin, Wm. Krenenberg, N. C. Fish and others; to conduct a system of telephone communication between Hamburg, Buffalo and various towns and villages of Erie County. Capital stock $10,000.

Batesville, Ark.—The Batesville & Winnerva Telephone Co., incorporated with E. C. Cook, Sr., President; John A. Cockrum, Vice-President; E. A. Farris, Secretary and Treasurer. Capital stock $25,00.

Salem, N. J.—Steps are being taken to construct a telephone line between Salem and Pennsville. ffl

Millville, N. J.—Millville Telephone Co., incorporated by Wm. H. Ott, Ephraim P. Clark, Lillie P. Ott and Pleasant R. Clark. Capital stock $7,500.

STREET RAILWAY NEWS.

Mankato, Minn.—An electric street railway line is to be constructed, to build and operate an electric street car line. It will be known as the Mankato Electric Street Car, Light and Power Co., with L. S. Lamm, President; O. W. Schmidt, Vice-President; S. Wilbartz, Secretary, and C. J. Macbeth, Treasurer. Capital stock $75,000.

Montague, Mass.—An electric street railway is to be constructed to connect Montague with the Greenfield and Turner's Falls system.

Philadelphia, Pa.—The Electric Traction Company of America is being organized by John Lowber Welsh, Silas W. Pettit, W. F. Shelmerdine and former Mayor Warwick. Capital stock $25,000,000. ffl

Mankato, Minn.—Mankato Electric Street Railway Light & Power Co., incorporated by L. S. Lamm, Chas. J. Macbeth, O. W. Schmidt and others; operating electric railway in the city of Mankato. Capital stock, $500,000.

Boston, Mass.—The Beacon Motor Traction Co., of Boston, has been incorporated at Dover, Del., to operate cars and deal in electrical supplies. Capital stock, $1,000,000.

BUSINESS CHANGES.

Pekin, Ill.—Pekin Gas Light Co. has changed its name to Pekin Light, Heat & Power Co.

POSSIBLE INSTALLATIONS.

Abbeville, La.—Lee & Sayers have been granted franchise for the establishment of an electric light plant.

Durant, Miss.—The Mayor may be addressed concerning the issuance of $10,000 worth of bonds for an electric light plant.

The Electrical Age.

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ELECTRIC LIGHTING.

The Electrical Fountain at the Greater America Exposition, Omaha.

[Courtesy of "Electricity."]

ELECTRICAL EFFECTS AT THE OMAHA EXHIBITION.

In the fall of this year an opportunity will be given to American to view the progress made in electrical and other fields of industrial effort. The name given to this magnificent spectacle will be the First Greater America Colonial Exposition, which will be opened in Omaha July 1st and continue to November the 1st, 1899. Henry Rustin, in the capacity of superintendent, has taken entire charge of the lighting. A minimum of forty-five thousand lights will be employed and through their aid a fairy city has thus far been constructed, which is more like a crystallized dream or a magic city, created by a wave of the wand, than a thing of stone and plaster and mortar and brick. Through the courtesy of one of our contemporaries we are able to give the reader a night view of the scene at the Grand Court and of the electrical fountain. Everything is finished in pure white with a strict adherence to the idea that Venice, as she was in her days of glory, was to be as nearly duplicated as possible. The co-operation of the architect, landscape gardener and electrician have resulted in some remarkable effects which will not fail to leave an everlasting impression on the minds of visitors. At certain sections of the exposition the mingling of color and classic architecture creates an indefinable sensation. The inimitable hues of color shot out of the electric fountain, the splashing of these shafts of light upon continuous objects, and the wide dazzling circle of splendor reflected from the lagoons and canals presents a scene indescribable in detail.

Electric lighting on the exhibition grounds will be done by the aid of underground cables. A large electric light and power plant has been installed by the exposition company. The Omaha Electric Light Company have received the contract for the arc and commercial lighting on the Midway. A novel feature of this exposition will be the race track. At night races will be run over a course as bright as day. Search lights, focussing lamps and incandescent lamps will be used ad libitum to make this an unqualified success. In all probability this spot will be the Mecca of our Western friends, of which they may well feel proud. The general plan of the buildings is like that followed out by the founders of the Chicago Fair, although differing from it in elaborateness and being, in many respects, more beautiful. It is strange to realize that a quarter of a century ago this portion of American territory was regarded by the inhabitants of Eastern cities as unsettled, and, in many respects, uncivilized. No delusion could have been greater and no quicker transforamtion can be imagined in practice than that which has led unbiased judges to believe that the West shares the crown of civilization and successful progress with the East.

The Grand Court at the Greater America Exposition, Omaha.

[Courtesy of "Electricity."]

PLEA FOR A WORKING STANDARD OF LIGHT.

BY S. EVERETT DOANE.*

It was my desire to present what I am about to say as a part of the discussion on the report of the committee on the standard of light. As this committee will not report at this meeting, I bring the following before the Institute with no intention, of course, of interfering with the work our comittee is doing. We all agree as to the importance of this work. What I wish to propose is that this committee or a new one, fix definitely the means for maintaing a working standard of light pending the adoption of a primary one.

There are scattered over the country many well equipped laboratories, and in the near future every central station and large isolated plant will be provided with means for measuring light. There is not now in existence any workable primary standard which can be used by the ordinary photometer corps.

It may be said that this is equally true of all primary standards. The mercury column or resistance standard, in fact presents so many difficulties that it is rarely ever used, even in our best equipped laboratories. In reply we can say that the standard of light differs from all these in that its terms are so indefinite and so crudely outlined that two laboratories cannot produce the same value for the candle power, if they work entirely independently. The discussion on this paper will probably bring out very

*Presented at the 16th General Meeting of the American Institute of Electrical Engineers, Boston, June 27th, 1899.

diverse views as to what is the proper direction in which to work to eliminate our present difficulties with the light standard.

The standard of light is in quite another class from the other standards. Every instrument maker is anxious that his instruments shall be calibrated in true units and he can so calibrate them if he uses care. He sends his instruments out so calibrated to the best of his knowledge.

A lamp user may say to the manufacturer, "Your standard is wrong," and neither ever dreams of suggesting a recalibration; they know by experience that an agreement cannot be reached. No observer can ever duplicate his own work. What is the result? Every lamp maker in the country is sending out some lamps which are wrongly marked according to his own standards because some of his customers have standards of their own.

Lamp makers differ among themselves and there exists no way by which they can be brought together. It is obviously to the interest of the whole electrical engineering fraternity that some action looking to the correction of this condition be inaugurated.

In passing I wish to go on record as saying that in a very few years the incandescent lamp will be adopted as a primary standard. It could be so adopted to-day if lamp makers would only tell what they know.

Every committee (our committee included) ever having to do with investigation of proposed light standards has found an incandescent electric lamp a very convenient secondary standard. It has been entirely satisfactory, so much so that my whole purpose in writing this paper has been to see if we cannot inaugurate some action which will result in the appointment of a committee who will provide means whereby a standard of light may be arbitrarily maintained. This committee could send out under proper restrictions properly seasoned and calibrated incandescent lamps for this purpose.

It does not matter just how this is done. Possibly a national laboratory could be founded. A committee of the professors of electrical engineering from our various colleges might agree to do this for us. Something should be done, and the first step toward it will be the appointment of an Institute committee on the maintenance of what our committee on light may decide is a proper standard value. Such a decision will be arbitrary and may have to be changed later, but what of that? We need now a common working standard of light.

That the discussion may be entirely free I refrain from making any definite suggestions until the views of the members may be obtained, but whatever these views may prove to be, I hope some action will be taken which will afford us temporary relief, and enable our committee on light standard to pursue its work unhindered by the necessity for hasty action. We can take action none too soon. A year from now, at the rate photometers are being made, we shall have as many standards of light as Joseph's coat had colors, unless something be done.

AUTO-MOBILES.

ELECTRIC AUTOMOBILES.

BY ELMER A. SPERRY.*

At the National Electric Light Association meeting a few days since, Mr. Crosby gave expression to a sentiment which has been rapidly taking form for the past twelve months. He said: "To-day we are as near sweeping the horses off the street with the automobile, as we were in 1889, in taking them off the tracks with the electric car."

Why, I ask, was the date '89 chosen? True, it marks a decade in the history of a branch of electrical application which has made the most stupendous strides; in fact, distanced all sober predictions as to achievement. It marks more. To those associated with the early development of electrical traction, it was about these years that the conservative engineer began to breathe easily; through rigorous experience that seemed nigh about interminable, he became convinced that at last, insulation and materials peculiar to the art, startingly new to, and even held in derision by, the traction engineer, could nevertheless be relied upon to do the rugged work of heavy traction.

By '89, what we might call a "motor mortality" under severe conditions of service had been reached, that meant success. In a space then considered contracted, we had found room for ample area of journal and commutation; ample insulation and dielectric, to withstand the voltage strains. Methods of supporting and imbedding insulation and conductors had been devised, that ensured life not only against heat and overload, against vibration, pounding and concussion, and last, but not least, against misuse and abuse at the hands of the non-expert.

It had been an evolution, gradual though rapid, many had contributed to its success; it had finally placed on a firm basis, the dream of the engineering world from the time of Watt, down; namely, "The Rotary Motor." The achievement can hardly be over-estimated. Unnumbered engineers had planned, toiled and passed with the solution of this enchanted problem almost within their grasp. A rotary motor with no oscillating or reciprocating part had at last been developed. It delivered torque, pure and simple—constant and regular, and had a capacity measured by its size, and an efficiency measured by other motors, nothing short of wonderful. The motor was simply ideal.

At first much was said to the effect that the machine was not a prime mover; but it had been "hitched to a star." Its system of connection with the prime source of power was at once so complete, and its association so intimate as to perform more acceptably and economically than the prime mover itself, and as compared with the smaller sources, its economy back to the fuel, even at miles distant, was found to be superior.

The fact that the electric motor is a rotary motor, contributes to the success of electric motor-driven systems to a degree difficult to over-estimate. Our compressed air friends, compelled as they are, to use a multiplicity of reciprocating engines as motors, have made a long step backward and are certainly in the rear in this, as in other features of their system.

The electric automobile coming upon the scene at this time falls heir to many of the rich results worked out in connection with tramway traction. There are many who go so far as to predict that the younger claimant will displace the former, especially the lighter class of street car service, and this doubtless will be the case to a degree.

Electric railways are rapidly reaching out with wider radii of operation and heavier and heavier equipment, and the automobile will doubtless have wide use as supplemental to the heavier systems. In fact, co-operation has already been proposed in a number of instances. Its great flexibility and independence of track render it the ideal urban conveyance.

As the perfection of the electric motor gave the first impetus to electric tramway traction, so the point now reached in the perfection of the storage battery will yield results in the field of the electric automobile. The past three years have advanced the art remarkably, and drawn it to the attention of both skill and capital, and results have followed.

The perfected storage battery presents some remarkable features. It even rivals the electric motor in its fitness and special adaptability to the automobile problem. Its very large reserve power at instant command; its entire freedom from danger when fully charged; its

*Presented at the 16th General Meeting of the American Institute of Electrical Engineers, Boston, June 28, 1899.

almost constant pressure throughout its capacity; its recently developed capacity for quick charging; and ease with which charge may be obtained in almost any hamlet in the country, are among its advantages.

The author can state definitely from personal tests of the principal types of batteries built on the Continent and in England that most of the published records are trustworthy as to specific capacity at the various rates. Some of the structures, however, are open to serious objection from the standpoint of vehicular traffic. For instance, one of the most popular French batteries, though packed with the utmost care, reached this country with 50 per cent. of the positives broken off, and upwards of 40 fragments of positive plate disintegrated, per cell. What are we to expect with such a cell in the hands of the non-expert? Fortunately materials are at hand and systems of developing the plates perfected that render them thoroughly reliable and commercial to a degree commensurate with their life. The recent claim of one maker that batteries light enough for traction purposes would live through 5,000 full discharges is hardly credible, though the negatives of some special types seem to indicate a near approach to this figure. The engineer is at present engaged in increasing the life of the light positive, with every indicaton of success, at least beyond the point ensuring commercial requirement.

It has been supposed that compressed air is the ideal stored power, but it is safe to say that electric storage distances it in the important features. Compressed air reservoirs weigh about 85 pounds per cubic foot capacity for air at 2,000 pounds pressure to the square inch, the air itself weighing nearly 11 pounds. How many horse power hours will this cubic foot develop? Those who know are reticent. It is found by adding to the air a large quantity of heat, at extra cost, by compounding cylinders and using pressure reducers and wire-drawing valves, all with added weight, that about .27 of a horse power hour may be obtained. We know that this weight of storage battery will develop 1 1-2 horse power hours, requiring no reducing valves and maintaining its pressure practically at one point until exhausted, rather than gradually exhausting the pressures, as with air. This straight line of discharge of the batteries is not matched by any other storage system of which we now have knowledge.

(To be continued.)

MISCELLANEOUS.

STRAY CURRENTS.

SALT WATER AS A RETURN CIRCUIT FOR A TROLLEY ROAD.

According to the Australian Mining Standard some interesting experiments are being carried out, at the instance of the New South Wales Railway Commissioners, to determine the value of the salt water of Sydney Harbor as a return circuit for the electric tramways. If found practicable, the intention is to apply the principle to the North Shore system, so that instead of laying cables in order to establish a complete metallic circuit the salt water will be used as a means of conveying the return current to the conductor on the land side.—Electricity.

A MODEL MAN.

Adiline—When I marry I shall select a man who resembles an arc light.

Mae—Gracious! in what way?

Adiline—Not go out at night and never smoke.—Ex.

SMOKE AS A CONDUCTOR OF ELECTRICITY.

On the approach of a thunder storm French peasants often make up a very smoky fire in the belief that safety from lightning is thus assured. By some this is deemed a superstition, but the custom is based on reason, insomuch as the smoke acts as a good conductor for carrying away the electricity slowly and safely. In 1,000 cases of damage by lightning, 6.3 churches and 8.5 mills have been struck, whilst the number of factory chimneys has only been 0.3.—Industries and Iron.

GENERAL ELECTRIC OFFICIALS SETTLING AT SCHENECTADY.

The General Electric Company has purchased of Union College 76 acres of land at $750 an acre. The land, which is over a mile from the company's factory, will not be used for manufacturing purposes, but for residential sites for the officers and leading employees of the company. This sale will give to the college nearly $60,000 which will be devoted to carrying on the higher educational work of this well known institution. It is the intention of all the leading officials of the General Electric Company to make Schenectady their home and put up fine residences there.—Electrical Review.

OBSERVATORIES AND TROLLEY CURRENTS.

In his report on the year's work at Greenwich Observatory, the Astronomer Royal has the following regarding the effect of electric tramway and railway currents upon magnetic observatories: "The question of the protection of the Observatory from disturbance of the magnetic registers by electric railways or tramways in the neighborhood has caused much anxiety during the past year. A number of such railways are now projected, and the value of the magnetic registers, which have now been carried on continuously for nearly 60 years, will depend entirely on the conditions under which electric traction is used. Steps have been taken, in concert with Prof. Rucker, acting on behalf of Kew Observatory, to have a special clause inserted for the protection of Greenwich and Kew Observatories. This has already been accepted in several cases , and it is hoped that it will be agreed to in others when necessary."—London Electrical Review.

SPEED OF TELEGRAPHIC COMMUNICATION.

Forty years ago, after the first Atlantic cable was laid, the transmission of a message of thirty words occupied twenty-five minutes. To-day a similar message can be transmitted over the new Atlantic cables in less than one minute. The following are specimens of the quick work performed in the trials of the third cable of the Commercial Cable Co.: On June 13, 1893, between the hours of 6:54 A. M. and 4:42 P. M. (9 hours and 48 minutes), 807 messages were passed in one direction over one of this company's main Atlantic cables, 2,338 miles long, being an average of 82.2 messages per hour. This rate of speed has never been equaled. On the 21st of September, 1894, a Manchester firm sent a message to Victoria, British Columbia, over the lines of the Commercial Cable Co. and Canadian Pacific Telegraphs and received a reply in 90 seconds. The distance out and return is 13,000 miles. The vast strides in rapidity of transmission during one decade may be seen by comparing the two following: In December, 1884, a communcation was sent from New York to London and an answer received in 45 seconds. In October, 1894, a similar trial of speed was made over this company's new third cable, which ocupied 5 seconds. There are now 1,459 submarine cables, 1,141 of which are laid along coasts and in rivers. The total length of cable is 162,928 miles.. Of this mileage, corporations own 143,024, and of the companies themselves 76 per cent. are managed in London. France commands 12 cables measuring 2,033 nautical miles in colonial waters. Germany controls 11 cables of 3,040 nautical miles in European waters, and three cables of 470 miles in colonial waters.—The Railway and Engineering Review.

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GLASS MADE BY ELECTRICITY.

The use of electricity for industrial purposes has, in many cases, entirely displaced the power formerly used, and caused a revolution in methods of a most surprising character. One of the most interesting bits of news in this respect comes from Cologne, where a glass-making plant has been erected in which electricity is used almost exclusively.

An electric furnace has been erected in which the raw materials are placed from which glass is to be made. When the current is turned on the mass is fused into glass in a period of time not exceeding fifteen minutes. The quantity of glass made in this interval is not very great, but sufficient is there for immediate use. The coal consumption, which is ordinarily very great with the old-fashioned furnace, and by the use of which many difficulties were met with, is, in this case, at the boiler end, about forty per cent. of what it would be were it burned directly in the old-fashioned manner. Neither dirt nor ashes mixes in with the glass, and instead of a delay of thirty hours in getting one charge of glass ready, a quarter of an hour is sufficient, that is to say, an electric glass-making furnace takes less than one one hundredth of the time generally required to get the molten stream ready. The labor element is therefore reduced, the cost of operation reduced, as far as fuel is concerned, and the size of the plant for a given daily output likewise reduced.

It may be said without fear of denial that an electric glass-making factory operates at a reduced expense of at least twenty-five per cent., this being simply another illustration of how some of the oldest industries are transformed by the use of the most recently discovered forces.

BURNING GARBAGE FOR ELECTRIC LIGHTING.

The town of Shoreditch, England, derives its light and power from that which was formerly regarded as a nuisance and a menace to health. The garbage is carefully collected in this town and after a slight preliminary drying is burnt in the boilers of the municipal electric light plant. This disposal of the refuse has been seriously considered by the boards of aldermen of several large American cities. In Greater New York the matter received some attention, but no experiments have been conducted for the purpose of discovering whether the investment would be a paying one.

In Shoreditch the refuse burnt consisted largely of combustible material, such as wood, paper, etc. What the flotsam and jetsam of New York would be, from a calorific standpoint, no man can tell offhand. It is very probable that a large percentage of the waste of our homes contains sufficient carbonaceous material to sustain a very lively fire. If the sale of this refuse would fetch a higher price when auctioned off than the light itself would cost, were the matter consumed by burning, the city could not afford to erect its own plant. But if it can be shown by practical experiment that from every ton of refuse a certain number of horse power hours could be obtained, capable of giving all the light required, it would certainly pay in the end to undertake municipal lighting.

The residual products, if collected, would probably add an element of profit to the plant which might make the electric lighting cost nothing. We hear that Lord Kelvin and Prof. Archibald Barr made some experiments in Bradford, Oldham and Edinburgh for the purpose of discovering whether the town refuse, when consumed, would develop any disagreeable features, such as smoke, etc. According to their report, a large mass of garbage, consisting of vegetable matter, sweepings, and other forms of debris, when burnt, consumed without a suspicion of smoke and the by-products were of enough value to be saved for commercial purposes.

We do not think that the combustible properties of garbage differ so largely in American cities that it could not be relied upon for steam making. In Greater New York great masses of paper are wasted along with scraps of combustible foods, etc. This makes us think that a large municipal electric light plant, if carefully designed, could be run with every possible economy and in the end mean a saving of considerable money to its citizens.

THE RISE IN COPPER.

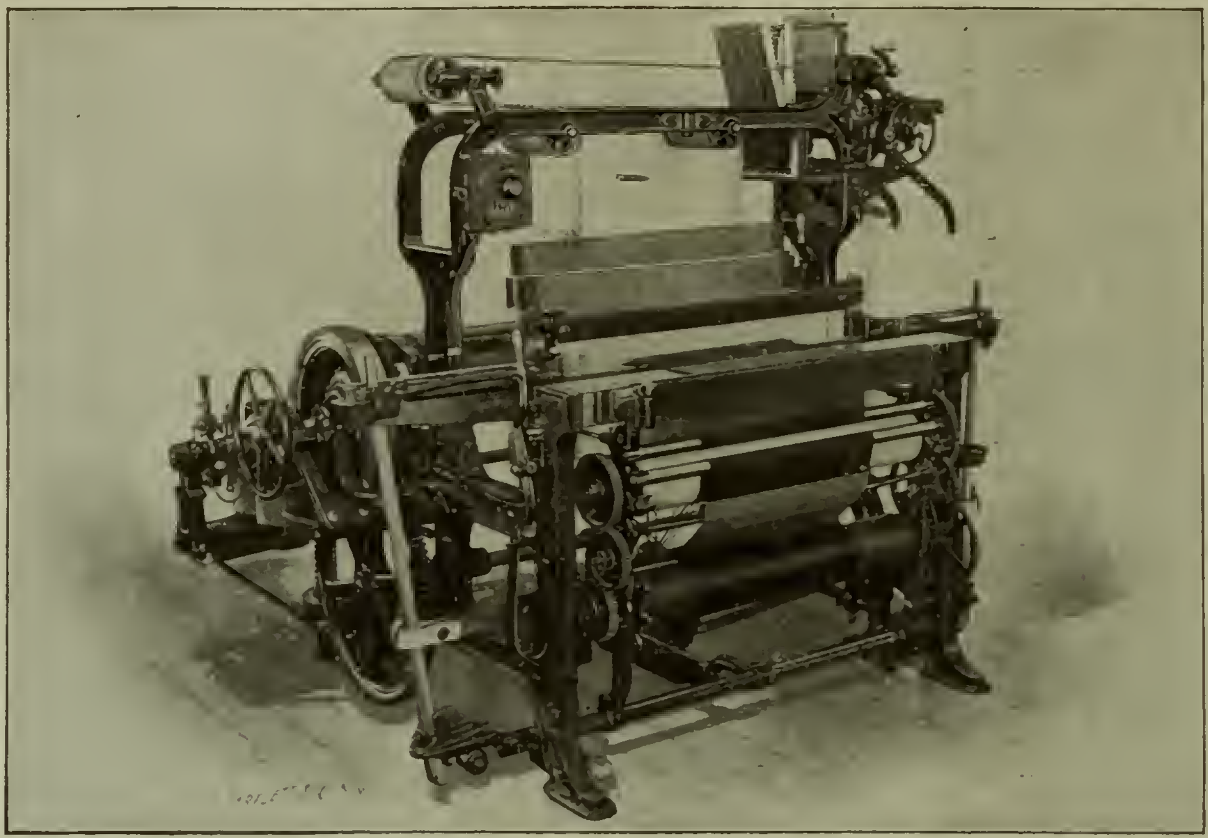
The steady rise in the price of copper can be largely attributed to the increasing demand made for it by electrical concerns. The spread of trolley roads over the country, the unusual development of electric light and power industries, the constantly increasing sale of motors and generators, and, in addition, the manufacture of more alloys containing copper, have all tended to raise its price so appreciably that the ownership of a copper mine is practically on a par, as far as profits and aggregate sales are concerned, with a diamond mine.

Each year the amount of copper used will increase, thus giving a chance to those who can suggest a substitute for it to open up a new field of industry. Quite a few transmission plants have erected between their limits an aluminum conductor of such a size that its conductivity is as great as copper and its weight is considerably less. One of our eminent electricians suggested the use of a system of water pipes of insulating material, the water within them acting as the conductor. If the price of copper continues rising such a scheme as this may be seriously considered by some Western capitalists.

ELECTRIC LIGHT AND POWER

BELTING VERSUS DIRECT CONNECTION.

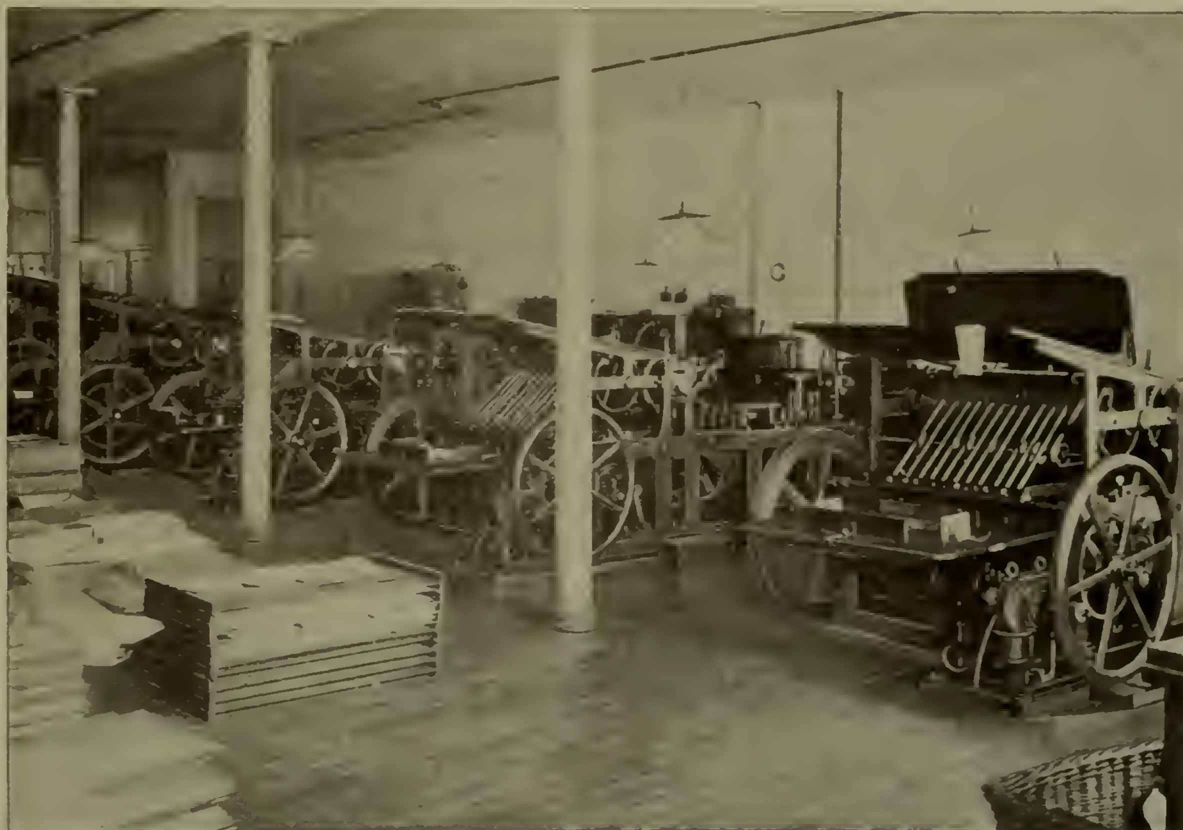
The problem of transmitting power is one which becomes of more vital importance day by day. The transmission of power is not limited to those cases which involve its transit over ten, twenty or thirty miles of territory but is related, and is part of those difficulties met in the engine room, the work shop and even the power stations of large cities. In Kapp's "Electric Transmission of Energy" the author says: "If we would judge fairly the merits of a new invention we should not only look upon it by itself but compare it with all that has gone before and might be superseded by it. This is especially the case if we have to deal with a new thing that has many rivals, and the electric transmission of energy is precisely in this position. Ever since man began to use tools worked by other than manual power he had to employ some system of transmission of energy and as a natural consequence the number of systems is not only very large but each has, in the course of time, been brought to great perfection."



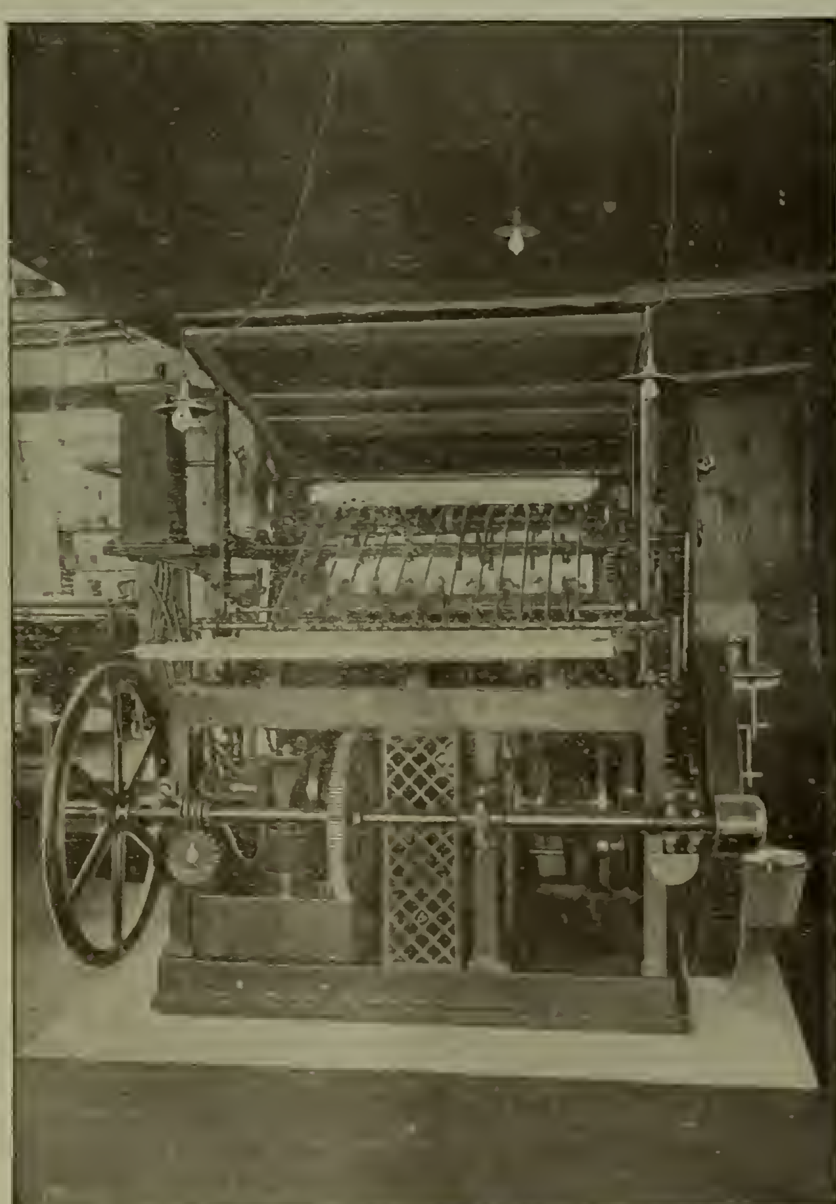
Crocker-Wheeler Motor Geared to Silk Loom in Operation. Finishing Side Motor on Left.

Crocker-Wheeler Motors Geared to Lithographic Presses, Donaldson Bros., N. Y.

It is hardly necessary to discuss in detail not the failures but the losses met with in transmitting power in driving machinery. If all the coal consumed by engine plants used for driving shop and other machinery by belt were carefully calculated it would be found that the lowest estimate would show a total loss of over forty per cent. It is true that the cost of power is a small item in comparison with the price paid by customers for the work done by this power, yet any large waste of energy should be stamped out and the system improved sufficiently to show that an effort has been made to diminish the working expenses. A prejudice does not actually exist against the introduction of motors into machine shops, but there is some doubt in the minds of many practical men as to whether the expense of an electric

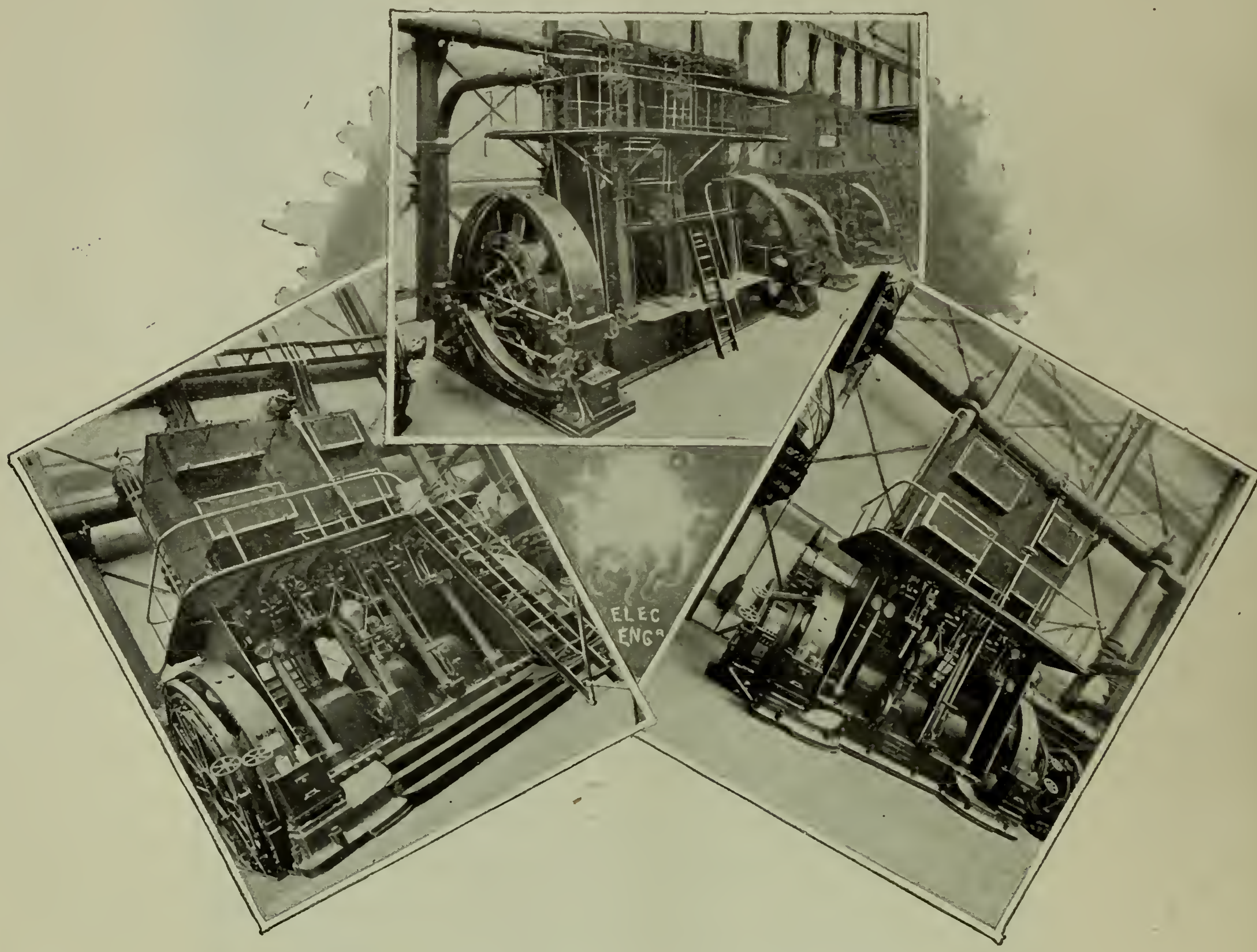


Printing Room Showing Electrically Driven Presses and Absence of Belting and Shafting; 17 C.-W. Motors Installed in this Establishment.



Crocker-Wheeler Motor Geared to a Lithographic Press.

installation would not in total be greater in the course of a year than the purely mechanical system adhered to by them for so long. It is surprising to realize that the machine shop ,the printing house, the factory and many other industrial establishments make free use of electricity for lighting, and yet doubt, in many respects, the advisability of installing an electric system of direct connection by means of motors. A rough estimate might be of some interest to those inclined to entertain a proposition relating to the installation for direct connection. Take a one horse motor whose market price would be at least one hundred dollars and for which the cost of power would be three cents an hour. On the basis of this supposition a motor would run at an expense of twenty-four or twenty-five cents per diem of reach to higher figures in case the shafting is run for any length of time without overhauling. At eight hours a day and for three hundred days in the year the cost for power would reach ninety-six dollars, to which may be added twenty-five dollars for shafting, belting and erection, reaching a total of one hundred and twenty-one dollars net. The difference between belting and direct connection would be even greater than the fifty dollars difference, but this calculation would show that the second year everything favors the motor; the third year probably showing a direct gain in dollars and cents. In one case coming within the writer's notice an engine lathe of nine-inch swing was shown direct connected to a six horse motor. Even though very heavy cuts were taken the use of gearing absolutely prevented any variation in



Modern Electric Light Station Showing Complete Absence of Belting.

eight hours duration. With three hundred working days in the year the cost for power would amount to seventy-five dollars, which, in addition to the first cost of motor, would figure up to one hundred and seventy-five dollars. With a belt drive, calculating the cost of counter shafting, belts, etc., the installation would certainly cost at least twenty-five dollars with a necessary loss in transmitting the power of from forty to fifty per cent. In other words, one horse power could be delivered to the machine itself by developing from one and a half to two horse power at the engine. This would increase the cost of power to at least four cents, which would probably speed or any signs of unusual load on the motor. There is every reason for believing that the reduction in power by direct connection amounts to at least one-quarter of that otherwise consumed. In the following illustrations some Crocker-Wheeler motors are shown direct connected to silk looms, lithographic and printing presses. It is worth while noting the appearance of the printing shop, free from all manners of belts. Other illustrations of the Chicago-Edison station as compared with one of a still existing, though older type, will certainly indicate advantages as regards floor space as well as saving in power. The most modern machine shop as well as the up-to-date station has not diminished in size on account of the use of direct connected machinery, but it presents the appearance of an establishment in which nearly twice as much machinery can be placed without interfering with the amount of floor space required for practical purposes. The Edison Electric Illuminating Company, of New York, actually save $25,000 a year by using their present system in lieu of belts or wire rope. This applies to the saving in floor space, the diminished strain on the building and the lack of noise usually deemed troublesome by residents closely adjacent.

OPERATING COSTS OF HORSE AND ELECTRIC DELIVERY WAGONS IN NEW YORK CITY.

By G. F. Sever and R. A. Fleiss.

(Continued from page 11.)

We find that, starting from the store, the average speed while in motion was 6.7 miles per hour. The actual running time was 1 hour 36 minutes; time at rest 2 hours 28 minutes.

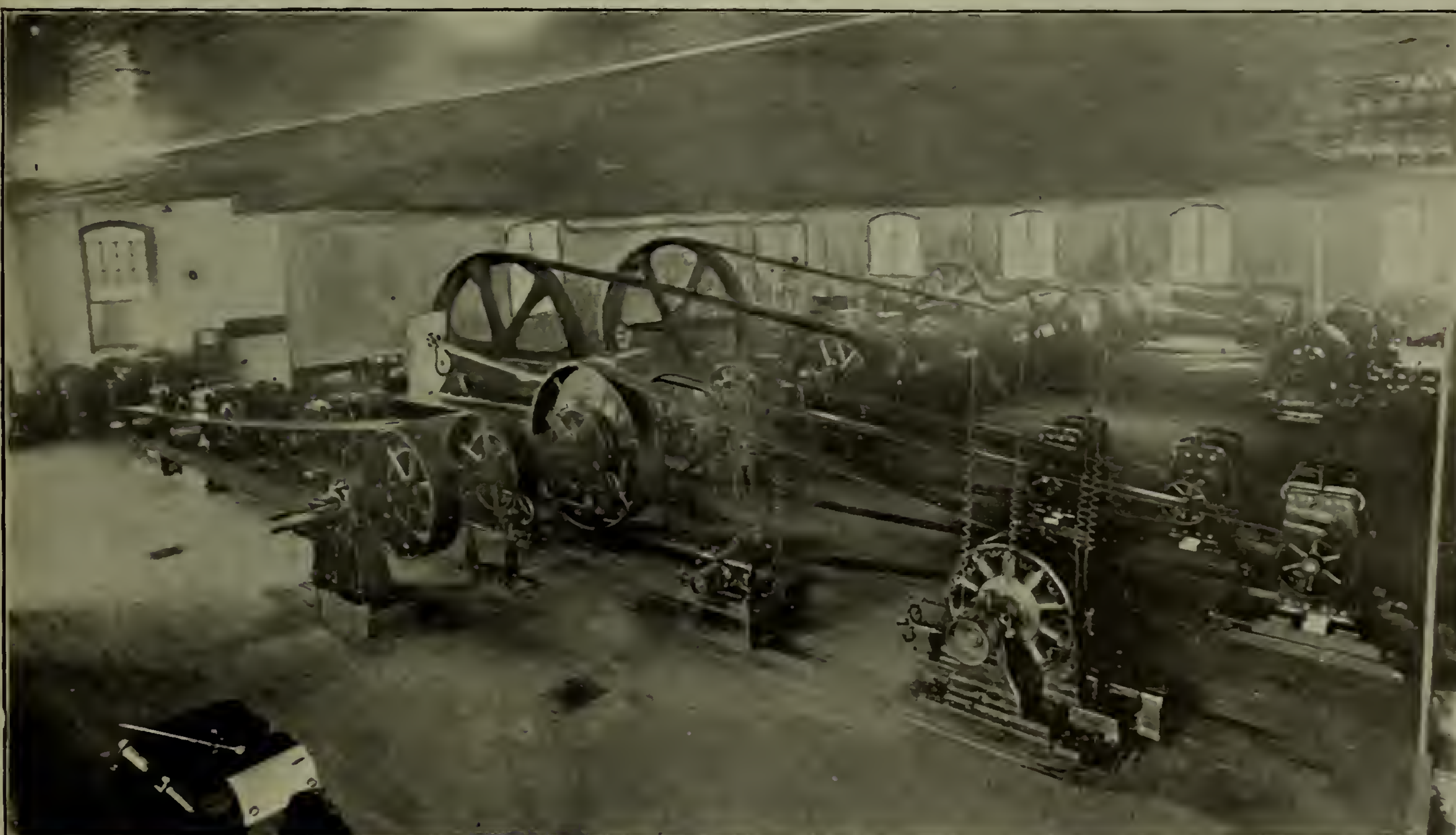
From the time the horse left the stable until he returned to it was 4 hours and 52 minutes. The time taken to load at store was 46 minutes. The time to run from stable to store was 2 minutes. Hence the actual time the horse was working from the time he left the stable until he returned to it was 1 hour and 38 minutes; time at rest 3 hours and 14 minutes.

It will be noticed that the horse was at rest and doing no work for nearly two-thirds of the time.

Taking the draw-bar pull as found, at 50 lbs. per ton, the number of foot-pounds of work done by the horse in traveling 11 miles was 50 x 58,080—2,904,000 foot pounds, or at the rate of 1,781,596 foot pounds per hour, which is at the rate of 29,693 foot pounds per minute. This delivery hose then exerted nearly .9 of a theoretical H. P. for 1 hour and 38 minutes. This was all the work done by this particular horse on this day. The following day this same horse made two trips over the same ground. From this data the average work done per day the year round by a horse in this class of service, may be taken to be not over 16.5 miles at 50 lbs. per ton, at a speed of 7 miles per hour. Other data bears out this conclusion. It is quite probable that on some special ocasion a horse may be called upon to do more than is shown above, but the average work, day by day, for the year is not more than this. In fact experience has shown that a horse in delivery service in New York city cannot average over fifteen miles a day for six days a week and be expected to render good service for any reasonable length of time.

The length of the working life of a horse in this service, is seldom over five years. At the end of this time he has depreciated in value at least 50 per cent. and cannot be sold for more than half his original cost.

The time that a horse is in harness per day the year round, will not average more than seven hours, and we have seen that he is only working a small fraction of this time. However, for the purposes of this paper, it will be considered that a horse can do a greater amount of work, day in and day out the year round, than experience has indicated that he accomplishes.



Electric Light Station Showing Floor Space Occupied by Belted Machinery.

We will assume, therefore, that it is possible for a horse to do 21 miles a day under a draw-bar pull of 50 lbs., at seven miles per hour and be in harness eight hours a working day, the year round.

The number of foot-pounds of work done per day by a horse, under this supposition, would be 5,280,000. This at the rate of .89 of a theoretical H. P. for three hours per day. This, of course, refers only to the time in actual motion.

Having established the amount of work that a horse is to do per day, it is now necessary to ascertain how much it costs to do this work. The basis upon which this calculation can most readily be made, for comparison with other values, is the ton-mile; that is, how much it costs to transport a ton one mile over a level road under ordinary conditions; the ton weight to include everything that enters as a factor in causing the draw-bar pull of the wagon. These factors are, the weight of the wagon, weight of driver and boy, and weight of load carried. In order to facilitate the calculation, the data collected has been condensed into a table and is given below. This table represents the results of a personal canvass of a large number of stables for delivery and for general livery service. The figures given are the lowest that were procurable in New York city.

TABLE III.

TABLE OF ITEMS ENTERING INTO THE CALCULATION OF THE COST OF MOVING A TON A DISTANCE OF A MILE ON LEVEL GROUND, IN LIGHT DELIVERY SERVICE IN NEW YORK CITY.

1.	Cost of food per day for one horse....	32.00 cts.
2.	Interest on cost of wagon (at 6 per cent. per annum) per day, original cost of wagon, $312	5.13
3.	Interest on cost of horse (at 6 per cent. per annum) per day, original cost of horse, $125	2.06
4.	Interest on cost of harness (at 6 per cent. per annum) per day, original cost of harness, $55	.90
5.	Part of stable rent charged to each horse per day, (cost of stable, $40,000. Int. at 6 per cent.—$2,400.) 46 horses in stable, part of rent chargeable to horses—$1,578.55.	9.39
6.	Part of stable rent chargeable to each wagon per day, 24 wagons in stable.. Part of rent chargeable to wagons—$822.85.	9.39
7.	Part of cost of attendance chargeable to each horse .... 4 men to take charge of 46 horses at $11 a week per man—$44 a week for care of horses.	13.66
8.	Shoeing per horse per day ($2 per month a head, the year round)...........	6.60
9.	Driver per wagon per day, $12 per week.	171.42
10.	Boy helper, $8 per week.............	114.28
	Total cost of 1 wagon, 1 horse and attendance per day.................	364.83c.

It is to be understood that this table represents the actual cost per day, to a stable in the city, for a wagon and horse, the figures given being those of a stable connected with one of the large dry-goods houses in the city.

Assuming 500 pounds as the average load carried by any one wagon per day, the total weight of the unit which causes the draw-bar pull as found before, is

Wagon	1,300 lbs.
Driver	150 "
Boy	125 "
Load	500 "
Total	2,075 "

Hence, draw-bar pull being taken as 50 lbs., the cost to move 1 ton 21 miles may be taken as 364.83 cents, the cost per ton-mile being then 17.373 cents.

Taking another case where the two horses and the delivery wagon are considered, and assuming the most ideal conditions, we find the following:

TABLE IV.

Supposition:

One wagon making three deliveries a day of 800 lbs. each—assuming 500 lbs. average load as before, making a total delivery per day—2,400 lbs.

To do this will require 2 horses, 1 wagon, 1 driver and 1 boy. The cost per day of this outfit from Table III. is as follows:

1.	Food for two horses		64
2.	Interest on cost of 2 horses......	4	12
3.	Interest on cost of wagon.........	5	13
4.	Interest on cost of 1 set of harness.		9
5.	Stable rent chargeable to 2 horses..	18	78
6.	Stable rent chargeable to wagon...	9	39
7.	Attendance on 2 horses..........	27	32
8.	Shoeing for 2 horses.............	13	20
9.	Driver	171	42
10.	Boy	114	28
	Total	428	54

The cost of delivery per pound is then .17856 cents. If we assume that in doing this work the wagon was out 12 hours and is in motion one-half its time, going at a speed of 7 miles per hour while in motion, then the wagon wil cover 42 miles per day. Under these conditions the cost per ton-mile is 10.2 cents. This is also the cost per car mile.

If we consider the load only, it costs 10.2 cents per 500 lbs. per mile, or at the rate of .0204 cents per lb. per mile.

If we assume that on the three trips the deliveries average 50 per trip, then 150 deliveries were made per day. This is at the rate of 25 deliveries an hour or 1 delivery in 2.4 minutes. It is well to call attention here to the fact that a wagon sometimes is called upon to make as high as 100 to 150 deliveries on a single trip and the average rate of delivery may be taken as not over 25 deliveries an hour. Hence it is evident that the case considered in Table IV. is for ideal conditions only. The weight per package under our supposition is 16 lbs., and it is not often that the packages will average over 10 lbs.

The results deduced from Table IV. it will be understood, represent the lowest possible figure under the conditions now existing in the stable under consideration. Therefore, if in making a comparison between the costs of operating a horse and an electric delivery service under identical conditions, the above figures are used, all possibility of error in favor of the electric automobile would seem to be eliminated.

(To be continued.)

LITERARY.

PRACTICAL INFORMATION ABOUT THE ADIRONDACK MOUNTAINS.

No 20 of the "Four Track Series," entitled "The Adirondack Mountains and How to Reach Them," has just been issued by the Passenger Department of the New York Central & Hudson River Railroad.

This folder contains an immense amount of practical information about the Adirondack Mountains in a condensed but very comprehensive form.

It has a map of this wonderful region, carefully revised to date, that is a marvel of accuracy and beauty, also a complete list of Hotels, Boarding Houses, Private Camps, Lakes, Rivers, etc., etc., plainly and correctly located on the map by marginal references, and which has been carefully corrected to date. The folder will be found an invaluable aid in arrranging a trip to the mountains.

Other valuable features are a complete list of stage lines, steamer routes and other modes of conveyance in the Adirondack region, together with the rates of fare for same.

The time to make the trip from any large city in the United States is also given.

A copy will be sent free, postpaid to any address upon receipt of a one cent stamp by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

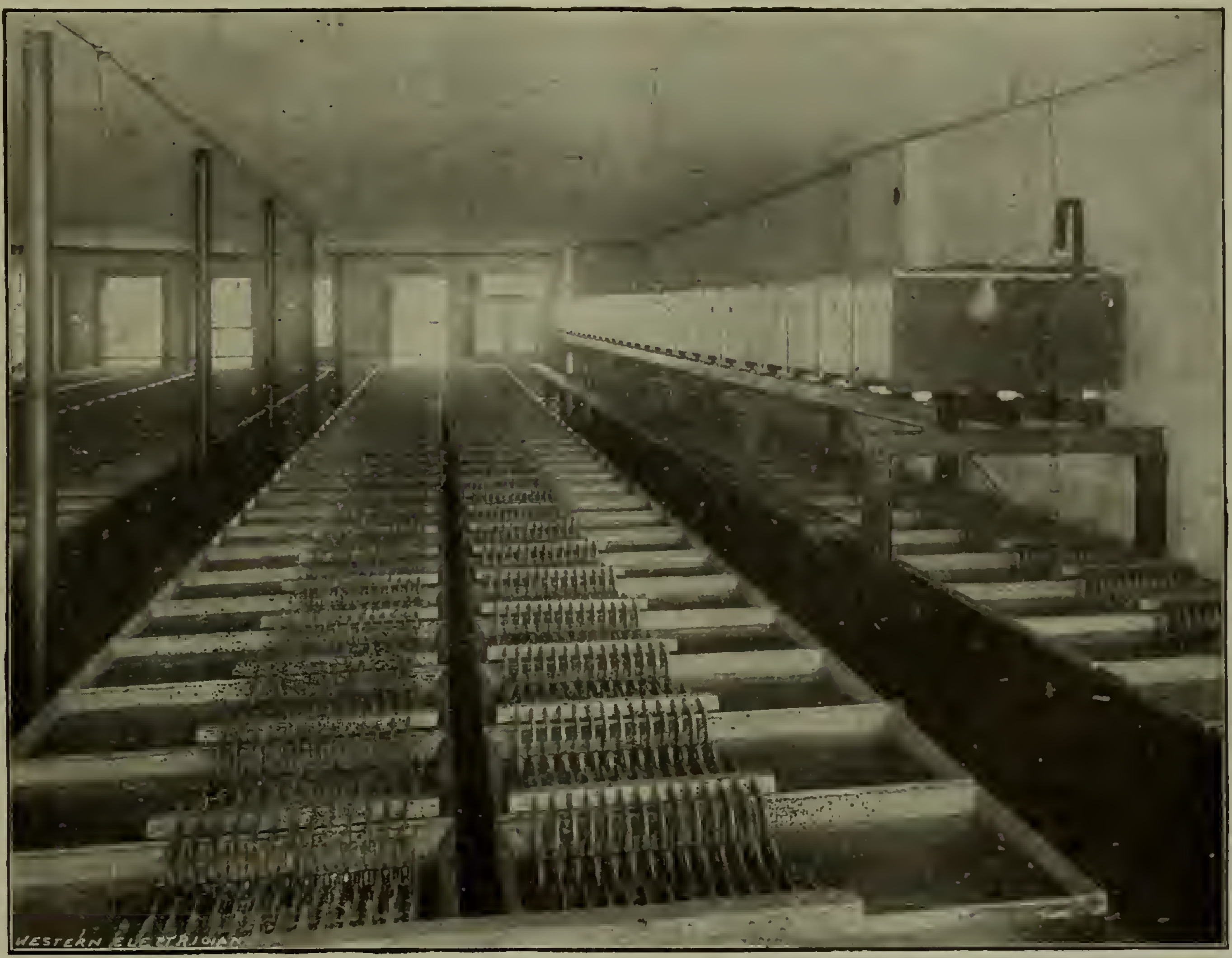
THE STORAGE BATTERY.

ACCUMULATORS AND VOLTAIC ACCUMULATORS.

Despite the prophecies of many would-be experts the storage battery has come to stay. Its failure to successfully establish itself at the beginning was largely due to attempts made to force its use in cases where it was not practical to apply it. For electric lighting, in connection with large stations, the accumulator has established itself as a necessary adjunct. During periods of heavy load, lasting for about an hour, a storage battery costs less to use than a heavier investment in generators, steam engines and boilers for that additional output. The peak of the load, as it is called, is taken up by the storage battery so successfully that nearly every large electric light plant in the country now recognizes the distinct advantages they possess.

A new storage battery or primary battery, called the "voltaic accumulator," is slowly appearing on the market. It is ably suited to traction purposes and may, in the course of time, find a place in that particular field of work. The average weight per horse power hour reaches one hundred and twenty-five pounds with storage batteries, but it falls below this to fifty or sixty pounds per horse power hour in the voltaic accumulator. This battery consists of a peroxide of lead depolarizer, a twelve per cent. solution of sulphuric acid and a positive element of amalgamated zinc. The E. M. F. of this cell is two and one-half volts, and its low internal resistance, simplicity of construction, etc., make it exceedingly practical to use. Until further experiments have been made with it it cannot displace the accumulator proper, although it can be charged by a current in the same manner.

A view of a large storage battery plant is shown in the illustration. It consists of many hundred chloride accumulators, which perform the function of supplying power as described above.



View of Storage Battery Plant.

BUSINESS NEWS

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FOR WEEK ENDING JUNE 27, 1899, $43,156.00.

New York, N. Y., June 27, 1899 The following exports of electrical material are from the port of New York for the week ending this date:

Antwerp—10 packages electrical material, $925.

Argentine Republic—25 cases electrical machinery, $2,588; 71 cases electrical material, $2,053.

Brazil—90 cases electrical material, $2,840.

British Guiana—7 cases electrical material, $145.

Bristol—1 case electrical material, $127.

British West Indies—89 packages electrical material, $3,685.

Chili—11 cases electrical material, $60.

Central America—14 packages electrical material, $251; 20 cases electrical machinery, $3,820.

Cuba—74 packages electrical material, $1,281.

Dublin—92 packages electrical material, $113.

Glasgow—8 packages electrical material, $179.

Genoa—37 cases electrical material, $3,600.

Havre—12 packages electrical material, $1,675; 19 cases electrical machinery, $691.

Hamburg—150 packages electrical machinery, $3,600; 98 packages electrical material, $5,543.

Liverpool—12 cases electrical material, $518.

London—65 cases electrical material, $2,240; 27 packages electrical machinery, $1,762.

Mexico—1 case electros, $21; 24 cases electrical material, $197.

Madrid—1 case electrical material, $53.

Peru—27 cases electrical material, $2,486.

Porto Rico—26 packages electrical material, $71.

Rotterdam—3 cases electrical material, $45.

Santo Domingo—3 cases electrical material,, $45.

Sandwich Islands—17 cases electrical material, $80.

Southampton—2 cases electrical material, $18; 21 packages electrical machinery, $1,140; 1 electrical whistle, $350.

GENERAL NEWS.

The Dayton & Eaton Electric Railway is at work securing a franchise to extend its line from Eaton to Richmond.

UTICA, N. Y.—H. C. Markham has purchased the water power on the Black River at Hurlbutville. Mr. Markham contemplates forming a company to furnish Boonville, Fort Leyden and Lyons Falls with electricity for light and power purposes.

TUNKHANNOCK, PA.—The plant of the Tunkhannock Light, Heat & Power Company was sold on foreclosure proceedings a few days ago, the property being sold to Mr. W. E. Little for $8,000. Mr. Little represented the bondholders. The new proprietors propose to pay the claims outstanding against the old company and put the plant in good condition.

AKRON, OHIO.—The Akron & Cuyahoga Falls Rapid Transit Street Railroad's strike has been settled by the company granting the wages demanded of the men, through declining to recognize the union. This company is owned by Henry A. Everett, of Cleveland, president of the Big Consolidated of Cleveland.

SAN FRANCISCO, CAL.—The Independent Electric Light & Power Company is rapidly perfecting arrangements to enter the field in active competition with other concerns engaged in the same line of business. The contract for the construction of an underground system of conduits involving an outlay of $1,500,000 has just been entered into with Gray Brothers. The work will be commenced at once and hurried to completion.

HOUGHTON, MICH.—Mr. Anson B. Miner and Donald McVichie, of Ishpeming, have concluded a careful examination of the copper country for a Marquette County syndicate and have decided to install a telephone system covering Houghton, Ontonagon and Keweenaw County, to compete with the Bell system. The promoters of the new company are owners of the Marquette County telephone system.

ALBANY, N. Y.—The Greene County Traction Company and the Coxsackie & Greenville Traction Company have been consolidated. The new corporation is to be known as the Coxsackie & Greenville Traction Company, and its capital stock is $200,000. The directors are T. E. Smith, J. D. Farrington, Dr. James D. Perry, G. L. Allin, William S. Smith, G. C. Spencer, of New York; William S. Vanderbilt, of Greenville; Newton A. Calkins, of Coxsackie, and Lucius Smith, of Ridgewood, N. J.

KANSAS CITY, MO.—The East Side Electric Railway Company has increased its capital stock from $2,000 to $200,000. Contracts have been made with the Lorain Steel Company, Lorain, Ohio, for over 600 tons of 82-pound rails, the St. Louis Car Company for eight 28-foot cars, the Westinghouse Electric & Manufacturing Company for the electrical equipment, and the St. Louis Iron & Machine Company for a 230 H. P. Corliss engine. It is expected that a portion of the line will be in operation by Aug. 1.

JOTTINGS.

Lowe & Leveridge, manufacturers' agents and dealers in general electrical supplies, 183 Greenwich street, New York City, have secured the contract to install one 50 K. W. and one 125 K. W. direct American Ball duplex engine and American Ball dynamo, together with switchboards, wiring, etc., at McCreery's, Twenty-third street, New York City.

The Manhattan General Construction Company, manufacturers of the well-known Manhattan Enclosed Arc Lamps, have removed to their new factory at Plane and Orange streets, Newark, N. J., where their general offices are located. The Manhattan Company, however, retains a sales office at their old address, No. 11 Bowling Green Building, Room No. 814, New York City.

IMPORTANT TO CONTRACTORS.

City of New York, Department of Public Buildings, Lighting and Supplies, Office, 346 Broadway, Henry S. Kearny, Commissioner.

Please take notice that on and after JULY 1, 1899, the Department of Public Buildings, Lighting and Supplies will require that the minimum thickness of wall for all metal conduits, whether flexible, enameled, insulated or otherwise, must conform to the following table:

Size in Inches. Internal diameter.	Thickness of Wall, In.	Size in Inches. Internal diameter.	Thickness of Wall, In.
½	.109	1¼	.140
⅝	.111	1½	.145
¾	.113	2	.154
1	.134		

An allowance of 2-100 inch for variation in manufacturing and loss of thickness by cleaning will be permitted. And said wall must be equal in strength to the commercial forms of gas pipe of the same size.

Also that the insulating compound of rubber covered wires for low potential systems (300 volts or less) must be approved and of a thickness of not less than that given in the following table for B. & S. gauge sizes:

From 18 to 16 inclusive, 1-32 inch.
From 14 to 8 inclusive, 3-64 inch.
From 7 to 2 inclusive, 1-16 inch.
From 1 to 0000 inclusive, 5-64 inch.
From 500,000 C. M., 3-32 inch.
From 1,000,000 C. M., 7-64 inch.
Larger than 1,000,000 C. M., 1-8 inch.

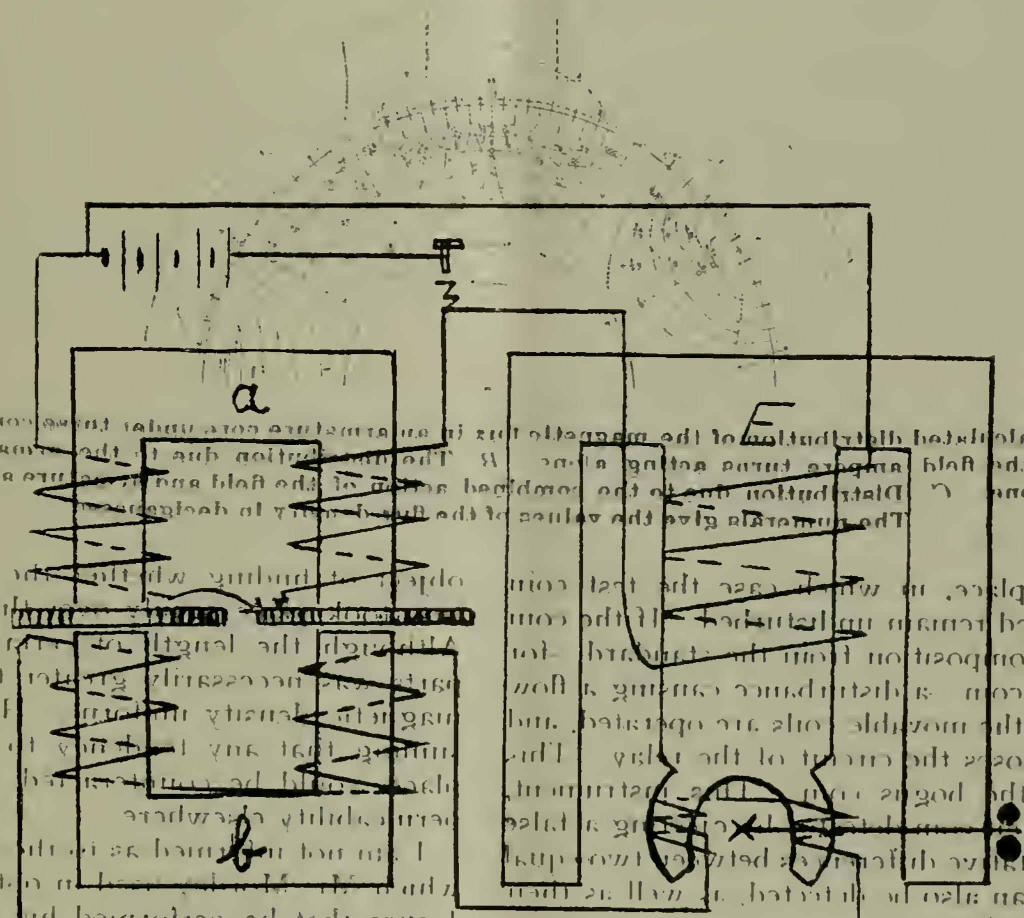
Measurements of insulating wall are to be made at the thinnest portion of the dielectric.

The completed coverings must show an insulation resistance of at least 100 megohms per mile during thirty days' immersion in water at 70 degrees F.

Respectfully, FRANK E. BROWN, Chief Inspector.

The Electrical Age.

Vol. XXIV—No. 3. NEW YORK, JULY 15, 1899. WHOLE No. 633.



Coils C and D.

Diagram of Connections of Counterfeit Coin Detector.

AN ELECTRIC COUNTERFEIT COIN DETECTOR.

In the following diagram an effort is made to show the principle and operation of an electric counterfeit coin detector. The apparatus can also be used for discovering the differences in purity between two metals or the differences existing between the proportions of alloy in each. The apparatus consists essentially, according to the inventor, of an electro-magnet energized by an alternating, pulsating or intermittent current of electricity. This magnet is shown by the letter A. An electro-magnet B, so situated as to be affected inductively by the first; the second magnet also carrying coils so adjusted and connected that the electromotive force in them shall be equal and opposite. By this means an electrical equilibrium is established. If a standard piece of metal or alloy of metal or a genuine coin is placed between the two magnets, so as to be in inductive relation to them, causing thereby a change in the electrical equilibrium if the test piece of metal or coin is not also a standard article, a flow of current takes place through the coils on magnet B, which are connected to a pair of movable coils, C and D. These small coils are pivoted over the middle leg of an E-shaped electro-magnet, figure E, having its middle leg bifurcated, which is also energized by either an alternating, pulsating or intermittent current of electricity. These coils, C and D, also carry a contact arm which, upon deflexion to right or left, closes a circuit through a relay placed between the magnets A and B, whose armature carries a support for the test coin or other piece of metal. The energizing coil on this magnet E is also on the middle leg, as shown in sketch. The operation of this instrument, as far as United States specie is concerned, is as follows:

A standard coin is normally in position on one side. and the test piece or coin is inserted on the other side. The dropping of the test piece of metal automatically closes the circuit. If the test is up to requirements—that is, if the coin is of exactly the same degree of purity or composition as the standard—no disturbance of electrical equilibrium will take place, in which case the test coin and the coin being tested remain undisturbed. If the coin tested be of different composition from the standard—for instance, a counterfeit coin—a disturbance causing a flow of current takes place, the movable coils are operated, and their extending arm closes the circuit of the relay. This will practically eject the bogus coin. This instrument, therefore, is a counterfeit coin detector by ejecting a false piece of money. Qualitative differences between two equal sized pieces of metal can also be detected, as well as their value from a specie standpoint.

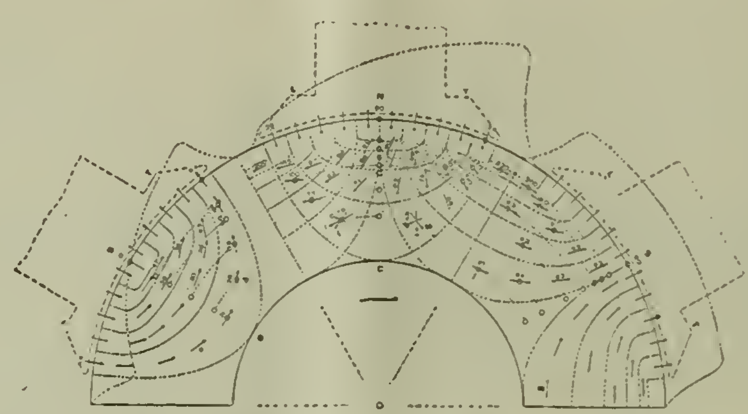


Fig. 1—Showing the calculated distribution of the magnetic flux in an armature core under three conditions. *A*—The distribution due to the field ampere turns acting alone. *B*—The distribution due to the armature ampere turns acting alone. *C*—Distribution due to the combined action of the field and armature ampere turns. The numerals give the values of the flux density in decigausses.

DYNAMO DESIGN.

AIR-GAP AND CORE DISTRIBUTION. THE MAGNETIC FLUX AND ITS EFFECT UPON THE REGULATION AND EFFICIENCY OF DYNAMO-ELECTRIC MACHINERY.—II.

BY W. ELWELL GOLDSBOROUGH.*

The exact analysis of problems, the solution of which depends upon a knowledge of the actual distribution of the magnetic flux in masses of iron, seems to have received scant attention if we judge the present development of the design methods in use, by the writings of Essen, Kapp, S. P. Thompson, Hopkinson, Elihu Thomson, Ryan, and many more of our engineers who have instructed us so well in other and intricate matters pertaining to the efficient construction of electrical machinery.

The only reference to research bearing directly upon this subject known to the writer was made by W. M. Mordey during his discussion of Dr. John Hopkinson's paper on the "Propagation of Magnetism in Iron" before the Institution of Electrical Engineers. He stated that some seven or eight years ago he made a test with the object of finding whether the penetration in laminated iron took place evenly over the whole area of the sheet. Although the length of certain paths of the magnetic parts was necessarily greater than others, he found the magnetic density uniform. He accounted for it by assuming that any tendency to a greater density in one place would be counteracted by the relatively stronger permeability elsewhere.

I am not informed as to the character of the apparatus which Mr. Mordey used in obtaining his results, nor am I sure that he performed his experiments with the end in view of investigating the subject from the standpoint from which it is taken up in this paper. Certain it is. however, that all theoretical considerations point to the fact that, as used in electrical apparatus, laminated iron is not in general so placed as to warrant the assumption that there is an even and uniform distribution of the flux in planes at right angles to the direction of the flux paths.

In many instances where the iron is not subject to cyclic fluctuations in the intensity of the magnetic lines, variations in the density in planes at right angles to the mean path of the flux are unimportant; but is this true in the case where masses of iron and steel are made to revolve in strong magnetic fields? or, when fields of flux are induced in masses of iron and by coils excited from sources of alternating E. M. F.?

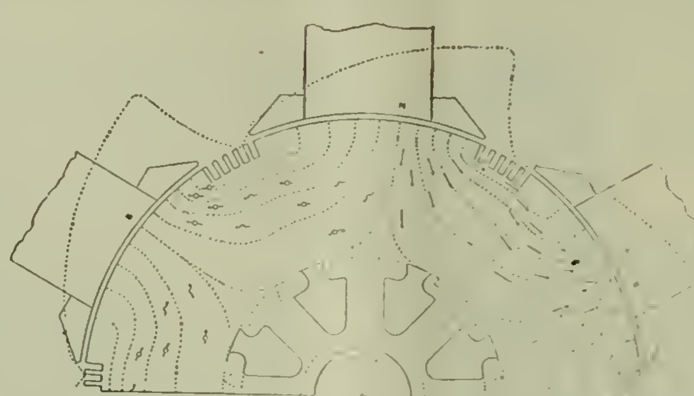


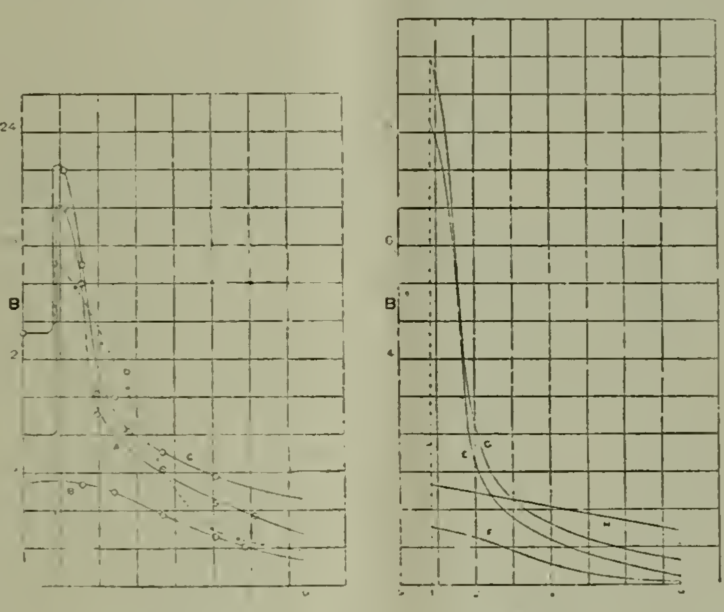
Fig. 2—Flux distribution in the core of an armature under full load conditions. Each path between pole faces as defined by the dotted lines embraces the same number of gausses.

*Presented at the 16th General Meeting of the American Institute of Electrical Engineers, Boston, June 28th. 1899.

In discussing this matter, suppose we consider the condition existing in the armature core of a six-pole, 110 K. W., railway generator, a half-section through the armature and field ring of which is shown in Fig. 2. We have shown in Section A, of Fig. 1, by the dotted curve extending across the pole-face, the air-gap distribution of the flux at no load. It is practically uniform over the pole-face owing to the toothed armature construction and the relatively narrow clearance space. Inasmuch as only a little over one per cent. of the total field ampere turns are used in forcing the flux through the armature core and 73 per cent. is needed to force the flux through the double air-gap, the assumption that the surface of the armature under any pole-face is an equipotential area is admissible. The problem of determining the exact position of the flux-paths, and the density at various points in the plane of the section then resolves itself into a problem of dividing that portion of a lamina that lies between the center lines of two adjacent poles into paths of equal magnetic reluctance connecting equipotential surfaces.

The pole-face over Section A, of Fig. 1 has been divided parallel to the shaft, into 10 equal strips, and these have been projected upon the armature surface as shown. The dotted lines joining the pole-faces through the armature show the dividing lines between the paths of equal reluctance. These paths have been determined by first equalizing their reluctance on the basis of a permeability of the iron of unity, and then making the necessary connection for the variations in the permeability of the iron with the varying densities by successive trial. Since each of the paths have the same reluctance and are influenced by the same M. M. F., acting at their terminal points, the same number of webers passes through each path and the number of gausses at any point on the center line of a path is equal to the flux per path in webers divided by the width of the path in centimetres at the point considered. The arrows drawn in section A, show the direction taken by the flux at as many points, and the numbers indicate the densities at the center of the arrows in decigausses. The magnetic density in the iron near the inner surface of the core on the dotted line between Section A and C is a little less than 3,000 gausses while the density in the iron just below the teeth on the same line is a little over 21,000 gausses. At no load the flux paths are symmetrical about the section lines, except in so far as they are distorted by being slightly depressed under the leading pole tips L and raised under the trailing pole tips T as each molecule of iron is carried through the cycle of the hysteresis loops by the rotation of the armature. The arrows passing through the small circles indicate the points of maximum density in the rings having radii equal to the distances of these arrows from the center O. In other words a molecule of iron is subjected to the greatest magnetic stress when it passes under one of these arrows. The arrows are supposed to maintain fixed positions relatively to the poles, while the armature core rotates. Projecting the maximum density points of section A circumferentially on a radial line, and transferring them to Fig. 3, we obtain the curve A, Fig. 3, Part 1. This curve shows the maximum core densities occurring in the iron at points having different radial distances from the center of rotation. The ordinates are expressed in kilogausses and the abscissae in inches. The distance (s-t) is the depth of the slots; the distance (t-u) the depth of the core iron below the slots. The magnetic density of 8,000 plotted over (s-t) is the average density in the teeth and slots; the actual maximum density in the teeth at no load being 20,600 gausses. In laying out the equal flux paths of Fig. 1, allowance was made for the difference in the actual magnetic density in the teeth and slots, by reducing the depth of the slots and increasing the length of the clearance space by an amount equal to the length of an air path having a width equal to the polar arc, and a reluctance equal to the reluctance of the path through the teeth and slots.

(To be continued.)



Part 1. Part 2.

Fig. 3—Core Distribution Curves and Hysteresis Core Loss Curves.

AUTO-MOBILES.

ELECTRIC AUTOMOBILES.

BY ELMER A. SPERRY.

(Continued from page 16.)

In common with other systems, it has its limitations, which are just beginning to be understood. These are, however, largely those of roadway and materials now employed. The fact that yielding tires are at present (practically) indispensable, amounts to a tacit acknowledgment of the prevailing inferiority of roadway and pavements. The universal cry of the automobilist is for good roads, and no one improvement will do more to create a giant industry.

Should the pavements ever be so improved as to render the rubber tire unnecessary, would the steel tire do the work? The bearing of this question upon the heavier class of automobile drays, vans, etc., led the author to cause trials to be made touching this subject. Tests were made with a vehicle having two driving-wheels, supplied with smooth, wide-faced steel tires, 72″ in diameter, carrying 60 per cent. of load. The approximate draw-bar pull was ascertained on various kinds of pavement, dirt and gravel roads and macadam, on the level, and on grades, wet and dry. It was found that under the most adverse circumstances, ample adhesion could be relied upon for any conditions liable to be met. Soapy and greasy Belgian block pavement was found to give most trouble, but even here, 20 per cent. drawbar pull could easily be relied upon, with some, but not serious, slipping.

A lasting impression of the adhesion and value of smooth tires for road traction, is made by seeing a vehicle of this kind, ascending a 20 per cent. grade on an ordinary gravel road and rising easily, uphill over a 4″ x 4″ timber, placed in front of first one and then both the driving wheels, working as well on the wet portions as on dry.

The designer of the automobile is confronted with some practical problems which have not received attention at the hands of the railway engineer. For instance, in the simple matter of rendering the vehicle directible and easily controlling the guiding mechanism. Especially is this true in so arranging the parts that obstructions will not easily derange the mechanism or throw the vehicle out of its course. When one or the other of the guiding wheels encounters an obstruction of importance, the reaction works back to the guiding handle, tending to "whip" it out of the hand of the operator and throw the vehicle out of its course. (Recall the threshing of pole or thills in ordinary vehicles.) Many attempts have been made to reduce the leverage of reaction, but at best it has remained a problem of some importance. The accompanying illustration shows the method employed by the author. Experiments designed to thoroughly test the practical operation of the device, and especially to compare it with the one ordinarily employed are illustrated in Figs. It was found that the amount of side-thrust transmitted to the guiding handle was practically in proportion to the leverage measured by the distance between the steering axis and the plane of the wheel, *at the height of the point of interception* of the obstruction. A 20″ controlling handle was connected for equal angular movement with the swiveling axles, the wheels being the same diameter, viz., 32″ and loaded with the same weight, viz., 370 pounds. A small obstruction causes so flat a trajectory curve as to be negligible; this curve is seen at X Y (Fig.). I have used, as the height of obstruction, the smallest dimension of an ordinary Belgian paving block, lying upon its side, assuming this to be the standard obstruction to be encountered by the various wheels in these tests. Operating the two devices each a number of times over this obstruction, at different speeds, a moment of effort upon the handle, tending to swing it laterally, or snatch it out of the grasp of the operator, was found to be in the two cases as follows: Figure ordinary device; mean value for pull = 10¾ lbs. Figure author's device; mean value for pull = 6 lbs. This shows an entirely different action under practical operating conditions.

It will be seen from the sketch that the steering axis AB is made to intersect the plane of the wheel well up from the bottom or ground line, where obstructions are encountered and where they may be met "head on," and therefore entirely neutralized, as has been demonstrated, giving no tendency to deflection of the wheel in either direction.

It is also found that the arrangement gives the vehicle a quality of self-centering, or running straight-forward, *hands off*. This, as will readily be seen, is a natural result of the obliquity of the steering axles. The wheels, when turned, in the act of guiding, describe a conic section, the lowest point of which is the straight-forward running position. Another peculiar feature is that in this action each wheel is entirely independent of the other, throwing no stress either upon the connecting or guiding rods. Another excellent effect is the result upon the tires, the act of steering tending to describe a small arc, rather than the usual twisting of the tires. This can be especially noticed when the vehicle is standing still.

This system of mounting the wheels is found to have peculiar advantages on rough roads and over obstructions, preventing entirely the reaction to the steering handle, giving entire immunity from fear of controlling handle being suddenly wrested from the grasp of the operator; and on ordinary smooth pavement, instantly assuming the forward position upon being "given the reins." This feature has been employed upon a number of vehicles, both here and abroad, and is well received.

It is found with automobiles that while the best practice in tramway traction can be followed closely in the main, yet the different conditions under which the vehicles operate, weight of motor permissible, height at which the motors are mounted, enormous variation in the rolling friction factor, and other points, allow of departures which have an important bearing on the motor design and construction. For instance: With the automobile only a small motor is allowable. This should be light and yet should deliver all the power necessary in case of emergency. It is found practical to use a motor with a somewhat increased ratio of copper to iron, which should have a high overload capacity, but more than all, it is found that the size and weight of the motor can be greatly reduced, if the gears can be practically compounded. This is especially desirable, owing to the enormous variation in the rolling friction factor.

Obstructions and grades are encountered, never met on tram tracks, and at the same time may be coupled with soft road, which, owing to the weights necessarily present, would render progress impossible, unless an inordinately large motor were at hand. At such times, often if a few feet only can be compassed, the journey can be resumed. It is under these and similar conditions, that the value of the compound gear becomes apparent. One form of this gear, employed in a number of vehicles, has been found to be entirely satisfactory, increasing the leverage of the motor over the load. In case of a motor, with a suitable over-load factor, this gear, while only doubling the leverage, is found to compass anything that has ever been encountered in city, park and country service. Any ratio of gearing can of course be employed. By means of the compound gear, the torque is brought up to nearly the slipping point of the drivers without overdraft of current-supply from the battery. The manipulation is by a small handle, usually imbedded in the cushion at the side, it being used only at infrequent intervals. This compound gear not only enables a small motor to meet an emergency, but has an important bearing upon the storage battery, acting as a safeguard in a very important sense, preventing, as it does, inordinate overdrafts of electric current, and in this way, enabling lighter plates to be employed without fear of "shedding" the active material. Another feature of importance in connection with the compound gear is found to be its interlock and interaction with the controller. This feature renders the compound gear entirely successful in the most incompetent hands. The gear cannot be thrown or changed when the current is on, nor can the current be put on until the gear is entirely thrown to either one or the other of its normal operative positions. This is done automatically and without the knowledge of the operator.

Speaking again of the motor as a whole, its elevated position and the comparatively open space it occupies, when compared with street car motors, enables the employment of ventilation. This should be designed with care, so as to prevent ingress of water and moisture. The ventilation is especially applicable to the small-sized motor, considering the heavy overloads to which they are frequently subjected.

(TO BE CONTINUED.)

Editor's Note.—Sketches and illustrations omitted by the author.

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CONTENTS. PAGE

AUTOMOBILES AND THEIR OPERATION.

The subject of automobiles and their operation has been frequently discussed in the daily papers of late. The automobile, as is well known, is not a distinctly electrical contrivance, but may be operated by any form of power capable of driving it. Two of the most popular types of automobiles are gasolene and electric. In the first a purely mechanical device is met with, consisting of a carriage, a supply of gasolene and the driving mechanism. In the second we find a carriage as before, storage batteries and a motor. The question now arises, not so much as to which is the fastest or can cover the most ground, but which is the most practical. By this is meant not only the ease of operation expected by untrained hands, but a reasonable cost of operation as well.

We cannot but confess that the electric automobile, as it at present exists, is limited to a comparatively short distance in its travels. Gasolene automobiles, on the other hand, as shown by a recent test of the Winton carriage, are able to cover a great distance at a high rate of speed. It may be possible that each of these types must be regarded from seperate standpoints. The city and the country are widely different, both as regards the nature of the roads and the conditions of the surface. For operation within the city limits the French seem to have demonstrated that the gasolene automobile is just as serviceable as the electric motor carriage, but we are inclined to differ. The noise and odor arising from a gasolene carriage makes it inferior in operation to the electric automobile. On the other hand, the expense of equipment and limited range of the electric automobile would make a choice between the two a matter of considerable difficulty.

In an article on electric automobiles by Elmer A. Sperry, the following paragraph appears: "By '89 what we might call a 'motor mortality' under severe conditions of service had been reached that meant success. In a space then considered contracted we had found room for ample area of journal and commutation; ample insulation and dielectric to withstand the voltage strain. Methods of supporting and imbedding insulation and conductors had been devised that insured life, not only against heat and overload, against vibration, pounding and concussion, and last, but not least, against misuse and abuse at the hands of the non-expert."

This general statement made regarding the motor applies equally well to the stationary motor, the street railway motor and a motor used for an automobile. But this is not all of the problem. The driving power, the dead weight of the batteries and their limited capacity are matters of serious consideration by the builders of electric automobiles. It is true that the storage battery, as far as its present construction is concerned, has climbed to the top notch of usefulness, but, weight for weight and bulk for bulk, it is inferior to any other form of portable power. Mr. Sperry states that "the perfected storage battery presents some remarkable features. It even rivals the electric motor in its fitness and special adaptability to the automobile problem. Its very large reserve power at instant command; its entire freedom from danger when fully charged; its almost constant pressure throughout its capacity; its recently developed capacity for quick charging and ease with which charge may be obtained in almost every hamlet in the country are among its advantages."

The freedom from danger implied by the use of a storage battery is admitted, but the difficulty still exists of being unable to get a charge of current readily and conveniently when required if the automobile is out of town. There may be many hamlets in the country, but it is not quite so easy as the author supposes to either charge an electric automobile or to get the automobile even that distance. Country residences, with the exception of the wealthiest, are in the large majority entirely devoid of current. But this is not the point. The distance question is much more important; then the necessity for the frequent charging of cells would disappear. The compressed air idea need not be considered as a competitive factor, as the author gives some facts relating to the same which seem to show that compressed air will never be a success for automobile purposes. The weight and bulkiness of the apparatus as well as its general inefficiency will entirely prevent this.

Vehicles equipped with rubber tires require but a slight tractive effort to move them. In a bicycle of racing equipment with a tractive effort of four pounds the efficiency is ninety per cent. and becomes almost one hundred per cent. when the tractive effort reaches ten pounds. With an automobile of greater weight the figures hold true, thus necessitating the use of a comparatively small motor. It does not seem to be such a difficult problem to build storage batteries that have double the capacity for the same weight of those commonly used. The weight of the supporting grid and the liquid is a large item. There are many forms of batteries that would be just as practical to use for short trips, and be less expensive, in certain respects, than the storage battery. At present a weight of at least one hundred pounds per horse power hour is required. Some newly constructed batteries do not exceed fifty pounds per horse power hour, and will stand a heavy rate of discharge without rapid deterioration. By doubling the distance an automobile can cover active competition will disappear, as far as other automobiles are concerned.

OPERATING COSTS OF HORSE AND ELECTRIC DELIVERY WAGONS IN NEW YORK CITY.

By G. F. Sever and R. A. Fleiss.

(Continued from page 22.)

SECTION II.

SOME TESTS ON ELECTRIC AUTOMOBILES FOR DELIVERY SERVICE.

The results recorded in this section were obtained under service conditions, in the streets of New York City. Over 60 miles were covered during the tests recorded below, and all grades between the lower section of the city and Washington Heights were surmounted with the greatest ease. During the tests, various conditions of weather were encountered, including heavy rain, strong head winds and muddy streets, as well as very clear weather, no wind and dry streets.

During the series of tests no accidents of any kind happened. It was not necessary at any time to stop the vehicles for repairs—all the mechanical and electrical parts performing their functions with the utmost ease, and with practically no noise, and absolutely no odor.

The method followed during all the tests was the same. It consisted in measuring the watt-hours of energy supplied by the storage batteries during the runs, by means of a Thomson recording watt-hour meter, which was accurately calibrated before the test began. The distance traveled by the vehicles was recorded by a tested cyclometer and the speed in miles per hour was noted at any second by means of a tachometer. Placed in series with the watt-hour-meter was a Weston portable ammeter, while a Weston voltmeter was placed across the battery connection at the controller. In this way, instantaneous readings of the power were obtained, while the watt-hour meter gave the total energy used. The Weston instruments were accurate, and every precaution was taken to guard them from any jolts or jars which might have impaired their accuracy.

The first tests to be presented were made upon a vehicle built for a large drygoods store in New York City. The vehicle was intended for the delivery of light goods about the city, and was to be placed in competition with horse delivery service of the same class. The results tabulated below show the instantaneous power consumption with this vehicle, while traveling over the same ground, at the same speed as recorded on two different days. The column headed "Rain" refers to readings taken during a severe storm which lasted throughout the entire test. The column headed "Clear" shows the consumption of power on a clear day with no perceptible wind.

Insert Table V. (Table omitted by author).

An inspection of Table V. brings us to the conclusion that the power consumption is not greatly affected by change of pavement, as from cobblestones to asphalt. There is, however, a slightly greater power required on wet macadam than on dry, and more power is required on macadam than on asphalt or cobbles. The grades were measured in every case after the tests were completed. In Table VI. is given the data obtained during a test run of a little over 13 miles, in very bad weather. For the greater part of the trip, a heavy wind was blowing.

Insert Table VI. (Table omitted by author).

The time given in the last column of this table has no bearing on the speed. The speed may have been 10 miles an hour while running, and yet, owing to "slow-ups," stops, etc., the time occupied in passing from one street to another, where the readings of the time were noted, may indicate a speed of only 6 miles an hour. The last column was inserted as a check on the trip—the speed in the second column being given as the speed at the time the readings of the voltmeter and ammeter were taken, the watt-hour-meter, of course, taking care of the intermediate fluctuations.

A study of Table VI. shows us that on grades the speed of the vehicle is very much reduced, and that the power required to propel the vehicle at the reduced speed is very large—which is quite natural. The table is instructive in showing the relative proportion of increase of power due to grades. It must be remembered, however, that the comparison is made in this case between level asphalted streets and macadamized hills that were very muddy, and that this condition would cause the variation in power to be greater than in the case of grades of asphalt surface. The average of ten readings taken from Table VI. gives as the power consumed on level asphalt the following:

Volts	85.3
Amperes	23.1

It is to be understood that these ten readings were selected from the table with the idea of eliminating up or down grades. The lowest ammeter reading taken was 20 and the highest 26. Above and below these readings the vehicle was on perceptibly up or down grades. It may be well to note that this wagon was equipped with solid rubber tires; these, as is quite generally recognized, absorb slightly less power than pneumatic tires.

Table VII. gives the results obtained during a test in very fine weather. The run was one of 6.25 miles over a continually ascending route.

Insert Table VII. (Table omitted by author).

The watt-hour-meter reading during this test showed a consumption of 1364.22 watt-hours. The wagon alone was weighed on balanced coal-scales and was found to weigh 3,750 pounds. On this trip it carried three passengers and the instruments used. The total weight was found to be as follows:

Weight of wagon	3,750 lbs.
" " passengers	413 "
" " instruments	37 "
Total weight	4,200 "

The distance traveled was 6.25 miles and the time actually in motion was 52.75 minutes.

Therefore:

Average speed in miles per hour was 8.44 miles.
The watt-hours per car mile were..218.28
The watt-hours per ton mile were..103.95

It should be remembered that these results were obtained during a run which was always tending up hill as was noted above. This becomes quite evident when the average of the 27 readings of Table VII. is compared with the average of the 10 readings taken from Table VI., representing level asphalt.

Average of the 27 readings of Table VII.:

Volts	81.72
Amperes	26.25

Average of the 10 readings taken from Table VI.:

Volts	85.3
Amperes	23.1

Table VIII. gives the results of a run made in the opposite direction to that recorded in Table VII., that is, starting on the high ground on which the run of Table VII. terminated; it records the power consumed during a run of 7.24 miles. The run ended where that of Table VII. began. Thus in the run recorded in Table VIII. the tendency was always down hill; this will be appreciated from an inspection of the table.

Insert Table VIII. (Table omitted by author).

The watt-hour-meter showed a consumption of energy on this run of 1243.38 watt-hours. The weight was the same as previously given, namely 4,200 pounds. The time in actual motion was 58.5 minutes. The distance traveled was 7.24 miles. The average speed per hour, 8.08 miles.

The watt-hours per car mile were........171.71
The watt-hours per ton mile were........ 81.08

Combining the results of the watt-meter readings for the tests of Table VII. and VIII., we find that for a total distance of 13.49 miles the average was as follows:

Watt-hours per car mile	191.01
Watt-hours per ton mile	9[illegible].875

The results were obtained under the ordinary service conditions, and can be duplicated at any time.

(TO BE CONTINUED.)

MISCELLANEOUS.

STRAY CURRENTS.

ALLOYS FOR DYNAMO BRUSHES.

The following alloys for dynamo brushes to combine conductivity with as little friction as possible are given by the "Elektrochemische Zeitschrift": Copper with .2 per cent. of bismuth, .3 per cent. of cadmium, and 1.5 per cent. of antimony. If the commutator is of hard bronze, the ingredients added should be doubled in quantity, and if the commutator is of steel, they should be trebled.—"Electricity."

A NEW STORAGE BATTERY PLATE.

An important improvement in storage battery plates—giving them lightness, high capacity, and great solidity and strength—is claimed by the patent of M. Camille Brault. The plate consists of two grids, between which the active material is placed, the grids being then forced together by great pressure. The triangular ribs, with the sharp edges inside, firmly hold the paste. The active material is a mixture of litharge with 10 per cent. of sulphate of potassium or similar alkali salt, to which is added 1 to 3 per cent. of the double chloride of platinum and mercury, ammonia gas being passed through the substances during the mixing.—London "Invention."

THE ACCUMULATOR AS AN INCUBATOR.

That an "incubator" is an essential part of an efficient electric light plant, is the gospel of electric lighting according to a member of a place of worship in the fair Vale of Conway, and as the Electric Light Company has not put down an "incubator," then it would be better to defer the question of lighting the church electrically for the time being. We will be charitable enough to assume that this was purely a case of *lapsus linguae*, or else imagine that the speaker was not used to the steep gradients and sudden curves of the Welsh dialect. Obviously, "accumulator" was meant, but as the speaker was a leading man of the town and professed to possess knowledge of the subject, we suppose no one presumed to contradict him, although the local press had a little smile all to itself. Some one suggests that the speaker was confused with that statement, whose frequency is very high, that electricity is in its infancy. But we rather fancy that electricity passed its incubator stage before that convenient invention made its appearance.—London "Electrical Review."

ELECTRICITY TRIUMPHANT IN CONSTANTINOPLE.

Until recently, as is generally known, the use of electricity in any shape or form in Constantinople was strictly forbidden. The final triumph over the prejudices of the Sultan, who has always imagined that dynamo was a synonym for dynamite, is now said to have been due to a Spaniard and the kinematograph. This Spaniard, Don Ramirez by name, so the story runs, started a circus in Constantinople, and in order to be up to date imported a kinematograph. But the city authorities would not allow him to set his new instrument in operation because it had to be driven by the condemned electricity. In his difficulty he applied to his ambassador, who promised to do his best for him. During the next audience which he had with the Sultan, the wily diplomatist took occasion to enlarge on the wonders of the kinematograph, and interested the Sultan so much that Don Ramirez was ordered to bring his instrument to the palace. Moving scenes from the leading capitals of Europe were thrown on the screen for the delectation of the Sultan, with the result that permission was finally granted the Spaniard to install in his circus the first electric light plant ever operated in Constantinople.—"Electricity."

WIRELESS TELEPHONY.

The "Sydney Bulletin" has a note referring to the fact that about 13 years ago the officers at the termini of the Milton-Milburn line (New Zealand) found their telephonic conversations frequently interrupted by a voice, which, as was subsequently discovered, belonged to the postmaster at Outram, some 30 miles away. The telephone wire from Outram to Japanni runs for some miles on the same posts as the telegraph wire from Outram to Mosgiel; it then branches off, and for some miles it is parallel with the Milton-Milburn telephone line, both lines being about three-quarters of a mile apart. Experts said, "Induction"; but, as they could not find a way either to control or utilize the phenomenon, the mysterious voice continued to contribute by its interruptions to the already somewhat flowery language of the country.—London "Electrical Engineer."

RADIOGRAPHIC EXAMINATION OF COAL.

The London "Colliery Guardian" says: "Many colliery companies are already provided with radiographic apparatus, which they apply successfully to examining the fractures that show themselves in the disturbances met with in their mines; and the apparatus they have at their disposal may readily be employed either for radioscopic examination or for radiometric analysis, so that it appeared interesting to M. Henry Couriot, Professor of Mine Working at the Paris School of Mines), to make known the methods that can be turned to account for obtaining this last-named result, in order to enlighten the mine owner as to the value of the mineral wealth he possesses. Thus terminates his communication to the Societe de l'Industrie Minerale; and M. Couriot observes that the X ray supplies fresh means, not only for ascertaining the greater or less degree of purity in mineral fuels, but also for at once determining their value without the loss of time required by incineration, with the tedious weighings that precede and follow that operation."—Ex.

LITERARY.

A TREATISE ON CAR HEATING.

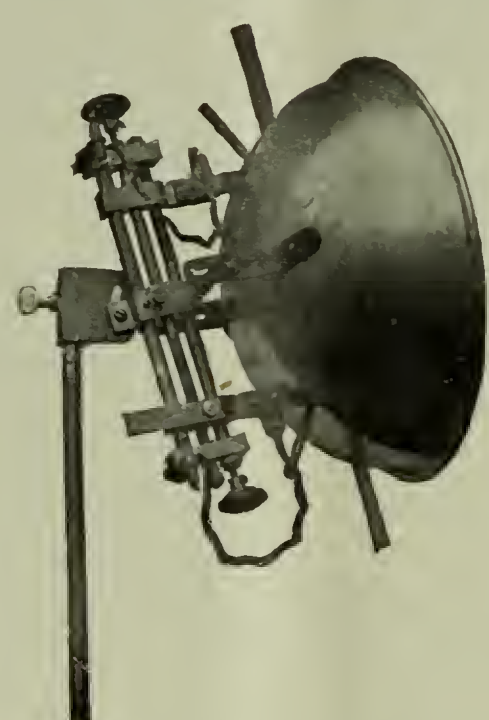
We have just received from the Gold Car Heating Company, of New York City, a copy of their 1899 and 1900 catalogue of the various improved systems of car heating and the accompanying parts and appliances which they manufacture. This catalogue—containing about eighty pages, 9½x12 inches, and handsomely bound in cloth—is, without doubt, the most complete of its kind published and well worthy of a place in the library of every electrical engineer and others interested in the subject of car heating. To railway men especially will it prove a boon. The various Gold systems of car heating, by means of either direct steam heat, hot water circulation, storage heating apparatus or electric heaters, are tersely described to their minutest details and fully illustrated by diagrams and drawings of the essential parts. Appended there are a number of testimonials from some of the largest surface and elevated roads in the country, who speak in the highest terms of the "Gold System of Car Heating." A list of the principal users of the Gold heating systems is also given, and, judging by this and the testimonials received, the Gold Company have reached the standard of perfection in car heating, one which it will be difficult to eclipse. We would advise those of our readers interested in the above to communicate with the Gold Car Heating Company, Bridge Store No. 6, N. E. Cor. Franklin and Cliff streets, New York City.

ELECTRIC LIGHTING.

THE BOGUE FOCUSING LAMP AND SEARCH LIGHT.

In the illustrations are shown types of focusing lamp and search light built by Charles J. Bogue, of 215 Centre street, New York City. The focusing lamp is so constructed that it rests upon a broad mantle base and operates in series with a set of resistance coils confined within a substantial metal framework which can be attached to the wall, ceiling or in any other convenient position. The mechanism of the lamp is exceedingly simple, the feeding being so regulated that the arc is always at the centre of the reflecting device. The search light shown in illustration is easily adjustable for marine purposes and general signaling. The feeding mechanism is strongly constructed, keeping in perfect order and producing a steady arc between the carbons of little or no changeability. The high-class workmanship, fine finish and economical current consumption of these lamps have created an excellent reputation for them. Mr. Bogue also engages in general repair work, and will undertake to build machinery of a special nature when so required.

The Bogue Search Light.



The Bogue Focusing Lamp

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

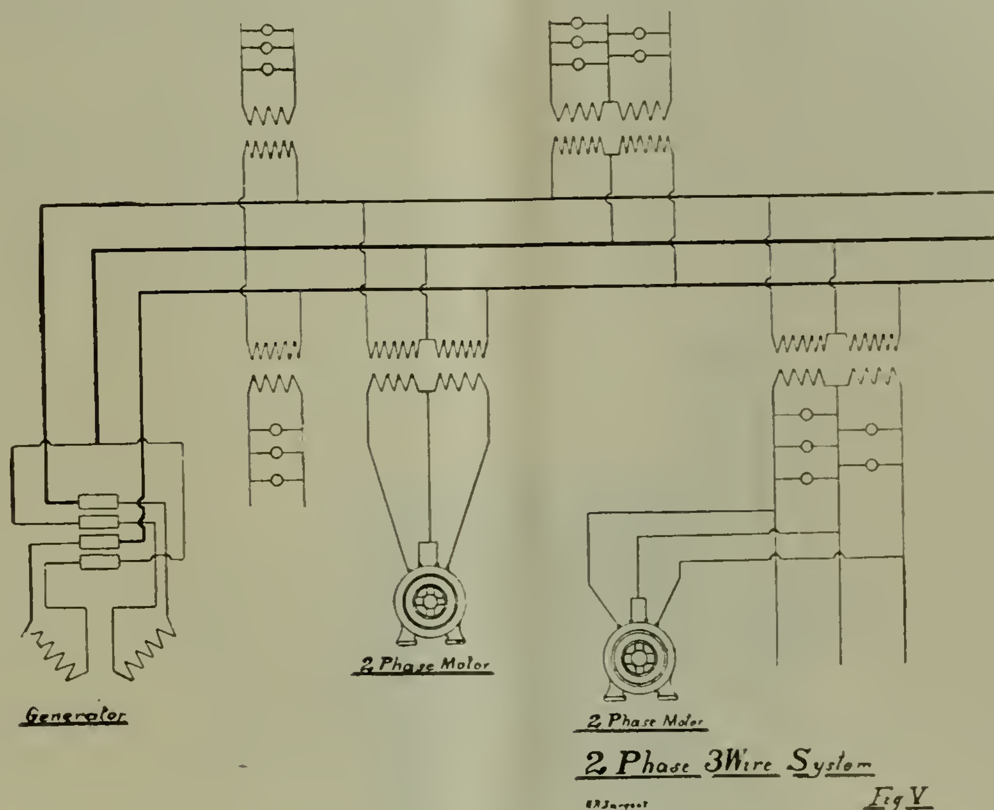
[*Note.—Any one is invited to ask questions on any point that is not made c'ear in these articles. Suitable explanations will be cheerfully given under the head of " Answers to Inquiries."*]

WHEATSTONE BRIDGE TESTS.

In figures 1 and 2 are shown the diagram of connections of a Wheatstone bridge and the appearance of a postoffice set connected up for testing insulation resistance. In a test of this description one wire of the bridge is grounded and the other is brought in contact with the insulation of the line by coiling the wire and allowing it to rest in a bucket of water. Another way, such as is practiced by builders of electrical machinery, is to connect one wire of the bridge to the metal framework of the machine instead of the G connection, shown in sketch, and the other wire of the bridge to any wire of the motor or dynamo. If there is a ground current it will leak through the insulation at that point, and the resistance will be measured by the bridge in the regular manner, by balancing up the arms A compact form of the Wheatstone bridge has been built and sold under the title of ohmmeter, which is about the most convenient form it has appeared in.

TWO-PHASE THREE-WIRE SYSTEMS.

The production of a rotary magnetic field is, of course, one of the objects in view in a two or three phase system of transmission or distribution. In the sketch a two-phase generator is shown, the power of which operates two two-phase motors and four groups of incandescent lights. By examining the generator carefully, the connections to the collector rings can be traced, by means of which the two phases are carried along three wires without interfering. The winding of the transformers is also shown for this current, and it will be noticed that in the first case the connections differ from those in the second, third and fourth for operating electric lights or motor. Two-phase systems are largely in vogue in this country, and have given great satisfaction to those operating them, both as regards the smoothness of running, as well as their general high efficiency.



THE GENERAL EFFICIENCY OF A CORLISS PLANT.

This rather curious investigation will not be from the indicated horse power of the engine to the watts output of the dynamo, but will trace out the resulting efficiency from the coal hole to the lamp itself. Making every allowance, it will be seen that the burning of coal, the storing up of its heat as steam, and the ultimate utilization of this caloric energy in producing power from the engine gives us a net result of fourteen per cent. in the best of steam plants. The furnace and boiler efficiency would be nearly sixty per cent.; that of the engine, as previously stated, about fourteen. Allowing ninety per cent. for the generator, the net output from its lines would be twelve and six-tenths, of which ten per cent. would again be lost in the mains, leaving about ten per cent. to be turned into light. An arc lamp whose efficiency is about ten

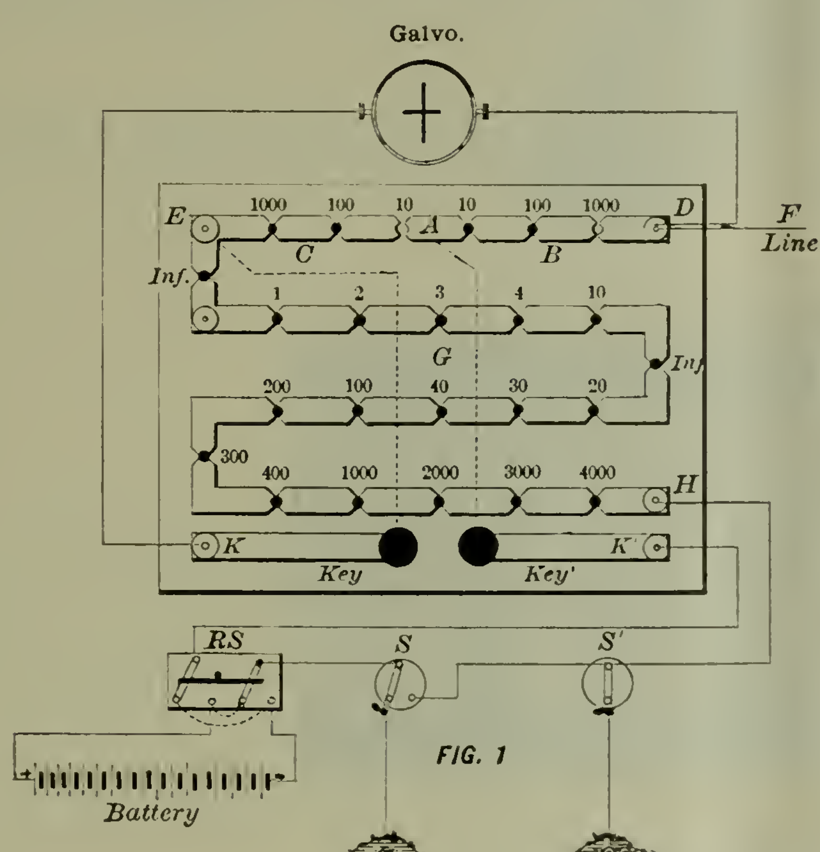


FIG. 1

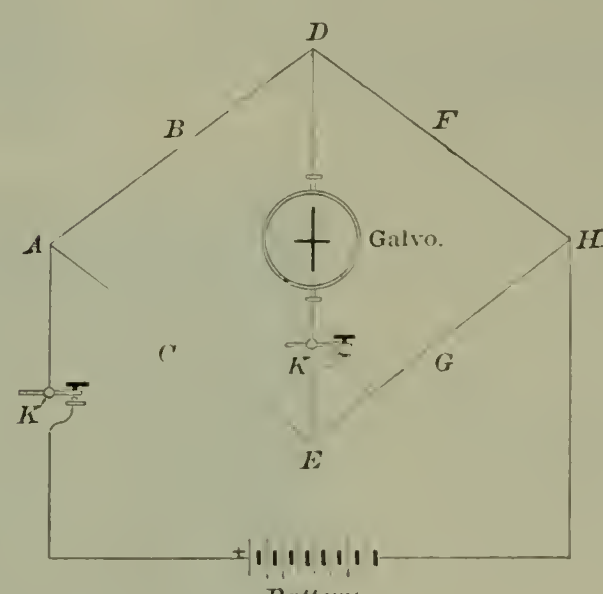


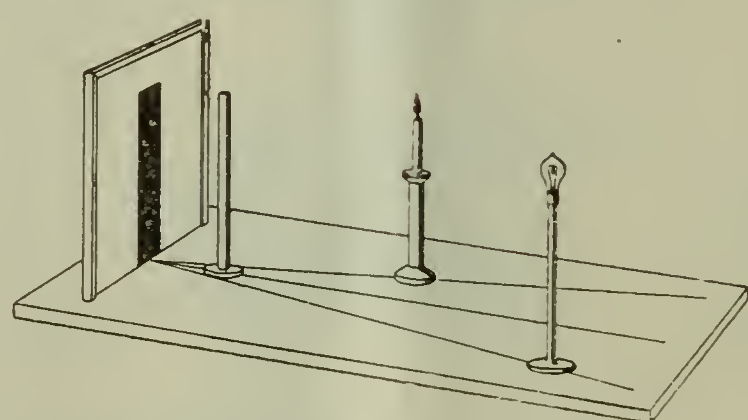
FIG. 2

WHEATSTONE BRIDGE.

per cent. would give us about one per cent. of the original fund of energy in the coal as light. For every hundred pounds of coal burnt in the boiler we create light equal to the energy of one pound of coal at the end of the line. Engineering skill can therefore be rated, as far as results go, at a one per cent. basis from this standpoint.

A SHADOW PHOTOMETER.

A Rumford photometer can be built for experimental purposes in a cheap and simple manner, as shown in illustration. All that is required is a pine board, a framework to hold a cardboard sheet, and a thin, round, wooden rod. An ordinary paraffine candle gives, approximately, one candle power. The shadow thrown by this lamp can be easily compared with that thrown by an incandescent lamp or other source of illumination. The respective distances from the rod can be measured and the candle power of each source of light, as tested, calculated. When the shadows are of equal color the candle powers vary inversely as to distance.



Rumford Shadow Photometer.

THE TELEPHONE.

THE THIRD ANNUAL CONVENTION OF THE INDEPENDENT TELEPHONE ASSOCIATION.

The third annual convention of the Independent Telephone Association, held at the Auditorium Hotel, Chicago, June 26, 27 and 28, was by far the most successful meeting ever held by that vigorous and growing body. A number of important papers, bearing on telephone matters, were read and discussed at the meeting, the greatest interest and enthusiasm being aroused by the same. At the business meeting, held on the evening of June 26, the following officers were elected for the coming year:

President, James M. Thomas, Chillicothe, O.; first vice-president, Charles Flower, Detroit; second vice-president, I. A. Lumpkin, Mattoon, Ill.; third vice-president, George T. Hewitt, Cedar Rapids, Ia.; secretary and treasurer, S. P. Sheerin, Indianapolis, Ind.; first assistant secretary, G. W. Beers, Fort Wayne, Ind.; second assistant secretary, S. E. Wayland, Wilkesbarre, Pa.

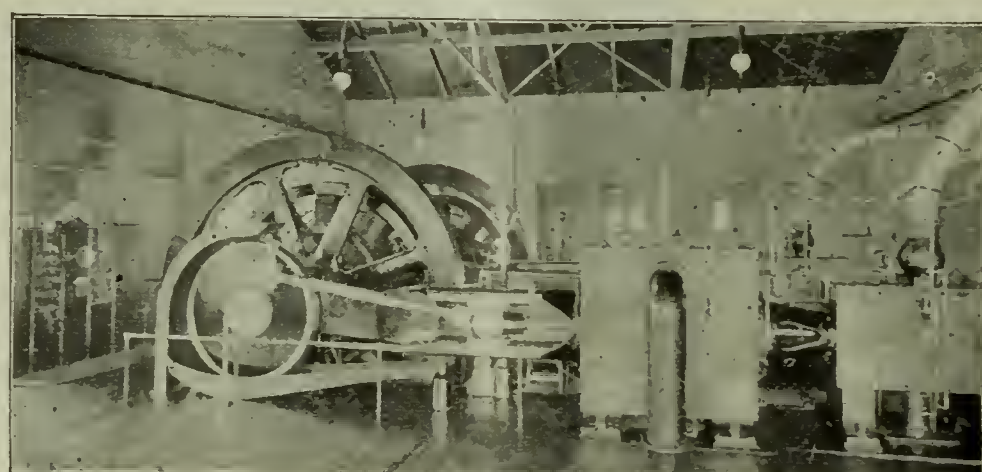
A banquet was tendered by the supply men, at which covers were laid for 250 guests. A number of gentlemen prominent in the independent telephone field were called upon for toasts. In connection with the convention an exhibition of telephone apparatus and supplies was held in the hall and rooms of the Auditorium, which was very successful.

TIDAL POWER.

It is stated that a London capitalist has offered to construct at Southend a huge sea-wall at a cost of $5,000,000. In return he asks permission to use the tidal force for working a generating plant, with the idea of supplying London with electricity. He guarantees that there shall never be less than 3 ft. 6 in. of water on the beach; in fact, it will be a huge marine lake. No particulars are given as to the kind of water engine to be used.—"Trade Journals' Review."

PRODUCTS OF THE ELECTRIC FURNACE ACETYLENE GAS.

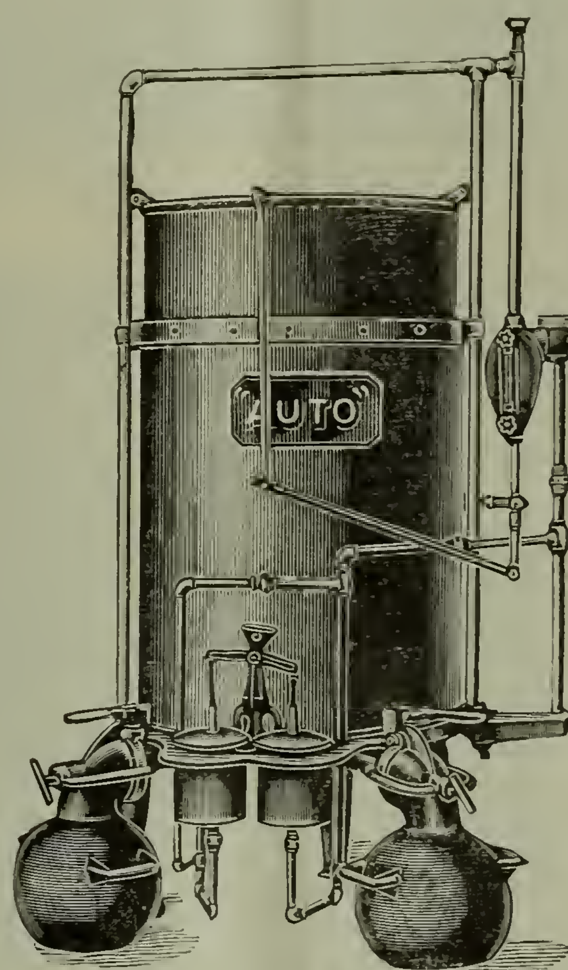
When it was announced a few years ago that a discovery of a new illuminant had been made which was likely to supersede illuminating gas and electricity as a light-giving medium, many people were sceptical, and even when the vastly superior light was exhibited, showing a beautiful, brilliant flame, the public still questioned whether it could be produced cheaply and safely enough to compete with electricity and ordinary coal gas. Results of the last three years have answered these questions de-



A Model Low Speed Direct Connected Plant.

cidedly in the affirmative and proven that acetylene gas can be furnished cheaply in a form which makes it available for individual use as well as that of communities.

Acetylene is a gaseous hydro-carbon of formula $C_2 H_2$. It was discovered by Davy in 1836. This gas is found in many reactive materials, and is commercially introduced in the form of calcic carbide, made direct from the combination of carbon and lime rock, fused in an electric furnace. In this form it is supplied with suitably made generators, which principally consist of means of supplying water to the carbide to set free the acetylene gas, and a gas chamber (gasometer) for retaining the gas and effecting a proper pressure under which it is consumed by burners, similar to those used in ordinary gas.



Auto-Aceytelene Generator.

Acetylene gas, as an illuminant, is sixteen times greater than ordinary gas, creates perfect combustion, leaving no residuum of smoke and very little heat, only about one-twelfth of that of ordinary gas. The burning flame of acetylene gas gives a pure white light resembling very closely sunlight, and it is possible with this new illuminant to distinguish the delicate tints of fabrics, flowers and paintings as accurately as can be done by daylight; when taken altogether, it appears to be one of the most useful discoveries for artificial lighting made during the present century.

Its cheapness, as compared with other illuminating mediums, is very clearly shown by stating that a dollar will buy 5,000 candle power of acetylene light; 3,850 of gasolene light, 2,625 of ordinary gas, or 1,600 candle power of electric light.

The Auto-Acetylene Company, 13-21 Park Row, New York, U. S. A., give in their catalogue a great deal of information about this new gas and its adaptability to commercial uses, and will be pleased to furnish particulars to persons desiring further information.

BUSINESS NEWS

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING JULY 4, 1899, $99,109.

New York, N. Y., July 4, 1899.—The following exports of electrical material are from the port of New York for the week ending this date:

Antwerp—I case electrical material, $10.

Argentine Republic—482 cases electrical material, $27,027.

Amsterdam—1 case electrical material, $25.

Brazil—7 cases electrical material, $180.

British West Indies—1 package electrical material, $25.

British Possessions in Africa—85 cases electrical material, $2,686.

British Australia—73 packages electrical material, $29,550.

Berlin—2 packages electrical material, $60.

Cuba—9 packages electrical material, $183. 19 cases electrical light material, $212.

Hull—11 cases electrical material, $115.

Havre—17 cases electrical material, $7,087. 96 cases electrical machinery, $2,000.

Japan—1 case electrical material, $24.

Liverpool—7 cases electric carriages, $7,000.

London—71 cases electrical material, $6,121. 50 cases electrical machinery, $428.

Mexico—83 cases electrical material, $2,251. 11 cases electrical machinery, $1,221.

Manchester—33 packages electrical machinery, $8,950.

Naples—6 cases electrical material, $567.

New Zealand—9 packages electrical material, $263.

Oporto—10 boxes electric motors, $2,100.

Porto Rico—25 cases electrical material, $816.

Tasmania—2 packages electrical material, $100.

Uruguay—3 cases electrical material, $77.

Venezuela—4 cases electrical material, $31.

NEW INCORPORATIONS.

Little Rock, Ark.—The Brown Electric Co., incorporated with George M. Heard president, Milton Mill secretary-treasurer, W. G. Brown and others. Capital stock, $30,000.

Bowling Green, O.—The Bowling Green Gas Co., incorporated by J. T. Lynn, and others; to supply electric light and heating power. Capital stock, $5,000.

Du Bois, Pa.—Du Bois Electric Co., incorporated by J. E. Du Bois, F. W. Hatfield, and others; supply light, heat and power. Capital stock, $42,000.

Mt. Kisco, N. Y.—Mt. Kisco Lighting Co., incorporated by D. Cromwell, C. D. Horton, R. B. Goodman, and others. Capital stock, $20,000.

Trenton, N. J.—New Jersey Gas, Oil and Electric Lighting Co., incorporated by Watson H. Linburg and others. Capital stock, $20,000.

New Brunswick, N. J.—Raritan Electrical Manufacturing Co., incorporated by Albert H. Gleason and others; manufacture electrical machines, etc. Capital stock, $150,000.

Camden, N. J.—Mason Heating and Lighting Co., incorporated by James A. Mason and others; manufacture electric and other burners. Capital stock, $1,000,000.

Chicago, Ill.—Chase Electrical Construction Co., incorporated by A. P. Peck and others; manufacturing and dealing in electrical goods. Capital stock, $10,000.

San Francisco, Cal.—California Power Co., incorporated by S. W. Ferguson, A. P. Woodward, and others; to manufacture and sell power. Capital stock, $100,000.

Minneapolis, Minn.—The Minneapolis Electric Light and Power Co., has filed a petition for dissolution. The company had a capital of $750,000.

Los Angeles, Cal.—Los Angeles Suburban Gas Co., incorporated by T. S. C. Lowe, L. P. Lowe, and others; general gas and electric light. Capital stock, $500,000.

TELEPHONE CALLS.

Huntingdon, Tenn.—The Carroll County Telephone Co. will increase its capital stock from $2,000 to $20,000.

Salem, O.—The Columbiana County Telephone Co., incorporated by S. C. Thayer, W. D. McKeefrey and others; operate a telephone system. Capital stock, $200,000.

Syracuse, N. Y.—The Syracuse Telephone Co., incorporated by J. J. Jermyn, J. L. Wentz, and others. Capital stock, $450,000.

Worcester, Mass.—Worcester Telephone Co., incorporated by H. F. Harris, W. P. Searles, and H. S. Pratt; telephone and telegraph lines. Capital stock, $200,000.

Lansford, Pa.—Carbon Telephone Co., incorporated by W. D. Zehner, E. H. Kistler, and others; telephone business. Capital stock, $2,000.

Yonkers, N. Y.—The Palisade Telephone Co., incorporated by Manning Merrill, Thos. T. Hill, Geo. W. Romaine, Wm. P. Catlin, A. T. Holbrook, Geo. B. Dresher, and George L. Catlin. Capital stock, $250,000.

STREET RAILWAY NEWS.

Glens Falls, N. Y.—Warren County Railway Co., incorporated by A. B. Colvin, J. M. Coolidge, and others; electric railway. Capital stock, $200,000.

Youngstown, O.—The Mahoning Valley Traction Co., incorporated by C. E. Sanders and others; to build and operate an electric road. Capital stock, $10,000.

THE WESTINGHOUSE COMPANY TO INVADE ENGLAND.

A press dispatch from London states that the Westinghouse Electric and Manufacturing Co., of Pittsburg, Pa., will erect works at Manchester, England, and employ five thousand men. George Westinghouse will direct the enterprise. Lord Kelvin, the English authority, will act as the company's technical adviser in England.

JOTTINGS.

John S. Nowotney, of 313 East Second street, Cincinnati, O., announces to the public and his many friends in the electrical business and kindred lines, that he severed his connection with the Nowotney Electric Company, March 31, 1898. Mr. Nowotney founded the Nowotney Electric Company, and managed the business from its inception until March 31, 1898. The assignment of the Nowotney Electric Company, which occurred June 30, 1899, in no way affects him. After severing his connection with the above-named company, he immediately embarked in the manufacture of Nowotney's semi-vacuum long-burning arc lamp and electrical specialties. The latter named business is owned solely by him, and operated under his personal supervision and name, and is in no wise connected with the Nowotney Electric Company, which assigned June 30, 1899.

The Western Electric Company will erect a ten-story fireproof factory building at Washington and Bank streets, New York City, the plans for which have been filed with the Building Department. The building will cost $500,000.

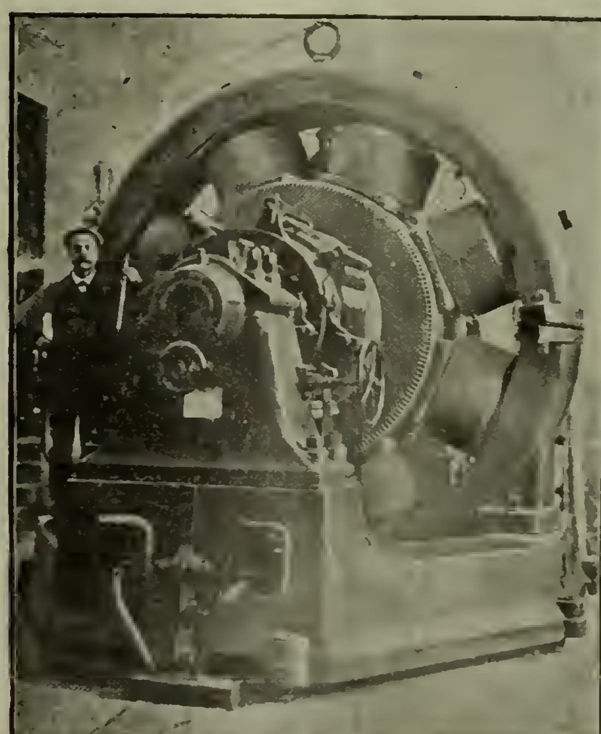
The Electrical Exhibition Company presented to Mr. Luther Stieringer a hunting-case gold imported repeater watch, striking the hours and minutes, with the following inscription: "Presented to Luther Stieringer by the Electrical Exhibition Company, in recognition of valuable and gratuitous aid rendered in connection with the Electrical Exhibition, held in May, 1899."

The Electrical Age.

VOL. XXIV—No. 4 NEW YORK, JULY 22, 1899. WHOLE No. 636.

Electro Chemistry.

Electrolytic Chlorate.—Pipe Lines on Bridge.



Electrolytic Chlorate.—One of the 830 H. P. Dynamos.

*THE ELECTROLYTIC CHLORATE WORKS AT CHEDDE, SAVOY.

JOHN B. C. KERSHAW.

Chemical works have in the past usually been grouped together in close vicinity to coal-fields or salt deposits; and allied with other manufacturing establishments—such as glass works—they have formed great industrial centers. In England such a center exists in South Lancashire. The chemical works of the future will be, however, in many cases, isolated units, placed in mountainous districts, the chief conditions requisite being water-power and railway communication.

Ten years ago the world's consumption of chlorate of potash was wholly produced by the older chemical method. To-day, more than half the chlorate production is the output of electrolytic factories; and the writer has little doubt that ten years hence the proportion of the total production made by the electrolytic method, with the aid of water-power, will be considerably increased.

The following facts may be given to show the progress of the new method of manufacture. In 1889 Messrs. Gall & Montlaur started the first electrolytic works at Villers-sur-Hermes in Switzerland; utilizing a few hundred horse- power from the falls in the neighborhood of the place for this experimental work. At the end of 1898 —or nine years later—there were seven electrolytic chlorate factories in operation, all operated by water-power, utilizing 30,000 horse-power, and producing 6,500 tons chlorate per annum. Two new electrolytic chlorate factories were also under construction in 1898; and the fact that one of these is promoted by the United Alkali Company—the chief producer by the older method of manufacture, is highly significant.

In a previous article on this manufacture, the writer was able to give a detailed description of the St. Michel Works of the Societe d'Electrochimie, where the Gall & Montlaur process is operated on an extensive scale * In the present article he is able to present a similar account

*Condensed from 'The Engineering and Mining Journal."

* "Electrical Review" (London), November 25th, 1898; "Engineering and Mining Journal," December 17th, 1898.

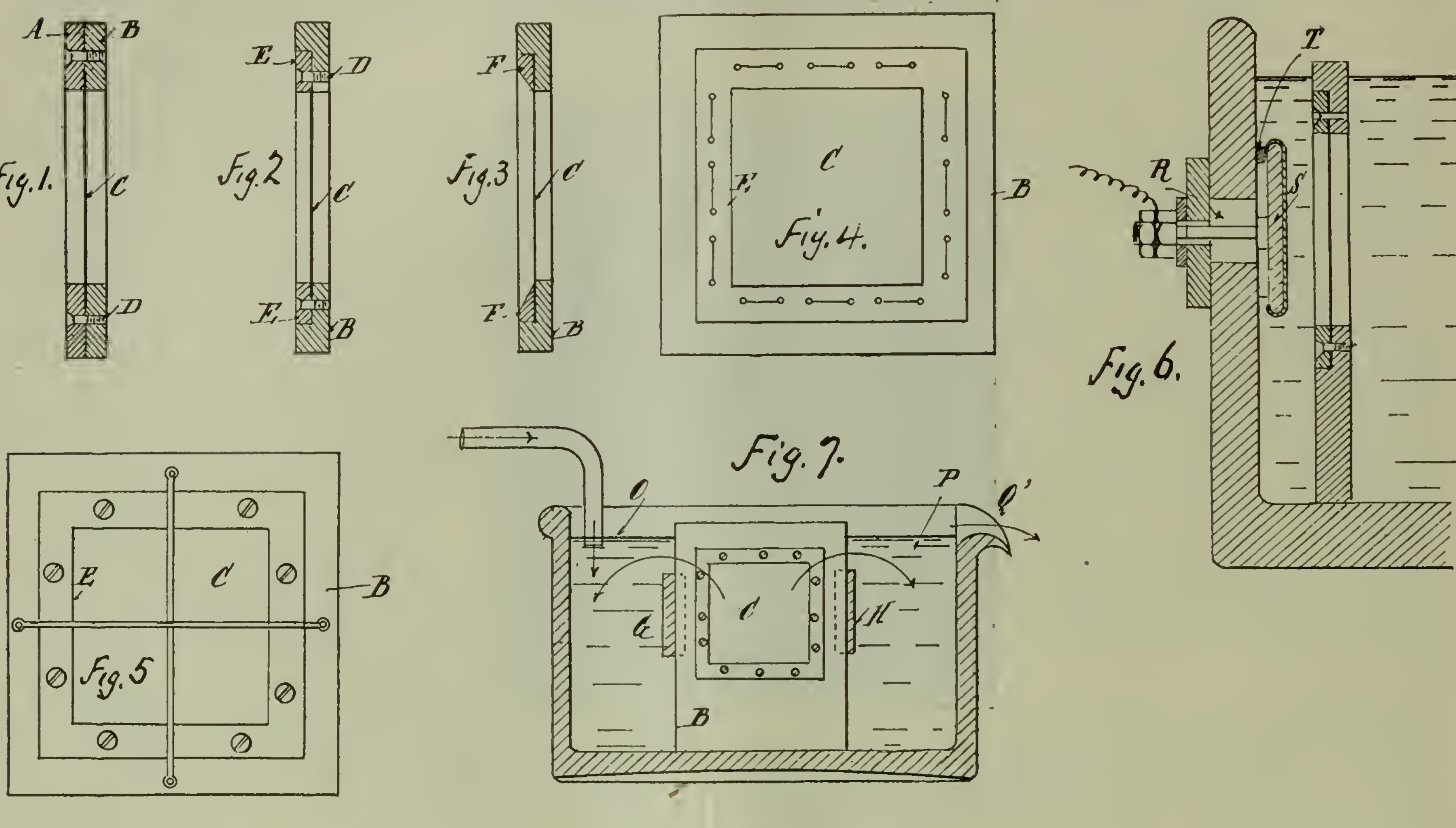
of the more recently built factory of the Societe des Forces Motives de l'Arve, which carries on the manufacture of chlorate under the patents of M. Paul Corbin. The works are situated at Chedde, Haute Savoie, close to Chamounix, and almost under the shadow of Mt. Blanc.

The patents of M. Paul Corbin, above referred to, were applied for in 1892 and 1894, and were based on experiments made at M. Corbin's cellulose factory at Lancey, Isere. They relate to the forms and details of electrodes and vats for the electrolytic decomposition of solutions of the alkali metal chlorides. The above named company was formed early in 1895, for development and utilization of the waters of the Arve and for industrial operation of the Corbin patents; and the building of the works at Chedde was commenced in June of that year. Six hundred men were employed upon the various hydraulic, engineering and building works required, and in 13 months from the date of commencement the factory was ready for manufacturing operations. It has been in continuous operation since July, 1896, and is now producing chlorate at the rate of 3,000 tons per annum, in addition to other chemical products, of which calcium carbide is the chief.

The power used in the factory is obtained from the River Arve, the most important hydraulic engineering works being situated at the point where the valley of Chamounix joins that of Sallanches. A dam with the usual flood gates and sluices has been built at this point, just below the bridge of Servoz. From here the water is led by a tunnel 698 metres in length to the foot of the ravine at Chatelard, where the first fall occurs. The power generated at this spot is to be utilized for the electric railway which is to unite Chamounix and Fayet. The water is then led through the valley of Chatelard in two steel pipe lines (each 1.40 metres in diameter), and enters a second tunnel 700 metres in length. From this it emerges at a point 140 metres above the works at Chedde, and is carried down to the turbine house, in two steel pipe lines, 600 metres in length, each 1.40 metres in diameter, and of metal 15 mm. thick at the lower end of the line. A bridge over the river is necessary to carry the two pipe lines into the turbine house. (See Fig. 8.) The total length of galleries and tunnels carying the waters of the Arve to the factory is 1,790 metres. The sectional area varies from 5 to 30 sq. metres; while the flow of the water varies between 5 and 8 cubic metres per second. The power available is said to be 12,000 H. P.; the maximum of course being in spring when the River Arve is in flood. At present only a portion of this total is utilized in the works.

The turbine house is a narrow building, 120 metres in length. It contains 12 vertically placed turbines, each of 1,000 H. P. The dynamo house adjoins and is of the same length; it contains 12 direct current Oerlikon dynamos, each directly coupled to one of the 1,000 H. P. turbines; and each capable of delivering 830 E. H. P. The total area covered by the buildings of the Chedde Works is 13,000 sq. metres. The chief building is that containing the decomposing vats, which is 130 metres long, 60 metres broad, and 21.5 metres in height. The vats in which the solution of potassium chloride is submitted to electrolysis are built of cement,* and have the form shown in Fig. 7, which represents a sectional elevation of the vat. Diagrams 1-7 illustrate the details of the chloride cell. The chief features of this form of decomposing cell are a large number of insulated intermediate electrodes —(second electrodes)—and the provision of external cement channels round the vats, for carrying off the electrolysed solution, which flows over its sides.

The secondary electrodes are all of thin platinum foil, held in ebonite or other non-conducting frames, of exceptional width. By use of these wide frames, M. Corbin holds that he has overcome the lossess due to lateral dispersion of the electric current, which usually occur when attempts are made to utilize secondary electrodes in industrial operations. The secondary electrodes are entirely submerged in the electrolyte, and are held in position by two longitudinal guide bars, running parallel to one another in the vat, bearing grooves for reception of



Electrolytic Chlorate.—Details of Vat.

*The description of the decomposing vats used at Chedde is based on that given in French Patents 226,257 of 1892, and 238,612 of 1894. It is possible that modifications of these forms have been introduced as the result of practical work.

the ebonite frames. The distance separating the secondary electrodes is only 12-15 m.m. The two terminal electrodes are alone connected with the external current conductors. They are formed of thick plates of metal covered with platinum foil, and fixed over the openings in the two end walls of the vats, as shown in Fig. 6. M. Corbin lays great stress upon the importance of having both secondary and primary electrodes mathematically in line, and exactly similar in form and surface area. The flow of the electrolyte within the vat is indicated by the arrows in Fig. 7. The current on passing through such a cell as this is confined to the line of the electrodes, by reason of the wide ebonite frames encircling them, and performs electrolytic work between each pair of electrodes. In this case, when a solution of potassium chloride forms the electrolyte, chlorine is liberated at the anode surface, and potassium hydrate at the cathode surface, of the platinum walls forming each separate cell; and these unite to produce potassium chlorate or potassium hypo-chlorate, according to the temperature at which the reaction occurs. The remaining buildings of the Chedde factory comprise the usual recrystallizing, drying, grinding and packing departments, common to all chlorate factories, whether using the old or new process of manufacture.

Auto-Mobiles.

ELECTRIC AUTOMOBILES.

BY ELMER A. SPERRY.

(Continued from page 28.)

In the hands of non-expert, simplicity of control is found to be indispensable to satisfactory operation.

With the automobile, there is one handle, which always should be kept in hand, viz., the steering handle. The question naturally arises, "why not let his handle do all of the work of controlling this vehicle?" In a paper before this body, in 1894, the writer pointed out a system of tram car control, which has since been widely adopted, in which starting, stopping, speed control and brake were confined to the operation of a single handle. This having now been classed as the best practice with tram cars, why not utilize the combination in connection with the steering handle, allowing it, by the most natural and almost trivial movements, to do the whole work of operation. In this way, the entire control of the vehicle is simplified to a single handle. The direction of the vehicle is controlled by lateral movement of the lever, the vehicle going in any direction to which the handle is pointed or aimed. Depressing the handle, from notch to notch, increases the speed, and pulling up the handle, as one would draw in the reins, in case of emergency, instantly turns off the current and applies powerful brakes. The intensity of the brakes is increased as the handle is further raised. When the speed has been reduced, by again lowering the handle, any of the speed notches can be readily picked up; the speed and brake being always under instant control, one hand only being engaged. It is apparent that the current manipulation to the motor and brakes require only an imperceptible effort. In production, the controlling handle is made either to stay where placed, or is self-raising to the brake position, to suit the fancy of the owener. The controlling handle lying nearly horizontal, the "aiming" action in steering, completes the almost ideal simplicity of the operation.

The controlling head, which is shown in Fig. —, is supplied with an indicator, showing at all times the position of controlling cylinder, and by touching a button on the side (seen in Fig. —) the handle may readily be raised to position shown in the figure, for convenience of occupants, especially for getting in and out on driver's side.

In crowded thoroughfares the brake is the most important feature of the automobile. The French authorities in passing upon vehicles insist upon this factor more than any other, and it is certainly the most indispensable. Whatever else the vehicle can or cannot compass, it must be possible to stop it, and that instantly, on occasions. The brake should be powerful and at least in duplicate. The carriages illustrated herewith are each provided with three separate brake systems.

The location of the controller beneath the footboard is found to present decided advantages in point of convenient interlock and inter-connection with the brakes. The motor cannot be started without first removing all the brakes. This location gives ready access at all times and upon all sides by the hinged floor; gives a natural interlock between the controller and the compound gear above referred to, and also between the controller and charging terminals, which are also here located. Numerous accidents and even wrecks have been caused for failing to open a special motor switch, when placing the controller in series position for charging. A simple interlock with the charging terminals, entirely eliminates this danger, and in need the interlocking system throughout the carriage very thoroughly protects it in inexperienced hands; for instance, if the directing indicator (seen in Fig. —) is removed, the motor and controller are locked. If the index or pointer of this indicator points forward, the vehicle will go forward. If to the rear, the vehicle will go backward. If it points upward, the carriage may be charged, but when in this position all the conductors of the motor cable are automatically open-circuited, preventing accident. The pointer can never be manipulated until the controller is first open-circuited, and if the index is only partially turned, through carelessness or otherwise, the controller cannot be operated until the mistake has been corrected.

The motor being light and small, normally should be of relatively "high speed," still farther reducing the weight. A small motor is possible with the compound gear. The double reduction motor possesses advantages of allowing the hand-brake to be operated on the intermediate shaft, thus working through the compensating gear. A small brake, in this way, gives all the leverage necessary, being one reduction back through steel gears with small peripheral velocity, thus acting without noise. Another advantage of double reduction is in keeping all the gears of the power system small, and thus insuring a neater appearance. The somewhat high speed permissible in the double reduction arrangement also renders possible the bipolar motor, with its higher efficiency, as compared with the multipolar. Every condition tending to higher efficiencies should be considered in connection with automobile equipment, as conserving the resources of the battery. These conditions are not as necessary with systems of tram traction, where the prime source of power is always available.

The location of the controller and current manipulating switches, low, and in front of the batteries, avoids hydrogen detonation and eliminates all danger of explosion from spark or opening circuit.

Much has been said of one motor versus two. This is largely a matter of mechanics; it is conceded that one motor gives higher efficiency than two of half the power, and is less expensive to maintain. As even the heaviest strains are comparatively small, the compensating gear, where one motor is employed, is easily maintained, yielding a combination which is far simpler and employs less parts than with a double motor equipment.

(To be Continued.)

OPERATING COSTS OF HORSE AND ELECTRIC DELIVERY WAGONS IN NEW YORK CITY.

By G. F. Sever and R. A. Fleiss.

(Continued from page 31.)

To determine as accurately as possible the lowest value for the power consumption at the different speeds, some special tests were made. A block paved with asphalt which was fairly level between 24th and 25th Streets, on Madison Avenue, was selected for the tests. The method of procedure was as follows: First, readings were taken while the vehicle was passing between 24th and and 25th Streets, and then readings were taken when passing back over the same ground, in every case care being taken that the vehicle had reached a constant speed an appreciable time before the readings were noted. The average of these readings should, of course, eliminate any slight grades, if present, and the average should give the true power consumption for absolutely level asphalt. The readings obtained for the three different speeds of the wagon were:

	Volts.	Amperes.
No. 3 speed—10.5 miles per hour...	82	22
	82	20
Average	82	21
No. 2 speed—5.4 miles per hour....	42	21
	42	18
Average	42	19.5
No. 1 speed—2 miles per hour.....	21	22
	21	16
Average	21	19

At No. 3 speed the rate of travel was 15.4 ft. per second and the rate of work 1722 watts. Since a watt represents 0.7373 foot pounds per second the total work required to propel the vehicle at this speed for one second was 1269.63 foot pounds. This represents a rate of 2.3 H. P. The draw-bar pull was then 52.44 lbs., or at the rate of 39.26 lbs. per ton. At No. 2 speed the draw-bar pull was 36.3 lbs. per ton. The value of the draw-bar pull at No 3 speed is probably very closely approximate to the value that would be shown at all speeds between 5 and 12 miles per hour if a dynamometer was used. From the results recorded in Table VII. we may take 105 watt-hours per ton mile as quite within the reach of actual practice under service conditions to-day. However, a more conservative estimate of 120 watt-hours per ton mile as a basis upon which to calculate the operating costs of electric vehicles for delivery service will be assumed. Under ordinary conditions a well-designed electric delivery wagon should not consume over 120 watt hours per ton mile. In support of this statement the following data is presented, these results being obtained while testing a small carriage which, owing to a number of circumstances, had failed to come up to the expectations of the designers. This carriage had been sent back to the shop for some alterations and it was at that time that an opportunity was afforded for making a number of experiments and tests upon it. The point of greatest interest in these tests is the fact that though working under most unfavorable conditions, the watt-hours per ton mile did not reach 120. The weight of this vehicle was 1200 lbs., over 300 lbs. more than the original design called for. With one passenger and the instruments it weighed 1400 lbs. Its draw-bar pull was found, by a dynamometer, to be over 42 lbs. at 8 miles per hour on level asphalt. This is at the rate of 62 lbs. per ton, and is approximately the same as found for ordinary horse delivery wagons on cobblestones. This excessive draw-pull was due to poor bearing design. Table IX. gives the result of a run of 9.45 miles with this vehicle on New York city streets.

TABLE IX.

Distance traveled	9.45 miles.
Watt-hour meter record.	771.15 watt hours.
Average speed	8.0 miles per hour.
Watt-hours per ton mile	116.5

It is interesting to note that even with this abnormal pull the watt-hours per ton mile were only 116.5.

The test recorded in Table X was a fairly severe one so far as hill climbing and bad roads are concerned. The vehicle on this occasion travelled from 59th Street up the Boulevard to 137th Street and return, taking en route the long hill from 125th Street to 137th Street on the Boulevard; on the return the hill from 125th street to 117th street was surmounted. The hill climbing part of the trip was over a very bad macadam road surface. The hill at 96th street and the Boulevard was surmounted twice during the trip and the carriage covered 14 miles.

TABLE X.

Distance traveled	14 miles.
Time in actual motion....	1 hour 47 minutes.
Average speed	7.8 miles per hour.
Total watt-hours recorded.	1162.29
Watt-hours per ton mile..	118.57

It is worthy of note that with all the hill climbing, the bad roads and the large friction loss due to bad design, the watt-hours per ton mile only reached 118.57. From the above, 120 watt-hours per ton mile would seem to be a conservative estimate for the power consumption of well designed electric delivery wagons in New York city under ordinary service conditions.

(To be continued.)

Dynamo Design.

AIR-GAP AND CORE DISTRIBUTION. THE MAGNETIC FLUX AND ITS EFFECT UPON THE REGULATION AND EFFICIENCY OF DYNAMO-ELECTRIC MACHINERY.—II.

BY W. ELWELL GOLDSBOROUGH.

(Continued from page 27.)

To determine the hysteretic loss occurring in the part of the core below the slots from the distribution curve A of Fig. 3, the ordinates of the curve A were raised to the 1.6 power of the density which they represent, and then reduced in the ratio of their distance from the center of rotation to the distance of the point t from the center of rotation. In this way the curve E, figure 3, part 2, was obtained, the area of which is proportional to the hysteretic loss in the core. The correction for the difference in the distance from the center o of the successive points of the curve A is necessary as the volumes of the rings which the densities influence vary 54 per cent. between the outside and inside rings. We therefore find that with the distribution given in section A of Fig. 1, the core loss due to hysteresis will be 663 watts.

If we follow the usual practice* in making these calculations and assume that the flux in passing between the poles spreads evenly over the core, the density in the core will be 7220 gausses and the core loss 492 watts, than which the value given above is 35 per cent. greater. (See curve H.) Apparently, therefore, if we admit the basis upon which these calculations have been made to be correct, the methods at present in use give erroneous results.

The discrepancy between the two methods, however, is greater than the considerations so far presented would

* Dr. John Hopkinson, "Philosophical Transactions," of the Royal Society, May 6, 1886.

Gisbert Kapp, "Dynamos, Alternators and Transformers," p. 242.

S. P. Thompson, "Dynamo-Electric Machinery," p. 176.

Ryan and Macomber, "Sibley Journal," Jan., 1897, p. 125.

lead us to suppose. In general it is assumed that if the total effective field ampere-turns impressed on the magnetic circuit are kept at a constant value, i. e., if the difference between the armature back ampere-turns and the total impressed field ampere-turns is kept at a constant value, the armature losses, in the part of the core that is below the slots, will remain constant in value from no load to full load.

With a view to investigating this point, suppose we consider the effects produced by the cross-magnetizing armature ampere-turns when the field circuit is open and the armature coils are separately excited. Under these conditions, as shown in section B of Fig. 1, a field will be set up through the trailing pole-tip T, across the air-gap, up into the leading pole-tip, L. The ampere-turns acting to set up this field, will be zero about the center line of the pole-face, but gradually increase to a maximum under the pole-tips. The M. M. F. acting on the core paths between the two halves of the pole-face, will be proportional to the ampere-turns, and if paths be traced through the armature core, connecting points on either side of the center line of the pole-face and having a constant reluctance, the average flux density per path will be proportional to the M. M. F. impressed upon each path, and a balanced system of forces will be established in the armature core. The paths traced in section C have been calculated, with due reference to the permeability of the iron at different densities, to fulfill this condition; and the densities as indicated by the numbers over the arrows have been determined as being the actual densities set up in the core by the cross-magnetizing ampere-turns. Owing to the fact that the M. M. F. acting on the longest path has the greatest value, the arrow points of maximum circumferential density all fall in this path. When these points are projected on the center line, and the values they represent transferred to Fig. 3, we get the curve B, which gives the values of the maximum densities through which the iron passes as it is revolved under the poles. In calculating the hysteretic losses that will take place in the core with separate armature excitation, we get curve F, obtained from curve B in the same way that curve E was obtained from curve A, and find that the core losses will amount to 174 watts.

Now to determine the distribution in the core at full load, when the total effective field ampere-turns are kept at the no-load value, we must combine the results already obtained and recorded in sections A and B of Fig. 1. This was done, and each of the arrows of sections A and B were properly transferred to section C, and the vector sums taken. As examples, vectors f and (c) were combined as shown to obtain vector s. Again it must be noticed, that vector f is numerically equal to vector g and vector c is numerically equal to vector d, but owing to the difference in the angular positions they assume when combined, vector r has a value 29 per cent. greater than the value of vector s. It is also interesting to notice that as the load comes on the machine the density at the point f gradually increases, with constant effective field excitation, from 4400 to 5800 gausses at full load; and that an increase of 32 per cent. in the flux density at this point has produced an increase of 55 per cent. in the core losses per unit volume for all iron at a distance f-o from o.

These same considerations apply to all points in the armature core to a greater or less degree, and result in giving us an entirely new distribution of the flux in the core. The points of maximum radial or circumferential density are also changed, and we find them located under the trailing pole tip T of section C, in the leading pole-tip L, in the lower part of the cone. If we project the maximum density points upon the center line and transfer them to Fig. 3, we get now the curve C, the curve of maximum core densities at full load. Calculating the hysteretic losses, we get the curve G, and finally determine the full load loss to be 830 watts. Between no load and full load, therefore, while the total flux entering the armature per pole is maintained at the same constant value, the hysteretic loss in the core would seem to increase from 663 to 830 watts, or 25 per cent. And if the final value of 830 watts is compared with the uniform density value of 492 watts, we see the discrepancy in methods is really much greater than at first seemed probable, being 69 per cent. instead of 35 per cent.

Of course these values refer only to the losses in the solid part of the core below the teeth. The hysteretic loss in the teeth at no load is 132 watts, and at full load 246 watts, owing to the change in the density under the strong or trailing pole corner, and an additional 27 per cent. must be added for eddy-current losses. The total armature core losses at no load are, therefore, 1000 watts and at full load 1370, and the real increase in the total core losses from no load to full load is 37 instead of 25 per cent.

(To be Continued.)

Stray Currents.

TELEPHONES IN DIVING BELLS.

T. A. Smith, district superintendent of the Bell Telephone Company at Kingston, Ont., has invented special instruments of unique design for communication between the attendants on the surface and the divers at the bottom of the river while they are engaged in the work of raising the Cornwall bridge across the St. Lawrence at Cornwall. The ordinary diving apparatus has been dispensed with and supplemented by special diving bells so constructed as to withstand the pressure of the current. They are also protected by heavy metal shields. The telephone is put inside the bell and electric alarms give the signal when either party desires to converse. Anybody can operate the ingenious mechanism.—"Electricity."

AN X-RAY PHOTOMETER.

At the Jefferson physical laboratory, Harvard University, some valuable experiments on the absorption of X-rays by air have lately been conducted by Prof. Trowbridge, and with interesting results, it being found that rarefied air under atmospheric pressure absorbs the rays largely. These investigations suggest the use, it would appear, of an exhausted air chamber in front of a Crookes tube for the purpose of obtaining more light and a clearer definition of forms in the use of X-rays in surgery. The important fact is mentioned that a new photometer for measuring the amount of light given by the rays through different media has been devised, consisting of a wedge of glass or aluminum in front of a slit which is illuminated by the rays; the medium to be tested is placed between the slit and the wedge, upon which a regular system of gradations is marked, and the wedge is moved forward until the light is entirely shut off—an arrangement very simple, but by means of which the degrees of absorption by various media can be tested with remarkable accuracy.—Ex.

IRON FELT.

A new insulating material known as iron felt, which is coming into quite general use in Europe, is made at the Aldershof Works, near Berlin. This felt, it is said, consists essentially of long and strong woolen fibres, impregnated with a by-product of petroleum, and then coated (with a certain amount of penetration) by a gelatine rendered insoluble, and also (alternately) or in addition) with india-rubber, afterwards vulcanized. After being subjected to considerable pressure, the iron felt assumes the form of plates, measuring 20 square centimeters (2 square feet 22 square inches) and upwards, with a thickness varying from 1 to 5 centimeters (13-32 inch to 2 inches). These plates are very elastic, being practically imperishable, while they will stand a pressure of 1,158 kilograms per square centimeter (20,736 pounds per square inch), and their surface is so hard as not to be cut by the sharp edges of bolt heads or of iron girders.

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CONTENTS:

THE FOURTH STATE OF MATTER.

As early as 1859 Pluecker, a physicist of those times, while experimenting with tubes exhausted to various degrees of rarifaction, discovered a curious greenish phosphorence in some of them. Being an authority on the magnetic field, he attributed this light to currents of electricity, eminating from the cathode along the surface of the tubes and back again. His knowledge of magnetism enabled him to discriminate between those discharges which produce the greenish light and the ordinary discharge. Certain reaction occurred in one case which did not appear in the other, when exposed to the influence of magnetic lines of force. A comrade and countryman of Pluecker's was Geissler, to whom Pluecker is under immediate obligations, as Geissler was the first to produce a vacuum of any consequence.

Hittorf was the first to notice that a solid body cast a shadow when placed between the cathode and the walls of the tube. The casting of the shadow was an important point as it clearly showed the direction of the rays from the cathode. A luminous disk used in place of the cathode would not cast a shadow from a small object. The reason for this was that the disk would throw out rays sideways and enough light would come through the small object, from which a shadow might have been expected, to entirely prevent this phenomenon from occurring. The first hint or suggestion of the nature of cathode rays came from Goldstein, who noticed the issuance of rays from the side of the disk and therefore concluded that cathode rays are transversal vibrations of the ether.

Crookes, the inventor of the tube bearing his name, in his efforts to extend his knowledge of radiant matter, investigated the properties of the mysterious cathode rays from which spring the now famous Roentgen rays. In identifying the cathode ray it might almost be said that the Roentgen ray itself is recognized. Certain peculiar qualities possessed by cathode rays may account for many of the irruptions and disturbances produced on the skins of patients of experimenters, exposed to the influence of X rays. Cathode rays, according to J. J. Thomson, F. R. S., when they fall on a substance produce changes of a physical or chemical character in the nature of the substance. From a purely chemical standpoint it has been noticed that the chlorides of the alkaline metals are not only affected in this manner but change color, which is a consequence of there having been created within the chlorides a sub-chloride. A photo-electric property also manifests itself, that is to say, bodies exposed to cathode rays are capable of discharging negative electricity after having been exposed to them and subsequently brought into a bright light. Prof. E. Wiedemann discovered a phenomenon called "thermo-luminescence," which means that although bodies exposed to the cathode rays seem to return to their normal condition, after the rays cease to operate, it has been found that when such bodies are heated to a moderately high temperature they become luminescent, giving out light which would otherwise not appear, except by exposure to a much greater temperature.

More curious than this however is the fact that some substances manage to retain this property for not only hours but days, weeks and even months after they have been removed from the influence of the cathode rays. A peculiar solution, ar rather mixture, called the Van t'Hoff solid solution, reproduce this phenomenon to a marked degree. A Van t'Hoff solid solution is made by precipitating two salts, one in greater quantity than the other, at the same time from a solution. By this means the salts are more closely combined, or at least mix better, than they would if purely mechanical means were employed. A magnificent luminescence is produced in this mixture for an exceedingly long interval after it has been removed from the cathode rays. Another curious feature of the cathode rays is shown by their influence over a charge of negative electricity, which charge is bound to follow their course, as shown by numerous experiments. Believed at one time to be a sand storm of charged particles they were regarded from a somewhat different standpoint, until it was shown that a body, charged with static electricity, could not deflect the cathode rays.

Yet more remarkable than any of the preceding statements is the one which relates to the charge occurring in a gas, through which cathode rays are allowed to pass. When such rays play upon a gas it becomes a conductor of electricity, acting in every respect as a high resistance conductor would be expected to act. Numerous experiments have been tried through the aid of which it has been shown that no known rays exeed in interest or mysterious significance those familiarly known as "cathode rays." The opinion of Crooks regarding the fourth state of matter seems to be supported by a great variety of experiments. The work of Lenard seems to show that cathode rays are charged particles moving with high velocities, the size of which are small compared to the dimensions of ordinary atoms or molecules.

In other words, it seems as though the cathode rays are streams of matter ultra-atomic. They are atoms to atoms and represent the true elements or primitive forms of those substances from which the rays emanate. In other words, the idea supported by the discovery of cathode rays is a startling one. No other than that primordial matter appears, the matter from which all elements have sprung, when its compositions and combinations are exposed to the conditions implied by the production of cathode rays.

Roentgen Rays.

THE MODUS OPERANDI OF RADIOGRAPHY.*

By Frederick Strange Kolle, M. D.

A few minutes of explanation sometimes saves a number of plates, as the uninstructed will naturally start at the snapping and buzzing of the coil and its adjuncts, and also by the unexjected fluorescence of the tube. It is best to tell them what to expect before the apparatus is brought into action. If the patient is a child it is advisable to go through the entire operation, showing the child the coil and the tube in action. Within a few minutes it will become accustomed to the procedure, enabling you to secure a good negative by a short exposure, without constant movment on the part of the patient. It may be necessary to hold the arm or limb to be radiographed so to prevent their moving during the exposure.**

X Rays Work as Practised in a Medical Labratory.

An expert using a 10-inch spark coil can make a picture of the hand and forearm in 4 to 8 seconds, at a distance of 18 to 26 inches. The amateur should give enough time in all exposures, at least until he becomes familiarized with the apparatus and the results obtained. Remember there is less danger of over-exposure than under-exposure. The best method of determining time is to develop the negatives personally. They will show the differences of time of exposure at once in their time of developing.

An over-exposed plate is quickly developed, and turns black in a short time, whereas an under-exposed plate takes minutes and sometimes as much as an hour or more to develop.

It is best to make radiographs of a few small objects to begin with and develop the negative yourself, to accomplish good results, and even the dexterity of an expert.

By all means study the tube effects with the fluoroscope, and when accustomed to that use the radiometer which can be graded to suit the operator or coil, furnishing at once a reliable and ever-ready means of telling the distance for, and necessary time of, exposure.

Some experimenters claim that by inserting a spark gap in the secondary circuit, efficiency of the tube would be increased, and that better results can be obtained from low vacuum than in circuits where the spark gap is not employed. This gap should be inserted at the positive or anode pole, and its width regulated according to the effects produced in the tube.

When making a long exposure, say from 20 to 30 minutes, it is advisable to rest the tube from time to time, as best results are obtained from a cool or cold vacum tube with cold electrodes, as already shown. A platinum disk heated to a white heat may give good results, but it is advisable to allow the disks to remain below that point, as the tube would soon be rendered low in vacuum by the disintegration of its metallic composition.

When the object has been exposed for a given time, the currents of the motor and coil are turned off, and the plate is removed to the dark room ready to be developed, etc.

If a radiogram of a foreign body is to be made, i. e., a bullet in the limb, where its exact location is required, two plates or negatives must be made. One laterally, giving the lateral view of the part and depth of the foreign body contained within, and the other negative directly antero-posterior, giving the distance of the foreign object from the outer borders of the limb. By comparing the two negatives, depth and distance can be exactly measured.

Another method of determining the exact location of a foreign body is obtained by triangulation.*** For this two tubes are used, placed a slight distance apart, so that two shadows of objects are thrown upon the dry plate.

*From "The X Rays. Their Production and Application." Published by the J. S. Ogilvie Publishing Company, New York City.

**See Kolle, an appliance for securing proper radiographs about the elbow joint. Elect. Eng., March 31, 1897.

***See, also, Dr. N. S. Scott, "The Location, by Triangulation, of Foreign Bodies in the Hand." American X Ray Journal, June, 1897.

By measuring the relative position of the tubes and object radiographed upon the plate or seen upon the screen, imaginary lines may be drawn from the picture to the screen or dry plate to the tubes, which will be found to cross or bisect exactly at the position of the object to be located. The former method, however, is much simpler, readily applied and less confusing to an amateur geometrician.

If the radiograph of a limb in splints is to be made, and the latter are composed of wood or felt, they can be allowed to remain on the limb during the exposure, as well as bandages, etc. Stiff starch bandages are not opaque and need not be removed. A plaster of paris cast must, however, be removed, to obtain pictures of the bones, etc.

Bandages are not opaque and, as has been said, need not be removed; in fact, you may find it necessary to bandage the plate to the limbs of children so that they may be firmly and safely held during the time of exposure.

Shoes should be removed, although leather offers but little obstruction—yet the eyelets, buttons and nails in the heel and sole of the shoe would show, obliterating certains portions of bony structure.

The object radiographed must be brought as close to the plate as possible to obtain an exact outline. It is therefore found necessary to remove extra clothing or bulging bandages.

Patients are best radiographed in bed, with the part to be exposed laid upon the plate holder. The tube employed can be fixed into the proper position by the use of the large laboratory stand described.

AUTOMOBILE CONSTRUCTION.

The name "locomotive" is not more inexpressive than the title "automobile." Yet custom has such an influence upon us that it would be impossible to change either of these titles for one more comprehensible or familiar to the lay mind. A locomotive and automobile are closely related. In the one case we have a heavy engine operated by steam and driven along steel tracks, and in the other case a comparatively light vehicle, the wheels of which are rimmed with rubber, carrying motive power either in the condition of steam, gasolene or electricity. Instead of running along well defined tracks it is propelled from point to point either in the city's thoroughfares or along country roads.

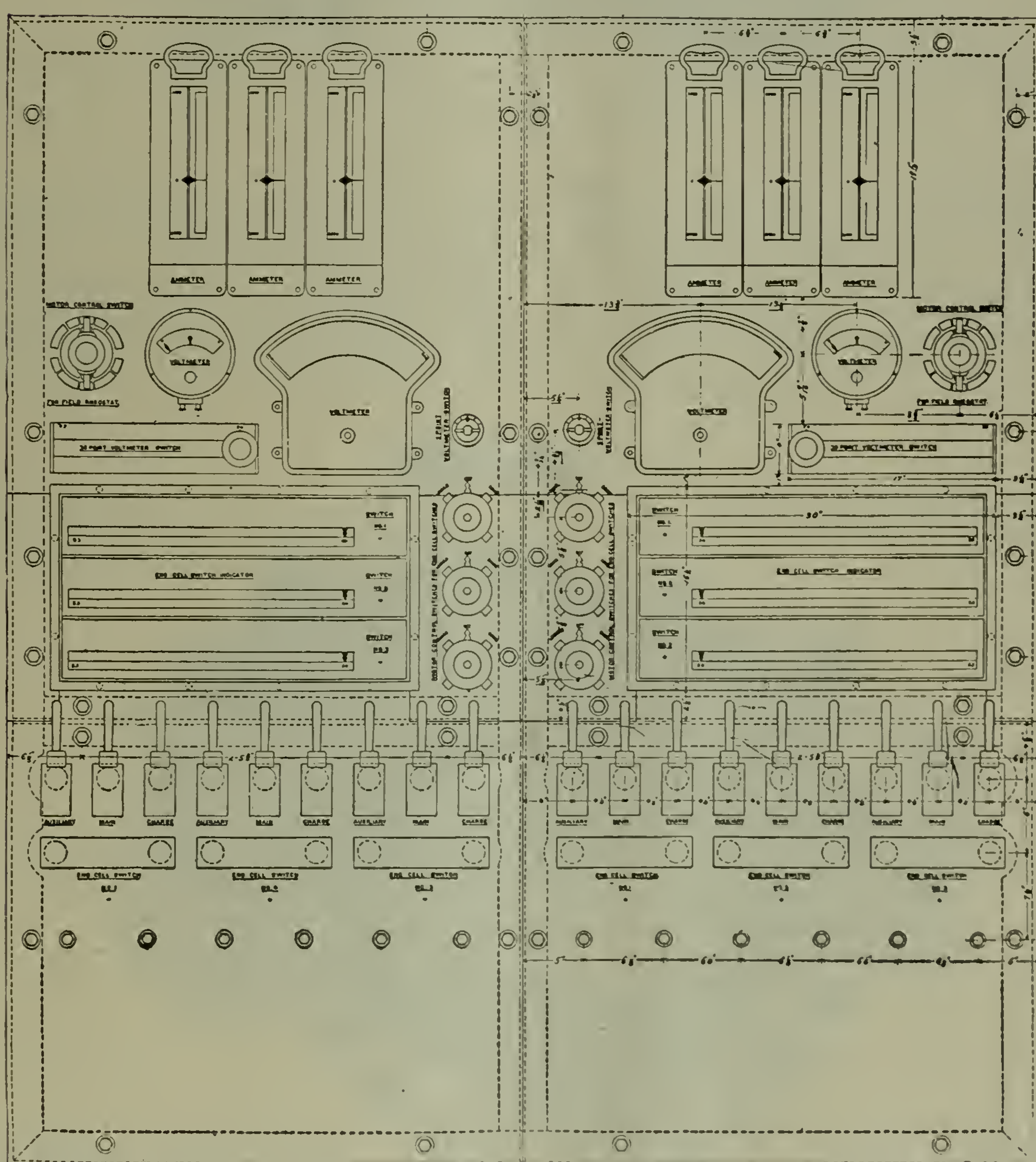
The difference, however, between them is obvious, as far as appearances are concerned. Yet one is practically the prototype of the other. The electric automobile consists of a vehicle, storage batteries, and motor. The construction is ideal, as regards the vehicle and motor, the method of governing or controlling, and the plan, as practically fulfilled, of carrying stored electricity. Taking a conservative technical view of the case, the following requirement must be complied with in the construction of a successful automobile. First a source of current or electrical energy which will carry the automobile not only over a given distance but also over hilly ground or undulating roads without either draining the storage batteries or injuring the motor.

The modern automobile, carrying either one thousand pounds or one ton of storage batteries, becomes chronically unable to pass through certain ordeals forced upon it within city limits or on country roads. A twenty-five mile run over hilly country is almost an impossibility at present unless storage batteries that have undergone pre-

Storage battery plant.

paration in construction are utilized. In these the rate of discharge is high and the life comparatively long. It and fifty ampere hour cell, limited to a ten ampere rate of discharge, might weigh fifty pounds inclusive, but a

Electric Surrey.



Storage Battery Switchboard.

may be worth while mentioning that the rate of discharge largely governs the weigth of the cell. A two hundred two hundred and fifty ampere hour cell, from which twenty or twenty-five amperes or more can be drawn, would weigh more than twice as much on account of the increased thickness of the plates. This, therefore, is the point of greatest consequence to automobile manufacturers. Either a lighter battery for the same rate of discharge or with the same outfit a greater distance of run. structed, would not weigh much more and its employment would doubtless prove a great source of satisfaction to those trying it.

In the following illustrations the charging plant, carriages and switchboard, as employed by a concern adjacent to New York, are shown. The storage battery plant

Electric Two Passenger Trap.

All that is of consequence in automobile construction is secondary to this question, and at present it is a hard nut to crack. The average weights of storage batteries, per horse power hour of output, vary from thirty pounds to two hundred; the lightest cell being the voltaic accumulator with zinc as the positive element and a thick peroxide plate serving as the negative element and depolarizer. The weight of such cells as these depends entirely upon their rate of discharge. In a certain cell known to the writer, of three hundred ampere hours capacity, and two and one-half volts pressure, three amperes were obtainable for one hundred hours, or one horse-power hour from about thirty pounds weight. With the rate of discharge increased this type of cell, recon-

is not entirely devoted to automobile purposes, but all that is necessary for a complete equipment is on the premises. Tests that have been made seem to indicate that within a very short time the storage battery, after undergoing a series of modifications, wil become an integral part of the electric automobile business. There is every possibility of the cost of automobiles reducing down to such figures that the general public may be tempted to consider this new addition to civilization. Orders have been placed with automobile manufacturers to the extent of more than one million dollars to date for this new and popular vehicle. In the large cities of the Union the electric cab will become as familiar a feature as that driven by the traditional horse in the streets of London.

Electric Four Passenger Trap.

DEPARTMENT OF ELEMENTARY EDUCATION.

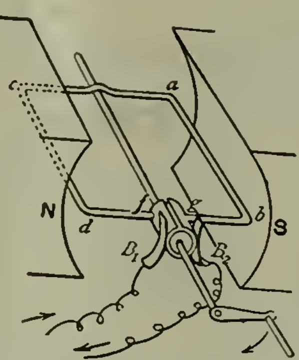
BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of " Answers to Inquiries."*]

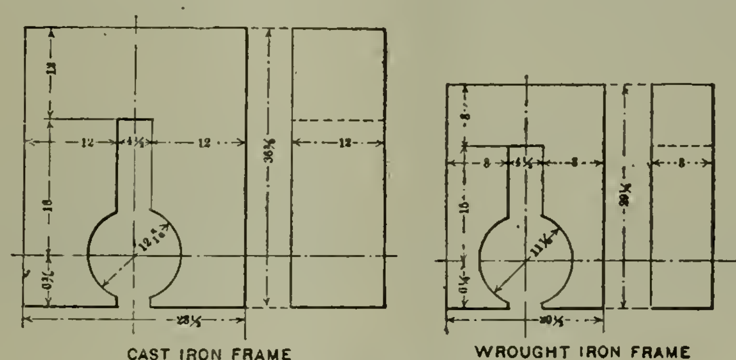
TECHNICAL NOTES.

LENGTH OF CONDUCTOR PER VOLT.

The length of conductor per volt on armatures varies from one yard to three yards on an average. A generator may average one volt per foot if its field is intense or its speed very high. With a saturated wrought iron core, a toothed armature and a moderate air gap the yard per volt basis is about the best, the speed being about eighteen hundred per minute. The above is subject to criticism, but is a good practical rule to go by.



The Simple Dynamo.



Comparative Sketches.

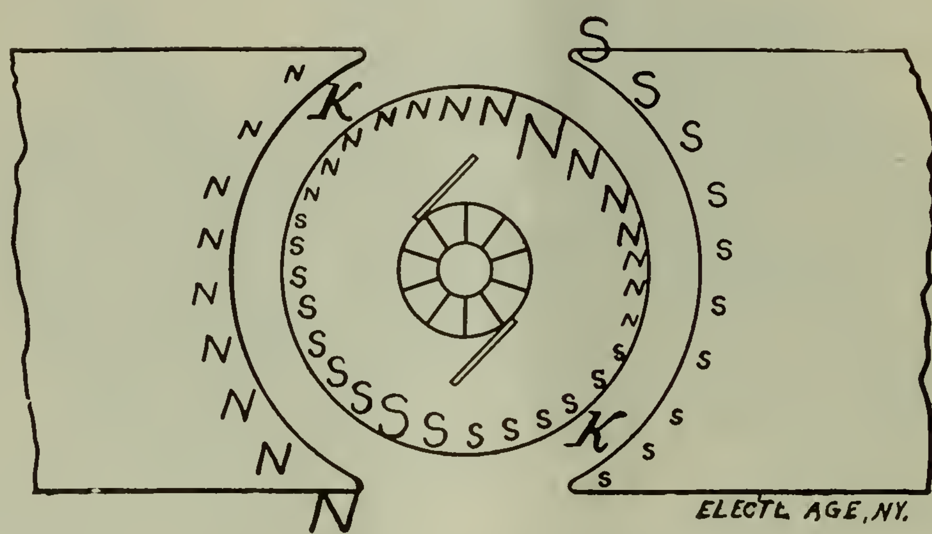
A Slotted Armature Plate.

WROUGHT IRON VERSUS CAST IRON FOR FRAMES.

The following sketches gives the dimensions and relative sizes of two machines producing exactly the same number of lines of force, one being of wrought iron the other of cast iron. The difference in bulk would be more striking in reality than by sketch. According to these diagrams a wrought iron frame need only be of two-thirds the size. In some cases where the wrought iron was unusually soft and pure the reduction amounted to fifty per cent. in favor of the wrought iron. Cast iron carries fifty to sixty thousand lines of force per square inch; wrought iron one hundred thousand. Not only is there a gain by reducing the weight and size but much less copper is used for producing the same magnetization in wrought iron as in cast iron.

THE TOOTHED ARMATURE,

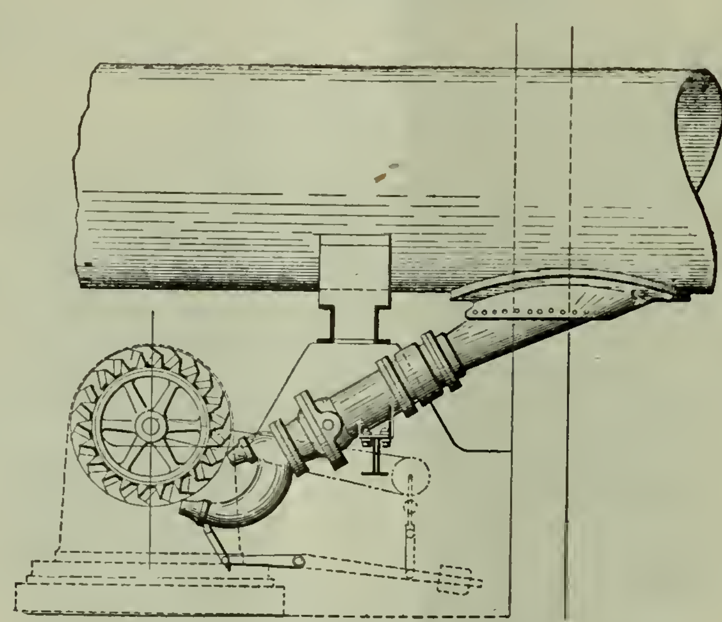
So much is said in text books about the toothed armature and the air gap that little can be mentioned of practical importance in a brief article. To begin with, the teeth enclosed by a pole piece should not be unable to carry the lines of force without a high specific induction. If two million lines of force emanate from the pole piece the teeth must have sufficient cross section to carry them. Another fact of consequence is the keeping of the air gap and width of slot at the ratios of one to three; a quarter inch slot requiring three thirty seconds clearance. By observing these two points not only will heat be avoided in the pole piece and teeth but magneto motive force that is not excessive will be used.



Sketch showing accumulation of magnetic field at corners.

ARMATURE REACTION.

Armature reaction causes two difficulties. First, a distortion of the field; secondly, a reverse magneto motive force. A distorted field changes the angle of lead; a back magneto motive force causes a drop in pressure with increase of load. In the sketch both armature and field are shown with this reaction occurring. The width of the air gap governs in some respects the distortion of the field. Armature reaction can be overcome as far as the voltage is concerned by means of a great series coil.


A high-pressure water wheel.

THE ECONOMY OF WATER POWER.

Self sustaining electric light plants represent an ideal combination; a water-wheel of eigthy per cent. efficiency and a generator of ninety per cent. It is hard to conceive of a more efficient outfit than this. Where water power can be obtained without involving the construction of very expensive dams or penstocks the cost of fuel disappears from the list of expenses. Were fuel the greatest item of expense in the running of a plant large fortunes would have already been made, but the constant expense of labor, the steady rate of depreciation, and renewals which are necessary bring down the fuel question to one of secondary consideration. Yet it must not be forgotten that with water power there is no outlay for coal. Consequently, at the end of a ten years' run a great saving would have been effected as far as this item is concerned.

AN ELECTROLYTIC PLATINUM ALLOY.

Dr. Foveau de Courmelles, writing in L'Electricien, describes a new allow of platinum formed on the surface of the anode of a Wehnelt interrupter of the usual form. The anode wire had previously been coated with silicate of potash. On forcing the current to an extreme point there was a sudden interruption, and the formation of a brilliant yellow metallic layer on the platiunm wire, probably a silicide of platinum.—Ex.

RUNNING TRAINS BY TELEPHONE.

An innovation by the Illinois Central Company is in the operating of trains by telephone instead of by telegraph. This telephonic train dispatching has been done on a two-mile stretch of elevated track in Chicago, over which 11,664 trains were moved, during much of the time on a single track, but without an accident. Whether to continue or to abandon the system, on the completion of the other tracks, has not been decided. The officials pronounce it a success, however, and as capable of application over 100 miles as over two. All of the trains moved were subject to the verbal orders of the telephone dispatcher from his office in an elevated blockhouse, and the quickness and cheapness of the service are the subject of comment among railroad managers. There is no time lost in sending and copying messages and no occasion to employ expert telegraphers.—Ex.

DELICATE HEAT MEASUREMENT.

A new calorimetric machine, said to be the finest of its kind in the world, has been received by the geological survey at the Johns Hopkins University. It is a contrivance for finding the relative quantity of heat in different qualities of coal. The testing apparatus consists essentially of a bomb, or heavy shell, about the size of a large orange, in which a small platinum crucible is suspended by a small wire and a jacketed tank of water. A gram of coal dust is compressed into a cake and placed in the platinum crucible, which, after receiving 375 pounds of oxygen and being rendered airtight by a screw cap, is immersed in the tank. By an electric spark the oxygen is ignited with the coal, and the increase of temperature in the water, caused by the consumption of the coal, is accurately measured by two delicate thermometers. The bomb is made of aluminum bronze, weighs about two pounds and is coated on the inside with 20 coats of gold plating.—Ex.

THE AUTOMOBILE NOT A NOVELTY.

The automobile is no new thing, says a daily paper. Fifty years ago Robert Dudgeon, a New York master machinist, invented a steam road wagon that was exhibited in the Crystal Palace and was lost when that structure was destroyed by fire. Mr. Dudgeon immediately began work on a new machine, his men in the shop helping him at odd moments. The resulting automobile, like the first one was heavy and awkward, as no doubt it had to be in order not to be shaken to pieces on the rough roads of the day. Still its trial trip was faily successful, and people, marveling much at the strange horseless carriage, talked just as men do to-day about the vanishing of the horse. Mr. Dudgeon used his carriage for ten years, usually to ride from his place of business to his house in Harlem. Sometimes on Sunday he would hitch an ordinary carriage behind it and draw his family to church. The carriage made considerable noise, and was finally ruled off the streets by the city authorities because it frightened horses.—Ex.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING JULY 11, 1899, $52,767.00.

New York, N. Y., July 11, 1899.—The following exports of electrical material are from the port of New York for the week ending this date:

Antwerp.—39 packages electrical material, $2,553.
Amsterdam.—1 case electrical material, $100.
Argentine Republic.—2 cases electrical motors, $30.
British Guiana.—4 cases electrical material, $200.
British East Indies.—16 cases electrical material, $288.
British Possessions in Africa.—21 cases electrical material, $997.
Berlin.—3 packages electrical machinery, $1,169. 4 packages electrical material, $5,759.
Central America.—4 cases electrical material, $54.
Chili.—10 packages electrical material, $667.
Cuba.—28 packages electrical material $207. 88 cases electrical material, $1,210.
Christiania.—2 packages electrical material, $22.
Glasgow.—6 cases electric motors, $80.
Genoa.—1 case electros, $10. 3 cases electrical material, 130. 3 cases electrical machinery, $119.
Hamburg.—78 packages electrical material, $6,081. 107 packages electrical machinery, $2,550.
London.—29 packages electrical material, $1,454.
Liverpool.—27 packages electrical material, $3,796.
Marseilles.—247 cases electrical material, $21,250.
Milan.—2 cases electrical material, $200.
Mexico.—12 cases electrical material, 315.
Newfoundland.—6 cases electrical material, $83.
Nova Scotia.—2 cases electrical material, $19.
Odessa.—28 cases electrical materiai, $780.
Porto Rico.—18 cases electrical material, $297.
Rotterdam.—7 cases electrical machinery, $350. 2 packages electrical material, $31.
Southampton.—3 cases electrical material, $132.
U. S. of Colombia.—43 cases electrical material, $1,388.
Venezuela.—51 cases electrical material, $446.

NEW INCORPORATIONS.

Georgetown, S. C.—The Georgetown Electric Co. has been incorporated by Frank K. Bull and E. E. Mandeville.

Chicago, Ill.—Commercial Electric Co., incorporated by H. N. Rose, D. I. Sicklesteel and J. R. Hastings; furnish electricity and manufacturing electrical machinery, etc. Capital stock, $10,000.

Point Pleasant, W. Va.—The Point Pleasant Water & Light Co., which was recently incorporated, has been granted franchise for construction of electric light plant, etc.

Charlestown, W. Va.—The Howell & Shanklin Construction Co. has been incorporated by Clark Howell, J. P. Shanklin, J. W. Spencer, W. R. Gunn and H. R. Howard; for the construction and equipment of water and power plants, etc. Capital stock, $100,000.

Wheeling, W. Va.—National Light, Heat & Power Co., incorporated by J. Piedell, J. A. Miller and others. Capital stock, $500,000.

Moristown, N. J.—New Jersey Engineering & Construction Co., incorporated by Frederick N. Taff, Frederick W. Schmidt, and Louis C. Bonnell; construct and equip gas and electric plants. Capital stock, $25,000.

Paynesville, W. Va.—The Paynesville Yargan Co., incorporated by G. H. Burrows, A. P. King, R. L. Moody and G. G. Grant; furnishing hot water, heat, electricity and other ingredients. Capital stock, $75,000.

Jersey City, N. J.—Butte Lighting & Power Co., incorporated by William J. Canning, William S. Brayton and others; carry on electric lighting, heating and power business. Capital stock, $1,000,000.

Toms River, N. J.—Toms River Electric Light & Power Co., incorporated by Thomas H. Smith, Aenas S. Bailey and others; carry on the business of an electric light and power company. Capital stock, $25,000.

Trenton, N. J.—The Electric Axle Light & Power Co. has been incorporated, with a capital stock of $25,000,000.

Dover, Del.—The Hill & Miller Co., a Baltimore-Washington company, has been incorporated with a captial stock of $50,000, to manufacture and sell electrical apparatus.

Trenton, N. J.—The Continental Compressed Air Power Co. has been incorporated by Frank R. Shattuck, Edward Everett and George Martin. Capital stock, $15,000,000.

Los Angeles, Cal.—The Pacific Wave Motor Co. has been incorporated by H. T. Hollingswerth, A. L. Perley and others; manufacture and operate motors by steam, electricity, compressed air or wave power. Capital stock, $1,000,000.

Wheeling, W. Va.—Ohio Valley Electrical & Motor Co., incorporated by M. Horkheimer, F. H. Lange, H. W. McLare, C. M. Fressell and J. F. Coniff; selling and dealing in electricity for the use of motor power. Capital stock, $500,000.

New York, N. Y.—United States Gas & Electric Improvement Co., of Mexico, incorporated under the laws of West Virginia, by H. H. Barnes and others. Capital stock, $5,0000,000.

TELEPHONE CALLS.

Monticello, Fla.—Mr. Drew of Madison will establish a telephone exchange in Monticello.

Lexington, Ky.—The Fayette Telephone Co. has been incorporated by J. J. Shelby, John R. Allen and others. Capital stock, $6,000.

Baltimore, Md.—The Maryland Telephone Co. has purchased site for $80,000, at Lexington and Courtland Streets, and will erect a telephone factory.

Buchanan, Va.—The Botetourt Telephone Co., incorporated by H. A. Latane, O. E. Obenshain, J. Z. Schultz; operate and maintain a telephone exchange. Capital stock, $5,000.

POSSIBLE INSTALLATIONS.

Kansas City, Mo.—James D. Wade of St. Louis has applied for franchise to erect an electric light plant in Kansas City.

McKenzie, Tenn.—S. C. Hearne may give information concerning proposed erection of electric light plant.

Plaquemine, La.—The Mayor may give information concerning establishment of an electric light plant.

Shelby, N. C.—H. D. Wilson is interested in the proposed establishment of an electric light plant.

JOTTINGS.

THE NEW RIKER THEATRE ELECTRIC AUTOMOBILE was on view at Broadway and Liberty street, Thursday, July 18th, and attracted the attention of merchants generally. The Singer Manufacturing Company, in whose office building the above vehicle was exhibited, are contemplating its adoption for their traveling men.

J. JONES & SON, 64 Cortlandt street, manufacturing electrical supply house and headquarters for everything electrical, have trebled their business since January 1st. They are constantly adding new novelties; their new automatic pull knife switch for ceilings, to operate fans, arc lamps, motors, etc., needs to be seen to be appreciated. The sales of their specialties in switches, switchboards and electric light goods are exceeding all their expectations.

F. M. PRESCOTT, 44 Broad street, the old and popular Edison and General Electric representative and creator of the large demand for phonographs in the United States and Europe, has lately opened an electrical department under the care of Mr. A. W. McLimont. They are making a specialty of export trade, but are also doing a large domestic business. Send to them for quotations on your fall stock order.

THE GOODSON GRAPHOTYPE illustrates one of the latest applications of electricity. This apparatus is a new form of type setting and type making machine, having the standard typewriter keyboard. Each type is made separately, differing in that respect from machines casting lines of type, coming out of the machine in galleys ready for the publisher. The whole system is worked by electricity, it being the only machine of its kind in which electricity is used exclusively. The company manufacturing these machines are preparing a complete line of dies for placing a large stock of the machines on the market this fall.

J. WEBBER, manufacturing electrician, Brooklyn, N. Y., has lately installed a complete gasoline plant and engine to operate his new works for the manufacture of special electrical musical attachments, etc. Mr. Webber seems to be a coming 'Edison" as far as the manufacture of electrical novelties of an attractive nature is concerned.

THE FALCON ELECTRICAL MANUFACTURING COMPANY is being organized and will operate a factory on Seventy-first street. Prominent in the company are Edward Lessner, a well known carpet manufacturer; L. E. Frorup, formerly with Schiff, Jordan & Company but latterly with the General Incandescent Arc Light Company, and H. O. Swoboda, also of the last named concern.

THE MANHATTAN RAILWAY COMPANY are making active preparations to equip their system with electricity.

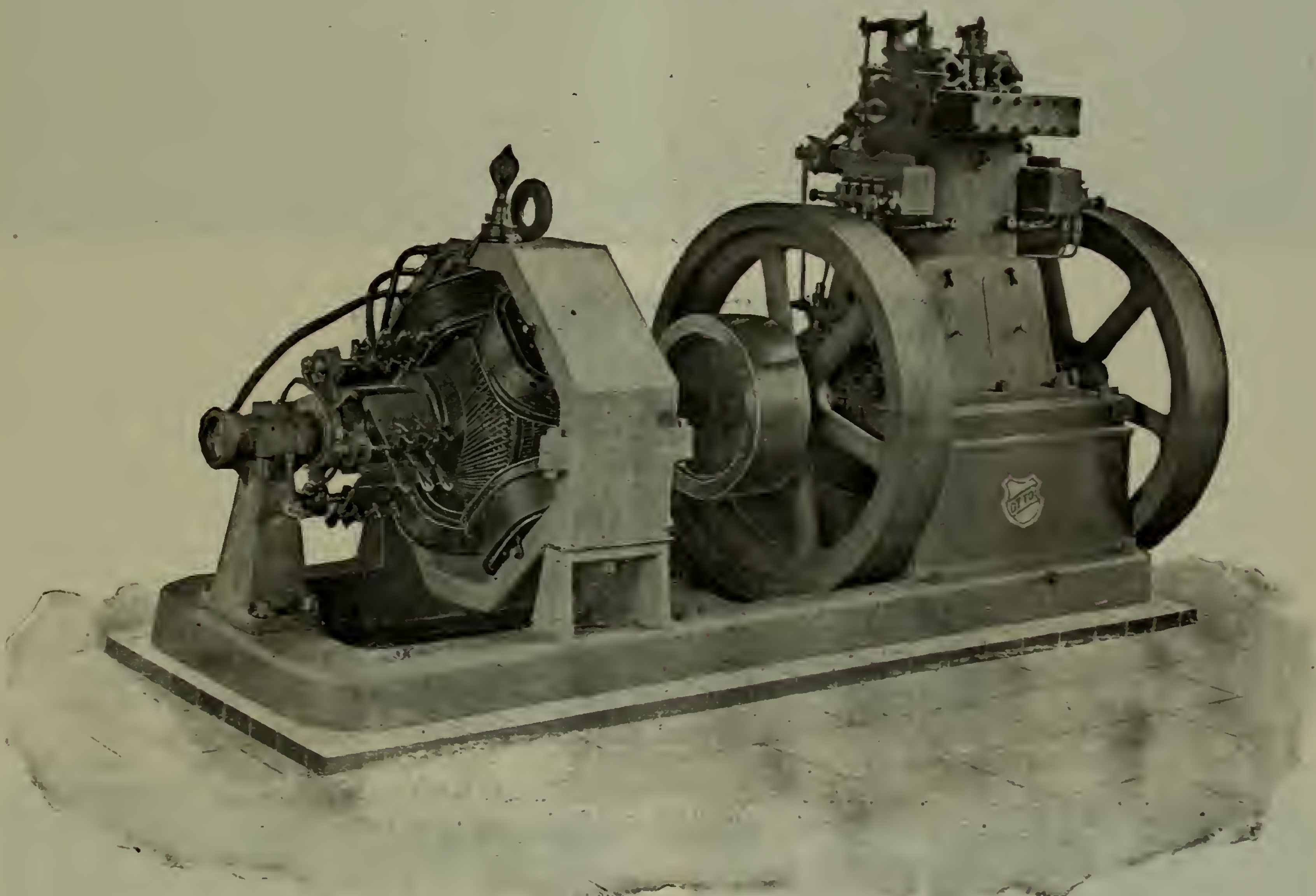
An order was lately placed with the E. P. Allis Company, of Milwaukee, Wisconsin, for nearly $1,000,000 worth of steam engines for direct connection to electric generators of 5,000 kilowatts capacity each. The erection of the power house at Seventy-fourth and Seventy-fifth streets will be begun at once.

A SYNDICATE OF NEW YORKERS representing the Sprague Electric Company, has purchased the Stanley Electric Manufacturing Company, of Pittsfield, Mass. Henry Hine, formerly manager of the Stanley Company, has assumed the position of general manager of the Sprague Company. Edward H. Johnson, one of the organizers of the Sprague Company, and who recently resigned his position as vice-president and general manager, has gone to England to look after his interests. The officers of the Sprague Electric Company are A. B. Chandler, president; John E. Searles, vice-president; Henry Hine, general manager, and Lieut. Frank J. Sprague, electrician.

The Electrical Age.

VOL. XXIV—No. 5 NEW YORK, JULY 29, 1899. WHOLE No. 637.

Electric Light and Power.



A Model Gas Engine Plant.

THE GAS ENGINE FOR ELECTRIC LIGHTING.

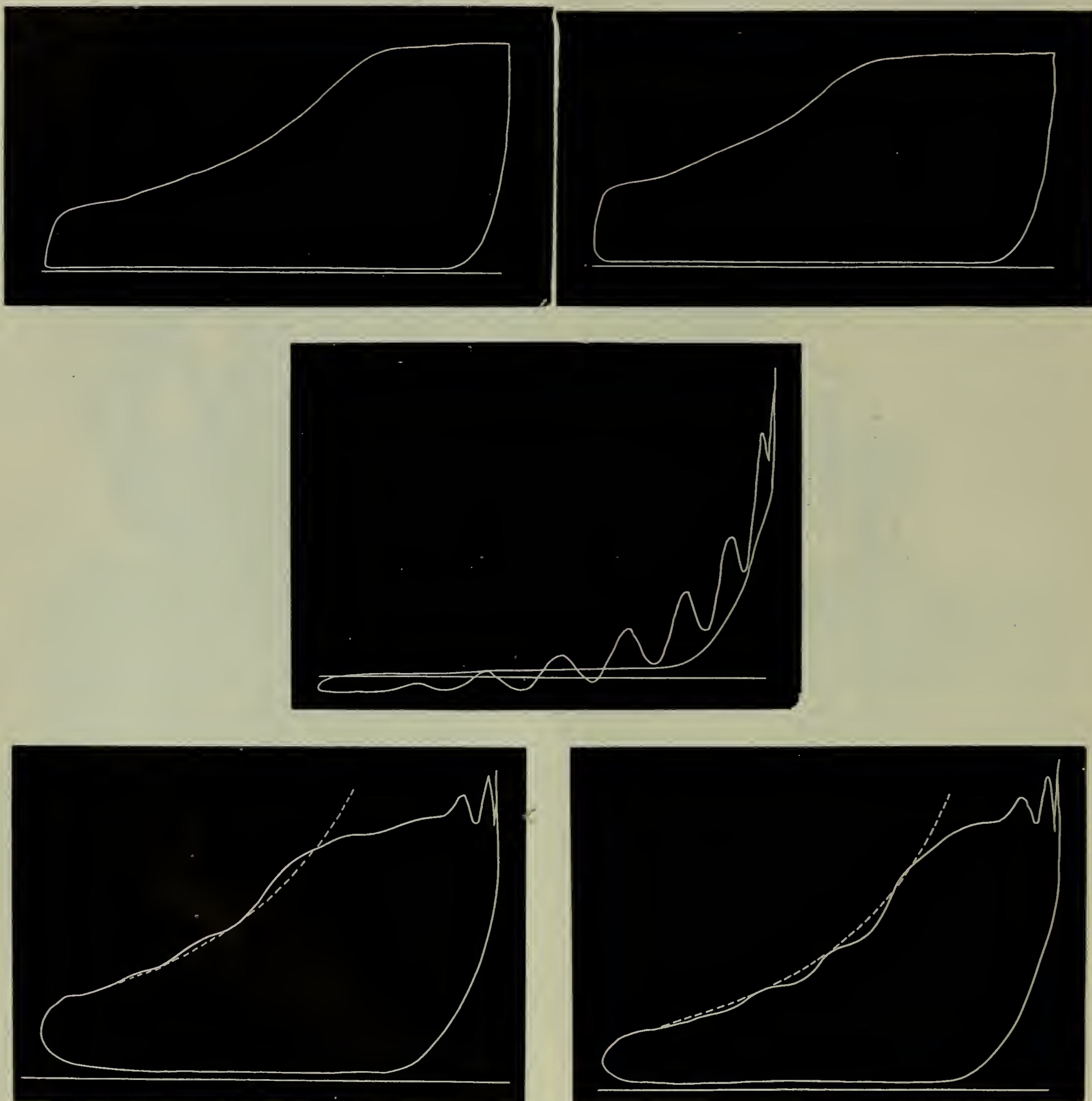
The thermo-dynamic efficiency of heat engines is represented by the total work done by the engine divided by the total heat expended. It has been shown by frequent tests that the theoretical efficiency of a steam engine cannot be more than .25, or its practical efficiency fourteen per cent. Gas engines as heat engines are superior because of the higher temperature limits between which they can work. One of the most historic types of gas engine is the "Otto," in which the various operations are conducted for the generation of power in a highly efficient and practical manner. In this engine the great difficulty has been overcome of having the explosion occur before the piston was ready to make use of it. The fact that the explosion and movement of the piston were not consecutive in many cases gave rise to inefficiency due to loss by radiation, conduction and wasted kinetic energy.

A direct connected electric light plant, the generator of which is driven by a gas engine, is shown in the illustration. Electric lighting conducted on this plan means a minimum of care and the least possible operating expenses. Various tests have shown that the consumption of gas per horse-power in cubic feet clings closely to an average of twenty. Of course, in smaller types of gas engines from thirty to forty cubic feet per horse-power will be consumed but in the large sizes the reduction is obvious. A ten-horse gas engine, operating a one hundred light generator, represents a fair example of electric lighting and the expense connected thereto when commercially considered. If the engine is always at full load its average consumption of gas per hour will be about two hundred and fifty cubic feet. At sixty cents per thousand cubic feet the cost of gas will amount to fifteen cents. The generator has meanwhile been producing electricity to light one hundred lamps for one hour, the actual cost of electricity for each being .15 of a cent. This is, of course, operating in New York City with gas at the latest reduced rates.

A householder in New York who desires to have at his command thirty incandescent lights throughout his home can operate a three horse-power gas engine and dynamo plant with a consumption of gas not exceeding one hundred cubic feet an hour. As a month's lighting amounts to about one hundred and fifty hours in total 15,000 cubic feet of gas per month would be consumed, the cost of which at sixty cents per thousand, would amount to $9. If five-foot burners were used in place of the generator and gas engine thirty jets would consume one hundred and fifty cubic feet an hour and for one hundred and fifty hours per month would consume in total 22,500 cubic feet, costing at the above rate of sixty cents per thousand $13.50, or $4.50 more.

The gas consumption in the case of a gas engine is figured in this case at the very highest. It would probably be less and therefore show that house lighting with the reduced price of gas can be more economically conducted on an electrical basis, aside from other conveniences, than by the mere combustion of this illuminant. A gas engine driving a dynamo tested in Brooklyn showed an efficiency at full load of over twelve per cent. At full load, consuming 171 cubic feet of gas per hour, the generator delivered 4,000 watts, the average consumption being about forty cubic feet per kilo watt hour or thirty cubic feet per horse-power hour. At half load 144 cubic feet were consumed, with a delivery by the dynamo of 2,200 watts, averaging about 45 cubic feet per horse-power hour. From these tests, made by the writer, with the cost of gas reduced to one-half, at full load with 4.000 watts delivered per hour gas cost ten cents. Sixty-six incandescent lamps, in other words, could be run at an expense of ten cents. At half load one hundred and forty-four cubic feet cost nine cents and enough electricity was generated to run more than forty incandescent lamps.

Special tests are apt to give unusually high results.



Indicator Cards of Gas Engine Tests.

but the conclusions arrived at plainly show that electric lighting by the aid of the gas engine is the most convenient and probably the cheapest method of illumination conceivable. Above are shown some of the indicator cards obtained during various gas engine tests. They clearly show how perfect and systematic an expansion has been obtained in modern machines. In view of this fact it seems likely that many electric light companies could save the expense of a large boiler plant and floor ren for same by the direct use of illuminating gas.

Auto-Mobiles.

ELECTRIC AUTOMOBILES.

BY ELMER A. SPERRY.

(Concluded from Page 39.)

The automobile will, for some time, necessarily be in the hands of the inexperienced and non-expert, and while it is not possible to render it "fool proof," yet certain safeguards may be employed in and about its operating devices and charging system which will materially reduce and almost prevent derangement. The manipulation may be so thoroughly interlocked as to effectually prevent a wrong operation preceding the right one, and rendering it nearly impossible to make a mistake in anything like normal operation. Interlocks and safety devices are used in many branches of engineering; the introduction of automatic interlocking switches is a notable example, having placed steam railway operation on an entirely new basis. After subjecting these devices to continual practical test, and altering them until the requirements seem to have been met, the author is prepared to say that there is no reason why the important results reached in the interlocking switch and signal system should not be compassed in automobile manipulation, and by devices vastly simpler and inexpensive.

As to charging and care of batteries, it is believed that the differential wattmeter system for ordinary use, coupled with the periodic inspection by an expert from the home office or local headquarters, is the best arrangement now at our command. The author has found that the differential factor of the wattmeter should be adjustable and should be brought from time to time into step with both the efficiency and charging curves of the battery. These curves change and are peculiarly altered by the time factors. These adjustments are easily made through determinations by the use of hydrometer. This can easily be one of the duties of the periodic inspection above referred to. The practical employment of the adjusting feature, or, in fact, any device by means of which the meter may be left in step with the battery, is found to constitute such a meter an almost perfect safeguard against the destructive effects of overcharge and overdischarge in inexperienced hands.

With the public conveyance, or a delivery system, operating a number of vehicles from one station, it may not be difficult to secure the services of a single expert attendant, yet for anything like commercial operation, the automobile itself must be entirely successful in the hands of the "raw recruit." The driver must be a man familiar, especially at first, with the routes and business in hand. The vehicle must be depended upon to perform successfully, even under the most trying conditions, without demanding especial thought or attention on the part of its operator, who should simply be a good driver, and who, from an engineering standpoint, would be considered thoroughly non-expert.

OPERATING COSTS OF HORSE AND ELECTRIC DELIVERY WAGONS IN NEW YORK CITY.

By G. F. Sever and R. A. Fleiss.

(Continued from Page 40.)

SECTION III.
HORSE VERSUS ELECTRIC DELIVERY SERVICE.—A COMPARISON.

In considering the advantages and disadvantages of two radically different systems for the performance of the same work, other things being equal, the cost is the deciding factor. Assuming that all other considerations are equal, it will be shown in this section that the cost of operation, maintenance, etc., of the electric automobile is less than for horses in the light delivery service of New York City, the horse being considered in the most favorable light.

From the results recorded in Section II. we are led to the conclusion that, under highly disadvantageous conditions, the power necessary to propel a vehicle through the streets of New York City from the lower part of the town to points situated on the highest ground, including all grades that may be encountered, will not average more than 120 watt-hours per ton mile. That this is a high figure for vehicles of good design and equipment is evident from the results obtained while testing the delivery wagon previously mentioned. The fact that the small carriage never reached 120 watt-hours per ton mile, though working under most unfavorable conditions, should lend weight to this conclusion.

Taking 120 watt-hours per ton mile as a basis on which to compute the power consumed by an electric delivery wagon, we will now compare the results obtained in Section I., Table IV., with the resultts that would be obtained if an electric wagon were substituted.

From Table IV. it was found that the total cost per day for 2 horses, 1 driver and 1 boy, was 428.54c. The wagon was to travel 42 miles a day—being an average of 21 miles per day for each horse. The time in motion was assumed to be 6 hours. An electric wagon with an average speed of 9 miles an hour could cover this distance in 4.66 hours, thus saving 1.34 hours—the other conditions remaining the same. The cost per day for the electric, assuming cost of power at 5c. per K. W. hour, is given in Table XIII.

TABLE XIII.

1. Cost of power for 42 mile run, at 5c. per K. W. hour ....71.28c.
   assuming power consumption as 120 watt-hours per ton mile.

Weight of wagon	3750 lbs.
Weight of driver	150 lbs.
Weight of boy	125 lbs.
Average load	500 lbs.
Total weight	4525 lbs.
	2263 tons.

Watt-hours per car mile, 271.56.

Watt-hours per 42 car mile, 11,405.00=11,405 K. W. hours.

Taking battery efficiency as 80 p. c.

Total power to be paid for = 14.256 K. W. hours.

2. Interest on cost of wagon per day............ 21.4
   Cost of wagon, $2,300, at 6 p. c. interest.
3. Interest on stable rent for one wagon.......... 9.39
4. Driver 171.42
5. Boy 114.28

Total cost per day for 42 miles, 1 wagon, 1 driver, and 1 boy ....387.77c.

Therefore, cost per pound of delivery is .16158c., or .01698c. less than the figures for the horse. The cost per car mile is 9.232c. or .968c. less than for the horse. Cost per ton mile is 4.08c., or 6.12c. less than for the horse service. If we consider the load only, it costs 9.232c. per 500 lbs. per mile, or at the rate of .018464c. per lb. per mile, or .00194c. less per lb. than for the horse service.

Attention is again called to the conditions under which this comparison is made. The horse is supposed to be able to average 21 miles per day, doing this at the rate of seven miles per hour, under a draw-bar pull of 50 lbs. In other words, he is doing work at the rate of .89 of a theoretical H. P. for three hours per day. The automobile, on the other hand, is to do 42 miles a day at the rate of nine miles per hour, and the cost of power is assumed to be 5 cents per K. W. hour. Under these conditions the automobile can do the work of two horses in 1.34 hours less time than they can do it with a saving of .01698 cents per lb. of goods delivered or at a saving of 40.752 cents per day on a delivery of 2,400 lbs.

Now, having shown that it is cheaper to use an electric delivery wagon than the present horse delivery wagon—even when the supposition is made that the horse is doing much more work than he really is—it is proposed to make a comparison between the two systems under conditions which actually exist to-day. It was shown in Section IV. that the delivery horse does not average 18 miles per day during the year. We will assume, however, that the horse does travel this distance per day. Each wagon will go 36 miles a day under this assumption; hence the total mileage of the wagon for the year will be 11,268 miles. This assumes that on Sundays the wagon does not go out. Then for 52 days a year, at least, the horses have to be fed without any work in return. This, of course, is a condition not met in electric automobile service.

The cost per day for the two horses, wagon, driver, etc., necessary to accomplish 36 miles a day was found from Table IV., Section I., to be 428.54 cents. The cost of covering 11,268 miles will then be $1,562.20. Here it must be remembered that 365 days have to be taken. The cost per car mile is then 13.86 cents.

(To be Continued.)

Dynamo Design.

AIR-GAP AND CORE DISTRIBUTION. THE MAGNETIC FLUX AND ITS EFFECT UPON THE REGULATION AND EFFICIENCY OF DYNAMO-ELECTRIC MACHINERY.—II.

BY W. ELWELL GOLDSBOROUGH.

(Continued from Page 41.)

The increase in the core loss with the load which these calculations show, probably accounts in part for the failure of many machines to come up to the expectations of their designers, and certainly presents an interesting field for speculation. With each change in the depth of the core, the core distribution of the flux changes. With each modification of the percentage of the armature covered by the poles it changes. With each modification of the armature winding, the distribution of the flux in the core changes. All these matters have a direct bearing upon the core losses, and are interesting as problems.

In Fig. 2 the results obtained in connection with Fig. 1 are displayed. The equal flux paths traced between the poles have been carefully located with reference to the full load flux distribution, and without reference to the direction of the vectors. It will be seen, however, that the black vectors on the right, which are the same as those of section c, Fig. 1, follow quite closely the direction of the paths, as is to be expected. On the left of Fig. 2 the trace is shown of only the maximum density vectors, to the end of bringing out more clearly the effect upon the core-distribution of the armature ampere-turns. It will be seen that they have the effect of forcing the flux toward the bottom or inner periphery of the core under the leading pole tips and of crowding it upward toward the outer periphery of the core under the trailing pole-tips. Accordingly, the maximum density curve c of Fig. 3 has an area a number of per cent. greater than the area of a similar curve plotted from densities taken in a plane at right angles to the direction of the flux. In other words, the area of the curve c represents a greater amount of flux than really exists in the armature core.

The regulation of the machine here discussed is modified to some extent by the effect of the saturation that occurs in the teeth and cast-iron pole shoes, so that the full load air-gap distribution is better than that shown in section c of Fig. 2, but for the sake of simplicity in taking up the subject for discussion, all modifying factors of this character have been eliminated.

With the end in view of obtaining experimental evidence of the correctness of the method of determining core losses that has been outlined above, two of my students, Messrs. W. T. Hensley and E. B. Kirk, constructed a special piece of apparatus. It is an electro-magnet, resembling as much as possible one pair of poles of a multipolar dynamo with a section of the armature. The armature is of rectangular form. As the flux divides in the pole of a multipolar machine each pole of the magnet was made to represent half a pole of a dynamo.

The magnet is built up of thin plates of transformer iron, .015-inch thick. The core and armature are made up of 180 of these laminations held by two side plates, each of the same surface dimensions, but 3-16-inch thick. The whole is fastened together in both armatures and cores by means of rivets.

A series of holes were bored in the armature, perpendicular to the side faces. They are .089-inch in diameter and placed in rows at right angles to each other, 5-8-inch apart either way. Exploring coils of five turns each were wound in each pair of holes, making 29 conductors in each pole. Double silk covered wire was used.

Before winding the armature it was placed in a coil oven and baked for twelve hours in order to rid it of all moisture. To insulate the sides of the armature and to keep the ends of the coils from coming in contact with the armature iron, side plates of wood fibre were put on, holes being bored in them, corresponding with those of the armature. The winding was then made by threading the holes with the wire by means of a long slim needle. Each coil was tested for grounds and short-circuit when the windings was completed.

The field winding of the magnet consists of eight coils which were so designed that when placed in a series the magnet could be energized from 110-volt mains and when connected in parallel it could be used with as low a voltage as 7.5.

(To be Continued.)

FUNERALS BY TROLLEY.

Several Chicago street railway companies are said to be running funeral trains on their lines, and it is further alleged that "trolley" funerals are becoming popular. The innovation, it is thought, will soon supplant the horse cortege method, as it is a good deal cheaper and quicker. The charge for a hearse car is $11, and for each additional car $3. The company makes the necessary arrangements with the undertakers along the line. As yet the Calumet Company has no funeral car, but it has fitted out an ordinary motor car which serves the purpose well. The word "Special" in black letters in the front part of the car tells its mission. Most of the trolley funerals so far have gone to Oakwood Cemetery, but three other burying grounds are also used a good deal. They are situated on the Chicago Electric Traction line.—Ex.

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CONTENTS:

A PHOTOGRAPHIC STANDARD OF LIGHT.

The difficulty of accurately measuring the intensity of any source of light is familiar to both physicist and manufacturer. All that is done, whether in the laboratory proper or in the photometer room of a large lamp manufacturing establishment, is to take a relative measurement with respect to a provisionally accepted standard of light. The standard candle, as manufactured by certain English concerns, has been shown by certain repeated tests to be unsatisfactory, both as regards its candle power and the uniformity of its light. One square inch of platinum of accurately measured thickness and area through which a definite current is passed, also carefully measured, the platinum square being raised to approximate incandescence in a vacuum, would certainly be a better standard than the sputtering flame of the so-called standard candle.

An inventor has recently described a simple piece of apparatus before the French Academy of Science, by means of which candle power or various light intensities can be accurately measured. "It consists of a box which is perforated with a number of holes. The first is covered with a single film of collodium with a slight tint; the second has two such films and so on. Beneath the holes is placed a strip of sensitized paper and an exposure of a certain length of time is made and the highest number that can be read on the paper gives a means for estimating the intensity of the light. The apparatus is first standardized with some source of illumination whose intensity is known and the results are then computed for the various openings."

With a plate, the chemical compounds on which are mixed in absolutely fixed proportions, and the time of exposure unchanged with each plate, we see a way of measuring the intensity of light by having it make a photographic record. Rays of various intensities will leave blurs of different shades of color, if the interval of time during exposure is the same in each case. Were it possible to construct a machine in which, upon light being admitted, the chemical changes in the nitrate of silver operated some delicate mechanism, thereby moving a needle over a dial, many of the questions which now arise regarding photometer tests would be satisfactorily settled. At present so much depends upon the eye of the experimenter making the test that absolutely correct photometer measurements are impossible. In fact, after having made a series of photometric tests with a Bunsen photometer. the eye becomes so uncertain in its estimate of the equal brightness of the two spots on the screens that further progress can only be made conscientiously after a long rest to the eyes. Not only would the invention of an accurate standard be of immense advantage, but the measuring of light in a positive manner would turn this somewhat empirical department of laboratory work into a perfect science.

WEIGHTS OF CELLS PER HORSE POWER HOUR.

That which has already been perfected to such an extent that further development in that direction is impossible is the electric motor, used for driving automobiles. The method of controlling it is above criticism and the reliance that may be placed on the motor over all roads and under all circumstances equals, if not surpasses, the high qualities of other engines used for similar work. Automobile practice, as far as the electrical engineer is concerned, has now become a question of motive power. Not only was this problem of carrying in a condensed form a storage battery, from which electric energy could be drawn at will, the most troublesome to those whose fortunes have been depreciated by investments in storage battery car lines, but it is still the same unsolved problem to those desirous of making automobiles whose operation is to be extended over a period of many hours.

At present there are two classes of storage batteries which may be used. In the first the capacity of the cell is great but its rate of discharge is low and insufficient for the demand made by the operator of an automobile. In the second class the cell capable of giving a high rate of discharge is disproportionately heavy and unreliable in the sense that heavy draughts of power on it may take place too rapidly to allow the cell time to recuperate. The capacity of the storage battery and its weight are therefore apt to affect the rapid development of automobile interests. From one hundred to one hundred and fifty pounds of storage battery per horse-power hour is the best that can be supplied without affecting the life of the cell. An automobile that would run ten hours and take two-horse-power would therefore require at least one ton of storage batteries.

Very little hill climbing could be done with this equipment because the capacity of a storage cell becomes an uncertain quantity after a heavy draught of power has been made upon it. This is apt to occur in a crowded city, the surface of which is irregular at any time of the day, and particularly if a layer of slippery slush or mud rests on the roadway. Storage batteries weighing fifty and seventy-five pounds per horse-power hour have been built, but the period of usefulness of such cells is as short in proportion as the reduction in weight. Some new means of storing power other than that at present adopted would be of inestimable value to those that have undertaken to place within our reach for the twentieth century a new means of locomotion.

Stray Currents.

THE SENSATION OF BEING SHOCKED ELECTRICALLY.

While Fred Bussler was adjusting a switchboard at the Lycoming (Pa.) Electric Company's power house, a few days ago, he fell to the floor as if dead, the full volume of 1,600 volts having passed through his body. After working with him for a long time he was resuscitated. Bussler says he experienced no pain, but enjoyed a beautiful dream while unconscious.—Ex.

A PATENT FOR MARCONI.

A patent has been granted at Washington, D. C., to G. Marconi, of London, for a piece of apparatus employed in wireless telegraphy. It is a receiver for electrical oscillations, consisting of an imperfect electrical contact, a local circuit through it, an induction coil, a capacity, a conductor connected to one end of the primary of the coil, a connection between the other end and the capacity, connections between the ends of the imperfect contact and the ends of the secondary of the coil, and a condenser in one of the latter connections.—Ex.

PREVENTING COLLISIONS AT SEA BY TELEPHONY.

The New York Journal states, on good authority we presume, that Thomas A. Edison has solved the problem of averting collisions at sea by a simple telephonic device. Following the lines of a diving bell, he concludes that by means of diapraghms at the bottom and sides of vessels collisions would be averted. Experimenting on these lines the electrical wizard finds that the idea is practicable. The diaphragms, which would occupy but a small space at the bottom or sides of a ship below the water line, just large enough to admit a man's body, would be constructed of a light metal. A seaman stationed within could distinguish the revolutions of the propellers of another steamer at a distance of eighteen miles. Communication by telephone with the navigator of the ship would warn him of the proximity of the other vessel and put him on his guard.—Ex.

PHOSPHORESCENCE.

Mr. Ernest Gerard found that by rubbing the glass bulb of an incandescent lamp with his hand or with his sleeve that an evanescent light, having the appearance of phosphorescence, manifested itself inside the tube or bulb. In seeking information on this point, it is explained by "L'Electricien" that it was the custom, in order to ascertain the degree of vacuum possessed by the bulbs, to rub these with a cat-skin in the dark, and that phosphorescence more or less intense was the measure of the degree of emptiness. The phenomenon observed by Mr. Gerard was brought under the notice of the Belgian Society of Electricians, and it was then pointed out that in 1660 the physicist Picard had noticed a luminous appearance in the vacuum of a barometer, and that Haukesbee, in agitating the mercury in the same tube, observed a purple light, and it was upon these evidences that Mr. Gerard, in rubbing with a cat-skin, found a Gessler tube to be illuminated. The phenomenon, which has not been clearly explained, seems worthy of attention.—Ex.

THE APPLICATION OF THE STORAGE BATTERY.

*C. D. Wood.

In no department of electrical engineering can we find a greater recent advancement than that perceptible in the manufacture of the storage battery. Ten years ago the promoter of the accumulator was a man suspected by the world in general as one dealing in fraudulent articles; he was handicapped by litigation and bound hand and foot by special patent laws, both of which tended to crush out the feeble industry. To-day the manufacture of the battery is upon a permanent footing. Rules and regulations have been established to protect the producer and likewise to guarantee satisfaction to the consumer.

The early inventor tried to produce in his system the greatest possible chemical efficiency, with apparent disregard for the mechanical construction. The result was a heavy, cumbersome apparatus, unfit for practical use.

The battery upon the market to-day, with its higher degree of economy and increased generating power, has become an acknowledged factor in electrical problems of the day and the increase in its manufacture for the past four years bears testimony to this statement. In December, 1894, the total weight of the battery plates then employed was 349,000 pounds; three years later the figure was 3,607,000 pounds, and the constant demand during the past year points to a proportional large advance for the year 1898.

If we should look into one of the large generating plants of our city railroads we should find the battery filling a position that has long been in need of just such an agent—namely, one to supply additional power to the generating machinery at the time of the maximum load requirements, as the action of the storage battery when charged depends upon chemical action alone, there is no danger of instantaneous failure, and an overload does not injure as in the case of an ordinary dynamo.

Every city railroad power plant experiences large fluctuations in the amount of power required during the twenty-four hours of service, consequently, when the time of the maximum load occurs the speed of the dynamo has to be increased and we find a proportional addition to the amount of coal consumed. The loss of this extra coal, together with the increased number of employees, caused those men interested in the traffic question to test the capacity of this new method of storing energy.

Let us take a specific case of a railroad in a certain Pennsylvania town of 50,000 inhabitants and examine the fluctuations in its daily output of power. In a recent number of the "Electrical Review" Robert McLloyd discussed this railroad and plotted the load curves for twenty-four hours while thirty-five cars were running upon the line. The curves were drawn upon a diagram whose axis of X represented the different twenty-four hours of the day and the axis of Y the strength of the current in amperes required at the different periods.

The maximum load was found to occur at 8 p. m. and to continue for one hour, requiring a current of 15,000 amperes, which was furnished by six dynamos, each supplying approximately 200 kilowatts apiece. The curve of the average load requires 650 amperes. Therefore, if a battery, charged at the time of the minimum strain was installed, capable of leveling off this load peak, the coal consumed in the running of two of the dynamos would be saved. The capacity of this battery should be 3,000 ampere hours, and if totally discharged in one hour should yield 1,500 amperes. The one-hour rate of discharge is a modern method of quoting battery capacity; the total discharge in ten hours was the rate formerly used. In order to furnish a constant current to the battery plant a shunt wound booster was placed in the dynamo circuit and both the generators and accumulators connected in parallel that they might furnish power to the same feeds. The battery we have installed would be able to carry a load peak that would completely stall the dynamo plant of 1,150 kilowatts; it would cost, however, as much as the plant, but would save 50 per cent. of the total amount of coal consumed during the twenty-four hours. At ten dollars per ton we would have a yearly saving of $5,474, an increase in the flexibility of the station and the number of hands employed diminished.

(To be Continued.)

*In the "Yale Scientific Monthly."

Among the Societies.

FOURTH ANNUAL CONVENTION OF THE NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS TO BE HELD AT WILMINGTON, DEL., SEPTEMBER 5th, 6th, and 7th, 1899.

A meeting of the Entertainment Committee of the Board of Trade of Wilmington was held in the parlors of the Clayton House last evening. The meeting was a large one and was held for the purpose of further arranging for the coming convention of the National Association of Municipal Electricians. Chief of Police Dolan and Fire Chief Sasse were present at the meeting, and there will be a fire and police review on the afternoon of September 6th, at 4 o'clock. Chief Sasse says that many of the companies are already preparing for the event and are repainting their apparatus and other equipment as well as the interior of their houses. President Aydon reported that he had sent out the final invitations and the replies that he had received point to a large attendance. Pyle's Cycle Academy which had been secured for the electrical exhibit had been blocked off and the spaces on the floor sold to various electrical companies. The spaces are all taken, and there will be an electrical show that will surprise the citizens of Delaware and people from afar. There will be almost every kind of electrical apparatus. Besides the electrical novelties there will be automobiles, moving pictures, electrical cooking utensils and other exhibits which will be enumerated at a later date. The convention will be a mammoth affair and the show will commence at 7:30 o'clock on September 4 and continue until 11 o'clock on Saturday night, September 9. The convention will meet at ten o'clock on the morning of September 5th, and will hold until the police and fire review on September 6th. About two weeks before the convention the reception and entertainment committee will meet and complete the arrangements for the entertainment of the members of the convention and of other guests. President Aydon is sparing no trouble and expense to make the affair one of the greatest if not the greatest event that has ever taken place in the State of Delaware. The Board of Trade is also with Mr. Aydon, and the Police Commission has notified him that it will do all in its power to make the affair a success.

Literary.

AMERICA'S GREAT RESORTS.

The new issue of "Four Track Series" No. 3, an illustrated and descriptive folder, 48 pages, entitled, "America's Great Resorts," has just been issued by the Passenger Department of the New York Central. This folder gives a description of a large number of the great health and pleasure resorts reached by the New York Central, and shows the time and rates of fare to the different points, not only from New York, but from all the principal cities along the line. This folder will be found invaluable to those arranging the details of a Summer trip. It is beautifully illustrated by half-tone engravings, reproduced from photographs of some of the most delightful spots at the different resorts. It also contains a large map in colors, which is a marvel o accuracy. A copy of this folder will be sent free, post-,.aid, to any address upon receipt of a 1-cent stamp by C eorge H. Daniels, General Passenger Agent, Grand Cen..al Station, New York.

Electricity in Canada.

CANADIAN ELECTRICAL NEWS.

(Special Correspondence to the Electrical Age.)

Kamloope, B. C.—The town will employ an expert to report on the advisability of purchasing an entirely new plant for electric lighting purposes, the one now in use being of insufficient capacity.

Hull, Que.—The town is without electric lighting, the council having not yet awarded the contract for a new civic plant, although tenders were invited some months ago. The pending lawsuit between the Hull and Ottawa Electric Companies is the cause of the council being slow in taking action.

Tweed, Ont.—The installation of an electric lighting system is in project.

Arnprior, Ont.—The council have appointed a committee to learn on what terms the Electric Light Co. will dispose of their plant to the corporation.

Almonto, Ont.—Mr. Ritchie is said to be considering the question of installing a 500 light incandescent electric light plant.

Shelbourne, Ont.—The council is considering the question of installing a municipal lighting plant.

Quebec, Que.—The Canadian Electric Co. expect to commence work at an early date in developing the Chaudiere Falls water power, for which plans have been prepared by J. M. McCarthy and by T. Pringle & Son of Montreal. The scheme includes the construction of an electric railway. John Breakey has been elected president.

Niagara Falls, Ont.—A by-law to raise by debentures $71,000 for the purchase of the Niagara Falls Electric Light Company's plant by the town was carried by the town on Thursday last. It is proposed to utilize the power by day by the Ontario Silver Plate Co., who have decided to remove their works to this town.

Lorette, Que.—The Lorette Electric Light Co. has been formed here, to light the village by electricity; capital, $10,000.

Moncton, N. B.—The Street Railway Company have plans prepared for considerable extensions to their system and the establishment of a park outside the city.

Bear River, N. S.—The people are trying to secure the construction of an electric railway five miles in length to connect this town with the main line of the D. A.R. railway.

Ottawa, Ont.—The Senate have reduced to two years the time allowed the Ottawa Electric Railway Co. to extend its line to Bell's Corners.

London, Ont.—A deputation from this city recently waited upon the Government at Ottawa and asked for a subsidy to raise the construction of an electric railway from this city to Goderich, a distance of sixty-six miles.

Barrie, Ont.—The Royal Electric Company are said to have made application to the council for a franchise for an electric railway between this town and Allendale, with right to extend it to other points.

Guelph, Ont.—Messrs. Carscallen and Wingate of Hamilton are said to be endeavoring to interest New York capitalists in the construction of an electric railway from that city to Guelph.

Montreal, Que.—The Montreal Belt Line Railway Co. are applying to Parliament for power to issue securities to the amount of $4,000,000 for the construction of the Montreal section of the company's system of proposed railway; also to issue bonds to the extent of 300,000 for each bridge, which it has authority to build across the Ottawa and Prairie Rivers; also debentures for $1,000,000 for docks, elevators, buildings, etc., etc. The com-

(Continued from page 65.)

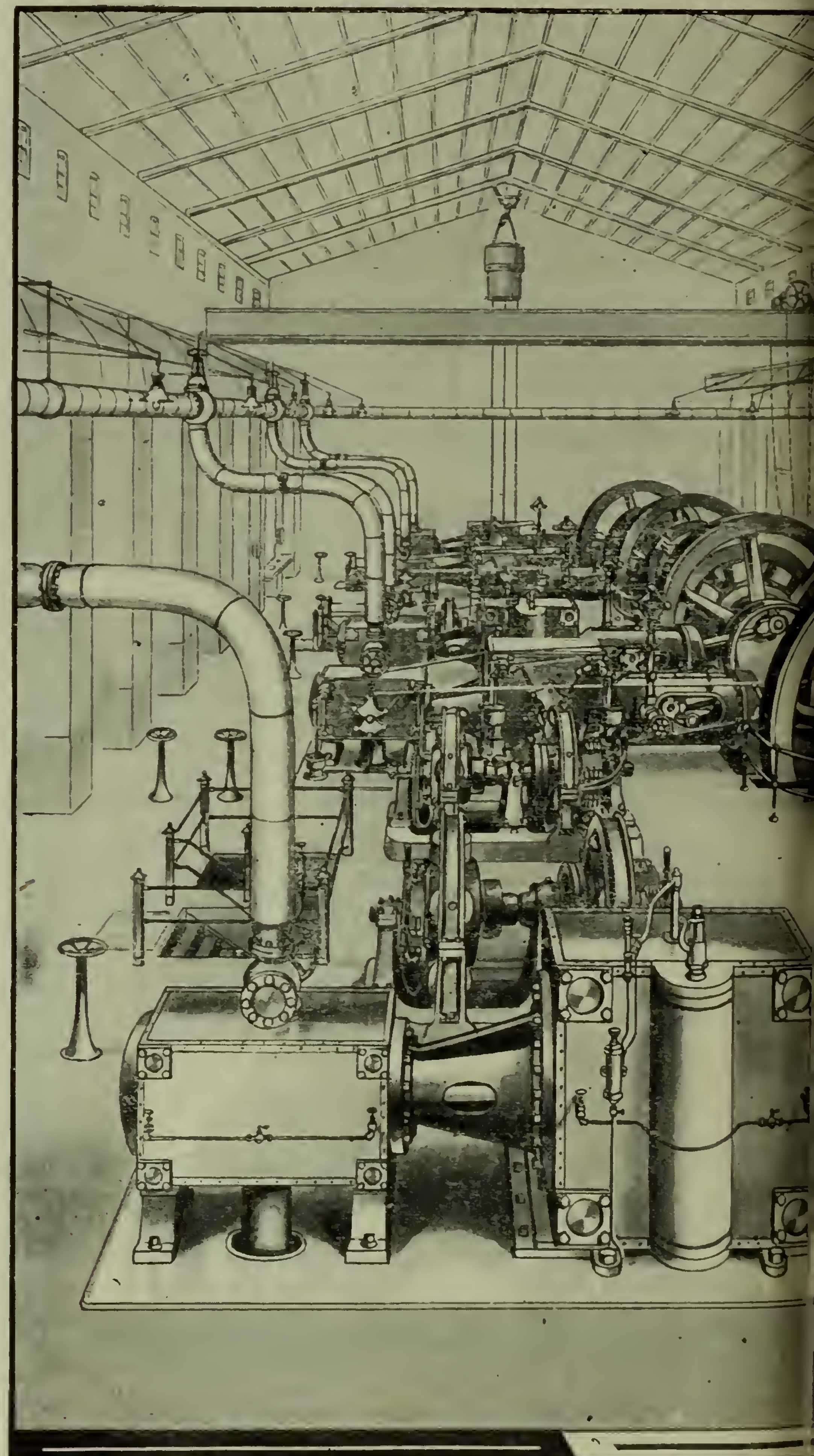
THE NEW POWER STATION OF THE CAPITOL TRACTION COMPANY, WASHINGTON, D. C.*

When the cable station of the Capitol Traction Company, on Pennsylvania avenue, in Washington, D. C., was destroyed by fire in September, 1897, it was determined to change the motive power to electricity. The company owned a large building on the Chesapeake & Ohio canal, near the Georgetown end of the line, which had been used for feed storage, paint and repair shops, etc. The proximity of the canal for coal carriage and water supply made this an ideal site for a generating station, and the work was commenced in December, 1897.

The brick walls of the original building were strengthened by pilasters, new windows cut in, partitions removed and the whole structure, 300 feet in length, divided by a substantial brick fire wall into an engine and boiler room as shown in the plan upon the following page. The original roof being retained facilitated the carrying on of this work during the winter months.

Steam is furnished by eight boilers of the Babcock & Wilcox type, built by the Aultman & Taylor Co., each boiler being equipped with the Roney stoker, operated by small engines as shown. The aggregate heating surface of the eight boilers is 28,648 square feet and the grate surface 600 square feet, giving a ratio of about 47.75. Each boiler consists of 18 sections of 9 tubes each 4 inches in diameter and 18 feet long, with flowed steel headers, Cahall swinging manholes, and Reliance water columns. The drums are 42 inches in diameter of half-inch open hearth steel with butt joints inside and outside straps triple riveted. The heads are bumped and $\frac{5}{8}$ths in thickness. The boilers are set in four batteries of two boilers each, connected three on one side and one on the other to a steel stack built by Campbell & Zell, of Baltimore. Some of the details of this stack are shown in Fig. 1. By digging a few feet a foundation of solid rock was reached. The jagged face of the ledge was leveled off with concrete and the brick foot of the stack, octagonal in section, and 26 feet 6 inches in height, built upon this. The steel portion is 150 feet in height and 9 feet in diameter at the top inside the brick lining. The flues entering at opposite sides are 10 feet in height and six feet wide, each containing a pair of five foot dampers swung horizontally and each controlled by a Locke damper regulator.

The boilers are covered with $1\frac{1}{2}$ inches of magnabestos bricked in. The steam piping was designed by the company's engineers, cut to their drawings, the pieces numbered, and erected by their own men. Extra heavy pipe and flanges were used throughout. Outside screw yoke Chapman gate valves with self packing spindles were used even for sizes as low as half an inch. All valves over eight inches are provided with a special by-pass shown in Fig. 2, the feature being the entire absence of flanged joints, which in the ordinary by-pass have to be all broken if one leaks. This use of the best material erected in the best manner after an intelligent design has resulted in a piping system which remains perfectly tight under the 130 pounds of steam pressure carried with the minimum of attention.

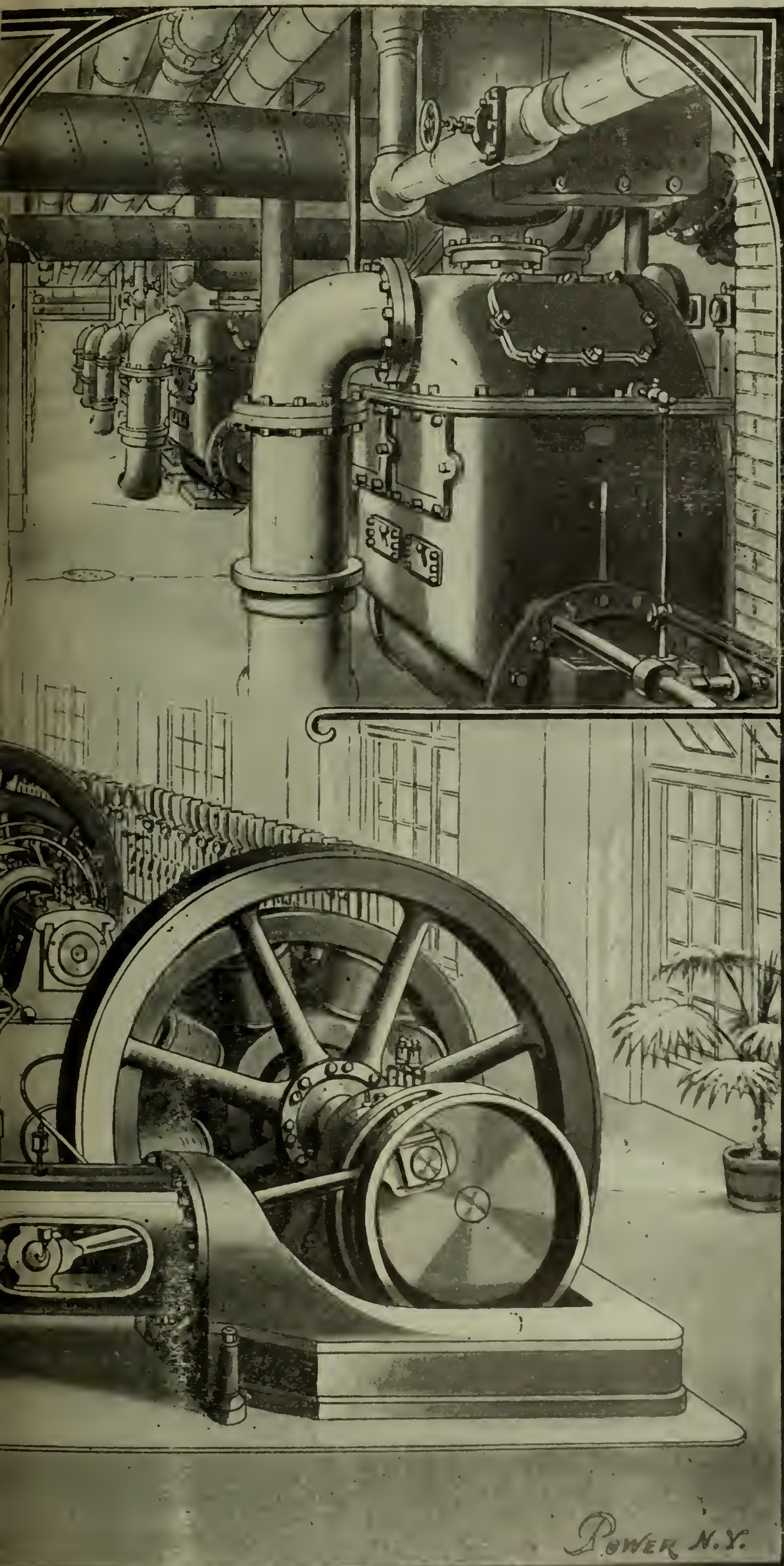


Engine and Condenser Room , New Power

The boilers and engines are piped upon the loop system. A 12-inch main makes a circuit of the boiler and

*Through the courtesy of "Power."

engine room as shown in the plan. Into this main each boiler is connected with an 8-inch branch, with two stop valves on each branch, one at the boiler and one at the



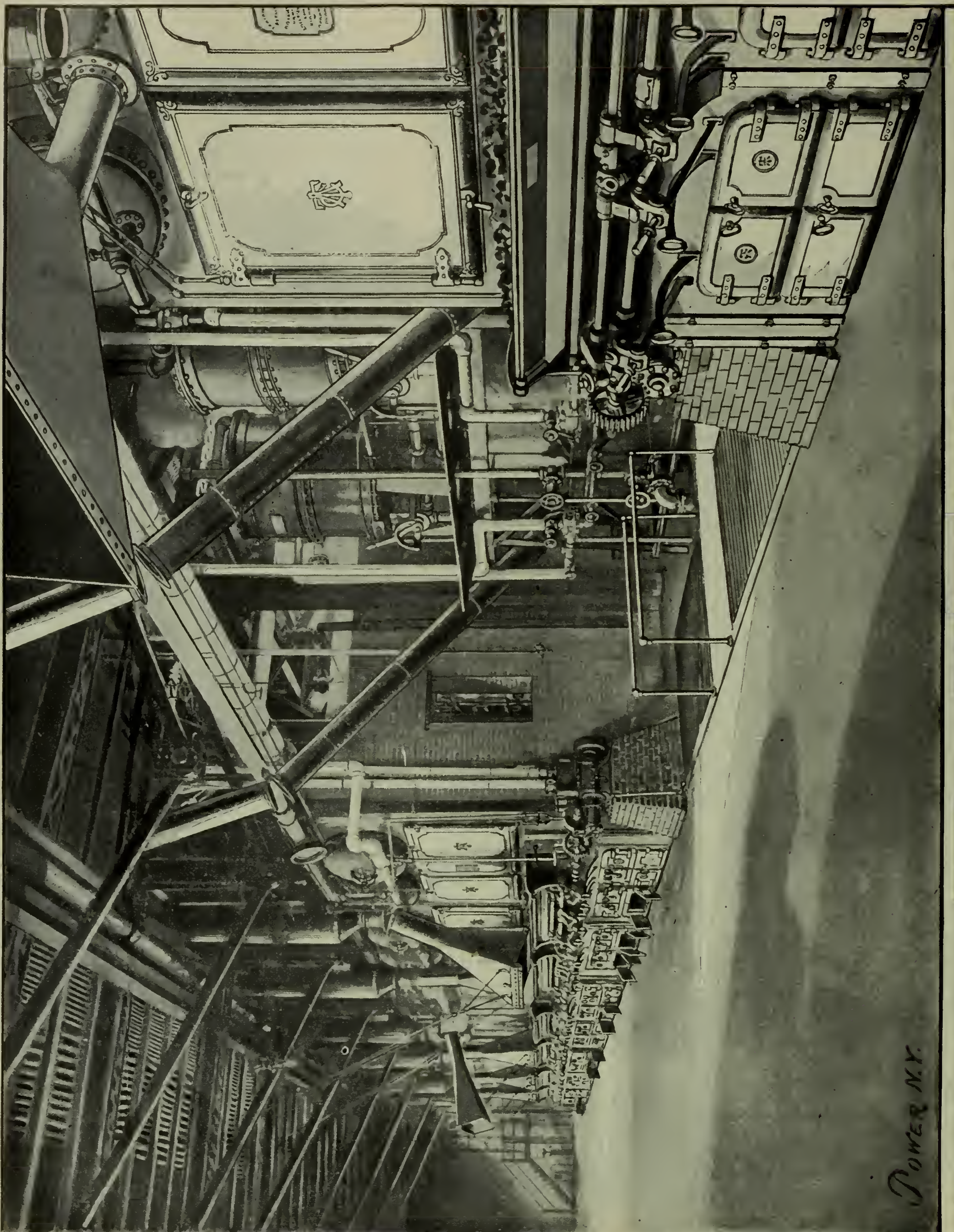
the Capitol Traction Co., Washington, D. C.

main line. The boiler room main is divided into four sections by stop valves, one section to each battery. Should anything occur to either of the boilers or the piping in either battery that section of the main can be cut out and all the other boilers remain operative, those beyond the break feeding through the back or auxiliary side of the loop.

Upon the 12-inch main just before it rises into the engine room is placed a Best-Fox separator, the drip of which is carried along the back of the boilers and connected into the blow-offs. This method of disposing of the drip is quite original and very efficient. Each connection is provided with a check valve, which works regularly as the pressure in the separator chamber fluctuates with the taking of steam by the engines, and the multiplicity of connections precludes any liability to disaster, as from the sticking of a single check. The water never accumulates enough to show in the gage glass upon the separator.

In the engine room steam is taken from the bottom of the twelve-inch main to each engine by a six-inch branch which descends to the top of the high pressure cylinder by a reverse curve consisting of two long bends. The ring or loop main is anchored in the partition wall between the engine and boiler rooms, which is at about one-half of its length, expansion taking place in both directions from this point. The probable expansion was computed and the branches made up so that their movement would be as nearly as possible to equal distances on each side of a line at right angles to the main, attention being paid to the increased movement at the further engines. No expansion joints or special bends to provide for expansion are necessary with the system here used.

The engine room contains five units of 525 kilowatts capacity each, consisting of Reynolds-Corliss tandem compound condensing engines direct connected to General Electric generators. The engine cylinders are 20 and 40 inches in diameter with a 42-inch stroke, and run at 100 revolutions per minute. The voltage carried is 600. Beside each armature is mounted a fly wheel, 16 feet in diameter, weighing about 25 tons. From the high pressure cylinder the steam passes through a receiver, provided with a live steam reheating coil, thence to the low pressure cylinder from which it is exhausted through a Hartford horizontal heater having 270 square feet of heating surface, to the condenser. These heaters were subjected to a cold water pressure of 500 pounds before acceptance. From the heater the steam passes to a Deane independent jet condenser, a separate condenser being supplied for each engine. The water supply is taken from the canal through a 24-inch main into a concrete well inside the engine room foundation, passing on entering through a double wire screen of half-inch mesh. The screens can be removed separately for cleaning, leaving one always in place. Each condenser has a separate 6-inch suction provided with strainer and foot-valve. Between the heater and the condenser an automatic free exhaust valve is inserted, each piped independently outside the engine house and upward to the gable level with spiral riveted galvanized pipe. The automatic exhaust valves were furnished by the Deane Company, and are so arranged that the valve once opened remains open until closed by the engineer, avoiding any tendency to slam. The condenser pumps can be exhausted into the condensers themselves or into a secondary heater, as desired. All the condenser valves are operated from the engine room through floor standards. The live steam coils in the reheaters are drained by Flinn

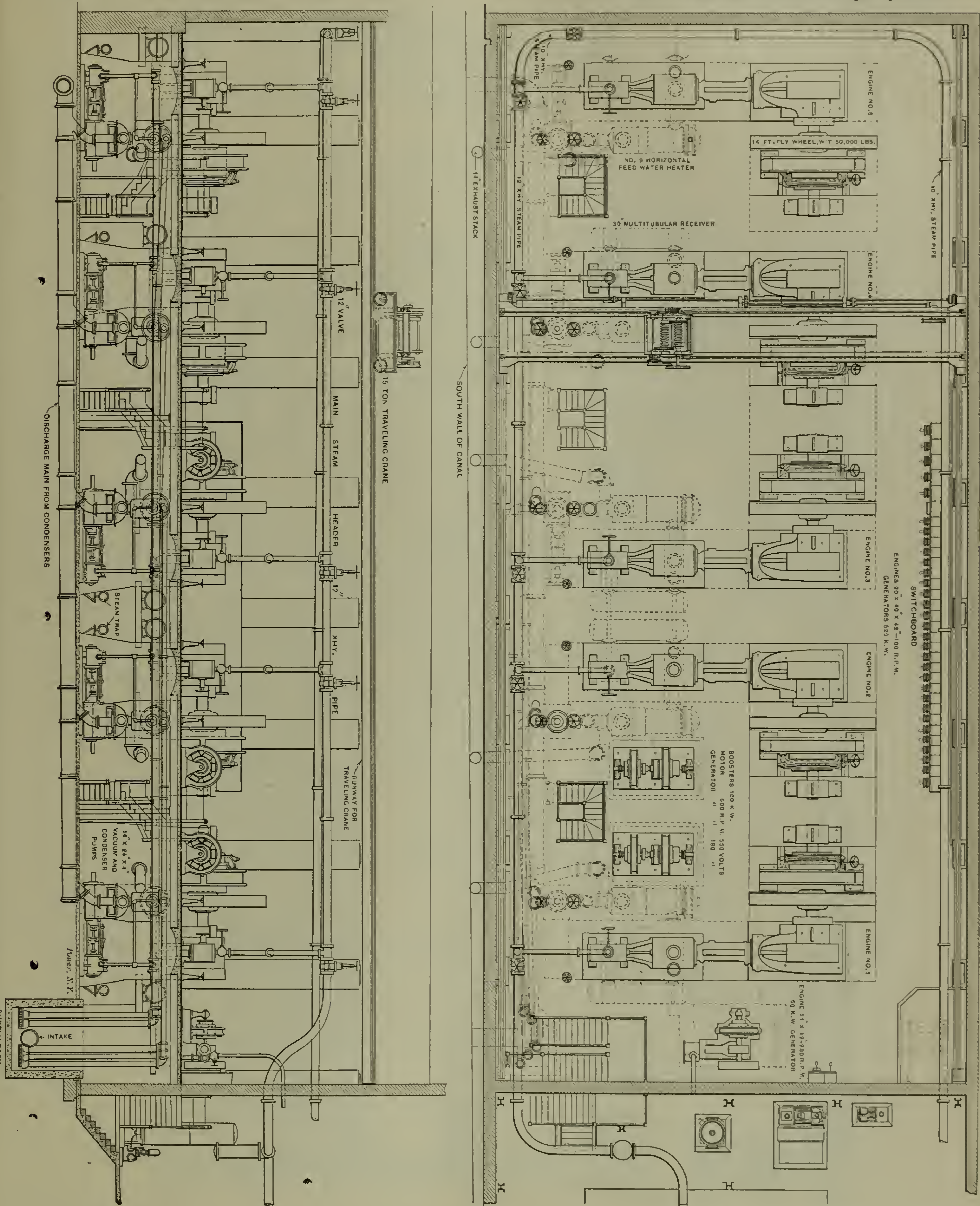


View in Boiler Room—New Station Capitol Traction Co., Washington, D. C.

differential traps, the barrels of the reheaters by Bundy traps. A large Bundy trap also takes the drip from the steam main beyond the separator, throttle drips, etc., all of which are discharged into the canal.

The feed water is taken from the same well which supplies the condensers, and pumped by a small Deane pump to an elevated tank, whence it flows to a pair of Loomis-

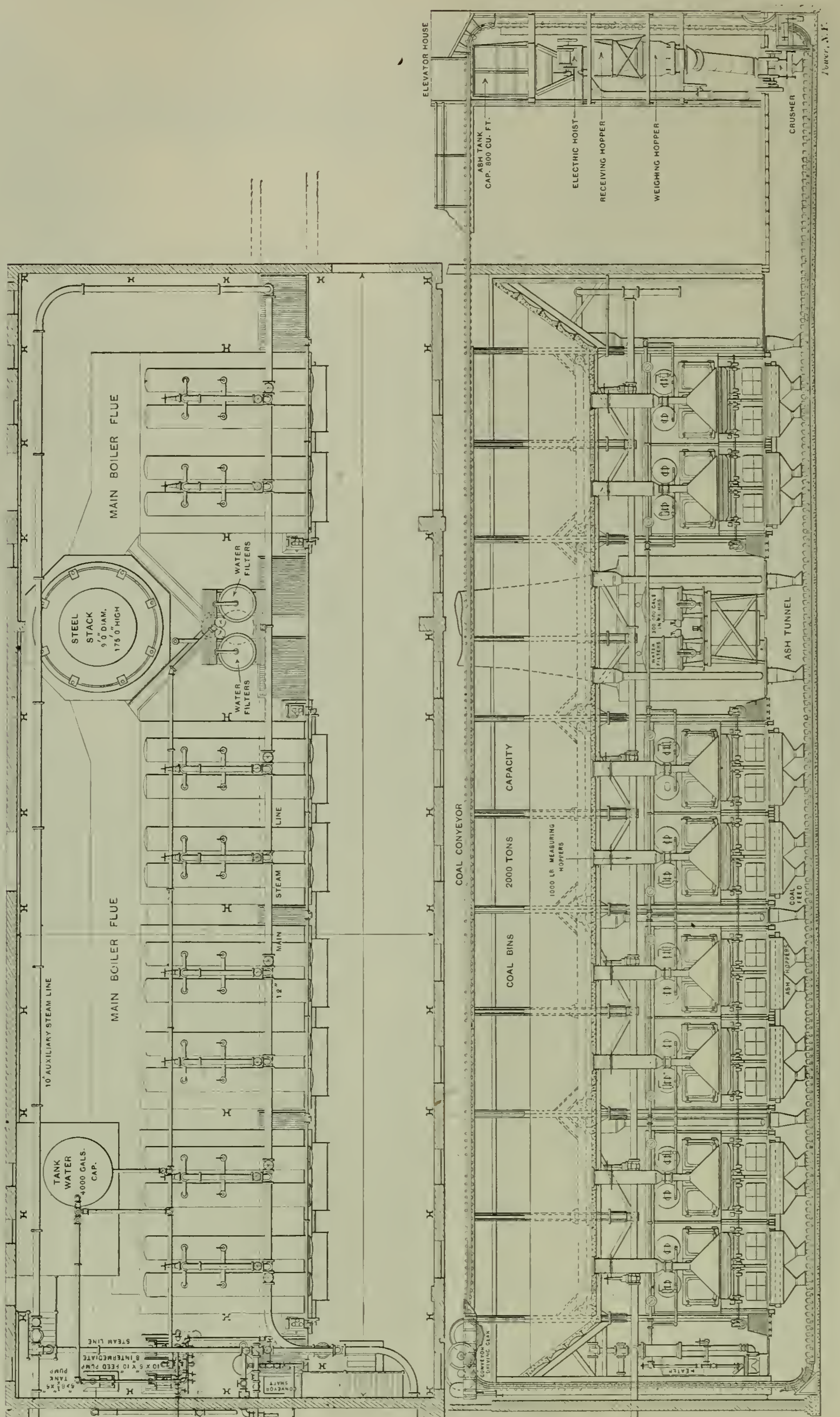
Manning filters, having an aggregate capacity of 300,000 gallons in 24 hours. The filters deliver to a storage tank from which the water is taken by one of a pair of boiler feed pumps also made by Deane and sent first to the primary heaters, where it is heated to about 120 degrees, then to a Berryman heater having 339 square feet of heating surface, where it is further heated by the exhaust of the pumps, stoker engines and other auxiliaries. This heater is piped with a by-pass and the three pumps are ingeniously arranged, so that water can be taken from either the well, the storage or the filter tank and passed through both, either or neither of the heaters. Either of



Plan and Elevation of Engine and Condenser Room. New Station of the Capitol Traction Company, Washington, D. C.

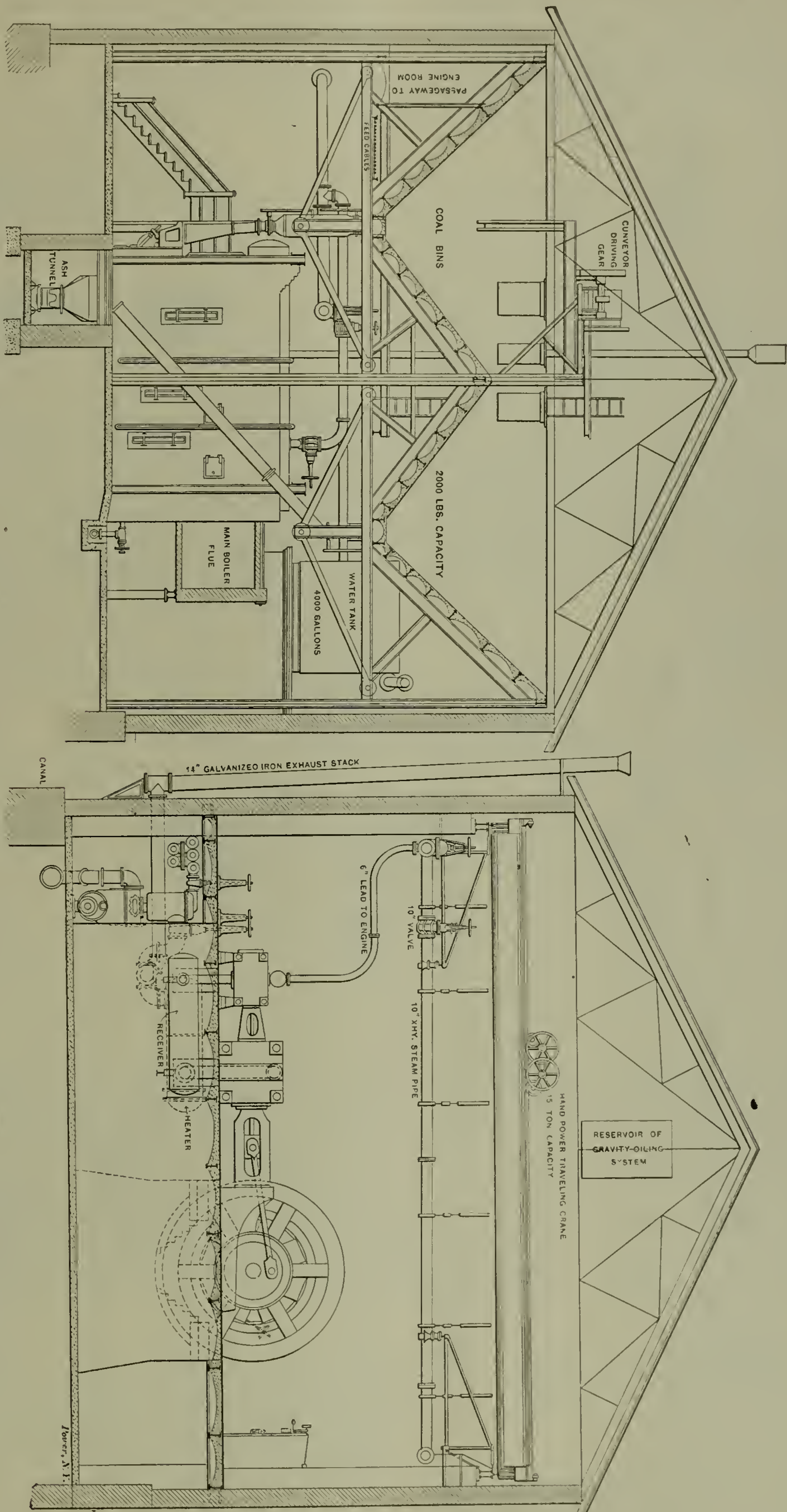
failure of both feed pumps or trouble with the feed main a pair of Metropolitan injectors is provided delivering into an entirely separate feed main entering at the back of the boiler drums. In case of a failure of the water supply, and for use during the eight or ten days of each year when the canal is drained off a connection is made to the city water service.

Coal is brought to the station by the canal and is hoisted from the boats in iron buckets to a receiving hopper in the top of an elevator house, a corrugated iron structure separate from the station, as seen in the elevation. From this receiving hopper it goes through the



Plan and Elevation of Boiler Room, New Station of the Capitol Traction Company, Washington, D. C.

weighing hopper to a crusher, which delivers it to a bucket conveyor, by which it is elevated to the storage bin above the boiler room. The bin is deserving of es- does not come in contact with the iron work, and the corrosion from this cause which has resulted in the rapid deterioration of some bins is avoided. The conveyor has



Cross Section Through Boiler Room. New Station, Capitol Traction Company, Washington. Cross Section Through Engine Room.

pecial attention. It is built in the form of a W, forming two pockets with a combined capacity of 2,000 long tons and is lined throughout with concrete, so that the coal a capacity of 40 tons an hour, but delivers only to one of the pockets, that over the boiler fronts. When this pocket is full the coal will be above the middle peak the boiler pumps can be used not only for its regular service but to replace the tank pumps and in case of a and must be pulled over and trimmed in the other pocket. From the front pocket it is chuted over and trimmed in the other pocket. From the front pocket it is chuted to the hoppers of the Roney mechanical stokers. Ordinarily the station will run with the front pocket, the other being for the purpose of storing a fuel supply for the several months when the canal is closed to navigation.

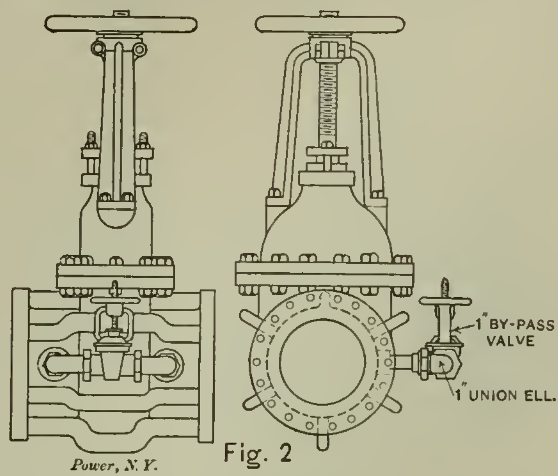


Fig. 2

When it is desired to use coal from the rear pocket it is chuted as shown in the end elevation to the ash conveyor, which is simply the return side of the coal conveyor, and elevated to the front pocket. Each boiler has an ash hopper of a capacity to hold the ashes made in a full day's

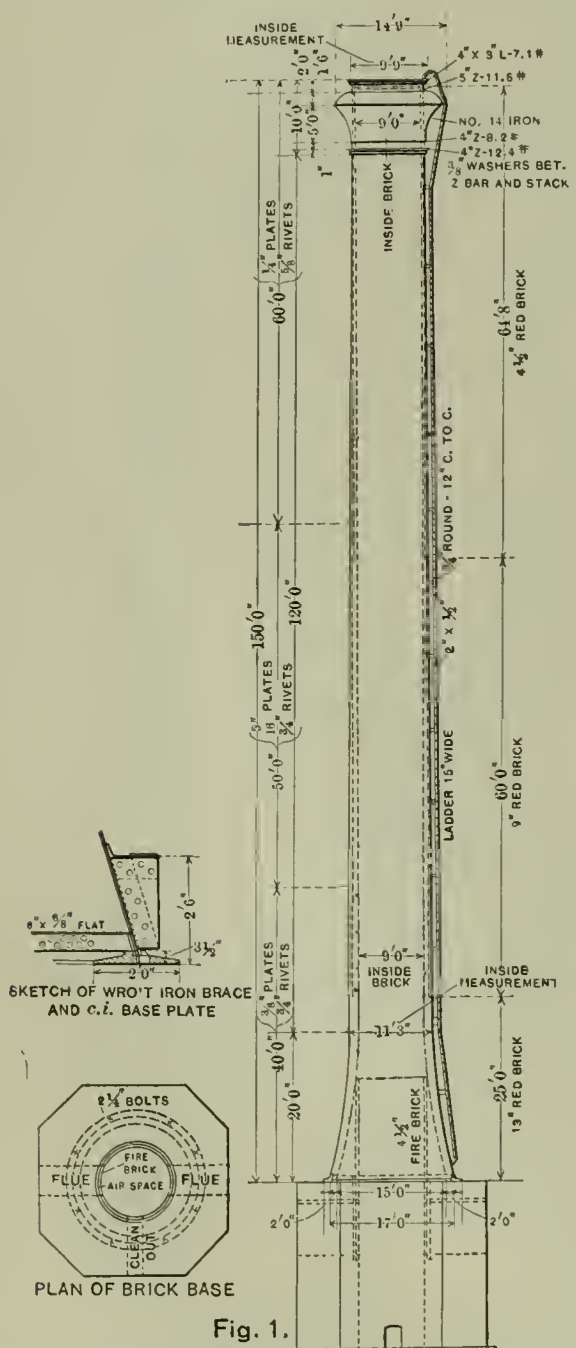


Fig. 1.

run. These hoppers deliver to the returning side of the conveyor, and the ashes are thus carried to an elevated tank in the elevator house capable of holding a week's accumulation. From here they can be chuted either to canal boats or to carts.

The elevator and conveyor machinery is operated by electric motors. It was furnished by the Steel Cable Engineering Company, of Boston. A sheet of steel is turned up at the ends so as to form the bottom and the two ends of a pan. Each of these sections is attached to a pair of trucks as shown in Fig. 3, and the axles of the trucks are attached to a pair of steel cables aa, Figs. 3 and 4, at such a distance apart that the sections overlap as shown at A, Figs. 4 and 5. Pivoted in each section is a bucket B, which lies upon the bottom of the pan as in Fig. 4 when

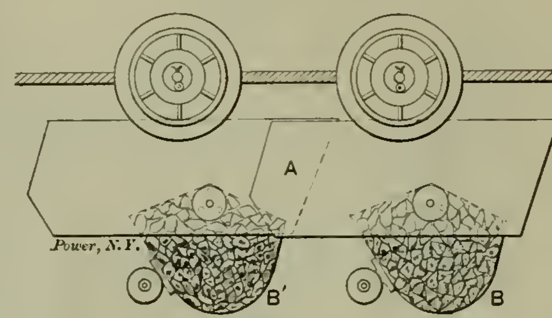


Fig. 5.

the pan is above the trucks, and hang as in Fig. 5 when the trucks are above. In passing from the position shown in Fig. 4 to that shown in Fig. 5, it is evident that the contents of the moving trough formed by the interlapping sections will pass into the buckets as the trough becomes vertical and be carried in the buckets as in Fig. 5 when the interlapping pans are inverted. This conveyor requires no measuring filler, it being necessary only to chute the coal into it as in Fig. 4. The tripping device for automatically emptying the buckets at any desired point is shown in Fig. 6. The frame supporting the cam d is attached to the under side of the T rail upon which the conveyor trucks run at the point at which it is de-

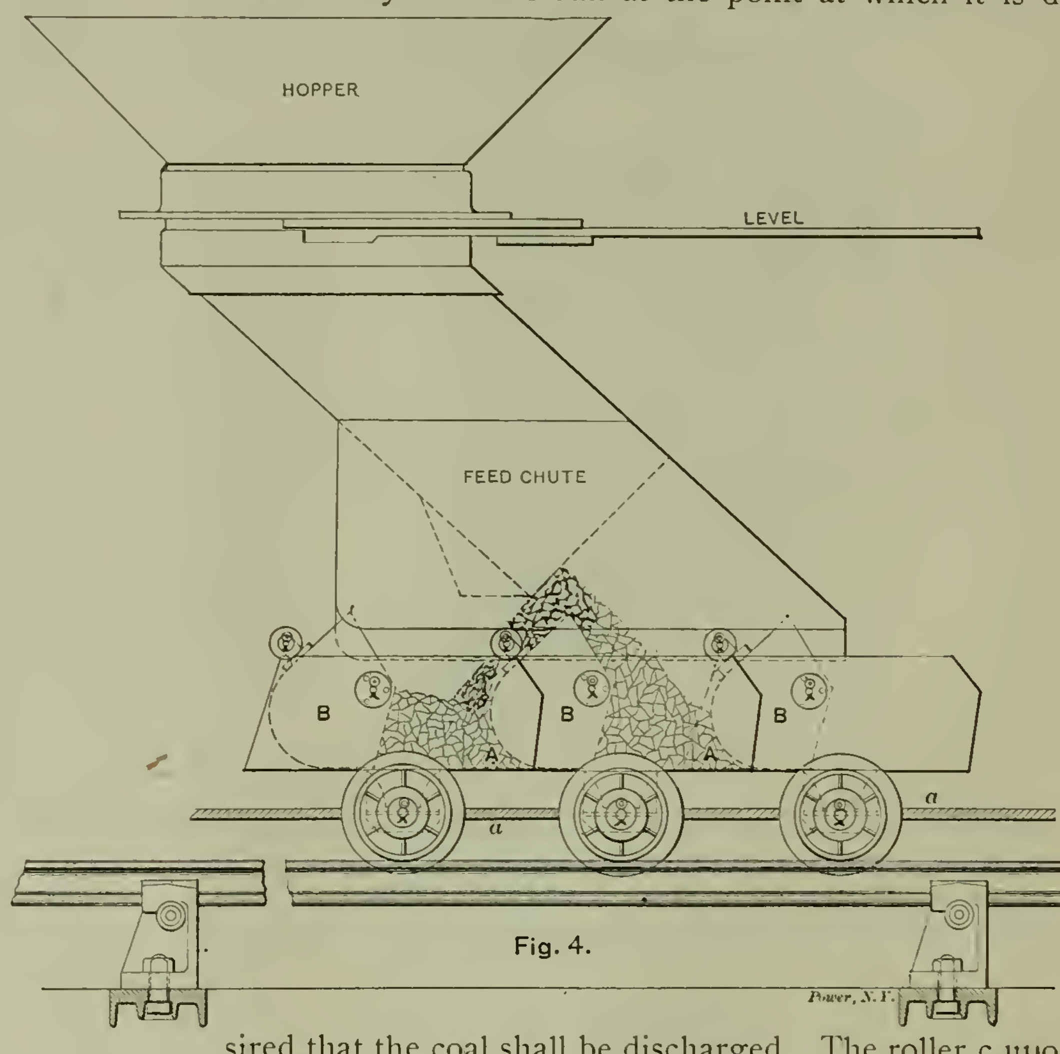


Fig. 4.

sired that the coal shall be discharged. The roller c upon the end of the bucket runs up the incline d, tipping the bucket as shown and discharging the contents. Beyond the highest point of the incline the cam track is continued horizontally with indentations which shake the bucket so as to insure its complete discharge. This tripping device can be set to be operative or inoperative while running, so that no stops are necessary to change the point of discharge. The conveyor is driven by an electric motor, the location of which is shown in the end elevation on page 3.

In the station under discussion nine tripping devices are employed, the last one having the corrugated track. These trips are set at regular distances along the bin and the successive height of the cams so adjusted that the first raises the buckets only sufficiently to spill a small portion of its contents, the next, enough more to spill an equal amount and so on until it is completely emptied

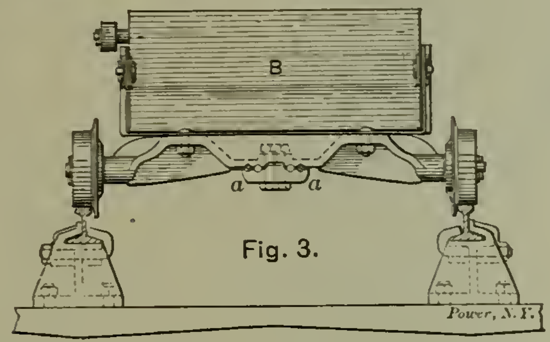


Fig. 3.

and shaken clean by the last cam. The coal is thus automatically distributed the length of the bin.

In the basement are two tanks into each of which is emptied from the engine room level a barrel of cylinder oil. One tank is used for a high grade oil for the engine cylinders, the other for a cheaper grade of oil for the condensers. Full boiler pressure is admitted to these tanks, and this pressure supplemented by that of the column of water reaching to the steam main level is sufficient to feed the oil to the cylinders through Ashton sight-feed lubricators, consisting simply of the sight-feed portion of the oridinary cup without the reservoir. The whole arrangement is in fact like a gigantic sight-feed cup, with a reservoir as big as a barrel, and numerous feeds. The same system is in use in the boiler room for the stoker engines, boiler feed and tank pumps.

The machinery oil is run into a tank in the basement having a capacity of about 20 barrels, and is pumped into another tank occupying an elevated position on the end wall of the engine room. From this tank the oil flows by gravity to its various points of application, the supply being controlled locally by drop-feeds. Regular cups are also provided and kept filled in case of emergency. From the bearing the oil returns by gravity to two Cross filters in the basement which it passes successively, after which it is returned to the receiving tank to make the same circuit. The oil from the guides, which is mixed with water from the stuffing-box is not returned with the rest immediately to the filters, but is first collected in a separating tank and the oil allowed to separate by gravity, the water drawing off automatically and the oil returning to the filters.

In addition to the main engines there is an Ideal engine direct connected to a General Electric multipolar generator run at 110 volts for lighting purposes, not only for the power house and the neighboring repair shops, but for the large Union Passenger Station where the administration offices of the company are located, several blocks away, which is the end of the line.

The switchboard containing all the necessary instruments, etc., is located on the floor of the engine room as shown in the engraving on the front page and in the plan and elevation on page 2. A hand power traveling crane spans and runs the entire length of the engine room.

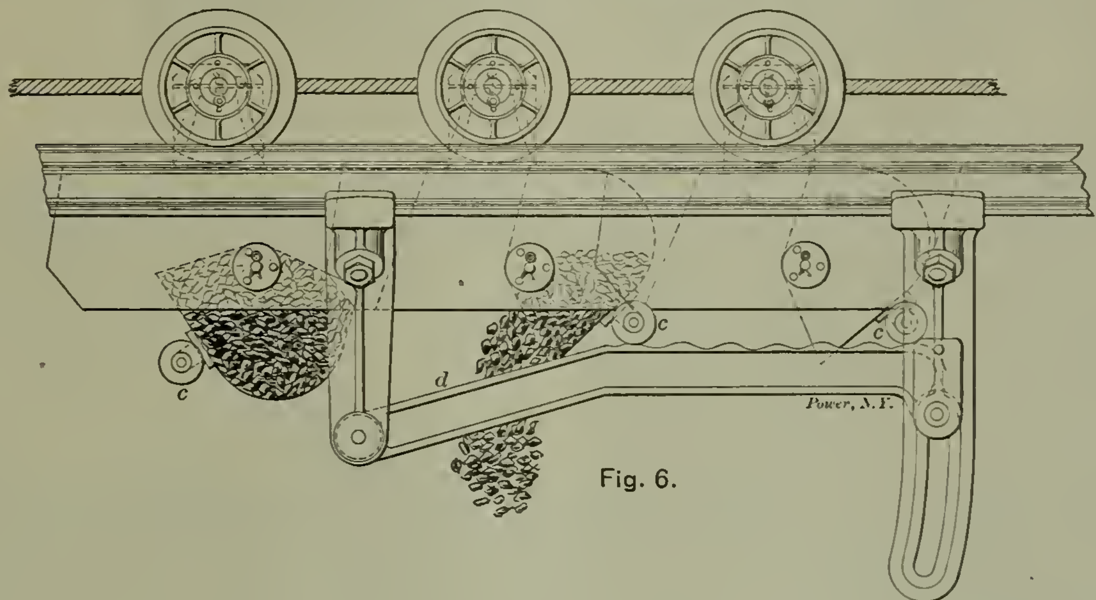


Fig. 6.

(Continued from page 58.)

pany also ask power to construct the following extensions: An extension of the main line from St. Anne de Bellevue to a point on the Canada Atlantic Railway at St. Justine, an extension of the main line from Brett de l'Isle in the parish of Pointe aux Trembles to the town of Joliette to a point on the Great Northern Railway at Joliette, a branch line from a point on the St. Justine extension to the town of l'Assomption, a branch to the village of Rowden in the County of Montcalm, passing the village of St. Jacques.

Hamilton, Ont.—The Cataract Power Co. is reported to have finally secured control of the Hamilton Street Railway. This acquisition will in all probability hasten the construction of the proposed electric roads to Guelph, Galt, Berlin, St. Catharines, and other points, but it is reported that owing to the large demand of iron it will be impossible to secure rails before next spring.

Ottawa, Ont.—The bill of the Ottawa Suburban Railway Co. was before the Railway Committee of the House of Commons last week. George E. Kidd, representing the company, stated that the railway would extend along the canal reserve to Hog's Back and Graham's Bay, with lines across the Ottawa to Kingsmere, Meach's Lake and Chelsea.

Ayr, Ont.—W. D. McNair of New York and J. S. Clarke of this town are promoting an electric road from Ayr to Berlin

J. ALCIDE CHAUSSE.

Business News.

SPECIAL EXPORT COLUMN.
TOTAL AMOUNT OF ELECTRICAL EXPORTS FOR WEEK ENDING JULY 22, 1899, $67,550.

New York, N. Y., July 22, 1899.—The following exports of electrical material are from the port of New York for the week ending this date:

Antwerp.—17 cases electrical material, $1,047. 3 cases electrical machinery, $54.

Berlin.—28 packages electrical material, $871.

Brazil.—16 cases electrical material, $160.

British East Indies.—5 cases electrical material, $95.
British Australia.—9 cases electrical material, $3,024.
Bremen.—2 packages electrical material, $265.
British West Indies.—81 cases electrical material, $1,874.
Chili.—4 cases electrical material, $189.
Central America.—63 packages electrical material, $1,542.
Dublin.—47 electric cable reels, $14,803.
Ecuador.—4 packages electrical material, $96.
Cuba.—40 packages electrical material, $4,967. 27 packages electrical machinery, $370.
Glasgow.—2 cases electrical material, $18. 2 cases electrical machinery, $210.
Dutch West Indies.—1 case electrical material, $22.
Havre.—111 cases electrical material, $5,091. 14 cases electrical machinery, $813.
Hamburg.—22 packages electrical machinery, $884. 60 packages electrical material, $7,878.
Japan.—121 packages electrical material, $7,239
London.—7 cases electrical machinery, $765.
Liverpool.—2 cases electrical material, $331.
Mexico.—15 cases electrical material $1,506.
Madrid.—80 cases electrical material, $1,621.
Manchester.—5 cases electrical material, $9,560.
Peru.—2 cases electrical material, $50.
Santo Domingo.—3 cases electrical material, $43
St. Petersburg.—3 cases electrical material, $135
U. S. of Colombia.—292 packages electrical material $2,449.
Vienna.—1 package electrical material, $50.
Venezuela.—10 packages electrical material, $438.

NEW INCORPORATIONS.

Kittery, Me.—Rhode Island Liquid Air Co. has been incorporated by George J. O'Doherty, of Boston; Jerome D. Smith, of Arlington, Mass.; F. E. Rowell, of Kittery Me.; to produce electricity, compressed and liquid air heat, light, power. Capital stock, $1,000,000.

Jersey City, N. J.—Marietta Electric Manufacturing Co. has been incorporated by Edward Barr, Herbert B Coho, Edwin M. Remhold, all of Marietta, Pa.; for the manufacture of all kinds of goods, wares, and merchandise. Capital stock, $125,000.

Camden, N. J.—Continental Compressed Air Power Co. has been incorporated by Frank R. Shattuck, Edward Everitt, George H. B. Martin; to manufacture air compressors, electrical machines, etc. Capital stock, $15,000,000.

Cleveland, Ohio.—The General Incandescent Lamp Co. has been incorporated by J. Insull, F. H. Goff, T. H. Bushnell, S. H. Tolles, J McGregor, Jr., all of Cleveland; to manufacture and deal in electrical machinery and electric lamps. Capital stock, $50,000.

Jersey City, N. J.—Electric Axle Light & Power Co has been incorporated by Aug. Treadwell, Jr., Benjamin S. Hart, Eads E. Schmidt, all of New York City; J. H. Potts, Jersey City, N. J.; to manufacture electric, compressed or liquefied air machines for lighting, heating and refrigerating. Capital stock, $25,000,000. Principal office, No. 1 Montgomery street, Jersey City, N. J.

Jersey City, N. J.—Rockaway Electric Light & Improvement Co. has been incorporated by Anthony Blum, Brooklyn, N. Y.; Kent E. Stearns, Jersey City; Isaac Blum, New York City; to construct and operate gas and electric light works. Capital stock, $15,000. Principal office, 83 Montgomery street, Jersey City.

TELEPHONE CALLS.

Chicago, Ill.—United States Telephone Manufacturing Co. has been incorporated by I. D. Perry, J. B. Wier, and J. B. Halpenny; manufacturing telephone supplies and operating telephone lines Capital stock, $2,500.

Niagara Falls, N. Y.—Niagara Falls Home Telephone Co. has been incorporated by S. B. Rawson, of Elyria, O.; W. R. Campbell, J. E. Rock, of Niagara Falls; to establish a telephone line. Capital stock, $100,000.

St. Louis, Mo.—The United States Telephone Company has been incorporated by F. A. Churchill, Jr., A. F. Garechie, and W. G. Lackey, all of St. Louis; for the purpose of manufacturing telephones, switchboards, etc. Capital stock, $10,000.

Watertown, N. Y.—The Citizens' Telephone Company has been incorporated by S. F. Bagg, C. B. Taggert and R. J. Buck, all of Watertown; to construct a telephone line. Capital stock, $50,000.

Syracuse, N. Y.—Independent Telephone & Telegraph Construction Co. has been incorporated by E. I. White, E. Barneman, of Syracuse; J. J. Jermyn, J. L. Wentz, of Scranton, Pa.; general contracting. Capital stock, $5,000.

Killbuck, Ohio.—The Killbuck Telephone Co. has been incorporated by D. R. Welker, C. C. Carpenter, J. Horn, J. J. Day, J. E. Duncan, all of Killbuck; to construct and operate an independent telephone. Capital stock, $5,000.

STREET RAILWAY NEWS.

Toledo, Ohio.—The Toledo & Adrian Electric Railway Co. has been incorporated by F. W. Hayes, L. B. French, A. L. Smith, G. H. Beckwith, I. E. Knisely, all of Toledo; capital stock, $25,000.

Columbus, Ohio.—The Columbus, Winchester & Lancaster Traction Co. has been incorporated by T. A. Simons, D. C. Beggs, R. E. Jones, H. C. Park, T. B. Beatty, and F. Post, all of Columbus; to construct an electric railway. Capital stock, $10,000.

Rockville, Md.—The Washington and Rockville Electric Railway will establish an electric line though Rockville.

Corsicana, Texas.—An electric street car line is soon to be established in this city.

POSSIBLE INSTALLATIONS.

Thomasville, Ga.—W. S. Keefer has applied for a franchise for an electric-light plant.

Belgrade, Minn.—Contract has been let for the construction of a water and electric-light plant for this village. The work will be completed Nov. 15.

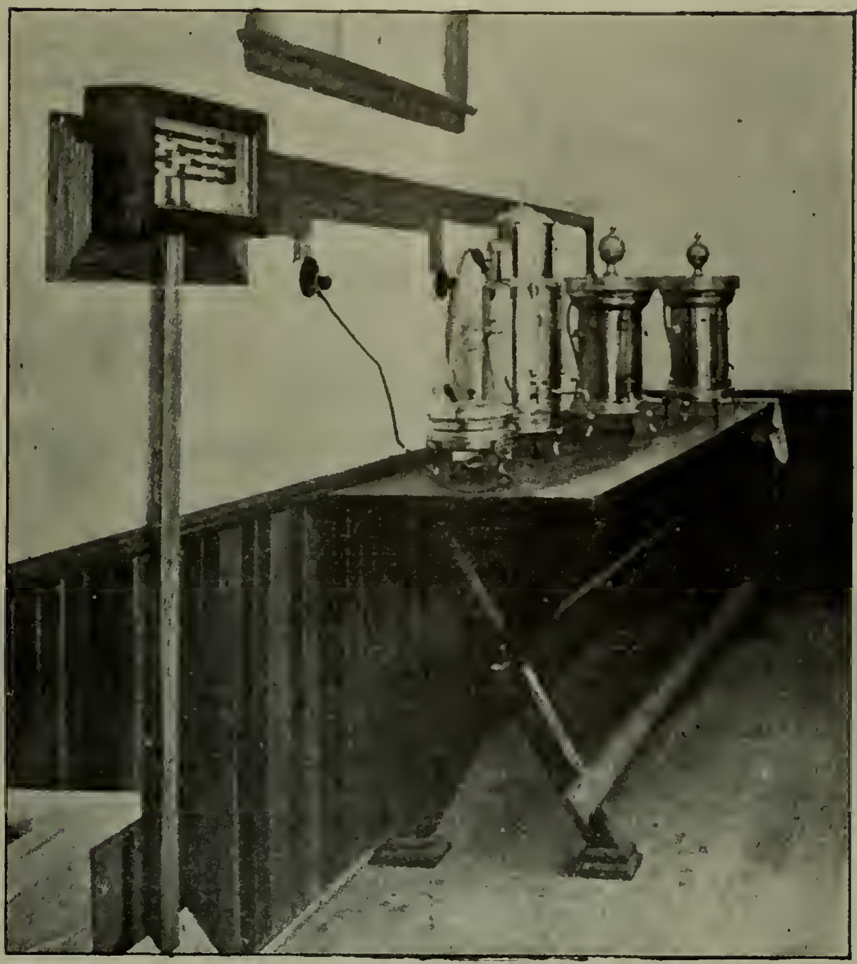
JOTTINGS.

ANDREW L. RIKER, the electrician and manager of the Riker Electric Vehicle Company, 45-47 York St., Brooklyn, N. Y., has just returned from London, where he has been organizing a new English company to build works for the manufacture of Riker automobiles. The automobile which he exhibited in London took the city by storm and the name Riker is on every tongue. Since his departure from London Mr. Riker has received a cablegram notifying him of the awards of two gold medals for the superiority of his own over all other American and English automobiles. This award was only made after an unusually severe test.

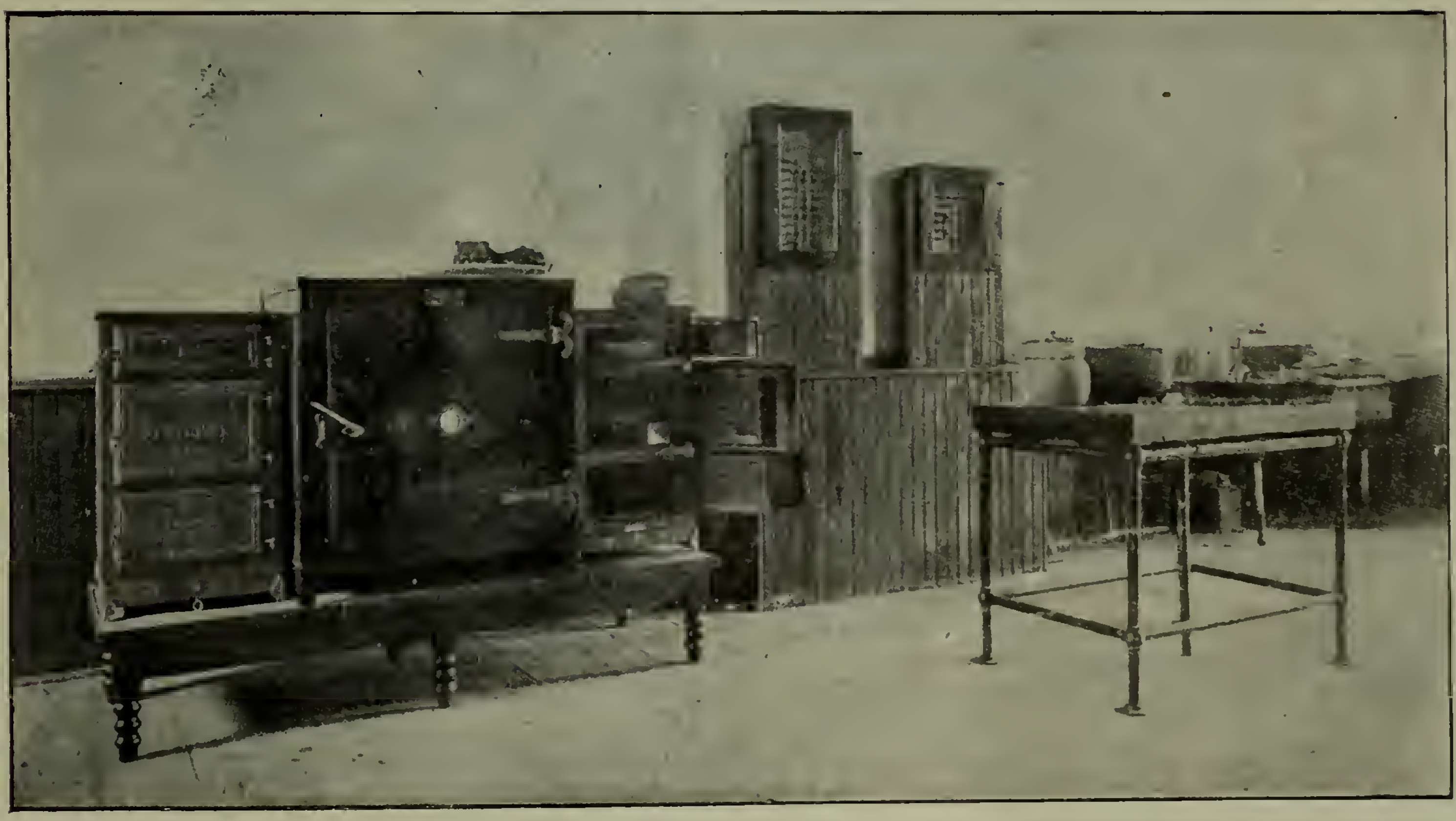
The Electrical Age.

VOL. XXIV—No. 6 NEW YORK, AUGUST 5, 1899. WHOLE No 638.

Electric Heating.



Tea and Coffee Urns Operated by Electricity.



View of the Electrical Kitchen.

ELECTRIC HEATING IN A CARMELITE HOSPICE.*

The developement of electrical power at Niagara Falls in vast quantities has resulted in the installation in the new Carmelite Hospice of an electrical plant for cooking and heating which has not its equal in the world. This hospice is located on the Canadian side of the river some distance back from the falls. It is on a bluff and from its windows a most magnificent view of the Niagara scenery is obtainable. Its location removes it from the circle of the falling spray cloud, but it is close enough to the cata-

*From the "Scientific American."

ract to secure the benefit of the electrical development made by the Canadian Niagara Power Company in the power station of the Niagara Falls Park and River Railway. This installation of the Canadian Niagara Power Company is a temporary construction, and in time will be supplanted by the magnificent development the company intends to make under the franchise it holds in Queen Victoria Niagara Falls Park.

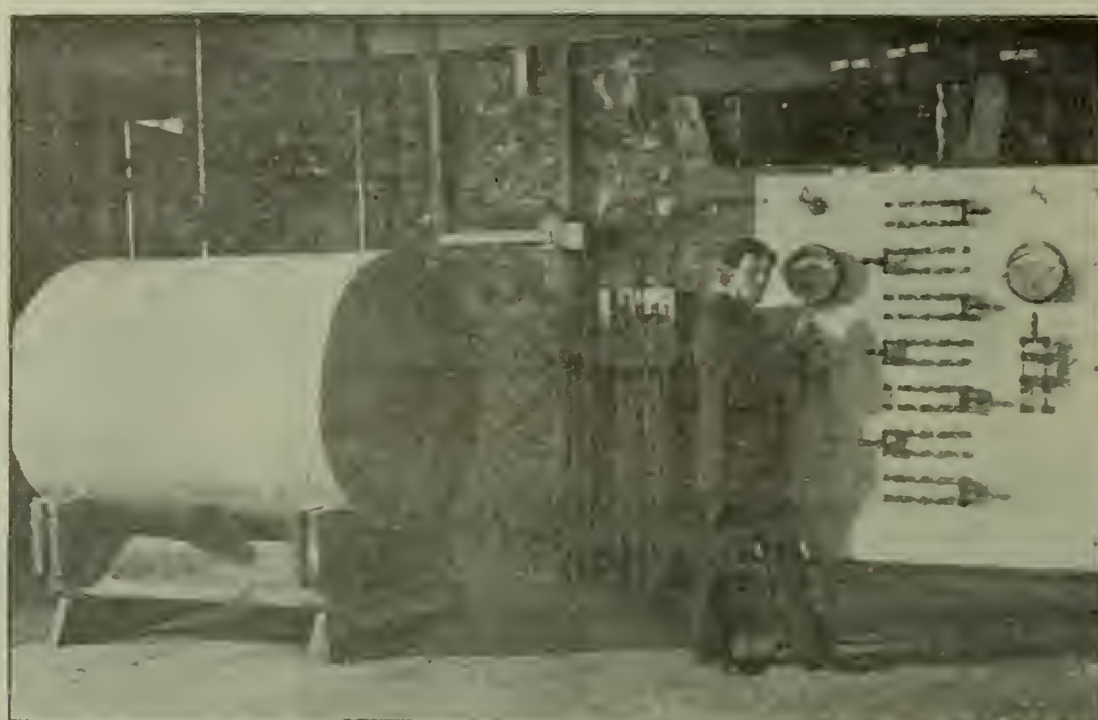
In the power station of the Niagara Falls Park and River Railway, the Canadian Niagara Power Company has installed two 1,000 horse power generators, the power from which is used for various purposes, but there has not yet been a demand of any magnitude for power on the Canadian side at Niagara. From this power station to the transformer house of the hospice, two miles, the current is conducted on bare copper wires. About 100 horse power is used in the hospice, 25 horse power for lighting, cooking, and heating water, and 75 horse power for heating the lower floor of the building.

In the transformer house of the hospice has been installed two 30 K. W. Westinghouse and one 25 K. W. General Electric transformer, primary 2,200 volts and three-phase secondary 110 volts, current being transmitted through underground cable to the switchboards located in the basement of the main building. One of these switchboards is shown in the illustration. The switchboard with double-throw switches controls two phases of the current, while the third phase is controlled by a switchboard adjoining the first one, and is used for cooking, lighting, etc. The arrangement of the switchboards is such that either transformer can be used independent of the other for either purpose.

The present building is but a wing of the structure contemplated in the plans of the Carmelite Fathers. In this building two hundred 16 candle power lights are used for illumination, and on the lower floor, which is heated by electricity, there are eleven bedrooms, a dining room, a reception room, and office. The corridor of this floor is 120 feet long, 10 feet wide, and 15 feet high. This corridor contains nine 4 horse power electric heaters, and in each bedroom, which is 10 by 12 by 15 feet, there is one 4 horse power electric heater with changeable heat switch of two heats.

In the butler's pantry there are three 5-gallon urns and a chafing dish electrically operated. One of the urns is used for tea, one for coffee, and one for boiling water to supply the coffee and tea urns.

In the kitchen are to be found features that are most interesting. The range has a heating surface of 6 square feet, and each square foot of surface has a switch and can be controlled to full or half heat at the will of the operator or cook. The baking and roasting facilities are included in two small and one large oven. Each of the two small ovens has three compartments and consumes 23 amperes at 110 volts, while the large oven takes 50 amperes at the same voltage. This large oven is so arranged that it will roast four 25-pound roasts of meat at one time. Some idea of the work this equipment in this electrical kitchen will do may be gained from what was accomplished in it on June 15, the occasion of the blessing of the building and its formal opening for sacred purposes. At that time all the meats for two hundred and fifty people were cooked in two and one-half hours, while all the other cooking for the same number of people was done at the same time. This is with the exception of the soup, which was made the day before, as it requires many hours of attention to be good. As the heat of all the apparatus is uniform, the liability to burn is less than with other fuels. As the point of baking or roasting is plainly indicated, the cook can make no mistake. In the small ovens bread can be baked in 18 minutes.



Water Tank and Switchboard.

In one of the illustrations, at the left of the switchboard will be noticed a large tank. This is the 400-gallon boiler in which water is boiled for the laundry and bathroom purposes. It takes a current of 120 amperes, being divided into three heats. Opposite this 400-gallon boiler, but not shown in the illustration, there is a 150-gallon boiler, in which water is boiled for kitchen purposes, but it services can also be used in connection wth the large boiler. This small boiler takes 125 amperes for its operation, being also divided into three heats. This small boiler is used mostly for quick boiling. Both boilers are covered with 2½ inches of asbestos covering. An effort is usually made to boil all the water at the time the current is not being used for other purposes. In this 400-gallon boiler water is raised from 60° to 212° in six hours, with full heat.

Naturally the main interest in this plant centers on the cost of the service; and here it may be said that the experience in the operation of the hospice plant can hardly be taken to form comparison with what the same service would cost elsewhere. This is because there are some exceptional features of cost found in this installation. The 25 horse power used for hot water heating, cooking, and for lighting purposes, costs $25 per horse power, but the 75 horse power used for heating the corridor and bedrooms is obtained at about one-fifth of this cost per horse power. It is evident that this power is not used the year around; and then another feature is that in the station of the Niagara Falls Park and River Railway there is always a surplusage of power in the winter time, as the business of the road is mainly a summer one. For this reason the same number of cars are not run in the winter as are run in the summer, and, therefore, not so much power is demanded from the power house.

Auto-Mobiles.

OPERATING COSTS OF HORSE AND ELECTRIC DELIVERY WAGONS IN NEW YORK CITY.

By G. F. Sever and R. A. Fleiss.

(Concluded from Page 54.)

When we come to consider the electric automibile for a year, covering 36 miles a day, its advantages are brought out very clearly. Since the vehicle, owing to the nature of its construction, does not consume any energy when not in motion, it follows that, during the periods of rest, while deliveries are being made and the wagon is being loaded, there is no more expense than that incidental to wear and tear. This, of course, is common in amount to all vehicles of the same class and may be considered the same in each case. That a slight loss does occur when the vehicle is at rest, due to local action, etc., in the batteries, is true, but this loss is considered when the efficiency of the battery is taken at 80 per cent. We may say then, that the factor most important in determining the expense of operating an electric vehicle is the price that must be paid for the power. This is a very variable factor indeed and the price per K. W. hour will determine in all cases the amount of saving that will be possible through the use of electric automobiles.

A stable taking power from a large central station would, if of average size, add a load which, if properly distributed as it easily could be, might become a considerable factor in straightening out the load curve of the station. If several stables were supplied from the same central station, this load would become a great source of economy to the station, and power could be sold to them at a very low figure. Owing to the regular nature of the work imposed upon the wagons in delivery service it could easily be arranged to have the electric vehicles charged at night after the heavy load is off the station. They might also charge early in the morning and at noon or at periods that experience would indicate were the most advantageous for the station, the time of deliveries being adjusted to suit the new conditions. In this way a stable should be able to buy power at from 1 to 2 cents per K. W. hour. As this time has not yet arrived we will install for our purposes a small isolated gas engine plant A plant of this kind should be able to produce a K. W. hour, at the switchboard for 3 cents. Assume the cost for a K. W. hour, as 3 cents, the power consumed per ton mile as 120 watt-hours and the weight as 3,500 lbs., for the wagon. Taking the average load as 500 lbs., weight of driver as 150 lbs., and that of boy as 125, the total weight is 4175 lbs. The cost for the electris vehicle to cover 11,268 miles is given in Table XIV:

TABLE XIV.

1.	Cost of power for 11,268 miles at 3 cents a K. W. hour, and a consumption of 120 watt-hours per ton mile, total weight—4,275 lbs.,—2,137 tons, watt-hours per car mile—256.44 K. W. hours per 11,268 miles—2889.57, taking efficiency of battery at 80 per cent. K. W. hours to be paid for = 3261.	$108.35
2.	Interest on cost of wagon at 6 per cent. for year. Cost of wagon, $2,300.	78.05
3.	Interest on stable rent for 1 wagon, for year.	34.28
4.	Driver	625.68
5.	Boy	416.83
	Total cost per year	$1,263.15

Then the

Cost per car mile	11.21 cents.
Cost per ton mile	5.246
Cost of power per mile	.961
Cost of power per ton mile	.45

Hence the saving considered that the horse drawn wagon does 36 miles a day 6 days a week, is 2.65 cents per car mile in favor of the electric vehicle which means a saving 95.4 cents per day per wagon.

Owing to the greater speed of the electric vehicle, it takes only 4 hours to travel 36 miles as against 5.14 hours for the horse. This is a saving of 1.14 hours per day, or of 356 hours a year.

The figures given above speak for themselves and would appear to be a most effective argument in favor of adopting the electric automobile for delivery service.

SECTION IV.

Conclusion.

In light delivery service in large cities, when a number of units are employed by individual firms, the adoption of the automobile would seem to be merely a question of time. For this kind of service it seems pre-eminently the best solution. It is cheaper to operate than horse service, and the mechanical problems have been so far solved as to make the vehicles commercially successful. Though, as stated before, it is not the intention to discuss depreciation, it may be noted that the comparison of the costs of operation as regards food, cost of power, etc., would show a saving in favor of the electric delivery wagon, in one year, of 20 per cent, which, under more favorable conditions as to the price of power, might easily be increased. Assuming, for the moment, that the depreciation in a year is 25 per cent. for the electric system, and, under the same service conditions, is only 10 per cent. for horse traction, we still have a saving of 5 per cent. in favor of the automobile. The advantages that will arise from the substitution of mechanical propulsion for horse traction on a large scale, are so well known and understood, that any extended consideration of the subject seems unnecessary. Among the many advantages, however, the following would seem to be the most important.

1. The hygienic condition of large cities will be improved, and the cost of street cleaning will be decreased.

2. The wear and tear on pavements and streets will be reduced, and the use of rubber tires will lessen the noise in the crowded streets.

ELECTRIC—THREE—

3. The traffic in cities will not be as congested, owing to the saving in room now occupied by the horse. When we consider that there are approximately 200,000 horses used in New York City alone, and that a horse increases the length of a unit by nine feet, it can be readily appreciated how great a saving will be affected. Taking the average width occupied by a horse and shafts as two feet, it is seen that 200,000 horses occupy about 3,600,000 square feet, or 82.6 acres of valuable street room.

4. When the use of automobiles has become more general, the cost of operation will be reduced. This is true for the reason that with an increased output of wag-

ons, the price will decrease, and with the greater use of power, the cost of it for this purpose will diminish.

5. The danger of accident from runaways will be eliminated.

Stray Currents.

A WIRELESS TELEPHONE SYSTEM.

Dr. Peter Steins, a Russian, is in England introducing a system of wireless telephoney which he says he has invented. He says that it is as successful as the wire system and that voices can be recognized at long distances. He proposes to experiment with his system between England and Belgium, and declares that it is feasible to use it between England and the United States.—New York Sun.

A GOAT AS A HIGHWAYMAN.

A bellicose billygoat held up a Jersey City trolley car full of passengers for ten minutes a few days ago by taking possession of the track and refusing to budge. The motorman was obliged to stop the car to avoid running over the animal. Then he tried to coax it off the track, but the goat would not be coaxed. Next the motorman resorted to the switch iron, and prodded the goat for fully ten minutes, with no effect. The passengers were delighted with the episode. They cheered the goat and chaffed the motorman unmercifully. Finally he called the conductor to his aid, and between them he lifted the goat from the track and so cleared the way.—Ex.

A NEW APPLICATION OF WIRELESS TELEGRAPHY.

A rather novel application of wireless telegraphy is suggested by Mr. J. J. Buckland, in Engineering, for warning vessels off dangerous shores.

By using verticals of varying heights and sending signals from each in turn, he states, a vessel suitably fitted would, on approaching danger, receive signals from each as it entered its effective zone. In this way, he explains, a signal could be received at, say, a distance of ten miles; a second, timed to follow the first, at a distance of six miles, and a third, timed to follow the second, at a distance of three miles. In other words, the navigator would learn of his increasing peril through the increasing warnings. The signals could be automatically given by revolving contacts.—Ex.

FREIGHT TRAFFIC ON TROLLEY LINES.

The freight traffic of the Detroit, Ypsilanti and Ann Arbor electric railway promises to be a profitable branch of the business of that line. Every day two shipments are made from its office depot on Griswold street, in Detroit, says The Tribune of that city, and two shipments are received back at the same place. The receipts from inbound freight average $10, and for outbound freight about $25 a day, and it is expected that the total receipts will be increased to more than $100 a day by June, 1900. Ann Arbor takes about half of the freight and Ypsilanti is next in volume, but shipments to Wayne are daily increasing. A good deal of the freight consists of vegetables and groceries, although trunks and all light articles usually carried in express cars on steam railroads are also taken.—Western Electrician.

THE ELECTRIC LOCOMOTIVE ON THE JUNGFRAU MOUNTAIN RAILWAY.

It is statated that the electric locomotive destined for the Jungfrau mountain railway is the most powerful rack-wheel machine hitherto constructed. It is designed to haul the trains over the steepest portion of the track. The motors are placed under the passengers cars, whereby greater adhesion between the driving wheels and rails is obtained. The car truck is provided with two bearing axles and two driving axles, which latter are situated between the former. Two motors, each of 125 horse power, at 800 revolutions per minute, actuate the toothed wheels through the medium of duplicate gearing. If required, these motors are capable of working up to 300 horse power. The driving current is conveyed overhead at a tension of 500 volts. The pivots of the toothed wheels are of aluminum bronze, the teeth being of cast steel. Three methods of braking are provided for; an electric brake arranged to work on the driving shaft, a hand brake, and a third brake which grips the rails by means of cheek pieces. The locomotive was constructed by Messrs. Brown, Boveri & Co.—English Electrical Review.

ALUMINIUM ELECTRODES.

Aluminium condensers, which stop currents to which the aluminium is an anode, were proposed by Buff in 1857 already, but it is only quite recently that they have found practical application by Graetz and principally by Pollak, who have aluminium rectifiers in use in Frankfurt-on-the-Main to charge his accumulators from the alternating current mains of the municipal electricity works, not only for laboratory purposes, but for running the tramways. The electrodes are placed in solutions of alkalies, soap, alum, etc. There have been various proposals, and it had not been thought that the electrolyte would be of much importance as long as it permitted the formation of the film of oxide on the aluminium, to which the effect is ascribed by Pollak, Wilson, and other scientists. According to Polzenius, however, who is working in Pollak's laboratory, the electrolyte plays an important part. He found hydrochloric and nitric acids of little use for stopping the currents; sulphuric acid stops 20 volts; silicic and phosphoric acids, 120; the silicates and phosphates are also much more active than the sulphates. Bichromate arrests 80 volts; the electrode sparkles and hisses all over. Some organic acides and salts are eminently suitable, and there seems to be a peculiar influence of the hydroxyle and carboxyle groups. Whilst glycerin and sugar (hydroxyle compounds) oppose a resistance equivalent to not more than 50 volts, tartaric and citric acids do not allow currents of 500 volts to pass. The luminous phenomena are always observed when energetic action takes place.—Ex.

THE COHERER.

Much attention has been devoted to the design and construction of the coherer, and much experimental work has been done. Among the mere advanced workers in this field, says the Western Electrician, is T. Tommasina, who discovered that a sensitive coherer might be constructed by inclosing a drop of mercury in a glass tube between two cylindrical brass electrodes. This fact led him to investigate the properties of liquids with reference to electro-magnetic waves. For this purpose he immersed a copper disc and a pendulum bob in distilled water. Both conductors had previously been coated with a film of electrolytic copper and well washed. On passing a current through the two electrodes a black deposit was formed in the disc which grew until a chain of particles, probably cupric oxide, joined the two electrodes. On increasing the distance between them the current was not interrupted, but the chain grew until it again united both electrodes, even when three centimetres apart. The chain followed the pendulum bob on displacing the latter to the right or to the left, although the chain is sometimes invisible. If a small incandescent lamp is inserted in the circuit, and the bob suddenly removed to three centimetres, the lamp continues to burn even before a visible chain is formed.

When the distance between the electrodes is very small, a chain may be formed simply by the action of electro-magnetic waves. Tommasina constructed a coherer on that principle with a very thin layer of distilled water.

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CONTENTS:

LET THERE BE LIGHT.

Since the first edict was thundered forth from the vaults of space the world has undergone a change. It is not the charm of color that arouses the deepest sentiment, but the first wan light stealing from the East—the bluish dawn with its hesitating advance and flood-like embrace. Many years ago the strange conclusion was arrived at that light was like the sand, or the water—a material thing. Sir Isaac Newton believed it to be due to the emanation of myriad particles—a blow upon the curtain of the eye of unaccountable and swiftly moving atoms. The corpuscular theory was the first definite conclusion arrived at, and it might have been still more correct had some idea of the existence of so tenuous and elastic a medium as the ether crossed the mind of its illustrious originator. But the ether was not the fact; it was merely the product of it. It simply became a modern idea when an explanation was sought; its existence was then verified.

The phosphorescent sulphur ball, glowing with cold-light, was the extraordinary phenomenon presented to the gaze of Otto Von Guericke. The awe-struck sailors viewed the lambent light of St. Elmo's fire creeping about the yard-arms with the same unspeakable sensations. It is not alone these few that had awakened in them some element of thought by this ghostly light. Faraday, Maxwell, Hertz, and a host of latter-day scientists saw in this "will-o'-the-wisp" more than an ignis fatuus; they saw in it the beginning of new discoveries and possibly a new and useful source of light.

Since the flickering aurora was seen by the Norsemen and the Vikings of old, its spectral presence has been the basis for many strange traditions. Like the rainbow, it entered into their superstitions and mythological tales.

It is this continual notice taken of so strange a light, not by the individual alone but by entire nations, that affects us to-day. To produce light without heat; to do what nature has done in her own subtle way for unrecorded ages; to follow in the footsteps of those whose efforts gave impetus to the science and whose ambition was lofty in its commendable object.

This is the work laid out for those that will enter the arena. Tesla has drawn aside the curtain and given us one glimpse of the glories within. There have been others silently achieving success. Moore and Haines, whose work in this inviting field has been publicly described, are approaching their goal. Etheric light they call the glow within their tubes. That is the light we want. Apart from the closer influence of grosser matter etheric light is lambent, soft, diffused and pleasant. In contrast with it we have an undesirable heat and a loss that pains the mind on contemplation.

The ether waves, undulating outward at the rate of many millions per second, comprise the underlying principle of light. With a vibrator in a vacum, a break of unequalled suddenness and resistance occurs. The ether waves are shot through the tube and the phorphoresence with dawn-like purity radiates as the softest illumination.

OUR MODERN MINTS OF THOUGHT.

Many have thought, but how few do think—or care to think. This might aptly explain many of the lost sentiments and unexposed ideas that for lack of vigor or appreciation on the part of their originators are lost. To-day money and ideas are almost one, in the opinions of active-minded men More so to-day because the ripeness of the age with its great crop of inventions has made the way easier and the applications greater for their discovery and development. The great masses are becoming more and more the actual, conscious and valuable thinkers of the day. Many a year has passed since the first evidence of inward pith manifested itself, and many a year will pass before this incomparable virtue shall depart. Yes, the public, the vast rushing horde do think with an intensity at times that produces a Stephenson, a Watt, a Fulton and an Edison. To struggle against environment, clinging to one idea through thick and thin merits some consideration.

To-day this is easier in the field of which we speak. One hundred years ago it was almost impossible. Yet the struggle seems to be as fierce as ever, because the objects strived for are harder to obtain. There is no doubt that the public are our modern mints of thought, for they coin the wants of the age and produce the men to supply them.

INVENTORS AND INVENTIONS.

There is a doubt existing amongst many as to the true meaning of the word "inventor." To originate a new article of popular or technical interest is sufficient to cause the expression to be used. Few of so-called inventive power have more than made additions to the large stock of inventions of a similar if not identical nature. A patent that is granted is not always proof that an invention has been made. An army of men make it their business to simply improve what already exists.

Few create entirely or make a radical departure from the beaten track. The discoverer of a new principle rarely makes an application of it himself. The ability to discover a new law requires a perfect equipoise of the reasoning abilities; it may not suffice at all for the construction of a machine making use of the discovery. Again it is a familiar fact that the original inventor of a new machine makes but few changes in its crudity, but the host that follow perfect it in detail until we have as an example, side by side, the first rough design of Watt and the elaborate triple expansion engine of a modern marine equipment.

The unfinished idea does not lose in value because it is not perfected. Like a rough casting it needs finishing and polishing. The general structure does not pass through other than detailed processes insignificant individually in comparison with the whole, but of equal importance in the concrete. An inventor may enter into either fields as his native qualities appear. It is therefore necessary to divide inventors, and therefore their inventions, into two classes; the first greater than the second. The first headed by such men as Watt; the second greater class, those that added their mite to the pile. Inventors may therefore invent the entire device; that is, originate the base of a great superstructure, or he may simply add or improve some necessary adjunct. The steam engine represented the original idea; its further application to rail and water required comparatively few changes in other than its external form. But the use of the governor, the thousand and one details, each of which was and is the subject of special study, give a perfect illustration of the variations and striking differences between "inventors and inventions."

The Storage Battery.

THE APPLICATION OF THE STORAGE BATTERY.

*C. D. Wood.

(Concluded from Page 56.)

It is the tendency nowadays for the electric lighting companies of our large cities to consolidate, thereby obtaining a monopoly of the lighting contracts, and here again in these stations we find the accumulator battery applied to a saving of time and labor.

In the city of Chicago there is one of the largest electric power plants in the country; in fact, the Edison Electric Lighting station is 50 per cent. larger than any other one plant in the world, and contains one of the finest battery equipments yet installed. The plant consists of 166 cells, having 83 plates to each cell, the plates being 15½ inches wide by 32 inches long, while the containing tank, to facilitate the action of the electrolyte, is lined with five pounds of sheet lead. The total weight of the battery is 1,092,000 pounds. The plant has been divided so that the main generating department furnished power to one portion of the city while the battery plant forms an auxiliary station of its own, situated at Adams street. During the winter months the main load occurred at 4.45 when the strain upon the Adams street station amounted to 11,000 amperes for a period of one hour, while the maximum load peak of the entire plant was only 55,000 amperes. By a competent series of switches the cells can be cut off and on at leisure, and any strength of the total current obtained. The cells are charged at the time of the minimum load and again we have a large saving in the coal supply. Twenty-six per cent. of the total output of the company's power is furnished by the battery plant of the Adams street station.

The tremendous electric power plant recently erected at Niagara Falls is well known, where we find power supplied for all kinds of manufacturing purposes. The owner of a factory in that vicinity purchases his power at the rate of so many horse power per day; this power is available for twenty-four hours and at the rate of 100 horse power per hour. He is entitled to 2,400 horse power during the entire day; but as the average factory is working for only ten out of the twenty-four hours, we see fourteen hours of power unused. Let the merchant buy a battery plant capable of furnishing 50 horse power for 10 hours, or 550 horse power hours, and by using the remaining fourteen hours of power, due time to charge his battery for the following day's work, he saves one-half of the total expense. The initial cost of the battery would weight heavily upon the balance sheet of the day, but would soon be equalized by the daily saving in operation.

The installation of accumulators in private dwellings and office buildings is now coming to be an every-day occurrence and we find in almost every instance that the battery is proving satisfactory. On one occasion during the past winter the Cushman Building of Maiden Lane, New York, was left without steam, caused by the bursting of a main belonging to the New York Steam Company. The storage battery of chloride accumulators, only partly charged, took up the load dropped by the dynamos, supplied current for the regular service until five o'clock, and ran the lamps throughout the building until the next morning.

For several years the manufacturers of automobiles have been in search of a suitable motive power. Gas, oil, compressed air and electricity have all been tried, with the result in favor of the electric current, which in this case means the storage battery.

In the Columbia Phaeton, built by the Pope Manufacturing Company, we find a chloride accumulator battery of 44 cells, encased in rubber jars and charged from a 110 volt circuit; the entire battery weighs 900 pounds, and can be charged without removing the cells. However, this use of the storage battery will not become general until the weight and cost has been reduced—an ordinary electric cab seen in New York City to-day costs approximately $2,400.

We have not yet touched upon the application of the battery at sea which in time will offer a large field for its operation. On board one of our larger men-of-war there are upwards of 75 auxiliary engines operating various contrivances, from the ammunition hoists to the refrigerating machines. Would it be practical to run these machines by power from a storage battery installed in the hold? Many naval engineers would advocate this proposition, but on further consideration it might seem as if the dead weight of a battery capable of performing this work would greatly lessen the ship's speed and that the space could be occupied to better advantage.

Suppose we are to furnish a torpedo boat of 140 feet over all, a draught of five feet and displacement of 110 tons, with electric power, allowing 45 tons for ammunition, crew, etc., which would give us 95 tons for electrical equipment. The requirements of a torpedo boat are speed, noiseless operation, and the faculty for quick movement. The noise of escaping steam when the small vessel is approaching a powerful man-of-war would be very likely to cause its destruction; but if we should substitute electricity as the motive power this danger would be overcome and our boat would be under a perfectly controlled power.

For a speed of 22 knots of a boat of the given dimensions, 1,500 horse power would have to be generated. A battery of 175,000 pounds, supplying current to four motors weighing 6,500 pounds apiece, would develop this power and we would have 140 horse power applied at the screws for a period of 24 hours; or if the time is diminished, 300 horse power would be supplied for 10 hours. If the battery were discharged entirely within the 24 hours at a speed of nine knots an hour the cruising radius of our craft would be 216 nautical miles—a fair area for the action of a torpedo boat. The batteries could be charged in four hours from an 80 volt circuit, commonly found on board a man-of-war, and as the torpedo boat

*In the "Yale Scientific Monthly."

works in common with the larger craft this would not be impracticable.

By placing the batteries below the water line we would lessen the chances of their being hit, and if connected in parallel the injured part could be cut off and power obtained from the portion still intact.

As time advances new fields open to this powerful agent of the engineer, and it seems as if the storage battery were yet in the infancy of its usefulness.

The Motor.

*MOTOR SPEED REGULATION.

Alton D. Adams.

While great advances have been made in the application of alternating machinery, the distribution of power by direct current was probably never increasing faster than to-day.

Tens of thousands of horse power are now delivered by direct current motors, and a large part of this work is done at variable speed.

In spite of this extended use, the direct current motor as commonly used for variable speed is by far the least efficient link between the central station engine and the consumer's machinery.

This lack of efficiency is by no means inherent in the motor, but results from the common method of speed regulation by the use of a variable resistance in the armature circuit.

As the case now stands the central station furnishes about 80 per cent. of the power developed by its engines to consumers. Manufacturers provide motors of from 80 to 90 per cent. efficiency at full speed and load and the user in order to regulate the speed to his requirements commonly employs a method of regulation which reduces the efficiency of his motor to 50, 25 or even 10 per cent.

Consider for example a motor having an efficiency of 86 per cent. at full load and speed, with losses of 3 per cent. in armature windings, 3 per cent. in shunt magnet winding and 8 per cent. local currents, friction and hysteresis.

Let this motor be loaded to full and constant armature current and then regulated for variable speed by a resistance in the armature circuit.

As the energy entering the armature circuit is 97 per cent. of that drawn from the line and the loss in armature winding is 3 per cent. of the total, this winding loss is $.03 - .97 = 3.09$ per cent. of the energy entering the armature circuit.

The pressure required to force the full current through the armature resistance is therefore 3.09 per cent. of the line pressure.

The counter electromotive force of the armature at full speed will be $100 - 3.09 = 96.91$ per cent. of the line pressure, and at one-fourth speed the counter electromotive force will be $96.94 - 4 = 24.22$ per cent. of the line pressure.

At quarter speed, then, the rheostat in armature circuit must consume $100-(3.09 + 24.22) = 72.69$ of the line pressure, and as 97 per cent. of the total energy is delivered to this circuit the rheostat in this case consumes $97 + .7269 = 70.5$ per cent. of the energy taken from the line.

Assuming that the losses from local currents, hysteresis and friction vary directly with the speed, the losses internal to the motor at one-quarter speed, became $(8 - 4) + 3 + 3 = 8$ per cent., and the total losses in motor and regulator became $70.5 + 8 = 78.5$ per cent., thus giving the combination an efficiency of $100 - 78.5 = 21.5$ per cent. at one-quarter speed.

At less than constant torque and armature current, the combined efficiency will evidently be lower than above figures.

As there are well known methods of speed regulation which involve only the small losses internal to motors, whatever the speed, it seems that a stronger effort on the part of manufacturers to introduce machines with efficient means of speed regulation, would benefit all concerned.

Two practical methods of motor speed regulation are the variation of magnet strength, and the variation in arrangement of armature conductors as to each other.

A rheostat in the shunt magnet winding, gives any desired speed above the minimum, with constant armature capacity, and two or more separate windings and commutators on the armature, give two, three or four times the minimum speed, with corresponding increase in armature current capacity.

The work required of variable speed motors is of three kinds, namely, constant whatever the speed, varying directly as the speed, and varying directly as same power of the speed.

These three classes of work are illustrated by machine tools, which require, when in use, nearly constant power for all speeds, by shafting which consumes power nearly as its speed, and by centrifugal fans whose driving power varies as the cube of their speeds, friction aside.

As constant power at all speeds involves a constant armature current, it is well provided for by a variable magnet strength to correspond with all desired speeds, but special proportions are necessary to avoid sparking with a constant armature reaction and weak magnets at the higher speeds.

When the required power and consequently armature current varies directly with the speed, the armature reaction, winding loss and magnet strength may be held constant and the desired speeds secured through two or more separate windings and commutators, provided a reduction of the maximum speed to one-half or one-quarter is sufficient.

If the power and armature current must vary as the cube or other high power of the speed it is well to combine the method of multiple armature windings with the variation of magnet strength, as the variation of armature conductors which gives the desired speed does not in this case afford proper current capacity.

It is certain that motors constructed for above methods of speed regulation will cost more than those of ordinary type, whose speed can only be regulated by a resistance in the armature circuit.

It is equally certain that the saving of energy effected by the more efficient means of speed regulation will soon offset its increased cost in any given case.

Efficient means of regulation in variable speed motors will benefit manufacturers through the sale of more valuable machines, the consumer by a reduction in power bills and central stations and manufacturers alike in the increased use that a large reduction in the cost of operation will produce.

Attention is called to these facts, not because they are new but because their importance entitles them to more consideration than they have received.

*Presented at the 16th General Meeting of the American Institute of Electrical Engineers, Boston, June 27th, 1899.

The Waxahachie Electric Light Company, of Waxahachie, Texas, has decided to use aluminium wire in making its extensions, on account of the prevailing high price of copper. It has ordered 500lb. of aluminium wire, and, should the present prices for copper wire be maintained, it will need several thousand pounds more for extensions in the Spring.—Ex.

Dynamo Design.

AIR-GAP AND CORE DISTRIBUTION. THE MAGNETIC FLUX AND ITS EFFECT UPON THE REGULATION AND EFFICIENCY OF DYNAMO-ELECTRIC MACHINERY.—II.

BY W. ELWELL GOLDSBOROUGH.

(Continued from page 54.)

As it was very necessary to know the exact area enclosed by each exploring coil, the distance between the edges of the holes was accurately measured. The exact area was then determined where the holes were not parallel by finding the area of the parallel part and the area of the trapezoid and taking the sum. The holes were parallel to a depth of 1.72 inch, but for the remaining distance the area was a trapezoid. Knowing the area enclosed by each coil, corrections were made for the readings from each coil.

The armature was made deep in order to magnify the distortion of the lines of force which it was thought would occur. The distribution in the armature core of a dynamo is the important element in calculating the core losses, whereas the field core distribution is unimportant.

The terminals of the exploring coils were brought up to mercury cups in a board above the armature. These were arranged in such a way that any coil could be put, when desired, in series with a ballistic galvanometer, terminals of the galvanometer being simply placed in the two mercury cups containing the terminals of the coil.

Since the coils were wound in places perpendicular to each other they afford a means of determining the horizontal and vertical components of the density. Hence, the vector sum of the components at a given point is the actual density for that point and the direction of the vector is the direction of the flux at the point.

The intensity of the magnetism at the center of the area enclosed by each four holes was determined by taking the mean of the readings from the (n)th and (n-1)th vertical coils and the mean of the readings of the (m)th and (m-1)th horizontal coils of the (y)th vertical and (x)th horizontal rows. The vector sum of these means gives the intensity at the point considered, and unless the curves for the horizontal and vertical components are extremely irregular from point to point, the method gives a very close approximation to the correct value.

The width of the face of the armature in contact with the poles was practically the same as that of the poles, hence the component of the magnetism perpendicular to the side faces was taken as zero, since the sides of the armature are parallel also. Correction was made for the distortion due to the holes containing the exploring coils as follows:

The actual area enclosed by a square having for its vertices the centers of four of the holes was found and the side of the equivalent square was determined. Then the ratio of the actual distance between the inner sides of the two holes from one another to the side of the equivalent was taken as the correcting multiplyer for the holes.

Correction for lamination was made as follows:

Weight of armature if solid, 24655.3 grams with wrought-iron at 480 pounds to the cubic foot.

Actual weight of armature, 21437.64 grams. The ratio of these weights, .87 is the proportion of iron in the armature.

(To be Continued.)

Telegraphing Without Wires.

FURTHER EXPERIMENTS WITH WIRELESS TELEGRAPHY.

The London "Electrical Review" states that the French naval authorities, acting in conjunction with Mr. Marconi, recently conducted some successful experiments with wireless telegraphy between a ship and the shore in the English Channel. The French storeship Vienne was used for the purpose. Wimereux, near Boulogne, and the South Foreland lighthouse, on the Kentish coast, were used as the land stations. Messages were sent between the vessel and the English coast from off Boulogne, and afterwards at intervals, until the vessel was 12 or 14 miles away from that port. The greatest distance through which the messages were telegraphed was 42 miles, this being considerably in excess of the distance hitherto successfully covered. The increased distance appeared to have no effect, the messages being recorded at the receiving station at the South Foreland with unvarying distinctness. Messages were exchanged while the vessel was traveling at various conditions of speed, with the same result. An interesting feature in the experiments was stated to be the facility with which Mr. Marconi's latest development for cutting out a station was applied. The messages were sent at will either to Wimereux or to the South Foreland, without the other station being able to intercept them. The results of the experiments are to be reported to the French Government.

Literary.

"A MESSAGE TO GARCIA."

Mr. George H. Daniels, the general passenger agent of the New York Central and Hudson River Railroad, is distributing broadcast Elbert Hubbard's editorial, originally published in the "Philistine," of which Mr. Hubbard is the editor, under the inspiring heading of "A Message to Garcia." This editorial, or preachment, as Mr. Daniels calls it, is one of the most forceful sermons which was ever written, and reveals the secret of success, obeying orders. The sound sense of the article at once appealed to Mr. Daniels, and with customary energy he began to make preparations to have copies of the same spread over the country. How Mr. Hubbard's preachment struck the country is best seen by the number of requests which have been received for copies of it—over thirty thousand. We advise our readers, not only those who employ help, but also those employed as help, to write for a copy of "A Message to Garcia." A copy will be sent upon the receipt of a stamp by Geo. H. Daniels, general passenger agent, New York Central & Hudson River Railroad, Grand Central Station, New York.

LEXINGTON, KY.—The deal for the consolidation of the street railways and electric light properties in this city has been closed and officers and directors of the new corporation have been elected as follows: Mr. R. Lancaster Williams, of Richmond, president, and Messrs. J. William Middendorf and S. Davies Warfield, of Baltimore, were elected members of the board. The new company is capitalized at $800,000, and will issue $830,000 in 5 per cent. gold bonds. It will operate about seventeen miles of track and furnish electric light and power for manufacturing purposes. The consolidation was arranged by Messrs. Middendorf, Oliver & Co., of Baltimore. Mr. E. C. Hathaway, of Charlotte, N. C., will have charge of the properties.

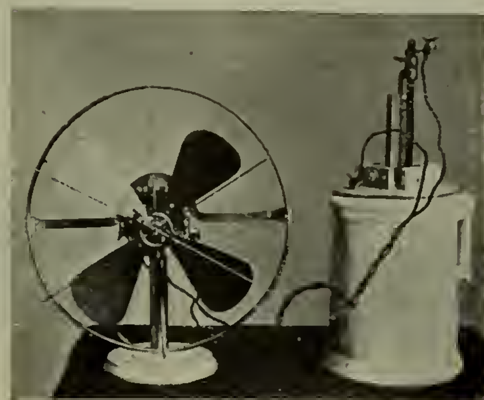
AN ELECTRIC GOAT.

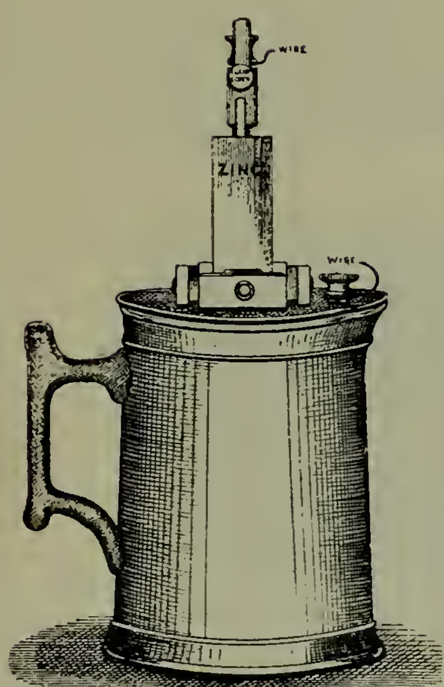
Electricity is being put to very novel uses. Here we read that in a Western city an ingenious electrician has sent out a machine which he calls an "electric goat," and whose use is to gather and carry away the sticks, paper and debris that gather in the city streets. This is done by a system of arms which reach out and take up whatever comes within their grasp.—Ex.

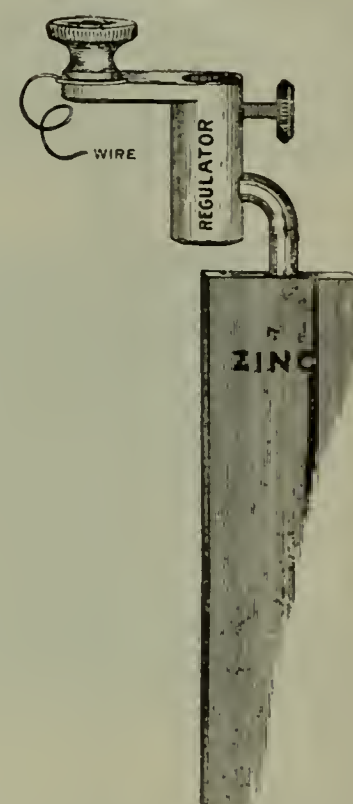
Electricity in the Home.

FAN MOTORS FOR HOME USE.

Thousands of men, women and children in homes, offices and factories are sweltering with the high temperature and humid atmosphere peculiar to the climate at this time of the year. A large percentage of deaths from exhaustion does not come from exposure to the sunlight but rather from the combination of heat, humidity and the stifling air in sun-baked buildings. Invalids above all others are the greatest sufferers in this respect and many means have been devised to make their lot a more comfortable one.







The "Prize" Battery Jar.

The Portable Electric Fan and Battery
The "Prize" Battery.
Details of Fan Motor.

The "Prize" Battery Zinc.

A boon is now offered to all such sufferers by the introduction of the "Portable Electric Fan and Battery," manufactured by James H. Mason, the well-known inventor and electrician, of Room 185. World Building, New York City. This outfit, illustrations of which are shown herewith, consists of a motor mounted on a stand, an eight inch, 4 blade fan, fan guard, conducting cord, a "Prize" battery with charges of battery salt, and full directions for the setting up and operation of the equipment.

The outfit is well constructed, beautifully finished throughout and cannot get out of order, the breeze thrown out from the motor is strong and constant and can be easily regulated to any desired strength.

The "Prize" battery consists of two carbons, set as shown in the illustration, connected in multiple and thus forming one electrode. Through the carbon support is a hole through which the zinc is raised or lowered as required, and also regulated to remain in a stationary position in the fluid, thus giving any amount of current desired. When the zinc is fully submerged in the fluid the battery will give one and nine-tenths volts and twenty amperes. The full capacity of the battery is fifty ampere hours, by the use of the "Prize" battery compound. The compound is a dry product and requires only the addition of water, preferably rain water, to reduce it to a fluid condition. It shows no polarization, has a high electro-motive force and low resistance, the consumption of zinc in batteries using this compound being reduced to a minimum. After the battery is charged with the compound and water, the generation of current is instantaneous, except when a porous cup is used, in which case the solution requires a little time to soak through the cup. One charge of compound is guaranteed to operate the fan for over fifteen hours; the zinc used in the battery will last through four charges and is easily replaced without any tools.

GOLD'S IMPROVED ELECTRIC HEATERS.

The efficiency of an electric heater depends very largely upon the access which the flow of air has over the heated wires. The principle of a free circulation of air through the heater, so that all of the electrical energy developed into heat is utilized to the best advantage by being carried off of the resistance wire and into the car body, in an even and steady flow of warmed air, has been demonstrated to be the most satisfactory, and proven itself the means of warming the cars at the least expense of current.

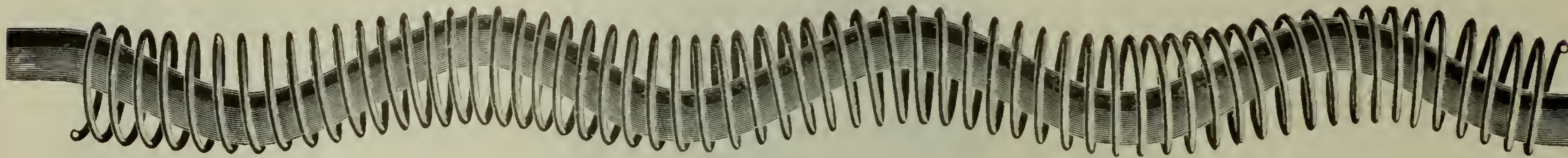


Fig. 81.

Fig. 82.

The Gold Street Car Company's object has been to so arrange the construction of their electric heaters that the freest possible circulation of air may be had, so that the air as it passes through the heater should be divided into the smallest particles, and each particle of air come in contact with the heated surface, and as a result, carry with it into the car body its full and equal share of the heat generated. It has been their constant aim to get the benefit in the form of thoroughly warmed air in the car body of all the electrical current expended in the heater, and the only known practical way of accomplishing this is by having a free circulation of air through the resistance coils.

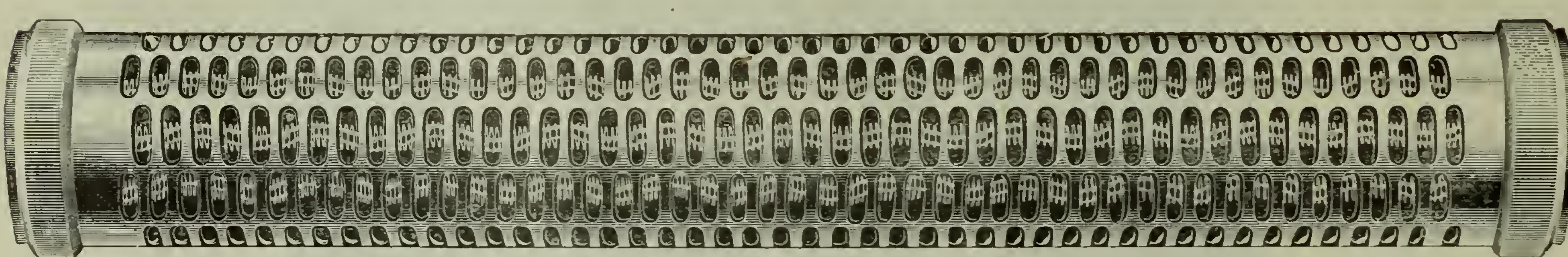


Fig. 84.

The construction of the Gold improved heater provides for the perfect features desired. The resistance coils have been arranged in such a way that the support itself, while holding the wire firmly in place and not per-

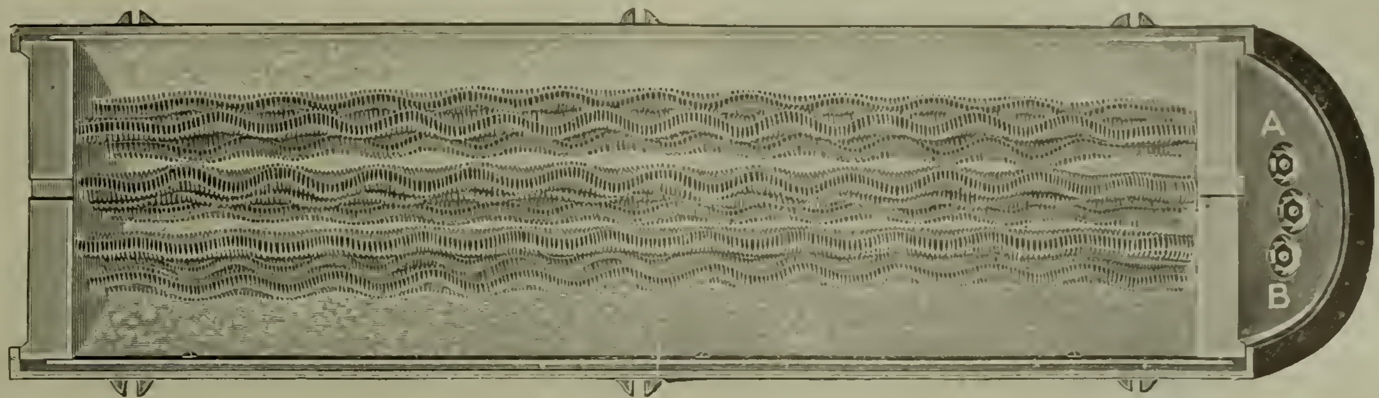


Fig. 87.

mitting vibration, will offer the smallest possible amount of friction to the flow of air through the heater. This new method is shown in Fig. 81, and as can be readily seen from the ilustration, this method of supporting the

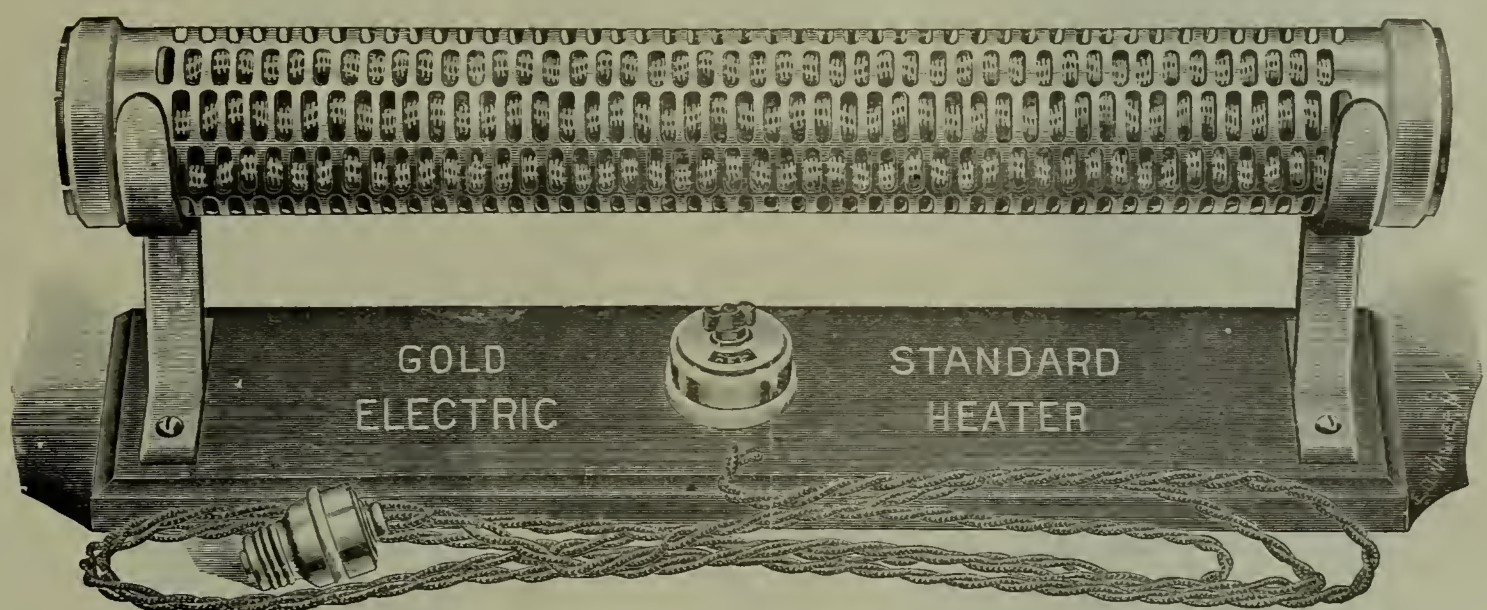


Fig. 88.

resistance coil of an electric heater is quite novel, and is radically different from anything of a like character that has ever been attempted. It is compact, efficient, simple

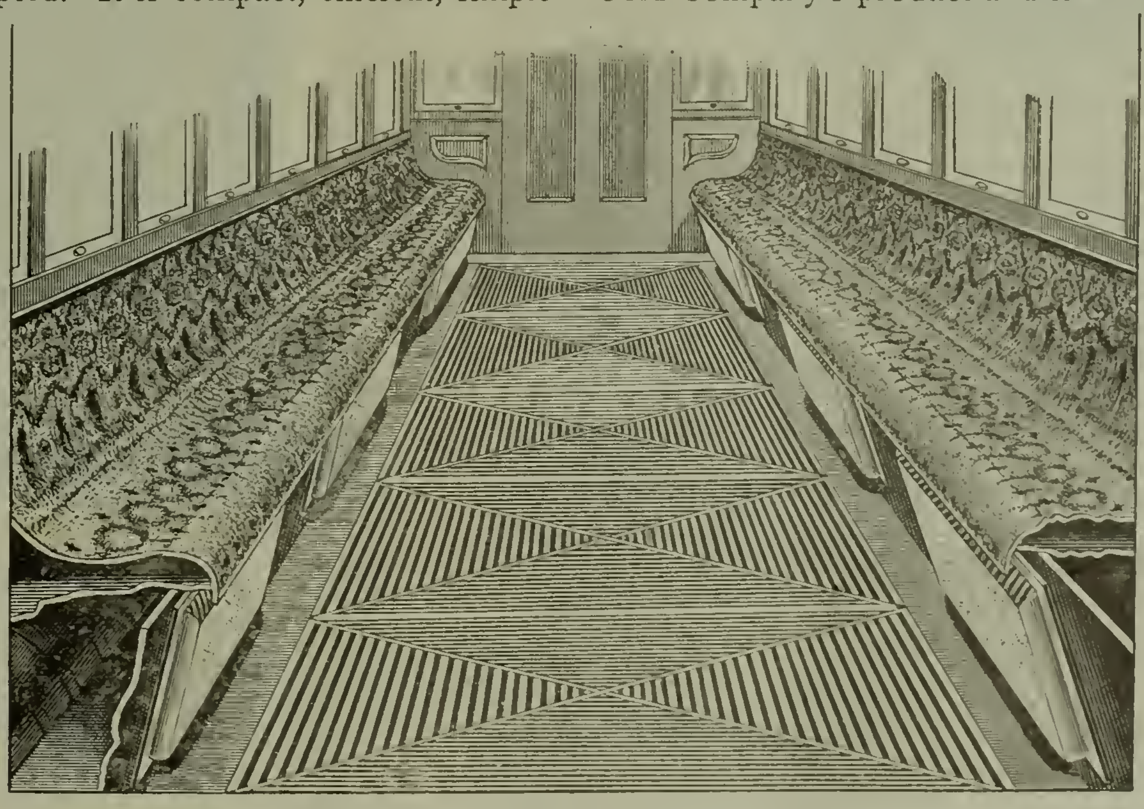


Fig. 94.

and durable, and that as a heating factor it far surpasses all other forms, is at once manifest. This support consists of a one-quarter inch steel rod, which is thoroughly covered with an insulating enamel and which enamel is burned on the rod at over two thousand degres of heat. It is therefore not affected by any heat to which it will ever be subjected, and is at the same time an absolute non-conductor. This rod is shaped in zig-zag form, and the resistance coil when slipped on in place assumes the position shown by the illustration, Fig. 81.

Special attention has been given to the composition of the resistance wire used in these coils, and in that which is now being produced a high resistance is combined with absolute non-corrosive qualities. This wire is the Gold Company's product and it is the result of long and careful experimenting. It has been tried under all sorts of conditions, and has never been known to fail. The result shown by this wire has made a very great demand for it as it has earned the complete approval of every one who has used it. For heating purposes, this wire combining, as it does, a high resistance, being positively non-corrosive and always maintaining its original condition is without any equal. The resistance coil is wound on an open pitch, so that when it is placed on the zig-zag rod the wire is in its natural condition and is not subjected to any strain whatever. It has only tension enough to keep it firmly in place. The many advantages of this method of construction are apparent. A large amount of wire is secured in a small space without resorting to the use of a bulky and solid core.

Persons familiar with the use of electric heaters know

Fig. 91.

that when resistance wire is wound around a solid core, the unevenness of the temperature on the wire caused by insufficient circulation of the air over the heated surfaces, has resulted in a great many instances, in the complete failure of such forms of electric heaters. Another disadvantage which was found with electric heaters was that the wire of the resistance coils was wound on a close pitch, and when applied to the support was necessarily pulled out under a tension. When the current was turned on to these coils, the inequality in the temperature of different parts of the coil caused it to draw apart or pull open in some places, and draw together in others, thus cutting out a large amount of the resistance, and consequently increasing from time to time the consumption of current. Fig. 81 is an exact reproduction of the Gold Resistance Coil and Support. This construction is of the greatest simplicity. There is no bulky core to obstruct the passage of the air, but, on the contrary, the very freest circulation of air through the coil takes place, and it is a known fact that to thoroughly heat air it must be circulated, or in other words must be divided up into the smallest particles and passed over the heated surfaces. The wire is evenly heated over the entire surface and always maintain its original and natural condition. In the improbable event of a wire breaking, it would be held fast on the supporting rod, whereas, in heaters which have the wire wound around a core under tension, when a wire does break it will unwind and short-circuit with the heater casing. Extensive tests made by disinterested parties have always proven that electric heaters using this improved coil far surpass in every way all other heaters on the market, and they show at least thirty per cent. more efficiency in delivering the warmed air into the space to be heated with our improved heaters than is possible with any others.

Fig. 82 shows Gold's most improved form of Electric Car Heater. This heater sets into the panel under the seat, the front of the heater being flush with the panel. It is the standard size of such electric heaters in use today. It is solidly built, the mechanical details are all perfect, and it is easily applied. The ends of the enameled supports are fitted into solid porcelain blocks. The resistance coils are connected to the binding posts on the inside of the porcelain ends and from the out-

Fig. 92.

side terminal of the binding posts connection is made direct to the adjacent heater. As two circuits are used, one for the single series and the other for the parallel series, two wires are run from the regulating switch to the first heater and thereafter from heater to heater around the car, teminating at the ground. This arrangement of the binding posts in the solid porcelain end plate of the electric heater is a decided advantage, as it affords the simplest possible method of wiring and avoids all liability of breakage, short circuits or mistakes in wiring. This heater has the coils so arranged that the upper sets are in multiple and the lower sets in single series. Six of these heaters are usually applied to a car of about twenty-four foot body, and graduate the heat into three different degrees by turning the handle of the switch to any of the three points noted on the dial.

Fig. 84 shows a large view of the Gold Standard Electric Heater. This heater consists of three Gold Improved Resistance Coils and Supports shown in Fig. 81. These rest in porcelain plugs or caps at either end, and are encased in a cylindrical perforated sheet-iron casing, as shown. This heater is three inches in diameter and about twenty inches long. It is particularly adapted for cross-seat cars, elevated railway or regular railway cars which are propelled by electricity.

Fig. 88 shows a Gold Standard Heater, supported on cast-iron base and made up complete, with cord and plug ready for attachment. The switch on the base is for the puropse of turning the current "on" or "off."

The Gold Street Car Heating Company also make electric heaters similar to the the small, round gas stoves (see Figs. 91 and 92) which are very ornamental as well as efficient. They are so constructed that they will boil water by placing a vessel on the support arranged at the top of the heater for this purpose. This is a very desirable form of electric heater, as it can be used for heating liquids or for ordinary room heating. As the original cost of installation and the expense of maintaining these electric heaters compare very favorably with the other systems of heating now in use, they are certainly a very valuable adjunct to any well-equipped building. They have been installed in a number of offices, dwellings, and in many of the largest transatlantic steamers, and in all cases the reports show that they have given universal satisfaction. It is needless to describe the advantages which such electric heaters possess over other methods of heating. The dust, dirt and ashes, together with the obnoxious gases arising from the use of coal stoves, hot air, steam, or hot water heaters, are all entirely eliminated when electric heaters are used.

Fig. 93 shows Gold's improved riser board electric heaters.

They have been designed to fit on the outside of the riser board and occupy a very limited space. They are wired for two or three degrees of heat, as desired, and are especially adapted for use in cars where the heel board sets back some little distance from the end of the seat. They are also very well suited for use in cross-seat or parlor cars where it is desirable to screw the heater on the truss plank. The resistance coils and supports used in these heaters are the same as shown in Fig. 81. The case is thoroughly ventilated, is nicely ornamented, and the whole is put together in a very concise form. As these heaters are very narrow and of proportionally small length and width, they require very little space for attachment. Several different patterns of this new style riser board heater have been made, some with closed fronts and others with the faces entirely of open work.

For catalogues, prices, etc., address the Gold Street Car Heating Co., Frankfort and Cliff streets, New York city.

Business News.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING JULY 25, 1899, $46,141.00.

New York, N. Y., July 25 1899. The following exports of electrical material, etc., are from the port of New York for the week ending this date:

Antwerp—50 cases electrical material, $1,122.

Argentine Republic—246 cases electrical material, $9,556.

British West Indies—10 packages electrical material. $263; 11 cases electrical material, $418.

Brazil—1 package electros, $15.

British East Indies—25 cases electrical material, $1,084.

British Australia—30 packages electrical material, $976.

China—16 cases electrical machinery, $515; 3 cases electrical material, $135.

Chili—1 case electrical material, $28.

Cuba—45 packages electrical material, $970.

Central America—74 packages electrical material, $1,240.

Ecuador—3 packages electrical material, $101.

Havre—20 cases electrical machinery, $750; 39 packages electric heating material, $1,607.

Japan—37 cases electric material, $2,434.

Liverpool—231 packages electric material, $10,915.

London—177 packages electrical material, $4,844; 7 crates electrical machinery, $1,620; 5 packages electric motors, $200.

Mexico—51 packages electrical material, $2,345.

Odessa—27 packages electrical material, $1,195.

Porto Rico—7 cases electrical material, $117.

Peru—35 packages electrical material, $427.

Rotterdam—4 cases electrical material, $94; 1 case electros, $50.

Southampton—2 packages electrical material, $125; 62 packages electrical machinery, $1,174; 6 cases electric cars, $1,200.

Siam—20 cases electrical material, $115; 1 package electrical material, $189.

U. S. of Colombia—21 packages electrical material, $317.

NEW INCORPORATIONS.

Raleigh, N. C.—The Standard Gas & Electric Co. has been incorporated by J. S. Carr, L. A. Carr, B. P. Williamson and others. Capital, $100,000 to $500,000.

Saco, Me.—Rhode Island Electrical Works has been incorporated by J. Booth, C. D. Wood, G. M. Clark, O. A. Newall, A. F. Montgomery, E. B. Seaver and A. Eastman; manufacturing insulated wires. Capital stock, $125,000.

Albany, N. Y.—Catskill Mountain Electric Co. has been incorporated by John B. Blish, George H. Lasher, Carl Herman and others; for the manufacture and production of light, heat and power in Ulster and Delaware County. Capital stock, $100,000.

San Francisco, Cal.—Napa Gas & Electric Co., incorporated by T. Addison, J. L. Howard, O. E. Clark, S. E. Keany and J. G. Whittengton; for the manufacture and sale of gas and electricity. Capital stock, $100,000.

Emporia, Va.—Meherrin Power Co. has been incorporated by W. S. Goodwin, W. F. Neal, H. Schwartz, G. B. Wood, C. P. Burgwyn, W. N. Puffin and H. H. Massie; to lease or sell water and electric power. Capital stock, $100,000.

Lakewood, N. J.—Lakewood Water, Light and Power Co., incorporated by Frederick H. Green, Wm. H. Blair, Carroll P. H. Bassett; furnish light, heat, power, etc. Capital stock, $150,000.

Harrisburg, Pa.—The Harrisburg Light, Heat and Power Co., incorporated by E. Z. Wallower, W. O. Bishop, H. Cohen and others; supply light, heat, etc. Capital stock, $2,000.

TELEPHONE CALLS.

Dillon, S. C.—The Home Telephone Co. has been incorporated with Bright Willamson, President; Duncan McKenzie, vice-president; E. L. Moore, secretary and manager. Capital stock, $5,000.

Ducktown, Tenn.—The Ducktown Telephone Co. has been incorporated by J. M. Rostell, W. M. Adams, J. M. Carter, E L. Auburn and G. G. Hyatt.

Bay St. Louis, Miss.—The Cumberland Telephone and Telegraph Co. has applied to the city for franchise.

Warm Springs, Va.—The Bath County Telephone Co. has been incorporated by W. M. McAllister, M. H. McClintic, J. W. Harper, J. T. McAllister and M. O. Ferrall; operating a telephone exchange. Capital stock, $5,000.

Pittsburg, Pa.—Home Telephone & Electric Co., incorporated by T. B. Lee, H. T. Van Ostrander, and others. Capital stock, $100,000.

Alliance, Neb.—Auburn Telephone Construction Co., incorporated by J. W. Kerns, G. W Homan, J M. Burress, and H E. Furlong; construction, operation telephone exchange. Capital stock, $5,000

Houston, Tex.—The Longview Telephone Co. has been incorporated with a capital stock of $10,000.

Monticello, Fla.—M. N. Drew, of Madison, Fla., will establish a telephone system in Madison.

Atlanta, Ga.—The Southern Bell Telephone and Telegraph Co. has applied to the city for permission to lay creosoted conduits, etc..

Shepherdsville, Ky.—J. M. Lee is president of a company which has been formed to construct a telephone line to Washington.

STREET RAILWAY NEWS.

Detroit, Mich.—The North Detroit Electrical Railway Co. has been incorporated by John Winter, O. H. Lau, D. W. Simons, Frank C. Andrews, James K. Andrews and others

Hancock, Ohio.—The Findlay, Fostoria and Toledo Electric Railway has been granted a franchise, and the road will be built to Fostoria this fall and to Toledo in the spring.

POSSIBLE INSTALLATIONS.

Belair, Md.—John H. Reckford will install a 150-horse power steam plant to furnish electric lights to Havre-de-Grace and other towns.

Mt. Pleasant, Tenn.—The Mayor may be addressed concerning establishment of an electric light plant.

Abbeville, S. C.—The Abbeville Electric Light and Power Co. will construct its electric light plants.

NEW YORK NOTES.

Mr. H. W. Bates, still young in years but old in experience in the electrical business, is a very affable gentleman and of unique address. His friends and acquaintances, and buyers generally, should know that he is associated with a good firm of well known gentlemen, J. Holmes and Company, of 39-41 Cortlandt street, general electrical supplies and also agents for the Liberty incandescent lamp. Send in your list of goods wanted for the fall and get their quotations.

Central station supplies and apparatus is a specialty with Mr. John C. Lott, the electrical engineer who on July 1st took charge of a department under the above heading for the Columbia Electrical Supply Company, of 93 Liberty street. Mr. Lott was formerly with the old Fort Wayne Electric Corporation and is carrying on the Eastern branch of the new Fort Wayne Electric Works at the above address.

B. H. Pomeroy, the electrician of the Hagedorn & Ward Manufacturing Company, of Brooklyn, N. Y., has just returned from Europe and reports that the Riker Electric Vehicle Company are erecting big works for the manufacture of their popular automobiles in London. He also states that Riker automobiles are on top and that they "take the cake" in Europe.

The Auto-Acetylene Company, of 13-21 Park Row, have made arrangements to open offices at 26 New Bridge street, London, E. C., and probably also at No. 9 Rue L'Opera, Paris, France. Mr. Walter K. Freeman has gone to the two cities to set up machines, showing what advancements acetylene has made in America. Mr. Freeman sailed for Europe, July 22d, on the French liner "La Bretagne," for a six week's business tour in Paris, London and St. Petersburgh.

Merritt & Lockwood, electrical contractors, 54 W. 28th street, since the inauguration of their business a little over a year ago, have built up an excellent trade among a large number of prominent firms, industries and residences in Greater New York. They have had an excellent fan motor season, having sold nearly one thousand fans; they make a specialty of 16-inch fans. Messrs. Merritt & Lockwood do all kinds of electrical work, install complete electric light and power plants, etc. Among their prominent installations is the Terminal Warehouse, 11th avenue and 27th street, where they installed a complete 1200 light plant, with Straight Line engine and special dynamo; they have exclusive charge of all the electrical work of the Iron Steamboat Company and the major part of the J. B. & J. M. Cornell Iron Works.

The Gold Car Heating Co. and the Gold Street Car Heating Co. report that the number of orders which they have taken during the past few months are of such magnitude as to surpass all former records of the companies. It is a certainty that the Improved Gold Electric Heaters have struck a popular cord among railway officials. Prominent among the orders for electric heaters, which have been taken recently is one from the Boston Elevated Railway Co., formerly the West End Street Railway Co., of Boston, which has awarded the contract for electric heaters for their one hundred new cars to the Gold Car Heating Co.

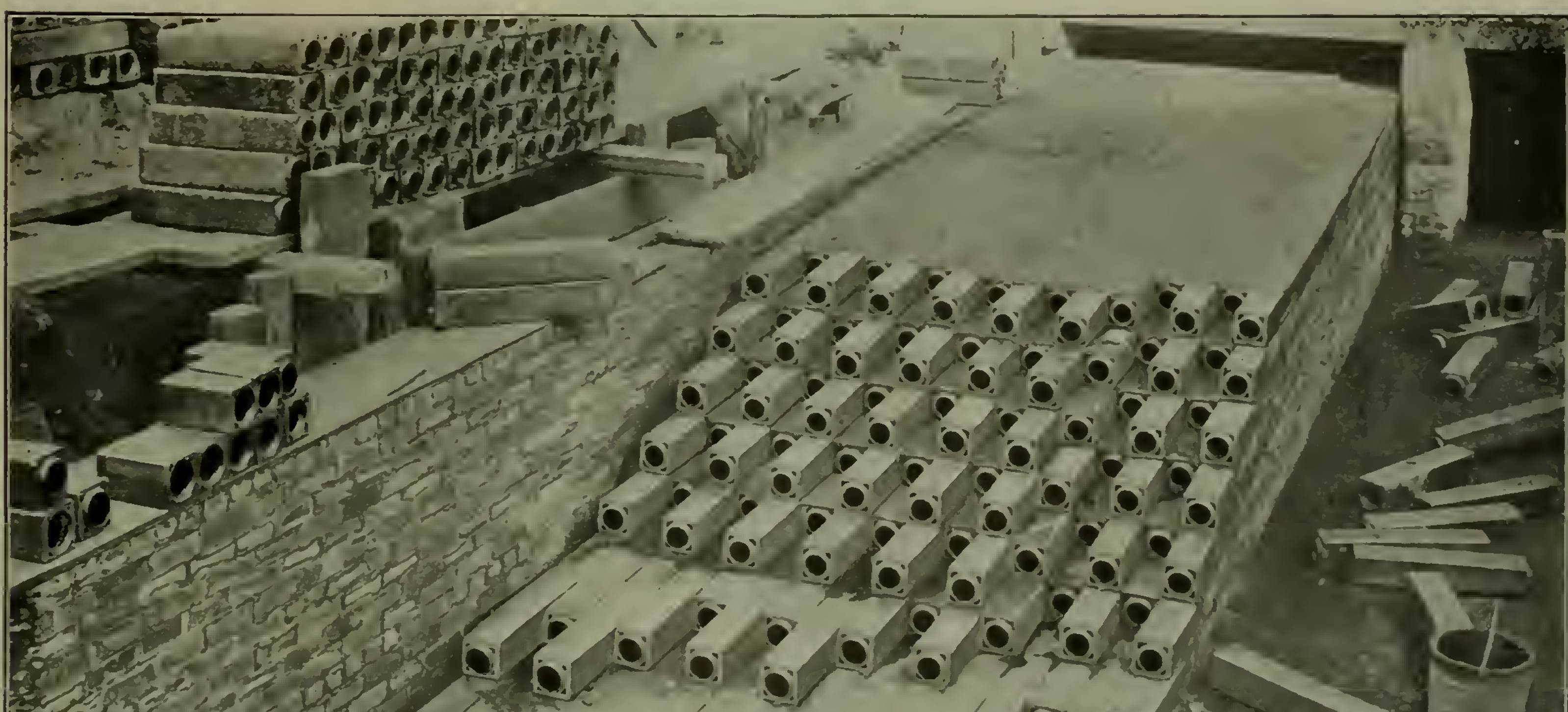
Mr. B. H. Pomeroy, the electrician and superintendent of the Hagedorn & Ward Manufacturing Company, of 331 Adams street, Brooklyn, N. Y., has just returned from London, Manchester, Paris and the principal cities of the Continent, introducing his company's new Perfect direct, alternating and constant current enclosed arc lamps. Mr. Pomeroy exhibited the first two in series, enclosed arc, alternating current lamps, for 200 volts and all alternations and circuits in the world. He left New York on June 24th, returning July 21st, and made an extraordinary trip, meeting with a big reception everywhere. Every buyer in Europe now has a craving for the new two in series alternators, and Mr. Pomeroy broght home orders for ten styles of enclosed arc lamps made by his concern. The Hagedorn & Ward Manufacturing Company will move into their new factory, 351-353 Jay street, about August first. Mr. Pomeroy closed contracts with a large number of big buyers and also organized a company to handle their lamps exclusively. The company is called the Perfect Enclosed Arc Lamp & Accessory Company of Europe, and orders are now on the way from Europe for all the lamps the Hagedorn & Ward Company can turn out within the next six months. Shipments have already been made of a hundred varieties of their lamps, and the future of the company already seems an assured success.

The Electrical Age.

Vol. XXIV—No. 7 NEW YORK, AUGUST 12, 1899. Whole No. 639.

Insulation.

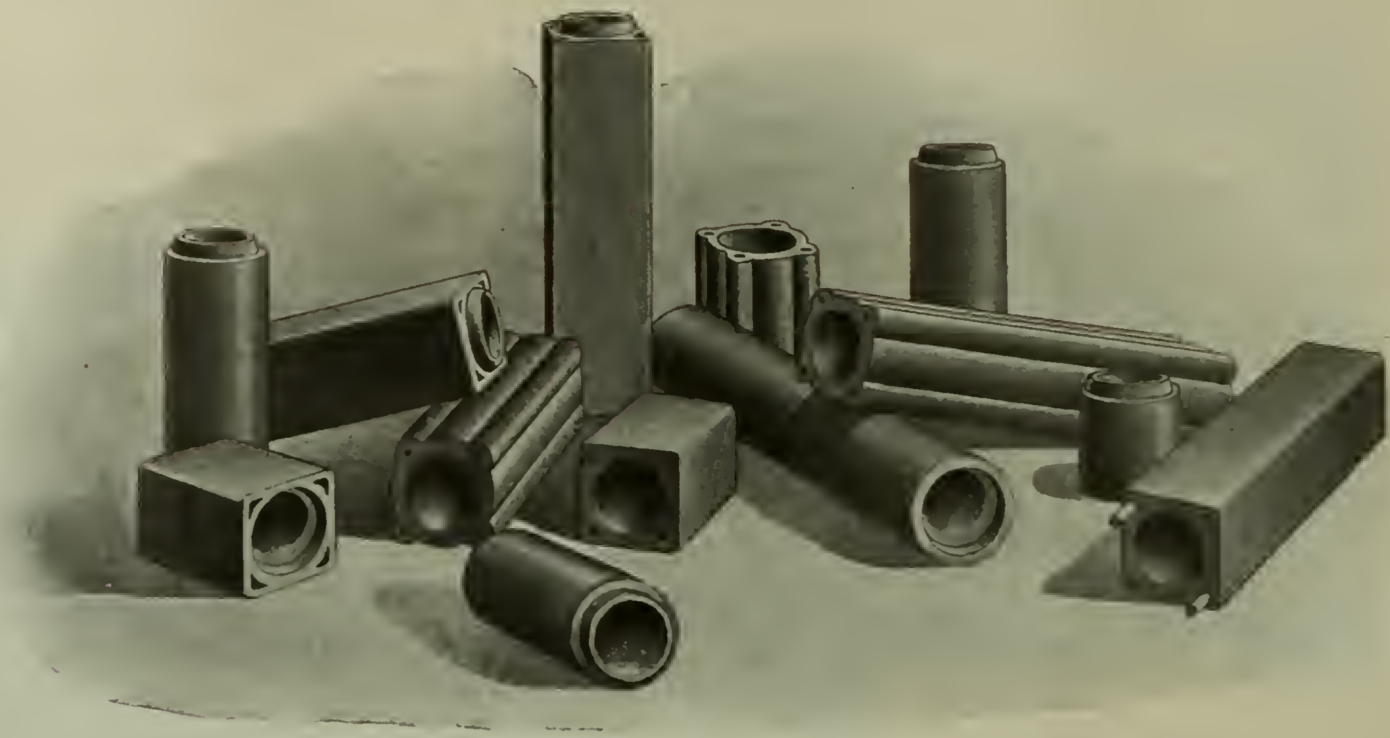
Method of Water Proofing Man-holes.



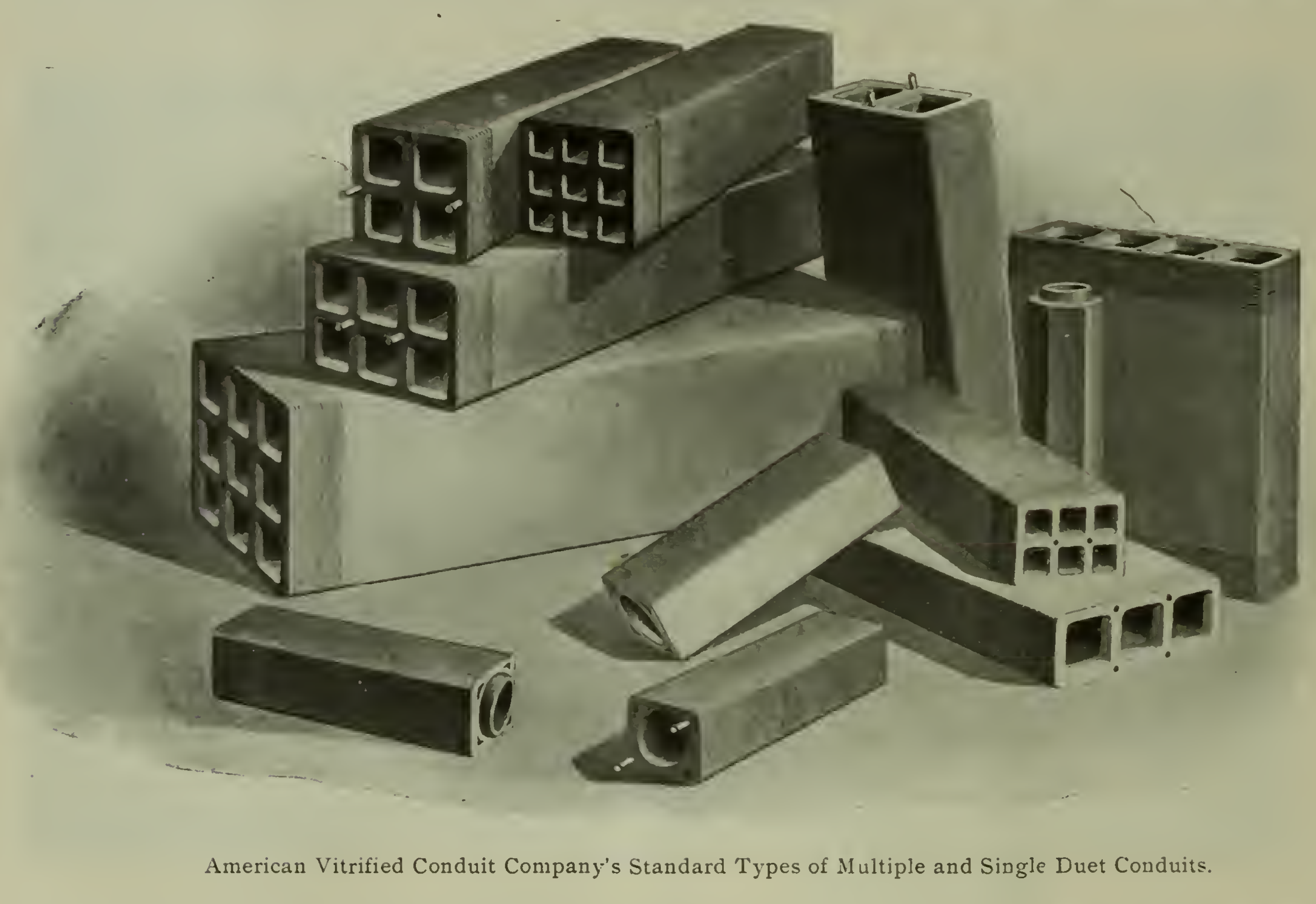
112 Duct Conduits at Providence, R. I.

VITRIFIED CONDUIT FOR ELECTRIC SUBWAYS.

The most durable of products, approximating in their nature that of the everlasting rocks, is burnt pottery. Excavations made in the ruins of ancient Egyptian cities and investigations of the mound of debris in the heart of and adjacent to Niniveh and other centres of Babylonian civilization have shown fragments of pottery untouched by time and almost as new after the thousands of years that have passed as on the day they left the kiln. Few things last better in the earth than those that have been made of its associated constituents. Clay that has been properly treated may be rendered by fire as durable as granite itself and thereby becomes as an insulator and basis for conduit construction superior to all other known materials.



American Vitrified Conduit Company's Standard Types of Single Duct Conduits.

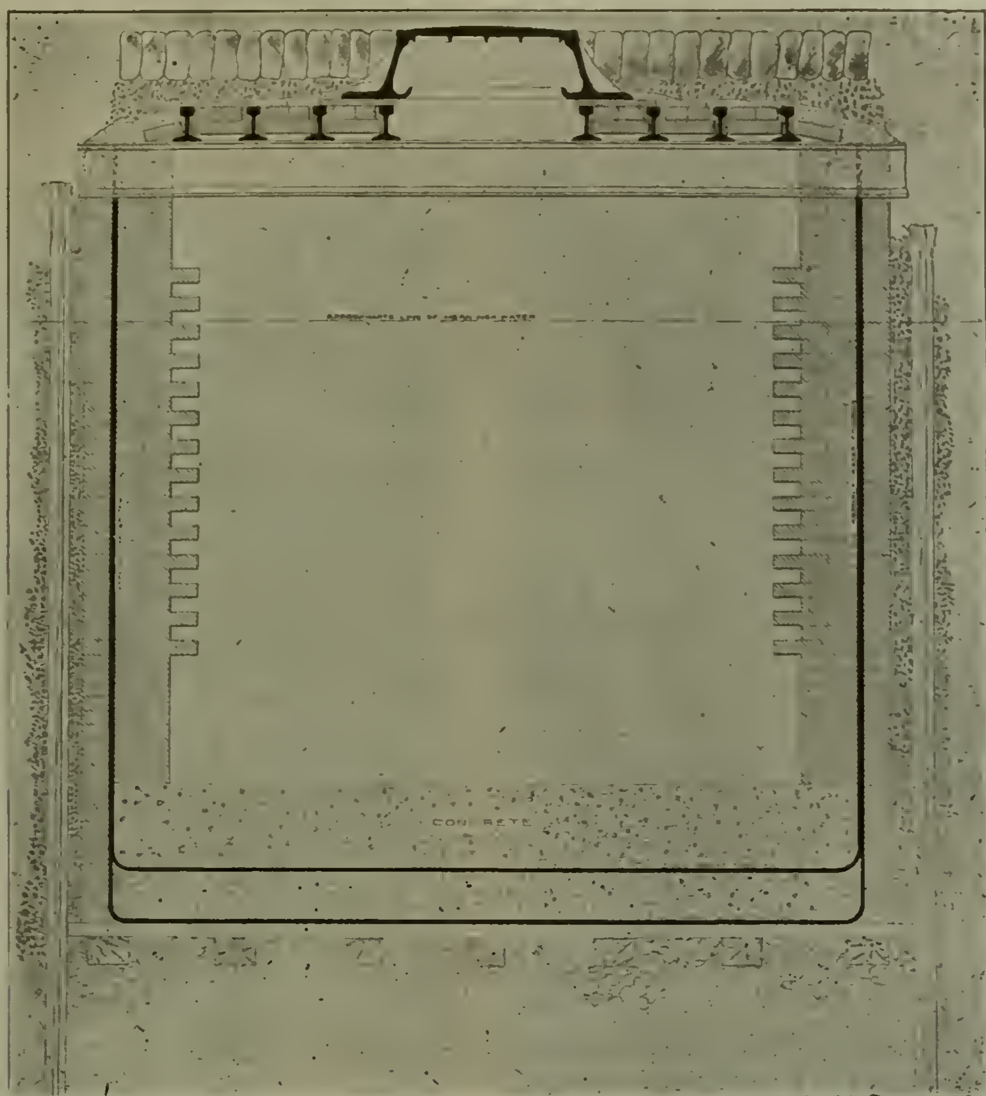


American Vitrified Conduit Company's Standard Types of Multiple and Single Duet Conduits.

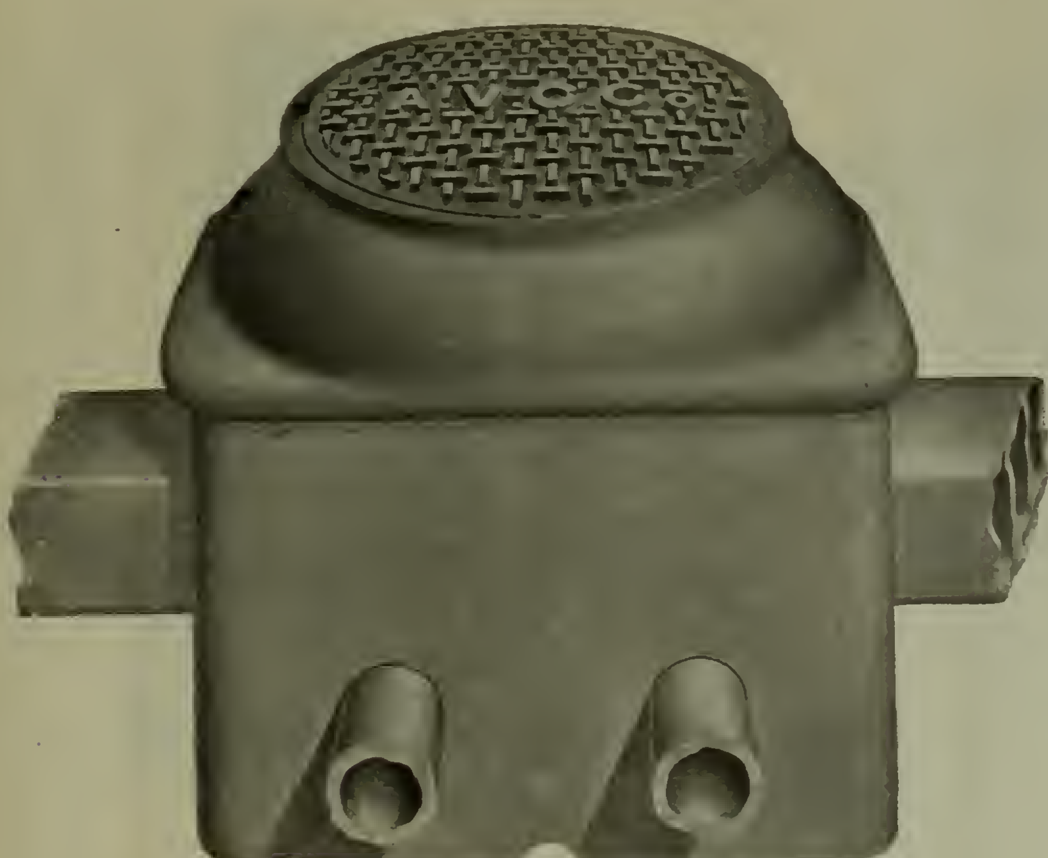
The American Vitrified Conduit Company, of 39-41 Cortlandt St., New York City, have developed and perfected, from a varied, extensive and practical experience, under all conditions and tests, both in the manufacture of material and the construction of same, the most perfect and complete underground system yet offered. The adaptability of this conduit to every purpose suggested by the use of trunk, feeder and distributing lines for electric light and power, electric railways, telephone and telegraph service has become assured by the practical experience of some of the largest electric concerns in America.

The American vitrified conduit is manufactured from a thoroughly mixed and ground combination of stoneware clay, fire clay and spar, by machinery. This machinery has been invented for the particular purpose in view and by its aid the American vitrified conduits are put through a process of manufacture which covers more than three weeks of drying, burning, glazing and cooling.

The advantages of the American vitrified conduits may be rehearsed and included by the following claims which leave but little to be desired by electric light, street railway or power transmission companies. The advantages of the American vitrified conduit are perfect alignment, as shown by the way they are recessed to receive each other at the end; freedom from deterioration, which, of course, is a foregone conclusion, considering the material of which they are made; the smoothest possible surface; the least frictional resistance, which latter two save labor in laying cables, which would be otherwise experienced were the surfaces extremely rough. The high insulating properties of these conduits allows of their use for any high pressure transmission plant that may be proposed, which is, in many respects, the most important feature of construction to electricians. The fire, acid, gas and waterproof qualities of the American vitrified conduits add immensely to their value and durability, particularly in large



Design of Water Proof Man-hole.

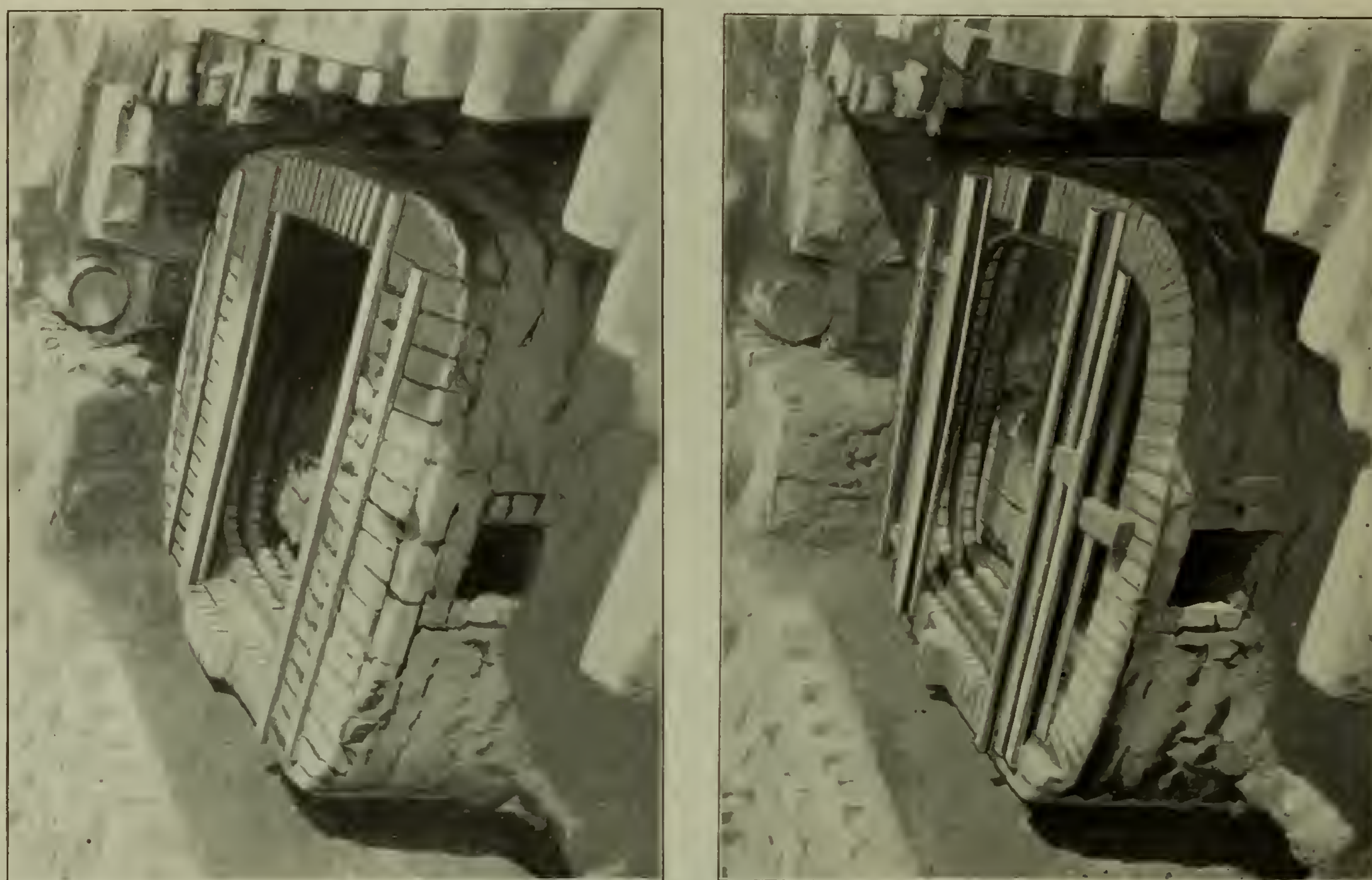


Round Tile Service Distributing Box.

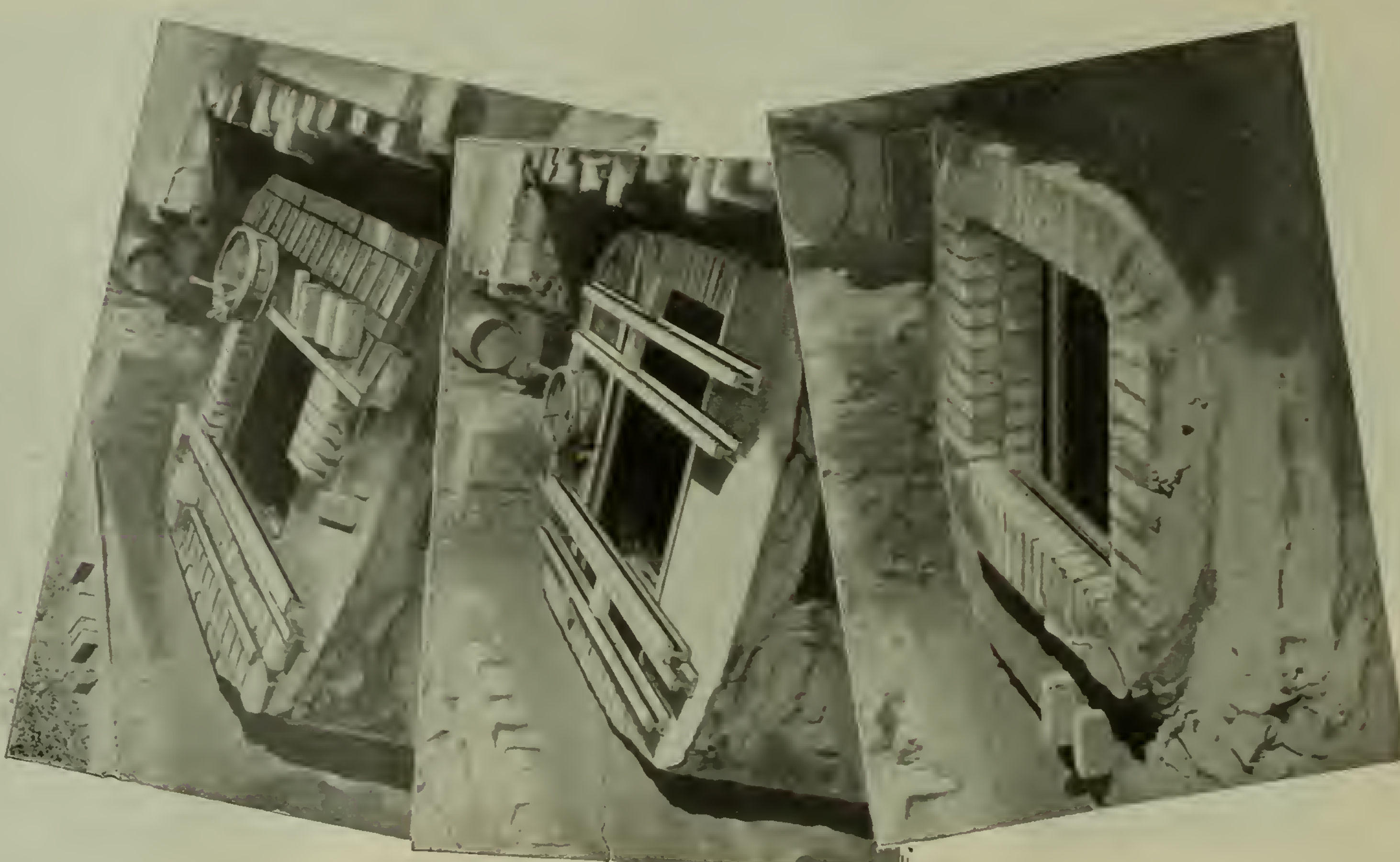
Tile Service Distributing Box.

cities. The absolute freedom from repair after installation means a practical saving of considerable money and the ease with which the conduit can be guided around corners with, however, each section in complete contact with the next adds a feature of the utmost value to this conduit.

sary, special types can be manufactured to meet unique conditions. The standard lengths of the multiple conduit are from two to four feet; the special lengths from four to six feet, and short length for fitting into man-holes, etc., without cutting, from six to eighteen inches.



1 and 2, Illustrate Laying of 1st Course of Rails and Bricks.



3 and 4, Illustrate Laying of 2d Course of Rails and Bricks. 5, Complete. Ready for Man-hole Frame.

Various types of conduits are manufactured by the American Vitrified Conduit Company, as shown in the illustrations. All requirements can be met and, if neces-

The single duct standard, as it is called, measures eighteen inches in length, although short lengths of it are made, varying from six to twelve inches. The above company

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NEW YORK, AUGUST 12, 1899.

CONTENTS:

SMALL SOURCES OF POWER.

The leading question of the day concerns small sources of power. The various utensils that have entered into the domestic economy of many homes, now that the first novelty of the usefulness of their application has worn away, call for a little more than mere application. It has become necessary to supply the home with a small source of power by means of which light work can be done without the effort of manual labor. Various inventors have turned their attention to this important problem with little or no success. The small steam engine is out of the question for domestic use and that unskilful care it would necessarily receive. The gas engine has been introduced into the home and fufills its particular functions with little or no difficulty. The motor, however, by means of which so much can be done that tends to add to the happiness of human life, requires a source of current which can only be procured in one of three ways.

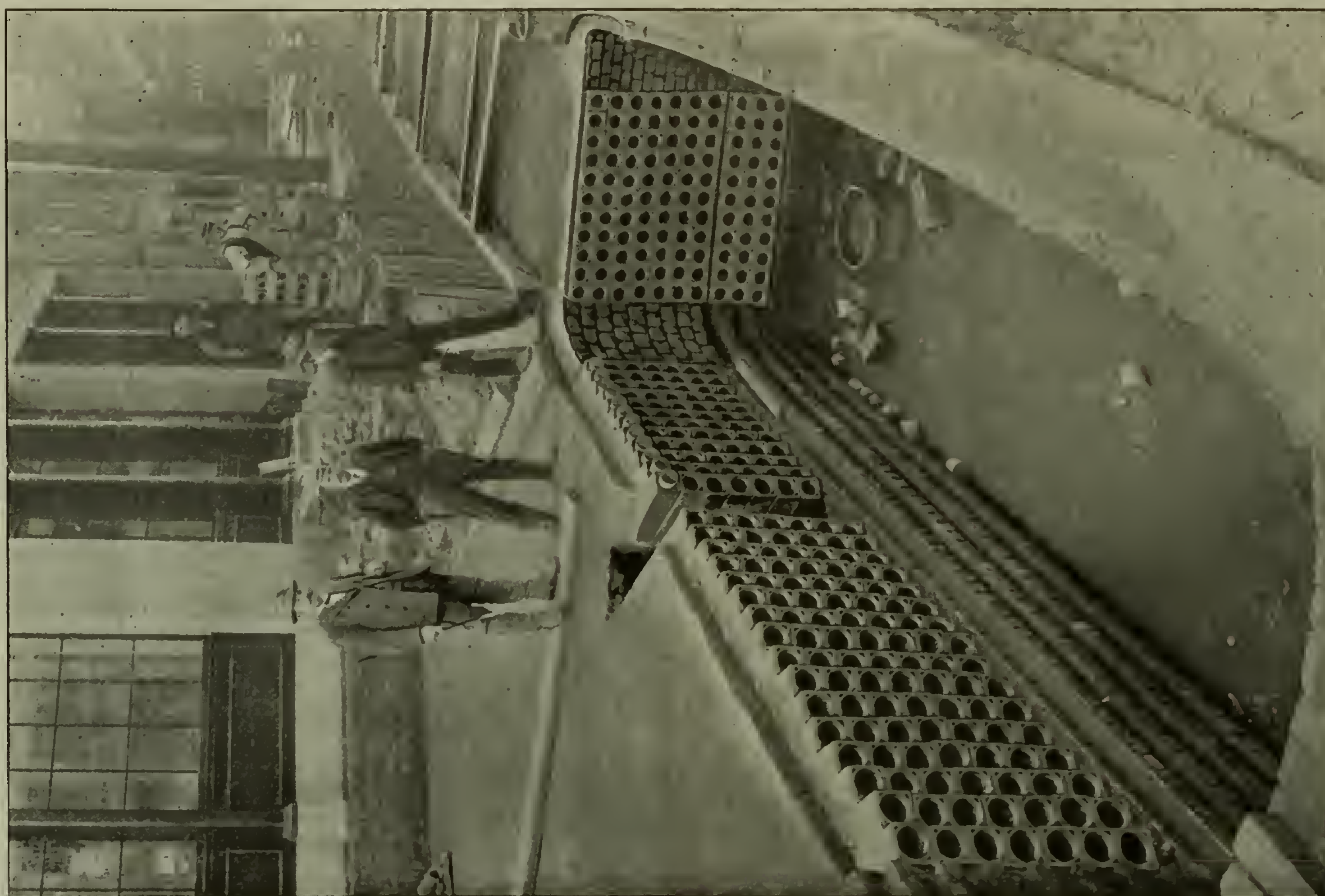
The first and most familiar method of securing electric power best known to small users is primary batteries. By means of dry cells and closed circut batteries local and continuous service becomes possible, electric bells and signals can be operated, and fan motors and motors to drive sewing machines, ice cream freezers, blacking brushes, etc., driven with the greatest convenience, but, unfortunately the latter class at an expense entirely incommensurate with the labor performed. In addition to the use of batteries current can be generated on the premises by means of a small power plant, consisting of either a gas engines and dynamo or small steam engine and dynamo, operating in conjunction with each other. Unless the supply of power required in the form of electrical energy is more than two horse power the first cost of the installation and subsequent expense of running will be too great to make this plant worthy of immediate consideration. In spite of this, however, many occasions arise where the financial question is not considered and fan motors and other motors for small power purposes are operated even at a comparatively heavy expense. The third method of obtaining power is of course well known to all city residents and that is by using the city mains through which power is supplied from a central station.

It is obvious from this brief review that the inefficiency of the first method, the expense and skill required for the second method and the inability of the majority of people to obtain current from the electric light main, if their homes are in side streets, by the third method shows how helpless that class is whose intention to use modern appliances is thereby frustrated. For this class of individuals the prolific inventor can offer little or no remedy. It is highly possible that an appliance in which a small amount of electricity can be cheaply, readily and conveniently generated will either be a primary battery, of still unknown construction necessarily, or a form of thermo-pile in which the ready transformation of heat into electricity immediately recommends its widespread use. The introduction of such a device in the household would immediately act as a tremendous stimulus to the trade in small power motors, electric heating and cooking devices and other machines of a similar class. The manufacturers of such apparatus would no longer construct for five per cent. of the population but would probably find themselves supplying machines in immense quantities to large houses to which the general public go for their husehold utensils.

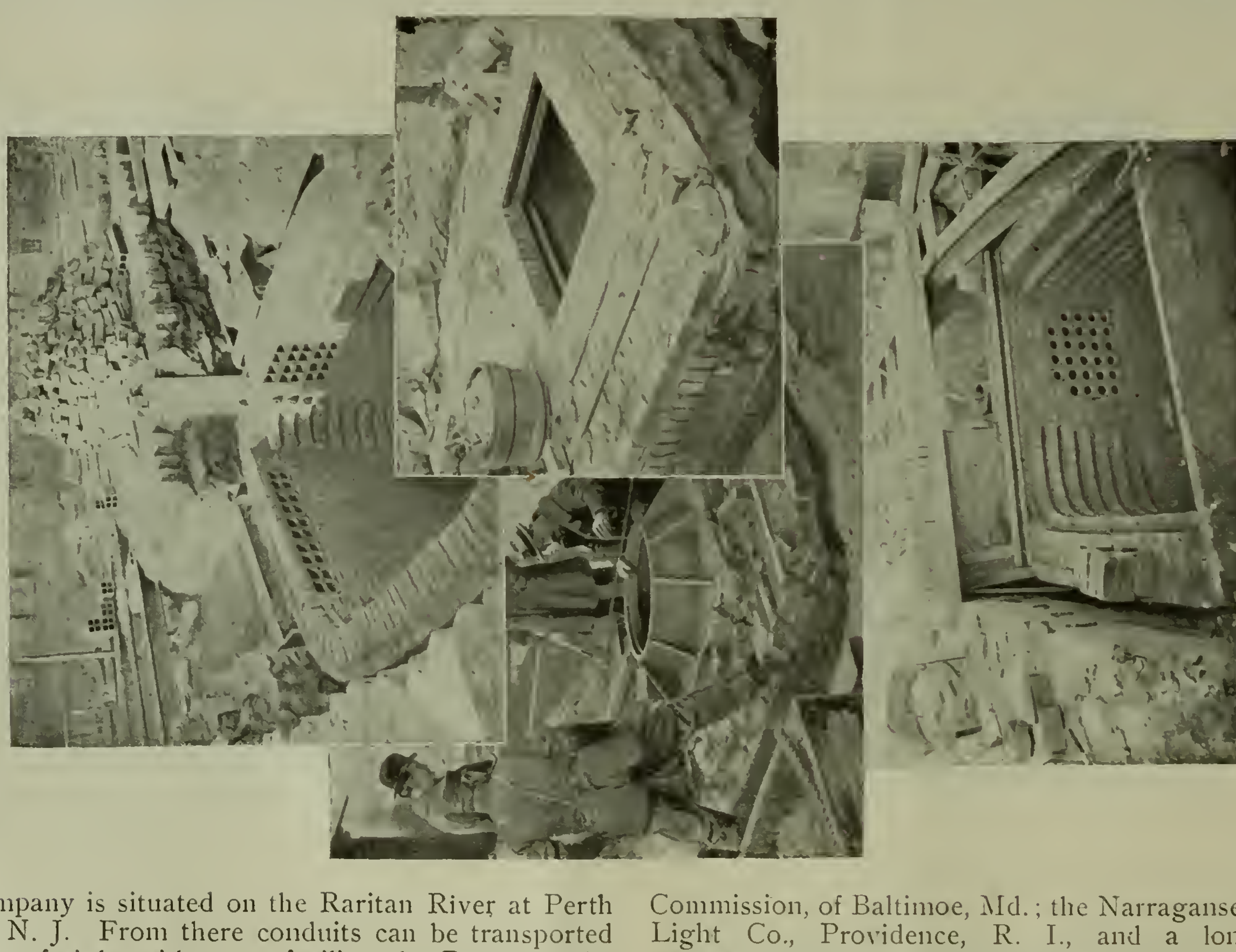
The automobile, electric delivery wagon and electric tricycle have appeared on a horizon already dotted with an endless variety of new and modern appliances. The sudden advent of the bicycle and its immediate popularity appeals to the great majority on account of its simplicity, inexpensiveness to keep in running order, and cheapness of operation. In a similar manner a variety of automatically operated vehicles will similarly appeal to those of the middle and upper class whose pockets are deep enough to meet the expense of purchasing one. Whether automobile or delivery wagon, the requirements in each case call for a source of electricity by means of which the storage batteries they at present carry can be readily charged. For this reason and purpose at present the central stations are inevitably called upon to supply the demand, but thousands of grocery stores, dry goods stores, butchers, etc., as well as breweries and express companies, would certainly invest in the automobile as it is did the owners of such establishments know for a certainty that the cost and care incident to the operation of these vehicles would be no greater than at present. To them the situation develops itself as follows: balancing the life of a horse against the period of usefulness of a machine; balancing the cost and care of a horse against the cost and care of an automobile. From these facts it would seem evident that to this great and increasing class of store keepers doing business in the city the expense and care incident to the operation of an automobile would become largely that of the cost of electric power. With this reduced to its lowest terms by the invention of a device for generating small power many complex problems would be solved.

conduit sections the conduits are centred with two dowel pins at each joint and then wrapped with a six-inch strip of asphalted burlap or with a six-inch strip of damp cheese cloth and given a coating of cement mortar. The above treatment is given to the multiple duct conduits, but single duct conduit joints do not require such treatment because being self centreing they are simply socketed into each other. The factory of the American Vitrified Conduit Company is situated on the Raritan River at Perth Amboy, N. J. From there conduits can be transported by ship or freight with every facility, the Pennsylvania, N. J. Central and B. & O. Railroads intersecting at this point. The officers of the company are R. C. Penfield, president; R. W. Lyle, secretary and manager, and W. J. Burke, treasurer.

The General Electric Company, of Schenectady, N. Y.; Edison Electric Company, of New Orleans, La.; United Electric Light Company, of Springfield, Mass.; the Western Union Telegraph Company, of New York; the Barber Asphalt Paving Company; the Electric Subway Commission, of Baltimoe, Md.; the Narragansett Electric Light Co., Providence, R. I., and a long list of other companies are among a few of the customers of this company. A recent test with twelve thousand volts,



Conduits Entering Man-hole at Sub-station.

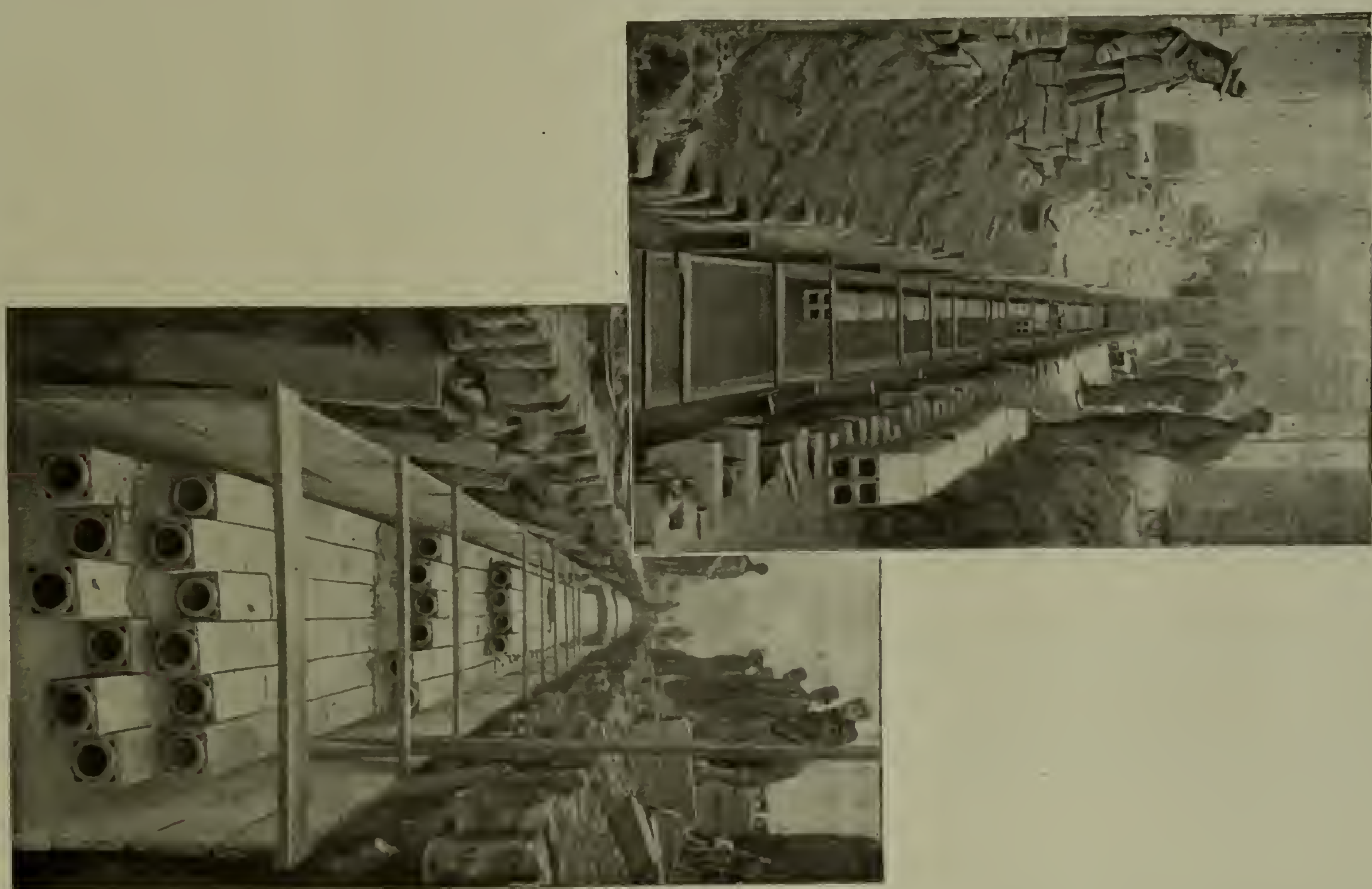


Man-hole Construction.

multiphase current, at the General Electric Company's works, at Schenectady, N. Y., shows that conduit was absolutely unaffected by the arc formed between the terminals of a fuse blown within the conduit at the above-mentioned pressure. "Also," the writer remarks, "I would

Conduits Illustrating Curve Construction.

state that our conduit in Schenectady is carrying three lead covered cables of a three-phase circuit running at 12,000 volts. It was installed during the month of July, 1898, and since then this circuit has been operated



Conduits at Providence, R. I.

continuously at the above potential, we having had absolutely no trouble in our conduit. We can therefore say that this material has proven itself in every way satisfactory."

Stray Currents.

WIRELESS TELEGRAPHY IN THE HAWAIIAN ISLANDS.

Marconi's system of wireless telegraphy is to be put in operation in Hawaii as a means of communication between the different islands of the group. An organization has been formed, capital has been subscribed for the project, and some of the material is already shipped.—Ex.

AUTOMOBILES IN THE POSTAL SERVICE.

Post Office Department officials expect to ask for an appropriation from the next session of Congress for the use of automobiles in collecting the mails at the first

Stray Currents.

FATTENING PIGS BY ELECTRICITY.

A Western college professor claims that he has discovered a method of fattening pigs by electricity. The process as near as can be ascertained consists in placing the animals to be treated in a cage, around which are strung a number of wires charged with electricity. It is hoped the professor will carry his investigation further, as many attenuated people are interested in his theory.—Ex.

CONDUITS TO SUPPLY CURRENT FOR STREET CARS ONLY.

A suit has been brought against the Metropolitan Street Railway Company of New York to restrain it from using it; conduits for any other purpose than to supply motive power for its cars. When the conduits were being built last winter it was generally thought that a greater number of ducts were being laid than would be required for carrying currents to operate the road and that the company proposed ultimately to dispose of any surplus power for lighting or other purposes. It is to prevent anything of the kind that the suit referred to has been brought.—Ex.

THE HISSING OF THE ELECTRIC ARC.

Mrs. Ayrton, the wife of the electrician, recently created quite a sensation by reading a paper on the hissing of the electric arc. The paper was an important one and has been highly commended by electricians. She appears to have demonstrated, according to the The Electrical World, that an arc hisses as soon as its cup overflows, that is, as soon as the crater in the positive carbon breaks its walls and the arc commences to ascend the side of the positive carbon. So long as the crater is kept within the sides of the carbon, or at the end of the positive carbon, the arc is silent, but the moment the crater expands so as to leave the end and cut into the side wall, the hissing promptly commences. The cause of this remarkable disturbance appears to be a rhythmical disturbance due to combustion. In the hissing arc air is able to gain more or less complete access to the highly heated surface of the crater and this is accompanied by a direct combustion of the carbon at the crater's surface, with semi-rhythmical rapid alternate heating and cooling. The paper is worthy of study, as showing how a subtle and apparently complex phenomenon may be explained and elucidated by systematic research.—Ex.

ELECTROTYPES OF IRON.

It has been disclosed that the Austrian and Russian Governments print their bank notes from steel faced electrotypes made by the electrolytic deposition of iron from a bath prepared according to the formula of Klein (ferrous and magnesium sulphates) under special conditions of temperature and current-density. This latter must be very small, inasmuch as a plate only 2 millimeters in thickness requires one and a half months for its deposition.

The thin iron electrotypes prepared according to this method are backed in the usual way (with stereotype metal?).

According to Herr Haber, in the Zeit. f. Elektrochemie, the advantage of plates prepared in this way lies in the fineness and hardness of the metal, which is first deposited, and in the delicacy of the copy of the original which is thus obtained.

The usual plan of preparing such printing plates—so-called steel-faced plates—is to obtain first a copper electrotype of the original, and then to face this with iron by suspending it at the cathode in the above-named electrolytic bath of Klein, or its analogue. The author declares, however, that the printing results obtained are not nearly so good as when the first method is employed.

A serious disadvantage of the all-steel electrotypes, however, is that they can only be renewed by repeating the entire process of electroyping, while the iron-faced copper plates can have their faces renewed in a few minutes.—From the Journal of the Franklin Institute.

A TRIUMPH OF WIRELESS TELEGRAPHY.

The upshot of this year's British naval manoeuvers is that while the weather spoiled a good part of the main programme, an auxiliary appliance, wireless telegraphy, came to the front and carried of a large share of the honors.

In the plan, as we recently noted, a convoy of British grain ships was crossing the Atlantic, and was to wait at a preconcerted rendezvous for a British squadron (B) to go out from Milford Haven and protect it; but meanwhile a hostile squadron (A) went out earlier from Belfast, supposed to be hostile territory, in order to discover its whereabouts and capture it.

From the fact that Vice Admiral Rawson, with fleet A, received a start of nineteen hours, and had the faster fleet at that, it is evident that the Admiralty desired that he should have an excellent opportunity of finding the convoy; for even then, Vice Admiral Domville, with fleet B, since he knew the place of the rendezous, which was 350 miles due west of Bantry Bay, would have an equally fair chance of intercepting A on its way back to Belfast, burdened by the slow convoy. B, too, was superior in battleship strength, so that if A could have captured the convoy, there might have been exciting subsequent manoeuvers. But a forty hours' fog, by preventing A from getting the full use of his scouts more than overbalanced the nineteen hours' start. A could not find the convoy in the fog, and B, though slower, and starting later, reached the rendezvous unmolested, and escorted the convoy safely to Milford.

But while the fog made the conditions unexpectedly one-sided, a great triumph was won by wireless telegraphy. Three vesels of fleet B, the Europa, the flagship Alexandra and the Juno, on which was Signor Marconi himself, were fitted up with wireless telegraph apparatus. The cruiser Europa, which had been sent ahead, telegraphed to the Juno that she had sighted the convoy and was on her way back to the Admiral with the news. The Juno thereupon herself turned back, and when thirty miles from the Alexandra repeated the message of the latter. At that time the flagship, says the account, was about 30 miles from the Juno, 55 miles from the Europa and 86 from the convoy. Four hours later the fleet and the convoy met, having meanwhile been moving towards each other, the former at 12 knots and the latter at nine. This was the great service of the wireless telegraph, but there were minor services no less successfully performed, and the triumph was the greater as the apparatus was somewhat temporary.

In general the Admiralty is pleased, no doubt, with the result of the manoeuvers, since although the conditions proved more unequal than was intended, the British fleet did its work well, and saved its grain convoy. Again, B's auxiliaries were destroyers, while A's were torpedo boats and some of the accounts indicare that the former were the more successful. But, after all, the man whose fame was most enhanced was Marconi.—N. Y. "Sun."

MARCONI'S LATEST PATENT

In a former issue we made note of the latest patent which had been issued to Mr. William Marconi, the famous Italian experimenter in wireless telegraphy. In the specification of a former patent granted to Marconi, he described a receiver in which the ends of an imperfect contact in a local circuit were connected one to earth and one to an insulated conductor. According to this invention the conductor is no longer insulated, but is connected to a capacity, which may be the earth through the primary of an induction-coil, while the ends of the imperfect contact are connected to the ends of the secondary one of the connections, being through a condenser.

The induction-coil preferably consists of a few turns of insulated wire. Over or under this winding, which constitutes the primary, is wound a secondary winding, which constitutes the secondary.

In order to obtain the best effects, it is essential that the induction-coil should be of very thin wire. It is desirable that the primary and secondary windings of the coil should be close to each other and that the windings of each should be in a single layer. It is desirable that the induction-coil should be in tune or syntony with the electrical oscillation transmitted, the appropriate number of turns and most appropriate thickness of wire varying with the length of a wave of the oscillation transmitted.

The capacity of the condenser on the connection between the imperfect contact and the secondary of the coil should be varied (in order to obtain best effects) if the length of wave is varied.

It is desirable that the conductor connected should offer a large surface, and therefore the use of such materials as broad wire-netting in lieu of a wire is desirable. It is also desirable to employ thick conductors or netting or its equivalents at the transmitting end. The introduction of the coil in the conductor not only improves the signals, but also prevents to a great extent any interference due to atmospheric influences, as any atmospheric electricity collected by the aerial conductor escapes to earth through the primary of the coil, thus preventing a charge from accumulating and discharging itself through the imperfect contact. Any stray interference can be further minimized by substituting a suitable capacity for the earth. A condenser of about one-fourth microfad capacity is used for the above purpose.

ACETYLENE GAS EXPLOSION AT WABASH, INDIANA.

The Sun says that the experiment of the Logansport and Wabash Valley Gas Company in using acetylene gas for municipal lighting in this city ended disastrously last night, when the gas works were blown to pieces. Nothing is left of the building or apparatus. The company will be unable to supply its patrons with gas for some time. Windows in all parts of the city were shattered by the shock. Duncan Edwards, one of the employes, was slightly injured. This was the first experiment made on a large scale with the new gas.

A NE WELECTRIC STREET RAILWAY MOTOR.

A press dispatch from Syracuse states that Benjamin S. Lawlor of New York, who constructed the engines of the battleship Maine, has invented an electric motor which it is declared will effect a saving of 25 to 30 per cent. in the cost of propelling street cars. As at present applied, there is a great waste of electricity. Mr. Lawlor uses electricity to compress air and the compressed air air to run the car. The air compressed is on the car and is managed by the motorman. Overhead or underground trolley connections may be used.

CHANGES IN THE FACULTY OF THE WORCESTER POLYTECHNIC INSTITUTE.

Prof. Wm. Ames, who has resigned from the chair of machine design of the Worcester Polytechnic Institute has been succeeded by Prof. Forest R. Jones, of Madison, Wis. Prof. Albert Kingsbury, of Durham, N. Y., has taken the chair of applied mechanics.

BIDS OPENED FOR THE NEW ELECTRIC LIGHT PLANT AT THE BROOKLYN NAVY YARD.

Bids for installing an electric light plant at the new machine shop at the Brooklyn Navy Yard were opened at Washington on August 8th. The bids ranged from $120,000 to $160,000 and covered the engines, boilers, dynamos, cranes, etc. The Westinghouse Electric and Manufacturing Company and the General Electric Company were the two most prominent bidders. It will probably be two or three weeks before the successful bidder will be named owing to the number of bids and the necessity of carefully examining all the papers and the accompanying plans.

TELEPHONING WITHOUT WIRES.

Experiments in wireless telephony have been made on the Italian gunboat Scilla, in the gulf of Genoa, in the presence of scientists and naval experts. The inventor is a Sicilian professor, Signor Mario Russo d'Assar.

Concerning the invention and the trials which have been made, a translation of an article in L' Italia Marinare, which is confirmed by official reports is given:

"It is well known that transmissibility of sounds is in direct ratio to the density of the means through which they are transmitted. It is equally well known that water is an excellent means for transmitting sounds to a distance. It has been noticed that a bather immersed in water hears with great distinctness the sound of a steamer's engine in motion, because the water in which the latter is immersed is in a special state of vibration, owing to the movement of the engine and the screw actuated thereby.

"From these principles the inventor derived the conclusion that if the ear could seize these vibrations of sound, an instrument of great sensibility functioning below water would be susceptible of seizing them at a greater distance and with greater distinctness, and became convinced that a telephone apparatus should be the point of departure for obtaining the practical means of signalling between two vessels. The water would take the place of the wires. It was necessary, first of all, to construct a sound receiver which would perfom the functions of the ear below the surface of the water, then another apparatus that would increase the sounds received and indicate the direction whence they come.

"The telephone apparatus is composed of the part which is placed on the conning bridge and the one which is secured to the ship's side and is immersed in the water, from which it receives the vibrations produced by the engine of motion of another vessel, and transmits them in increased volume to the telephone apparatus.

The submarine receiver is a kind of box secured to the hull, with a number of depressions, so as to receive the sounds from all directions. From the centre of each of these an electric wire leads to the telephone, which latter contains an ingenious mechanism based on Edison's well-known scientific principles. A dial plate on a board is divided into two part corresponding to the two sides of the ship. Two hands indicate the direction of the steamer signaled. A system of bells at the upper part of the dial-plate and one of the receivers on the board indicates by sound with the greatest distinctness the rythm of the screw of the distant vessel.

When coming within seven kilometres of a steamer the hand of the telephone turns and indicates the direction of the vessel and follows its route, while the bells and receiver beat simultaneously the cadence of the distant screw. The noises of the vessel on which the apparatus is located cause no disturbance, because, owing to the special construction of the submarine receiver, they are not transmitted.

Commander Richard Clover, chief of the Office of Naval Intelligence, says, that the invention has received a great deal of attention abroad and contains elements of success. If it is found practical it may be used in the American naval service."

Line Construction Methods.

THE PROTECTION OF SECONDARY CIRCUITS FROM FIRE RISKS.

BY CARY T. HUTCHINSON.*

The best protection of secondary circuits from the dangerous consequences of an abnormal potential in these circuits, has long been the subject of discussion. In the early days when the house-to-house transformer system was general, many fires were caused by the failure of the insulation between the primary and secondary coils of transformers; this was then the chief cause of such accidents. No secondary distributing networks were then used, and consequently fires following a failure of insulation were confined to the circuits from the single transformer; it was unusual for a wide-spead fire to occur, and public attention was not as strongly directed to the matter as it has been of late.

In the last few years the use of alternating current systems has increased greatly; individual transformer systems have been replaced in many places by the use of "banked" or "grouped" transformers, with secondaries feeding a low-pressure distributing network. Such systems are now in operation in many places in the country, and their number is increasing. The secondary distributing networks may be of two, three, or more wires, the latter for two or three-phase systems. The secondary circuits in all such systems are directly liable to the incursion of the high primary pressure through the failure of the insulation at some point.

In addition to alternating current systems, there is another class of distributing systems subject to the same dangers—systems in which transformation is made from high to low pressure alternating current, and thence by means of synchronous converters to low-pressure direct current for distribution. The use of such systems is growing rapidly; many of the Edison illuminating companies are already employing it, and it is a safe prediction that all the large companies will be obliged to adopt methods of this character in the near future.

Such a system has precisely the same conditions of insulation between the low-pressure direct current distributing mains, and the high pressure alternating current feeders, as a plain alternating current system, since the low-pressure side of the alternating current supply is connected metallically to the armature of the sychronous converter which feeds the low pressure direct current distributing system. In a word, there is only one insulation between high pressure alternating current feeders and the low pressure direct current network; hence such a system is liable to precisely the same risks as is the straight alternating current system.

There are a number of ways in which the high pressure alternating potential can get to the secondary system. The most obvious is the failure of the insulation between the primary and secondary coils of the transformer; another is the contact of the high pressure feeder and the low-pressure distributing main which may run on the same pole line, or in the same conduits underground. Wires that in ordinary circumstances seem to be secured beyond the possiblity of contact may be brought into contact through unusual conditions, as in a heavy storm. or by foreign wires falling across them.

The effect of the failure of insulation, however caused, depends upon the condition of the secondary system. A brief statement of the various possible consequences may help to make the matter clear.

Any circuit, overhead or underground, carrying alternating currents, is a condenser, of which the capacity depends upon the point of view. In an overhead circuit, there is a certain capacity between the two wires, considered perfectly insulated, each as the plate of a condenser; there is also the capacity of each of these wires referred to earth, each wire being regarded as one plate of a condenser, and the earth as the other plate. The capacity in the first case fixes the difference of potential between the two wires for a given charge, or conversely, regarding the earth as one plate of the condenser, fixes the charge. The capacity in the second case—that is, regarding the earth as one plate of the conrenser, fixes the potential of the wire above or below that of the earth for a given charge, or conversely. The capacity in these two cases need not have the same numerical value.

The same general considerations hold in the case of underground conductors; there is the capacity between wires determining the difference of potential between the wires, and the capacity of each wire and earth, determining the difference of potential between that wire and earth. The difference of potential between wires of a circuit transmitting energy is fixed, and the capacity is determined by the dimensions of the circuit hence the charging current is fixed. This charging current is the current on the system when no energy is transmitted and there is no leakage.

Calling V^1 and V^2 the potentials above and below the earth respectively of the two wires, and C^1 and C^2 their capacities, the equation

$$\frac{V^1}{V^2}=\frac{C^2}{C^1}$$

will hold in all cases. If one wire is connected to ground, that is, if capacity C^1 becomes infinite, the potential V^1 becomes zero. Under ordinary circumstances, the capacities of the two wires are substantially the same, and the potentials, so far as determined by the capacities, are equal and of opposite signs with respect to the earth.

Leakage over the insulators to earth has a similar effect, tending to fix a relation between the potentials of the two wires and the earth; that is, it tends to maintain the potential of the two wires at a certain value above or below the earth, but in no way affecting the difference of potential between the two wires.

Calling the conductance of the two leakage paths to ground G^1 and G^2 the equation

$$\frac{V^1}{V^2}=\frac{G^2}{G^1}$$

holds, and if G^1 is made infinite, or one side is grounded, the potential of that side becomes equal to the potential of earth. If the conductance of the leakage paths on the two sides of the circuit is the same, the potentials tend to become equal and opposite with respect to the earth.

The resultant effect of leakage currents and of the static capacity of the overhead system tends to cause the potential of the two wires to become more or less approximately equal and of opposite sign with respect to the earth when the circuits are symmetrical and insulated. In a circuit having a difference of potential of 2000 volts, the difference of potential between either wire and the earth is 1000.

The primary circuit then forms a condenser; any insulated conducting body in contact with either of the primary conductors, becomes a part of that conductor, and therefore part of one plate of the condenser, and at once acquires the potential of the wire with which it is in contact; that is, if an insulated secondary system is by any means brought in contact with an insulated primary system in which the potential difference is 2000 volts, this secondary system at once acquires a potential of 1000 volts above the earth. If the secondary system in addition has an electromotive force acting in its own circuit, then the difference of potential between this secondary circuit and the ground is increased or diminished by the voltage of its own circuit; in the extreme case, and difference of potential of 1000 volts plus the voltage of the secondary circuit, (say 100 volts) would exist, or, in all, 1100 volts between one side of the secondary circuit and

*Read before the American Institute of Electrical Engineers.

ground; between the other side and ground the difference of potential would be 1000 volts. It is important to note that this difference of potential exists when the primary circuit is insulated. While this is true, it is also true that no current other than the charging and leakage current of the system can pass through the secondary system unless the primary system is grounded on the side opposite to that making contact with the secondary system. The charging current of the condenser will be practically inappreciable in all cases. For instance, at a frequency of 60 cycles per second, with a primary pressure of 20000 volts, the charging current is only three-fourths of an ampere for each microfarad capacity of the primary system. As the capacity of the primary system will probably be a fraction of a microfarad, it is clear that the passage of this current through the secondary system cannot possibly be the direct cause of danger.

The danger then lies, not in the application of an abnormal pressure to a well insulated secondary system, but in such application to a secondary system where the insulation is too weak to stand the stress brought upon it. In ordinary house wiring systems designed for, say, 110 volts, the application of 1000 volts may or may not break down the insulation from ground, depending upon the care with which the work was done and the goodness of the materials used. If the insulation of the secondary system from ground breaks at only one point and if the break is of such a character as to dead ground the secondary, then the abnormal pressure is at once relieved; the maximum potential above the earth that can exist on the secondary system as soon as this ground is formed, is the voltage of the secondary system; the moment the ground is formed, the danger is removed,—abnormal current cannot flow and consequently no fire can begin.

Assume, however, that the insulation of the secondary system is broken down at two or more points on opposite sides. In this case a short circuit is formed of resistance varying between zero and some higher value. The electro-motive force acting in the secondary circuit, either alternating or direct, sends current around this short circuit, in amount depending upon the resistance of the short-circuit. The current continues to flow until the grounds are entirely removed, or until the circuit is isolated, by fire or otherwise, from the source of supply. This abnormal current flowing around the short-circuit causes the fires; at every point where the current flows to ground, more or less energy is liberated in the form of heat, and fires will occur if local circumstances are favorable. The application of an abnormal pressure to the secondary system, in all probability will break down the insulation of the secondary system at several places, and these places will be distributed between two sides of the secondary system, as a matter of probability.

If the primary circuit is grounded on one side, and contact is made between the grounded side and the secondary, no harmful consequences can follow. If contact, however, is made between the insulated side and the secondary system, the full difference of potential of the primary will exist between the secondary and the ground, —that is, twice the difference of potential that existed in the case of the insulated primary. To all intents and purposes, the difference in effects caused by grounding one side of the primary circuit, will not be material. One-half of the difference of potential of the primary circuit will probably be as effective as the whole.

Although alternating current electric lighting systems have been in use in this country for a number of years, no definite practice has been followed for the protection of secondary circuits. The chief improvements that have been made in the art, have been in the character of the insulation between the primary and secondary coils of the transformer. After careful investigation as to the present practice here, I am in a position to say that in practically no case is any device regularly used to protect secondary circuits against abnormal pressure. A number of station managers have attempted to use, and in a few cases have used, devices such as I am about to describe, for a short time. The outcome of all such work has been, in general, unsatisfactory. The need of some effective method for protecting secondary circuits is well recognized, yet there is at present probably no device for the purpose that is thoroughly trustworthy and efficient in all circumstances.

The means that have been employed for this object, may be classified generally under three heads:

1st. Devices intended to ground, short-circuit or open circuit the secondary circuit when subjected to an abnormal difference of potential.

2d. Grounded metallic shields interposed between the primary and secondary coils of the tranformer.

3d. Permanent grounding of the secondary system.

Under the first class are the Cardew earthing device, in which a flexible metal strip is attracted to a fixed ground plate by the action of the abnormal potential, thus grounding one or both sides of the system; the Thomson film cut-out, in which an insulating film designed to withstand the working pressure, but to puncture at an abnormal pressure, is connected on one or both sides of the circuit between two plates, one connected to the conductor, the other to earth; the Stanley automatic circuit breaker, in which a flexible metal plate is attracted by the abnormal pressure to a fixed plate, thereby closing a local circuit through a solenoid, which acts to open the main switch on the secondary circuit; and others of similar character.

These devices all have one fundamental weakness,—they do not prevent the existence of the abnormal potential, but merely aim to remove it quickly; they all require time to act,—the secondary system acquires the abnormal potential at all points at the same instant, and there is no certainty that the insulation of the circuit, say at a combination fixture, may not give way before the device acts. Further, those that act to ground and to short-circuit the secondary, depend upon the blowing of fuses before the cause of danger is removed; those that disconnect are subject to all the criticisms brought against high voltage quick-acting switches,—in particular, the maintenance of the arc.

I believe that all devices under this class are, at best, temporary makeshifts.

The grounded shield is obnoxious to various criticisms, —it is not effectual with a cross outside of the transformer, and therefore is of no value in many cases; it must be heavy enough to dissipate the energy of the short-circuited primary quickly; otherwise it melts and is itself the cause of a fire; it degrades the transformer, tending to cause unsatisfactory service, particularly in the regulation.

The third method, grounding the secondary permanently, is the only sure way to prevent the potential above earth of the secondary system rising above the voltage of the circuit. With a system grounded on one side, the maximum difference of potential that can exist between any point of this system and earth under any circumstances, is the voltage of that circuit. No cross nor any failure of insulation of the primary or secondary circuits, can raise the difference of potential between the secondary circuit and ground above this. That side of a primary circuit touching a grounded secondary circuit, at once acquires the potential of the ground or a potential differing from that of the ground by the voltage of the secondary circuit. The grounding of the secondary circuit thus absolutely insures the safety of the circuit as regards abnormal pressures; it makes permanent the condition that the various protective devices seek to establish,—devices that may or may not work, depending on many conditions.

It would seem that a remedy as simple as this,—one generally applicable,—would have been applied in all cases; but the fact is that it has attained a limited use only. The reason for this state of affairs is the refusal of the Board of Fire Underwriters to authorize the practice of grounding any part of a circuit carrying current. The underwriters take the position that to ground one side of a circuit brings about an increased liability to fire, because the full voltage of the circuit continually acts upon the insulation of the circuit, instead of one-half of this voltage, as in an insulated system, and because one accidental ground on the insulated side may cause an arc. The danger with grounded circuit is said to be increased by the fact that the full voltage of the circuit instead of one-half acts upon the insulation of the insulated side. This argument implies two things: first, that insulation good enough to withstand halt the voltage of the circuit; or, that danger would be materially increased by having the full voltage of the circuit on the insulation, instead of one-half. This is contradicted by the fact that the underwriter's rules class all circuits having a difference of potential of 300 volts or less as ow potential, to which the same rule applies. That is, in the case of an insulated 110-volt circuit, which means 55 volts on the insulation of each side, the same rules hold as in the case of 220-volt circuits, with 110 volts on the insulation of each side.

If the 110-circuit had one side grounded, there would then be 110 volts on the insulation of the ungrounded side. It is true that the classification ostensibly permits only 150 volts on the insulation of one side of the circuit; hence, if one side of a 220-volt circuit is grounded, the stress brought upon the insulation is greater than is seemingly permitted; but as a matter of fact, the factor of safety in work of this kind is much greater than called for by this slight difference. There is no doubt that a wiring system properly installed in accordance with the rules laid down by the underwriters, is perfectly safe with 300 volts on the insulation on one side, and practically speaking, it is just as safe with 300 as with 150 volts; if the former would cause trouble so would the latter. I have assumed that one conductor of a two-wire system is grounded. If the middle point of the secondary coil of transformer be grounded instead of one wire, then the stress on the insulation is in all cases one half of the voltage of the circuit, precisely as in the case of the grounding of the neutral of a three-wire system, mentioned below.

The main objection brought against grounding is, however, not the increased stress brought to bear upon the insulation, but the fact that only one additional ground is required to establish conditions favoring a fire. The argument is, that the simultaneous existence of two grounds on the opposite sides of the circuit is less probable than the occurrence of a single ground on the insulated side of a grounded circuit.

I do not consider these arguments strong for several reasons. In the first place, they imply that an indefinite condition as regards the insulation of the circuit is preferable to a clean-cut, definite condition. Circuits supposably insulated may or may not really be so, and as a matter of fact the full stress may be, and frequently is, on one side of the circuit; the very condition that the underwriters refuse to sanction is continually occurring without such sanction.

The Association of Edison Illuminating Companies has had a Committee on Grounding the Neutral since 1890. The recommendations of this Committee being based on extensive experience are entitled to great weight. Their recommendations have uniformly been that the greatest safety was assured by the practice of grounding the neutral. This is the practice of nearly all the large Edison companies,, as is well known. In some cases, the companies have been forced to this position because they were not able to free the neutral from grounds; in other cases they have deliberately adopted this as the best remedy for many troubles due to operation, to dangers from fire, and to abnormal pressures.

This Committee has claimed at all times that grounding the neutral has the advantage of "Reduced fire risk, since a ground created inside a building will, if on the neutral conductor, be in no danger, while if on the outside conductor it will probably fuse a safety catch, or do all the damage of which it is capable at once, and not remain inactive until the appearance of a subsequent ground on the opposite side of the system, at a time, perhaps, when no person may be on hand."

"Also, that the electrical pressure capable of causing damage by reason of any ground established, either in tubes or in buildings, is limited to 120 volts, whereas the active pressure might otherwise be 240 volts; and for overhead circuits greater immunity from lightning."

The disadvantages reported by this Committee are possible troubles in operation, particularly in regulation and excessive registration on the meters, but no increased risks are foreseen. The Committee has made its reports in face of the fact that the underwriters have uniformly refused to countenance the practice.

It is a notorious fact that the systems in nearly all of the large cities, particularly the Edison systems, are grounded, the neutrals in most cases being permanently grounded at the junction boxes. It is equally well known that in several of the large alternating current distributing systems, the neutral wires are grounded. The authorities of the Board of Underwriters certainly should, and probably do, know these facts. To keep rules in print prohibiting such practice under the circumstances, must weaken their authority, and lessen the respect for all their rules.

The rule against grounding the circuit is not the only one that is ontinually violated, and, by inference with the knowledge of the Board of Underwriters. The second is that which calls for double insulation between primary circuits carrying 6,000 volts or more, and secondary house-wiring systems. I protested against this rule when it was promulgated, citing cases where it was violated at that time, and saying that it would without doubt continue to be violated. It is violated in every large city employing alternating current distribution with synchronous converters feeding a direct current distributing system, as for instance, in Brooklyn, New York and Boston, not to go further. Such a rule is vicious in its tendencies, and should unquestionably be modified.

In this discussion alternating and direct current systems are considered subject to the same risks; this is the case now in the large cities where synchronous converters are used; but in any event, the arguments outlined will apply to any system subject to an abnormal potential, whatever may be the cause.

This is a matter that concerns every electrical manufacturing company and engineer in the country; this Institute has recently taken part in the formation and modification of rules governing electric installations and has endorsed the National Electric Code. Therefore, it is entirely in the province of this body to make recommendations as forcibly as it may see fit to the Board of Underwriters. I therefore offer the following motion:

That the Committee of the American Institute of Electrical Engineers on the National Electric Code is hereby directed to urge upon the National Board of Fire Underwriters, the passage of a rule permitting the permanent grounding of one wire of every distributing system, and the abrogation of the rule that "Secondary wires must be installed under rules for high potential systems, when their immediate primary wires carry a current at a potential of over 3,500 volts, unless the primary wires are entirely underground."

New York, June 13, 1899.

WIRELESS TELEGRAPHY IN THE HAWAIIAN ISLANDS.

Marconi's system of wireless telegraphy is to be put in operation in Hawaii as a means of communication between the different islands of the group. An organization has been formed, capital has been subscribed for the project, and some of the material is already shipped.—Ex.

AUTOMOBILES IN THE POSTAL SERVICE.

Post Office Department officials expect to ask for an appropriation from the next session of Congress for the use of automobiles in collecting the mails at the first class post offices. The purpose is to ask permission to use the appropriation of $410,000 for horse hire allowance. The recent tests in Buffalo have satisfied the Washington officials that they may be used to advantage.—Ex.

Business News.

THE E. T. PAULL MUSIC COMPANY.

We wish to call the attention of our readers to the special half page "ad" in this issue of the E. T. Paull Music Company, who have fitted out and equipped one of the best phonograph plants for making original master records to be found anywhere in the trade. A cut of the building which this company occupy will be found in their advertisement. The E. T. Paull Music Company are one of the largest and most successful music publishing firms in New York City, and as such are known all over the United States by the music dealers. Mr. E. T. Paull, the head of the concern, has the reputation of writing the most popular marches of the present day. He has won pronounced fame on his "Ben Hur Chariot Race March," "Charge of the Light Brigade March," "America Forever March," and other marches, the sales of which run largely in the hundreds of thousands. It is the purpose of the E. T. Paull Music Company to make only original master records. They claim with the approved appliances at their command, and the "up-to-date" plant they have established, to be able to sell a better record at a lower price than any one else; their facilities are of such a character as to enable them to do this. They have been particularly fortunate in securing such men as Charles Clinton Clark, who has no peer in the matter of singing coon songs which at present are having a universally large sale. Mr. Clark will sing for this company exclusively, and it is safe to say that his records will become the most popular on the market. Mr. A. J. Loiselle is also connected with this company. Mr. Loiselle was employed for several years in the largest factories, operting machines for the manufacture of records, and he is probably one of the best men in the business. He will have charge of the machines used by this company, and being an expert in this line, the very best possible results may be expected. Mr. Charles Jerome Wilson is also connected with this company. Mr. Wilson is what may be termed an old time phonograph man. He had charge of the laboratory of the North American Phonograph Company for the manufacture of records. With such men as these, it is only natural that the E. T. Paull Music Company will place on the market records that will have no superior. It will pay any one interested in records in any way to glance over their advertisement in this issue, and it will be well, as a matter of curiosity if for no other reason, to send for a sample order, which they agree to supply at a special low price, simply to show the character of their goods.

Total Amount of Electrical Exports From New York for Week Ending August 1, 1899, $4,783.00.

New York, N. Y., August 1, 1899. The following exports of electrical material are from the port of New York for the week ending this date:

Antwerp—84 packages electrical material, $3,245.

British West Indies—15 packages electrical material, $2,778.

British Possessions in Africa—1 case electros, $11; 12 packages electrical material, $369.

British Guiana—9 cases electrical material, $350; 3 carriages, $810; 7 packages electrical material, $23.

Brazil—55 packages electrical material, $2839; 11 packages electrical machinery, $992.

Central America—24 packages electrical material, $1,315.

Cuba—4 boxes electrical machinery, $82; 30 packages electrical material, $970.

Dutch West Indies—1 case electrical material, $50.

Dublin—33 electric cable reels, $9,612.

Ecuador—6 packages electrical material, $80.

Glasgow—6 cases electrical material, $152.

Genoa—12 cases electrical material, $1,562; 1 case electrical machinery, $500.

Hamburg—39 cases electrical material, $1,999.

Hayti—8 packages electrical material, $113.

Havre—16 cases electrical material, $621; 47 cases electrical machinery, $10,902.

Liverpool—52 cases electrical material, $4,422; 4 cases electrical machinery, $365.

London—117 cases electrical material, $1,830; 21 cases electrical machinery, $935.

Mexico—12 packages electrical machinery, $10,000; 26 packages electrical material, $636.

Marseilles—20 cases electrical material, $233.

Nice—58 packages electrical material, $14,148.

Naples—5 packages electrical material, $128.

Newfoundland—4 cases electrical material, $66.

Oporto—19 cases electric motors, $2,588.

British Possessions in Africa—2 cases electrical material, $4,218.

Peru—26 packages electrical material, $993.

St. Petersburg—6 cases electrical material, $185.

U. S. of Colombia—11 packages electrical material, $342.

Vienna—11 packages electrical machinery, $3,110.

Venezuela—421 packages electrical material, $1,206.

NEW INCORPORATIONS.

Brooklyn, N. Y.—G. B. Cornell Co. has been incorporated by G. B. Cornell, J. Huber and O. Huber; manufacturing electrical machinery and supplies. Capital stock, $5,000.

Porterville, Cal.—Porterville Light and Power Co. has been incorporated by W. H. Hammond, A. G. Wishon an others; to buy and dispose of electric power. Capital stock, $10,000.

Tuxedo, N. Y.—Tuxedo Electric Light Co. has been incorporated by Pierre Lorillard, Jr., R. Talbot and others; electric lighting. Capital stock, $80,000.

Kittery, Me.—The Hatch Accumulator Co. has been incorporated by G. E. Hatch and J. Middleby, Jr., manufacturing and dealing in electrical supplies. Capital stock, $1,000,000.

Portland, Me.—Massachusetts Manufacturing Co. has been incorporated by E. A. Hall, W. A. Nutting, O. B. Johnson, J. A. Saunders and others; manufacturing electrical appliances. Capital stock, $25,000.

St. Petersburg, Fla.—The St. Petersburg Electric Light and Power Co., incorporated by Frank A. Davis, E. Irem, C. Davis and others; for furnishing light, power or heat by electricity, etc. Capital stock, $13,000.

Huntsville, Ala.—The Huntsville Electric Light Co., incorporated by T. C. DuPont, John H. Waters, N. F. Thompson and F. J. Thompson.

Commerce, Tex.—The Commerce Electric Light Co., incorporated by W. B. De Jarnett, T. U. Thompson, L. W. Rutland and others; to construct and operate an electric light plant. Capital stock, $10,000.

Shreve, Ohio.—The Shreve Electric Light and Power Co., incorporated by E. K. Gardiner, Elizabeth Gardiner, L. M. Gardner, H. J. Good and C. M. Gardner; to furnish heat and light. Capital stock, $8,000.

TELEPHONE CALLS.

Easton, Pa.—United States Long Distance Telephone Co. has been incorporated with a capital stock of $1,000.

Tom Bean, Tex.—The Tom Bean and Sherman Telephone Co. has been incorporated with a capital stock of $1,500.

St. Louis, Mo.—The Kinloch Telephone Co. has been incorporated with a capital stock of $5,000; to operate a telephone line. Capital stock, $5,000.

Columbus, Ohio.—Franklin Telephone Co., incorporated by F. A. Davis, H. D. Critchfield and others; to construct and operate a telephone exchange. Capital stock, $50,000.

Vanceburg, Ky.—The Vanceburg, Kinniconic and Carter Telephone Co. has been incorporated by R. D. Wilson and others. Capital stock, $700.

Farmville, Fla.—Venable and Vanderslice are constructing a telephone system.

Columbus, Ohio.—National Telephone Co., incorporated by P. H. Bruck, W. J. Dusenbury, J. J. Dun, G. W. Dun and L. P. Stephens; to construct and operate a telephone exchange. Capital stock, $10,000.

Hallsboro, Va.—Chesterfield and Powhatan Telephone Co., incorporated by W. W. Baker, B. T. Watkins, Dr. J. B. Fisher and others; general telephone exchange. Capital stock, $5,000.

Salisbury, N. H.—Kearsarge Telephone Co., incorporated by W. H. Burbank, H. Dodge, I. W. Little, T. D. Little and A. A. Beaton; maintain a telephone line. Capital stock, $2,300.

STREET RAILWAY NEWS.

Leavenworth, Kan.—The Leavenworth Construction Co. has been incorporated by Herbert K. Wolcott, Henry G. Pert, George J. Kensinger and others; for the purpose of constructing an electric road. Capital stock, $200,000.

Lansing, Mich.—The Port Huron and Port Austin Electric Railway Co. has been organized with a capital stock of $25,000.

Harrisburg, Pa.—The Trappe and Limerick Electric Street Railway Co., of Montgomery, Co., has been incorporated.

Xenia, Ohio.—The Xenia and Cedarville Railway Co., incorporated by C. P. King, J. W. Neff, M. Shoup, O. Dodds and others; operate an electric railway. Capital stock, $50,000.

POSSIBLE INSTALLATIONS.

Havre de Grace, Md.—John H. Reckford will erect an electric lighting plant.

Abbeville, S. C.—An electrical plant will be established.

Dickson, Tenn.—The Mayor may be addressed concerning the erection of an electric light plant.

Cullman, Ala.—John F. Beyer, Mayor, may be addressed concerning erection of an electric light plant.

NEWARK, N. J., NOTES.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, Plane and Orange streets, are getting settled in their new works, which occupy a space of one hundred square feet, four stories high. They report having orders ahead for over one thousand new "Manhattan" enclosed arc lamps. They still retain their New York office at 11 Broadway.

THE U. S. PHONOGRAPH COMPANY, Plane and Orange streets, are preparing some excellent new records for the fall trade.

YATMAN RUBBBER COMPANY, 216 High street, make a specialty of moulded rubber goods and metal specialties.

J. C. BLEVNEY, 132 Orange street, makes a specialty of the Blevney friction clutch pulleys.

THE GREENFIELD STEAM ENGINE WORKS, Fifth avenue and Cross street, East Newark, established in 1874, make a specialty of vertical engines for stationary and yacht purposes. A large number of these engines are being used for isolated electric light stations. They are now completing a 10 H. P. automatic, vertical engine, direct connected to a Westinghouse dynamo. They are also building two large 25 H. P. four cylinder gas engines.

C. F. CROSELMIRE, 25 N. J. R. R. avenue, has one of the largest works in Newark for the refining of platinum and manufacture of platinum sheet and wire for all kinds of electrical uses. He reports a large and growing business.

BAKER & COMPANY make a specialty of platinum sheet and wire for all kinds of electrical apparatus. They do a large and extensive business with incandescent lamp manufacturers. For years Baker & Company have been noted as buyers of scrap platinum, paying the highest market prices.

GOULD & EBERHARDT, the well known makers of all kinds of machine tools, are having their factory building enlarged and new outside walls erected. Large light windows are being put in place of the old style small ones, thus affording plenty of light to the employes in the works. Gould & Eberhardt are busy day and night filling orders.

C. McINTIRE, of the C. McIntire Company, 15 Franklin street, manufacturers of McIntire's patent connectors and terminals, is enjoying a well earned vacation in Massachusetts.

STUCKY & HECK ELECTRIC MAUNFACTURING CO., 35 N. J. R. R. avenue, make a specialty of rewinding, repairing and reconstructing armatures, dynamos, railway motors, transformers and commutators, and also make up from plans and drawings all kinds of dynamos, motors and other kinds of the electrical apparatus.

The business outlook among Newark's electrical and kindred industries is very bright, the majority of the works being run day and night to meet the demand.

W.T.H.

NEW YORK NOTES.

WILLIAM H. MEADOWCROFT tendered his resignation as secretary of the Edison Decorative and Miniature Lamp Department, the same taking effect August 5th. Mr. Meadowcroft has accepted a position with the Perrett Storage Battery Company, of this city, and at a banquet, tendered him by his associates on the evening of August 4th, they united in wishing him success in his new venture. Mr. Meadowcraft had been connected with the General Electric Company and its predecessors for over eighteen years, having been engaged during that time with the various departments of the companies. He is also well known as an author, having written several books on elementary electricity. His "A B C of Electricity" is about the most popular book of its kind ever written, the large sale and demand for it attesting to that fact.

The Electrical Age.

VOL. XXIV—NO. 8 NEW YORK, AUGUST 19, 1899. WHOLE NO 640.

The Applications of Electric Power.

Dynamo Room, William Carroll & Co., Matteawan, N. Y.

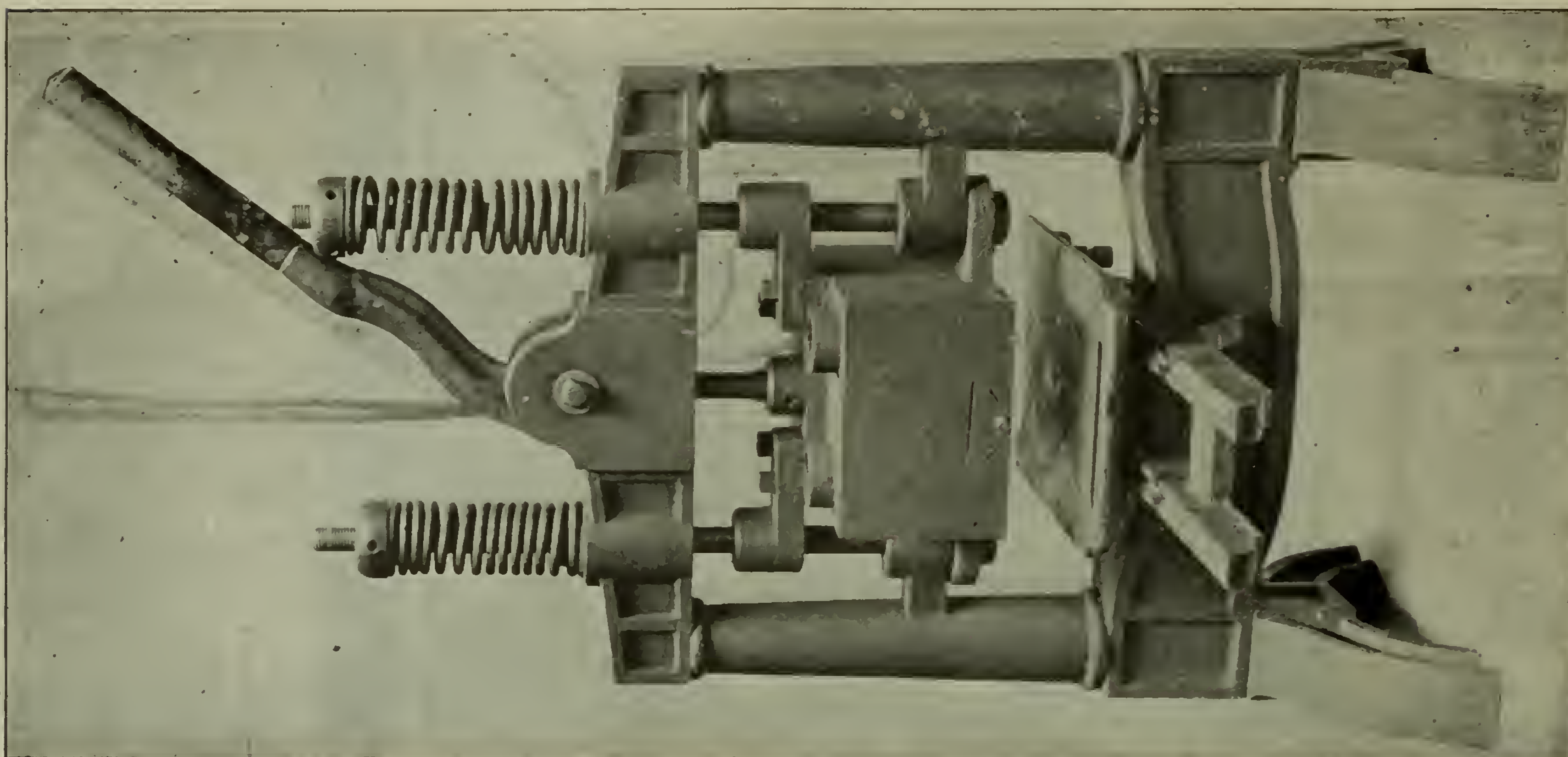
Group of Electrically Driven and Electrically Heated Ironing Machines. Factory of F. Berg & Co., Orange Valley, N. J.

MAKING HATS BY ELECTRICITY.

In the manufacture of hats certain processes must be carefully followed before the hat receives the shape, finish and general appearance required. Electricity may be used in hat manufacturing for shaping it and giving it that high finish which generally betokens care in manufacture. Various details of hat manufacturing of course constitute an art which can only be dilated upon by an expert in that particular field of employment. But in those respects in which the use of electricity is of consequence the reader becomes acquainted with rather unique applications of the current.

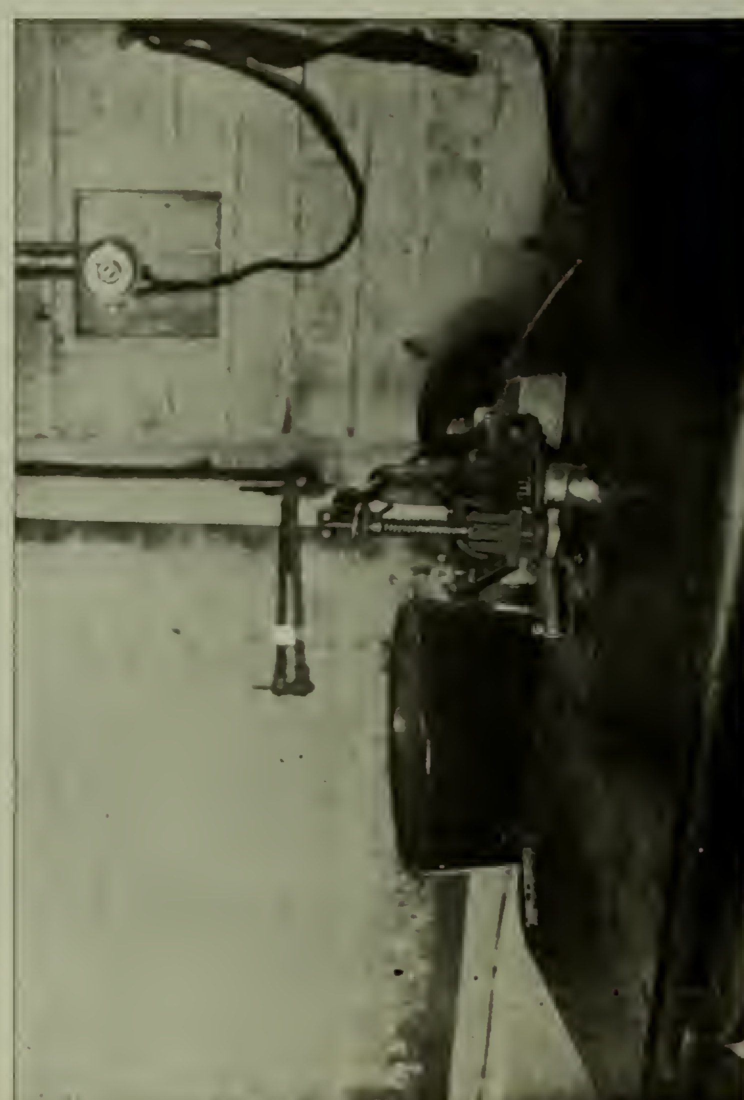
By carefully studying the subject of hat manufacture from various standpoints the Hadaway Electric Heating & Engineering Company, of 107 Liberty Street, New York City, have developed a system of machines, some of which are illustrated, which are used exclusively for the above purpose, that is to say, the manufacture of hats. Electricity plays its part especially in heating various ironing machines, presses and other devices which are applied in their turn to hats that are being systematically treated. The heat is thereby obtained in a convenient and economical manner. In fact, in such a way that it is impossible to conceive of a more satisfactory system for the treatment of headgear.

The following concerns have electric installations for the treatment of hats: F. Berg & Company, Orange Valley, N. J., who make soft fur hats; the New Milford Hat Company, of New Milford, Ct., who make stiff fur hats; William Carroll & Company, of Matteawan, N. Y., manufacturers of straw hats, and a variety of other concerns in allied lines. The system developed by the Hadaway Electric Heating & Engineering Company bears the name of the "homogeneous heating system."



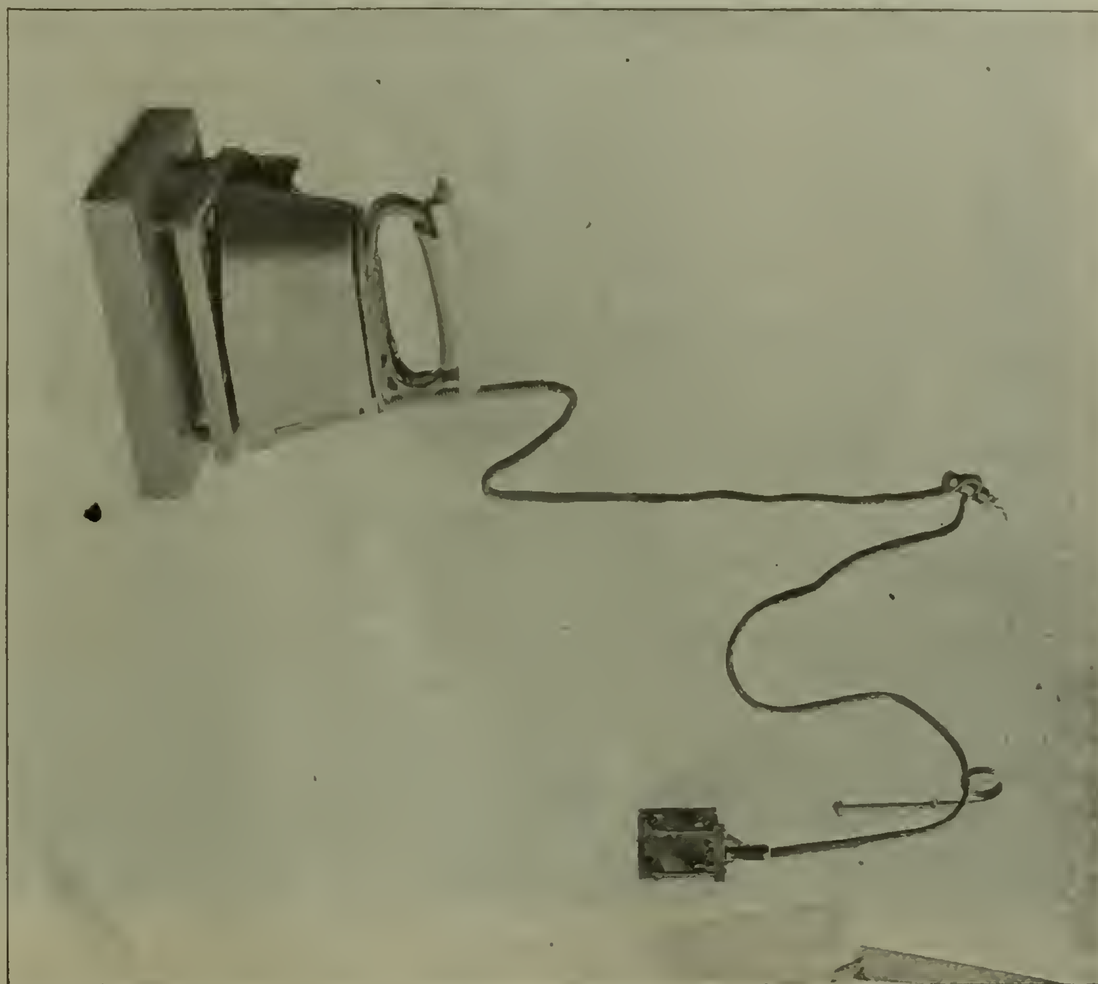
Electrically Heated Press Head.

Machine Ironer for Straw Hats.

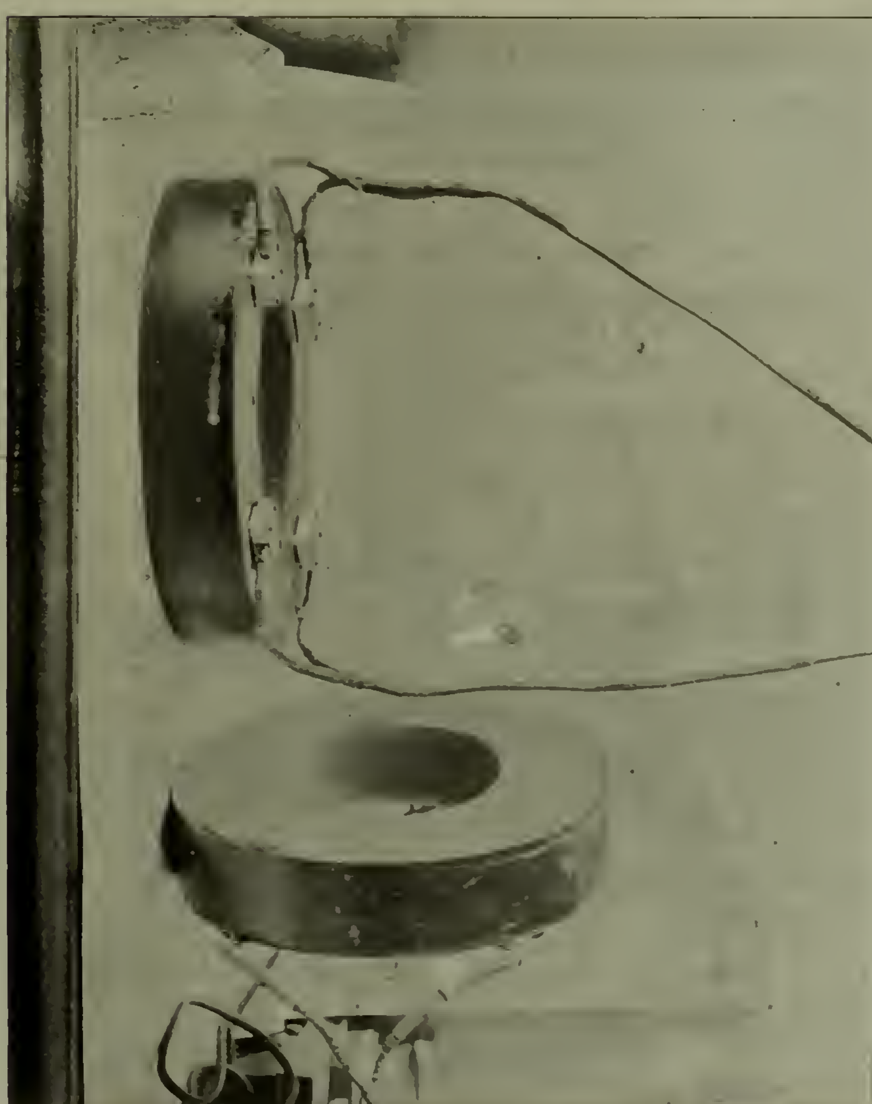


Electrically Heated Soft Hat Curling Machine.

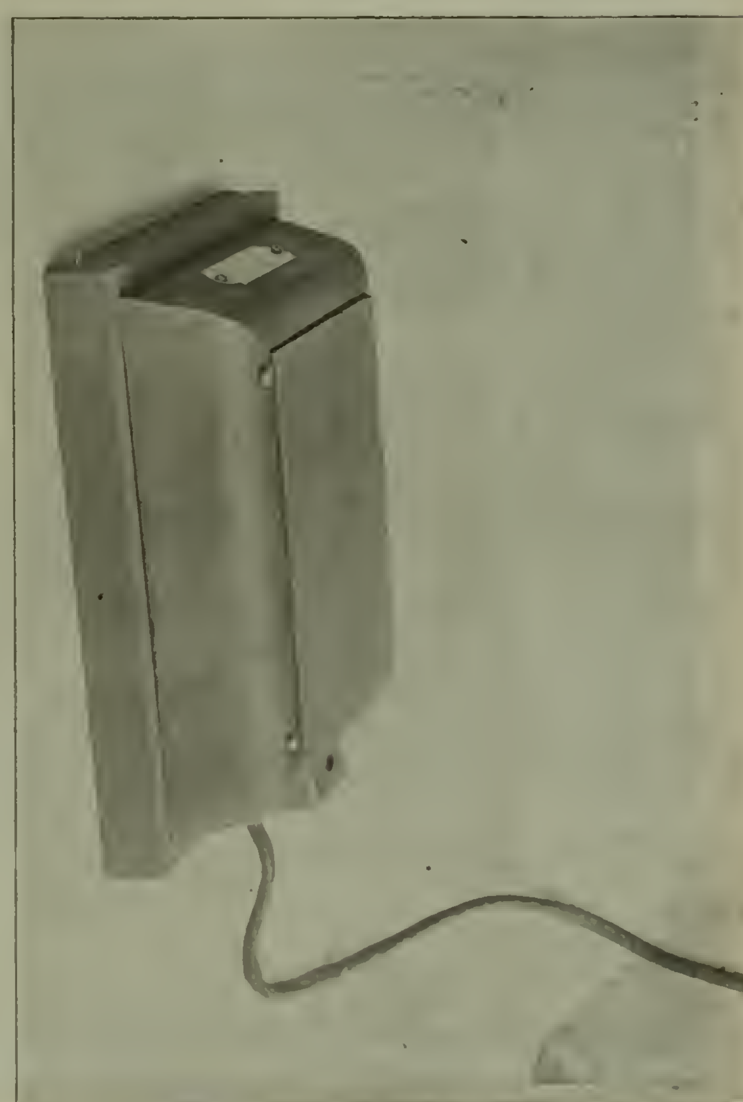
The company states as follows: "The keystone of our system is electrically heated finishing tools. The foundation is steam engineering. By combining the generation, distribution and application of heat from a common source we construct a system of the highest possible working economy, for we use all of the boiler energy and the boiler is the most efficient heat transformer of the coal pile known to engineers." Hat manufacturers have discovered by the use of these improved appliances that many advantages are gained both as regards operating expenses and ability to deliver more goods in a given space of time. These advantages are enumerated as, first, reduced operating expenses; secondly, better goods from better tools, and, third, less fire hazards. The last is certainly of great importance to the proprietors of factories.



Hand Shell, Showing Installation with Switch and Cord Support.



Electrically Heated Rings for Press Machines.



In the illustrations are shown a variety of appliances, heated by electricity, specially made and used by the manufacturers of straw and fur hats. The idea of utilizing the steam in the boiler and its energy by transformation in the form of electricity is an excellent one, as borne out by the satisfactory experiences of many responsible houses. Electrically heated hand shells, including those used for velouring and ironing, are manufactured by the above company. Also press heads for embossing and pressing, and curling machines for stiff fur hats. These

Dynamo Room. New Milford Hat Co.

take the place of shells heated by an air blast, in many respects most inconvenient to use, but entirely obviated

Section of Finishing Room. New Milford Hat Co., New Milford, Conn.

by these devices.

In the Berg factory the power plant is provided with three boilers of a rated capacity of 225 horse power each. The main engine is 425 horse power Corliss, driving two main shafts on opposite ends of engine with fly-wheel grooved for rope transmission. A supplementary engine of 75 horse power is direct-connected to a 50-kilowatt dynamo. The main dynamo is of 150 kilowatts capacity

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NEW YORK, AUGUST 19, 1899.

CONTENTS:

ELECTRICITY IN THE PUBLIC HIGHWAYS.

The slowness with which New York approved of the widespread application of electricity can be best attributed to its London-like conservatism. The immense fortune represented by electric street railway, light and power interests will convey some faint idea of what the future has in view for these comparatively undeveloped concerns. At a period not exceeding ten years ago incandescent lights were used by a favored few and some private plants had been installed. With the exception of a few high tension arc lamps and the ever present telegraph systems little use was made of electricity for municipal purposes. Since that momentous period capitalists have become profoundly impressed with the positive future which the use of electricity in its various forms practically guarantees and lent their money freely to those enterprises which resulted in the foundation of colossal electric light, power and street railway companies. As in all similar cases the public demand increased for electricity for light and power.

As its widespread introduction ultimately resulted in its use for street railway purposes the benefits derived by the city represented in a material form the saving of large sums of money. In a few months all the main arteries of trade in greater New York will have operating along their entire length electric cars. The Metropolitan Traction Company has been successful in this respect on the Second, Fourth and Eighth Avenue lines and it is being rapidly followed by the Third Avenue Cable Company for whose wire rope transmission electricity will soon be substituted. When the main road and important side streets have car lines smoothly operating the problem of rapid transit will be practically solved. This refers more to those going north and south than passengers going east and west. At least a dozen or more cross-town roads are required to facilitate transit to points of the city widely separated. Rapid transit, or at least convenient transit, is thereby secured for the people of Greater New York. As far as the city is concerned the use of electric cars implies clean streets, less disease and a tendency on the part of the population to settle the outlined suburban districts.

To the city therefore the introduction of electricity on the main highways has added largely to its sum total of happiness and prosperity. In the innumerable side streets that cross the main thoroughfares electricity has as yet not found its way and it becomes therefore a duty that can be expected of the electric light companies to send their wires east and west to the thousands of homes in which electricity would be used for lighting, if its price was within their means. It is rather surprising to realize that electric light companies do not offer greater inducements to the mass of people constituting Manhattan Borough, so that their stations will pump current, not only to that limited locality of which they are the center, but to myrids of homes where it is now regarded as an unapproachable luxury. If electricity can be produced cheaper than gas it seems that the electric light companies are losing time and money in not running their lines through all the side streets available. If this comes to pass there will be few corporations of greater magnitude and benefit than those supplying light to the residents of Manhattan Borough.

ARTIFICIAL LIGHTNING DISCHARGES.

Although not new Prof. Trowbridge, of Harvard, has produced artificial lightning discharges that compare well with those previously obtained by Tesla, Elihu Thomson and Steinmetz. Prof. Trowbridge has produced discharges over six feet long which crackled and bristled with all those branch like deviations so characteristic of lightning au naturel. The Professor's experiments were performed in a glass tube from which the air had been exhausted sufficiently to leave the pressure about two pounds per square inch. Through this tube tremendous flashes were obtained of enormous potential. According to Trowbridge discharges thirty or forty feet in length are within the scope of the operator. He experimented with glass tubes six feet long, filled with water. When a discharge was passed through the tubes burst with explosive force. The discharge passed between the inner surface of the glass and the water, vaporizing it sufficiently to cause the explosion. This experiment leads to an explanation of the phenomenon observed in trees struck by lightning. The discharge passing through the sappy, moist wood generates steam which rends the tree with all the signs of the employment of some terrific force.

THE DEATH OF ROBERT WILHELM EBERHARDT von BUNSEN.

Prof. Bunsen, the famous German chemist and inventor of the well-known Bunsen burner, lies dead in Heidelberg. He was born at Goettingen, March 31st, 1811. He was eighty-eight years old when he died. His work in spectrum analysis, investigations in chemistry, in electricity and in general physics were of the utmost value to the commercial and scientific world. He is well known to the electrical engineer as the inventor of the Bunsen cell, in which he substituted a carbon rod for the platinum plate previously used. His name will never be forgotten by the chemist in whose laboratory the Bunsen burner has found a permanent place, and to the astronomer and mining engineer his investigations were so useful that the science of spectrum analysis disclosed the constituents of the planets and served indirectly as a means of detecting the unsuspected presence of rare metals and minerals.

He was the father of spectrum analysis, and through the assistance of Kirchhoff thoroughly developed that department of science. He created these three branches: spectroscopy, as a department of optics; spectroscopic astronomy, and spectroscopic chemistry. By means of the spectrum lines he discovered the metals caesium and rubidium. In 1883 he was elected one of the eight foreign associates of the French Academy of Sciences, considered by many scientists the greatest honor to which a man of science can attain.

Continued from Page 98.

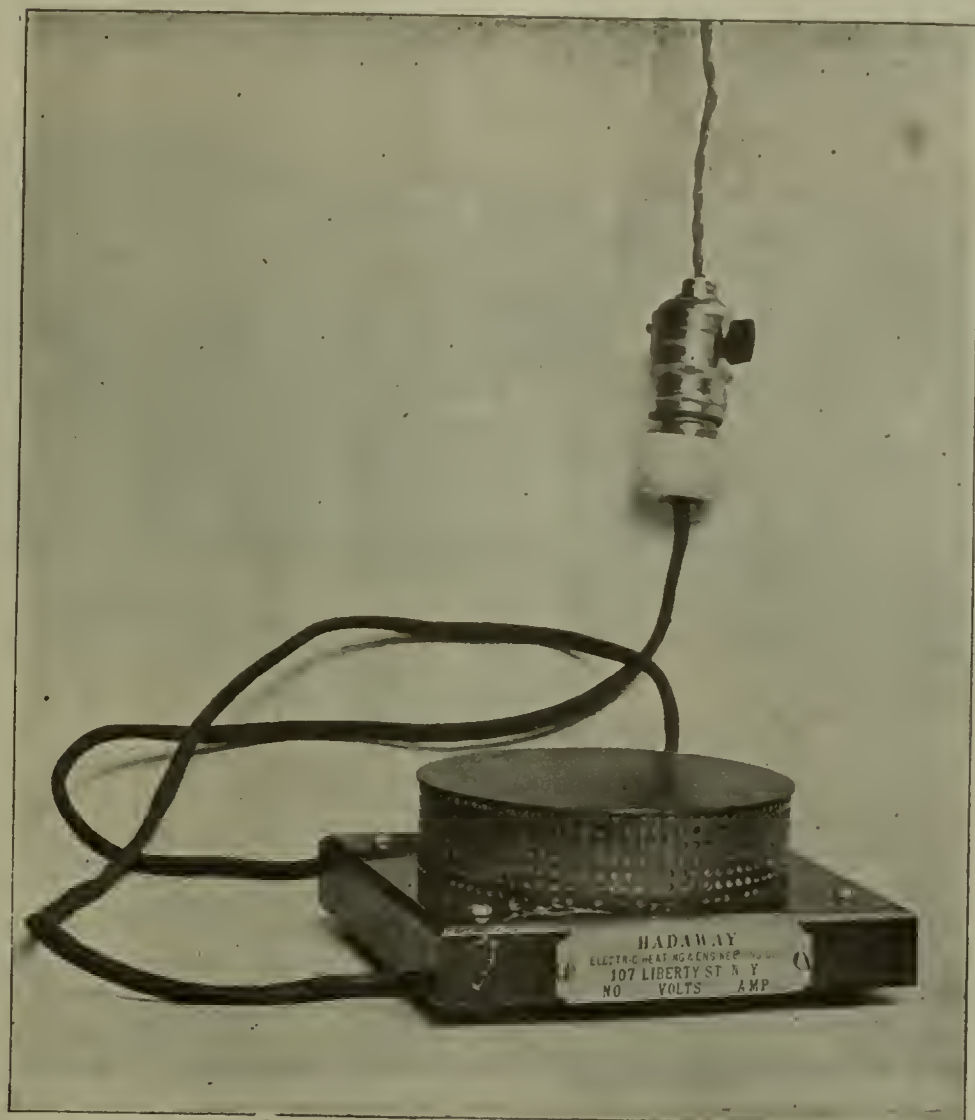
and is belted from a main shaft. The water heaters are of 1,200 horse power rated capacity. The exhaust system is provided with separator, back pressure and automatic reducing valves. Electric motors are used for driving the pouncing, drying, shaving, sizing, ironing, curling and sewing machines and "whizzer." The motors have a rated capacity of 40 horse power. There are about 800 incandescent lamps of 16 candle power each and 20 enclosed arc lamps for lighting interior bays in finishing rooms. Small cluster lighting is used to a considerable extent for general illumination. All of the finishing is done by electrically heated tools, of which there are over 300. These consist largely of 15-pound hand shells, supplemented by velouring stoves, machine iron shells, curling-machine heaters, flanging bags, etc. The switchboard is provided with switches for the various heating circuits, lights, motors, etc. All of these circuits are independent for facility of control, running to distribution boards on each floor. The exhaust is used for boiler-feed and hot-water supply for sizing and coloring, for heating the "vertical" dry-rooms by hot blast, for boiling the water in plank shop, etc. Coils are immersed in the tubs for boiling the water and the back pressure on the system is about four pounds. The balance is established so as to use all the exhaust the entire year, the factory heating being treated as an intermittent load and using live steam.

For the stiff hat plant of the Milford company the boiler plant is rated at 250 horse power. The engine is an 18 by 36 Corliss, running at 80 revolutions per minute. The dynamo is a moderate speed 75-kilowatt belted machine. Electric heating and lighting are used, but no motors. There are about 225 incandescent lights of 16 candle power each in this plant. The electric heaters used are velouring stoves, curling-machine shells, hand shells, rounding-off shells, tip-printing and embossing presses, etc. The switchboard carries switches for the light and heater circuits, which run to panel boards on each floor. The water heaters are of 250 and 500 horse power capacity respectively, the first being used for boiler feed-water heating, the second for water heating for sizing and coloring department, etc. The system is run without back pressure, the water heaters condensing the exhaust. The hot-water heater is connected to a storage tank for equalizing the condensation, and so that the coloring and sizing vats may be filled rapidly with water heated to at least 205 degrees F. The system is arranged so that the moderate-temperature dry-rooms may be heated by hot water. The storage capacity of the water is valuable for this purpose in reducing the amount of steam required at night. The hot water from condensation in water heaters and waste hot water from coloring department is collected in a large iron shell in which a long coil of heavy pipe is immersed. The waste hot water heats all the water used in the factory from 40 to 50 degrees F. The factory heating is done by live steam, as well as the high-temperature dry-room, presses, etc. There is not an open coil in the factory, all condensation being returned to boilers through an automatic return trap. The large-capacity hot-water system is of value in the winter in reducing the amount of steam required to protect the "wet"

Portion of Ironing Room. Factory of William Carroll & Co., Matteawan, N. Y.

sprinkler system.

The plant of the Carroll factory has an especial interest, as it was the first in which electric finishing appliances were used on a large scale. Matteawan is on a small river which empties into the Hudson, and power is obtained for most of the time from a 42-inch turbine operating under 29-foot head. A 150 horse power Corliss engine is in reserve for low-water periods. The dynamo is a 65-kilowatt alternating current machine with belted exciter. The primary voltage is 1,000; transformers are placed at convenient points throughout the buildings. The secondary windings are for 104 volts. The switchboard is of the skeleton type, with main and throw-over switches and instruments. There are 500 16 candle power lamps for lighting. No arc lamps are used, but 300 candle power Mogul incandescents are installed in the bleach house. The electrically heated appliances in use are hand flats, glue pots, pressing irons, press machines, tip-printing presses, machine ironers, etc.



Small Portable Stove, $4\frac{5}{8}$ in. diameter.

Electric Soldering Tool.

Stray Currents.

ELECTRIC WATERING CARTS.

Paris is said to be making use of an electrically-propelled watering cart in which an electric motor is utilized to distribute the water, and it is further stated that this trial cart has proved so satisfactory that in the near future electrical carts will entirely replace the older type of horse vehicle.—Ex.

MOLECULAR FATIGUE.

We read in a Belgian contemporary that:—

"Metals get tired as well as living beings. Telegraph wires are better conductors on Monday than on Saturday, on account of their Sunday rest, and a rest of three weeks adds 10 per cent. to the conductivity of a wire."

We wonder what the conductivity would be in six months, at this rate!—London "Elec. Review."

THE FIRST ELECTRIC RAILWAY IN CHINA.

A Japanese contemporary states that the first electric railway in China was opened for traffic on June 24, between the Peking station at Machiapu and the south gate of the city of Peking. Eventually it is proposed to extend the line inside the city. The barrier at present in the way is the necessity for breaking a new gate through the city walls. It is thought that in the course of time the authorities will yield this privilege.—Ex.

WIRELESS TELEGRAPHY IN AERONAUTICS.

An experiment was made in Austria last month in which for the first time it was attempted to communicate between two balloons on the Marconi system of telegraphing without wires. One station was fixed to the car of a captive balloon while the second was placed in a free aerostat. Notwithstanding the fact that, on account of the movement of both cars, the apparatus could not be fixed with the same accuracy as in a stationary position, dispatches were exchanged with satisfactory results for some considerable time. Occasionally the signals were not clear, and some interruptions also occurred, but, on the whole, the outcome of the experiments was such that the military balloon detachment has resolved further to study and perfect the system.—Ex.

CONDUCTIVITY OF MIXTURES OF ELECTROLYTES.

In a communication to the Journal of the Chemical Society, F. Barmwater, referring to the conductivity of mixtures of electrolytes, says: "Expressions are deducted for the conductivity of solutions of two or more electrolytes, and the applicability of these expressions is proved by determination of the conductivity, in the case of mixtures, at various concentrations of sodium and potassium chlorides—sodium chloride and potassium iodide; sodium chloride and potassium nitrate; potassium chloride and nitrate; sodium and potassium chlorides and potassium nitrate; and sodium and potassium chlorides, potassium nitrate and potassium iodide. The expressions are based on the previous deductions of the author, are simple, and in all cases yield values in good accord with the observations."

COST OF OIL LOCOMOTIVES AND ELECTRIC MOTORS.

A comparison between the cost of oil locomotives and electric motors in some of the mines of Europe, where both are used, has been made, with interesting results. It is said that in one mine the cost of the former has been one and a half pence per train mile, as against three and a fourth pence in the case of the electric motor, while the cost of two oil locomotives is reported to have been one-fourth of the cost of one electric motor. The steam, nitrogen and carbonic acid evolved by the former are not enough to vitiate the atmosphere, and it has the advantage of compactness; working on a two-foot and one-inch gauge and when exerting six-horse power, it is able to take a maximum load of seventeen tons. It further appears that, when running at the maximum speed of four and one-half miles per hour, and with the full load, the consumption of oil is barely six and one-half pounds per hour. By means of special gear the engine runs backward or forward at the will of the operator.—Ex.

NOVELTIES IN TRANSMISSION LINE CONSTRUCTION.

The thirty-one-mile line of the Kootenay Transmission Company in British Columbia, says the "Electrical Engineer," consists of two parallel and duplicate pole lines, on one of which the cross arms are roofed over to prevent the wet snow from pilling upon the cross arms around the insulators, which it does to the height of some eighteen to twenty-four inches during seasons when there is no wind. The cross arms are two in number, the upper one some eight feet in length with four pins, and the lower shorter, holding two pins. The upper one is covered with a cedar roofing twenty-four inches wide, sloping slightly downwardly from the pole each way towards the ends of the cross arm. The lower, immediately below it, is roofed to a width of sixteen inches. During the past winter service was continued over both lines, even when the exposed line had from ten to twenty inches of snow on the cross arms. If any leakage existed it was impossible to detect it, so that the roof appears to be quite an unnecessary precaution. Another peculiarity of the same line is the crossing of the Columbia River, which is in a single span 1,500 feet in length. The wires are No. 000 bimetallic, maintaining a conductivity equal to that of the balance of the line, which is No. 0 copper. These spans are unsupported by strain cables, the total being some fifty-two feet with the strain taken up by a number of ordinary porcelain insulators in a strain tower at each end of the crossing. The interaxial distance between the wires is only six feet, but no trouble has been experienced from swinging crosses or from breakage due to wet snow, which has at times adhered to the lines to a diameter of about four inches.—Ex.

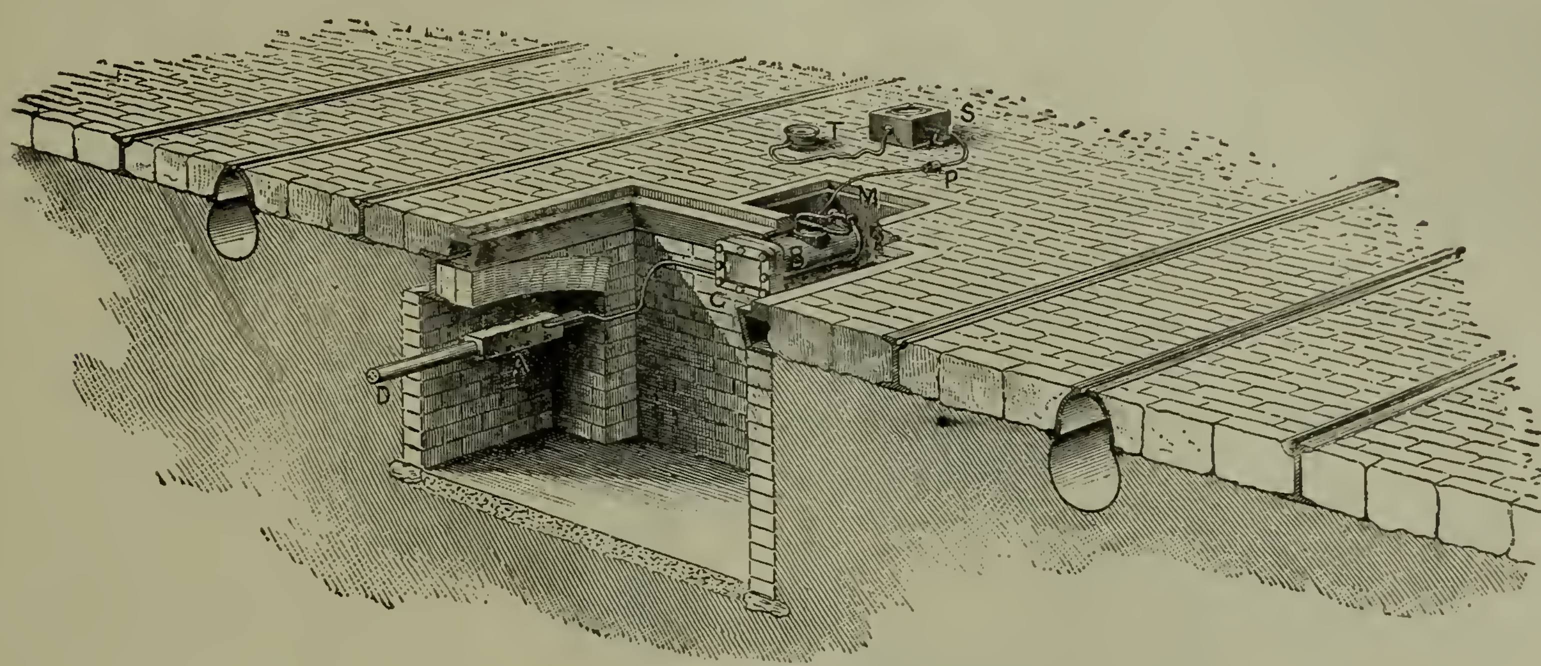
The Storage Battery.

STORAGE BATTERIES AND ELECTRIC RAILWAYS.

Within the past few years a new field, and one which promises to be of great magnitude, has been opened for the use of storage batteries. This is the installation of storage batteries of large size to act as regulators in connection with the trolley or third-rail system of propulsion.

A reliable battery, properly installed, will reduce the problem of generation and distribution of electric current by a street railway system to the simple question of handling an even, steady, predetermined load. Installed in the power house, it will allow the use of a similar number of the most highly efficient generating units, which, being operated for long periods, fully and steadily loaded, will reduce the cost of power generation to one-half of what is possible with the apparatus best suited to the variable demands made upon most railway power houses.

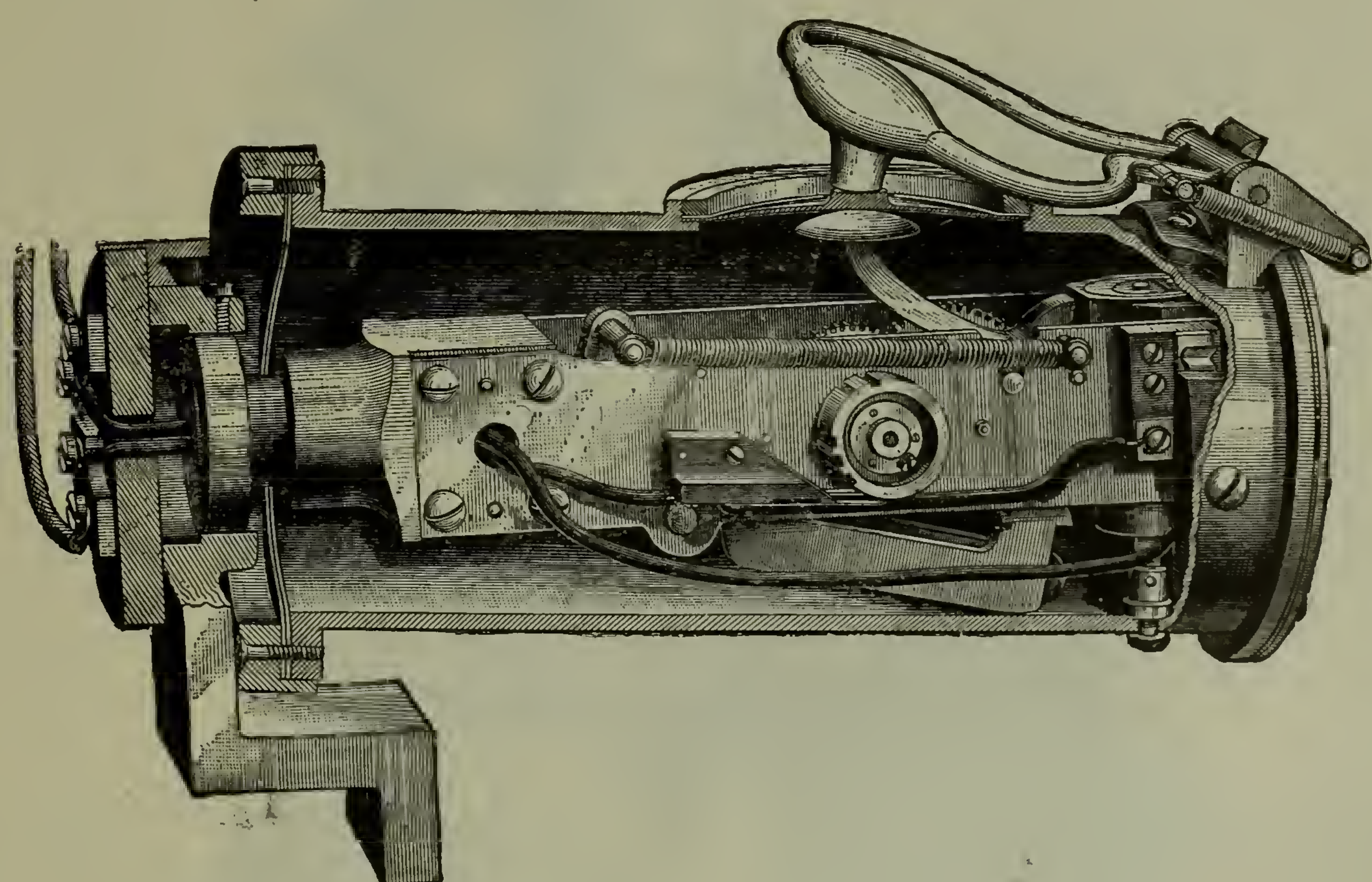
A battery will take the place of all that generating machinery which is made necessary by the loads in excess of the average output. It will act absolutely instantaneously in regulating a violently fluctuating load. It is more economical to install for a continuous output of energy than a generating unit that will not have at least a full, steady load for three hours at a time, and it has the great advantage over generating machinery for such loads that, instead of sharing with the rest of the plant a fluctuating load, it is a source of additional output that, in itself, takes care of all such fluctuations and violent changes, leaving the rest of the plant fully and steadily loaded and allowing the use of a class of machinery of much higher economy than is otherwise possible. A battery further reduces the number of times a unit has to be started and stopped to follow the load line, as with a steadily increasing load coming on the station, the battery, by discharging, can take care of it until it reaches



View of Manhole and "Automatic."

such an extent that an additional machine can be put in service fully loaded, filling the battery again until the output increases to the capacity of the machine.

The battery, whether gaining or losing in the amount of energy stored, will still regulate for the instantaneous load changes. The same reasons apply also to the in-



The "Automatic."

crease in size and reduction in number of generating units, as a battery, having half the output of a unit, can keep it fully loaded by discharging on first half of the increase of load, and charging on the last half, at the beginning of which the machine would be thrown in. The number of running hours of the station can be materially reduced, as the night load is usually so light, for four or five hours, that it can be taken care of entirely by the battery.

A battery is also an admirable protection against fly-wheel accidents. For instance, in case of a short-circuit on the line the increase in current will be taken by the battery, and when the circuit breaker goes out, the battery will keep practically the full load on the generators. When the circuit breaker is thrown in again the high load for the first few minutes, due to the cars starting up, will be taken care of by the battery, so that the machines will go on undisturbed even under such conditions.—Herbert Lloyd in Cassier's Magazine.

The Telegraph.

THE PEARCE SIGNAL SYSTEM FOR ELECTRIC OR CABLE RAILROADS.

A means by which signals can be transmitted from the power house to any section of a cable road or street railway is necessarily of value to a corporation operating such a system in a large city. Various causes, such as fire, accident, injury to the cable, cars, etc., which mean

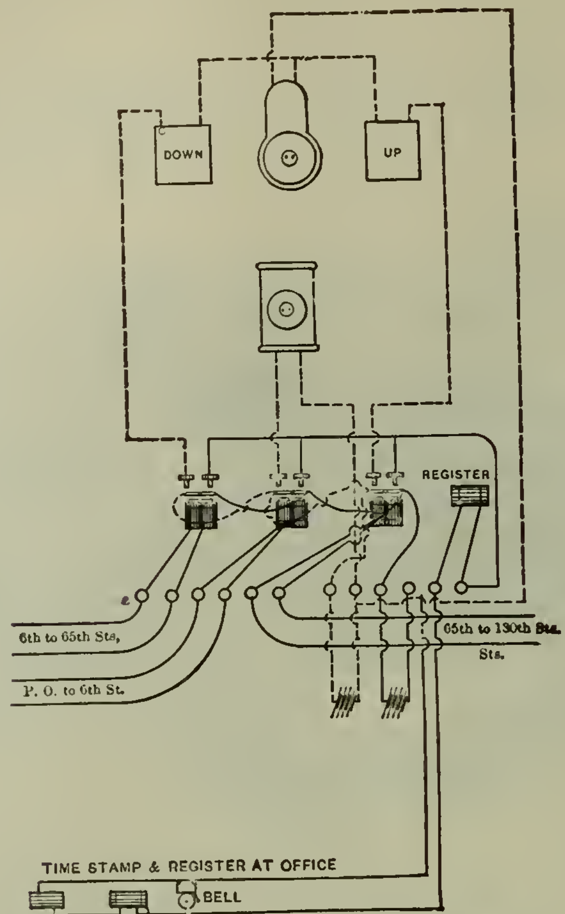
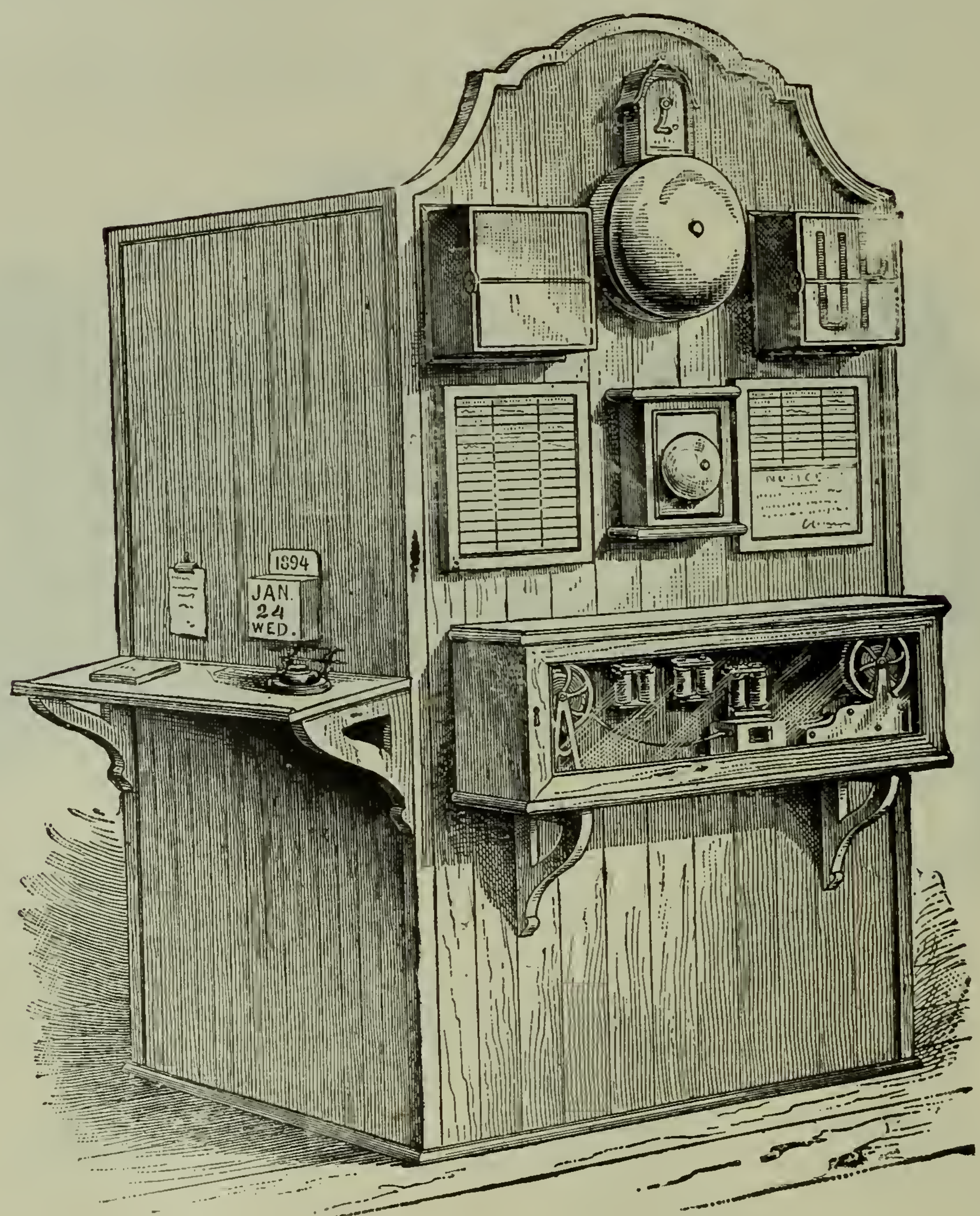


Diagram of Wiring in 65th Street Power House.



Signal Box in 65th Street Power House.

a stoppage of the line, can be more rapidly met and remedied by an electric signalling system than any other known practical method. A simple system of this description, which can be operated by motorman or conductor, is certainly of immediate and pronounced value. The system to be about briefly described was invented by Frederick Pearce and patented March 28th, 1893. It is being used at present on the Third Avenue Cable Road in New York City with every satisfaction and success.

To begin with, it may be stated that the power house or houses may be signalled to and from any point of the road. In addition to this, the only requirement the employees on the cars are supposed to meet is that of sending but one signal to stop the cable in case of emergency. mechanism in such a manner that by breaking a closed circuit signals are immediately transmitted to each station. The general diagram of connection is shown in figure 6, in which all the apparatus required is illustrated.

"When the conductor raises the cover of the box containing the automatic B, he lifts the handle at the same time. This strikes one in each power house on either the large or small gong, according to the location of the automatic sending the signal." After having done this he replaces the cover prior to depressing the handle of the automatic. When the cover is put in place the mechanism of the automatic rings up the particular

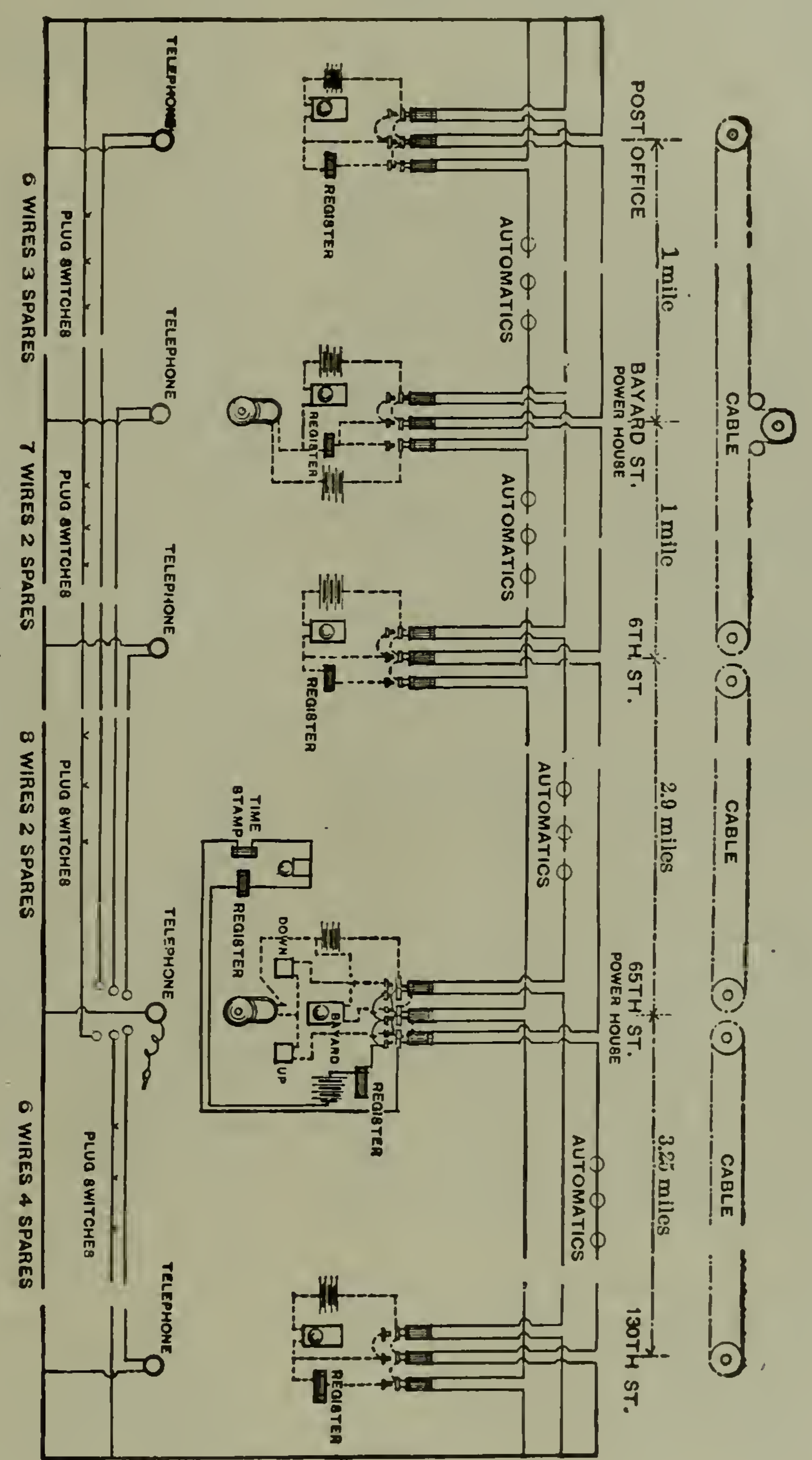
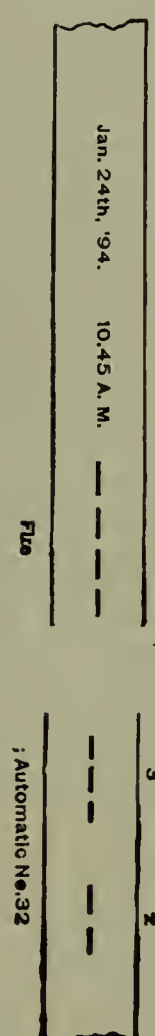


Diagram Showing Wiring of Entire Road.



Record Printed on Tape.

The first feature of this system is the use of manholes, shown in figure 1, which are numbered to correspond with the streets they are nearest to. In each manhole is an automatic device B, by means of which communication is established with power houses and telephone stations. The signals merely consist of strokes on a gong, following the code shown in figures 3 and 4. The automatic device itself is illustrated in figure 2. This device is entirely sealed up in an iron cylinder and is therefore free from the attacks of moisture and corrosion. The handle, shown in the illustration, controls the number of the box on the gong. By raising the automatic to send the first signal the mechanism is wound up through which it is able to send its own number when depressed again. The signal box at the Sixty-fifth street power house is shown in figure 5.

In figure 4 a tape is shown which fully describes itself according to the code, meaning January 24th, 1894, at 10.45 A. M., a warning of fire sent from automatic number 2. After a signal of this kind has been sent the wrecking wagon generally makes its appearance which carries a telephone system, by which conversation is rendered possible between the point of interest and the power house or telephone station. Any employee on the cars can stop the cable by the use of this appliance. It is a signal which is instantly obeyed. Lifting the cover, raising the handle and then replacing the cover constitutes the sum and substance of any mental or physical effort gripman, motorman or conductor is called upon to perform.

Not only is this mechanism of direct advantage to street railway corporations employing wire rope transmission or electricity but it may be used with the same facility by steam roads, particularly near or within the city limits, and when the train runs through a tunnel, in which case a break-down oraccident requires as immediate attention as a local city line. The above appliances are manufactured by Frederick Pearce, of 216-218 William street and 18-20 Rose street, New York City.

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*ELECTRICITY IN COAL MINING.

By John Price Jackson and Frank F. Thompson.

The statements in this short paper on the use of electricity in mines refer especially to the mining of soft coal. Of the essential elements in operating such mines, two of the most important are: first, apparatus to obtain efficiently the rapid handling of the coal; and second, to do this with the least possible number of openings. These conditions have evidently been large factors in causing the application of electricity to such operations.

The applications of power to mines, which we wish to consider, are principly for, (a)lighting, (b) haulage, (c) cutting or drilling, (d) pumping and driving fans.

Systems.—The systems worth considering which are in use at present may be tabulated as follows:—

1.—Rope haulage, and steam for all other purposes.

2.—Electric haulage and compressed air for other purposes.

3.—Electric haulage and electricity for other purposes.

Various other combinations are of course used, but these three will serve the purpose, as representing well defined types.

Rope haulage and steam power.—In the past this system has been the standard, and even yet in many portions of the hard coal fields has a very firm hold. Experience has shown rope haulage much inferior to electricity in point of working economy, as is now being illustrated by the continual substitution of electric for rope haulage now going on in the soft coal field.

The Mitchell Coal and Coke Company had two mines running for some time at Galitzen, Pa., under exactly similar circumstances, but one using rope, the other electric haulage. It was quickly proven that the electric was far preferable.

Steam power for pumps and fans in the mines has likewise been shown by experience to have many faults. Timbers along which the pipes pass rapidly deteriorate. The piping is expensive to install and can only be kept in good conditon by constant attention. If the lines are long they are a source of large loss of power by radiation and condensation, even when well covered. They are a nuisance in the mines because of their high temperature. The steam motors are expensive from the standpoint of repairs and attention. Steam cutting and drilling will in most cases prove unwieldy. Mines operated under this system are without suitable means of lighting, an important matter in rapid operations.

Electrc Haulage and Compressed Air Power.—The Berwind-White Company's mines at Windber, Pa., furnish an excellent example of this system, and so far as known it has given complete satisfaction. This plant, which has now six mines in operation with an output capacity of 5,000 tons per day, is eventually to be increased to ten mines with 10,000 tons capacity. The haulage in the mines is done by electricty, while the drills, interior pumps, and fans are driven by compressed air. The use of compressed air has many obvious advantages. It is found that the machinery, working under the extremely severe conditions to be found in a mine, performs its duty well. It requires little attention and is thoroughly reliable. On the other hand, pipe lines in extended mines are expensive to lay and keep in repair. The pipes soon deteriorate and when the lines are removed from old workings it is usually found that much if not all the pipe is in too bad shape for further use.

The flexibility of the system, or its adaptability to quick changes, is not satisfactory.

Electric Haulage and Power.—For convenience in discussion this head may be divided into two sub-systems, as follows:

(a) Direct currents for haulage and other power.

(b) Direct currents for haulage, and polyphase currents for other power.

The use of direct current machinery for pumping and fans has not been found satisfactory in many instances. One large company after a thorough trial of such apparatus rejected it in favor of compressed air. The pumps in a mine are subject to only rare inspection, and that oftentimes by unskilled workmen. These conditions combined with the unfavorable location of the machinery will soon cause electrical troubles in the commutator, or elsewhere, of the most carefully constructed motor. Inasmuch as the stopping of a pump, even for a short time, may cause excessive damage, the use of such a motor is a constant menace.

The second electric system, that using direct and polyphase currents, has the inherent disadvantage of requiring the installation of two distinct and separate sets of generators and wiring. That is a matter of serious importance , as will be indicated later, but is neither so expensive nor cumbersome as the piping used for compressed air. The great advantage in the use of polyphase currents lies in the fact that they permit the use of a motor that is perfectly reliable under essentially all condiditions of operation to be met with in mining. This compound electric system seems without doubt to be the best that can be installed for large operations. It comprises the advantages of all the other systems while eliminating their most serious defects. A system using polyphase currents alone might possibly prove more advantageous, but would have the serious defect of requiring two trolley wires, and even if this difficulty were overcome it would have to await the development of a polyphase motor suitable for a mining locomotive.

The Davis Coal and Coke Company.—The Davis Coal and Coke Company's plant at Thomas, West Virginia, is so efficiently equipped with this compound electric service as to be worthy of a short description. The company operates two mines at Thomas, the Thomas drift and the Davis shaft, and one mine at Coketon, a drift.

The power station is a roomy brick building containing Ames 200 H. P. engine direct conected to a 150 K. W. 500-volt direct-current generator; two Atlas cycloidal heavy duty engines of 150 H. P. one of which is belted to a 100 K.W. 550-volt three-phase alternator, and the other to a 76 K. W. 550-volt direct-current generator. The last mentioned generator has been installed temporily in the place of a second 100 K. W. three-phase 550-volt alternator which had been operated in parallel with the other three-phase alternator. This 75 K. W. machine is used to help the haulage generator.

The coal is hauled by horses from the "rooms" to convenient points where it is collected into "trips" of from six to twelve "wagons." The inside haulage motor, a 14-ton G. E. T. M. M. 35, takes these "trips" and hauls them to a central point of the breast and there they are com-

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*Presented at the sixteenth general meeting of the American Institute of Electrical Engineers, June 27th, 1899.

bined into larger "trips" of about 15 to 35 wagons and hauled to the mouth of the mine by another similar motor. At Coketon, two miles away, another 14-ton haulage motor is installed.

The alternating three-phase generator is used for operating three 10 H. P. induction motors for driving small pumps, one 5-H. P., one 10-H. P., two 20-H. P., and one 30-H. P. induction motors for operating elevators; one 5-H. P. induction motor for a car lift; and three G. E. chain coal cutters. The induction motors for driving the pumps are located at the foot of the side entrance both at Thomas and Coketon. One 10 H. P. induction motor connected to a pump having a 5-inch suction 250 ft. long, and a 4-inch discharge pipe 750 feet long, with a total elevation of 28 feet, pumping 106 gallons per minute, was tested and found to take 11,000 watts. Induction motors are also used for driving fans, and conveyors which carry the slack coal from beneath the screens to the bins where it is stored until needed to charge the coke ovens.

Haulage.—Electric haulage equipments have been so long in use as to be now in a thoroughly good state of development. Even yet, however, the following faults may be observed in some of the machinery: Poorly acting brakes, unwieldy arrangement of the various controlling levers and trolley poles, brake rods or other projections too close to the track, and unsatisfactory speed and power regulation. Although some of these seem of small importance, any one of them is apt to seriously interfere with efficient work. The brakes on a mining locomotive should be very powerful and quick acting, likewise the arrangement of motorman's seat, brake handle, controller and sand box lever should be such that the motorman can control his machine with the greatest possible dispatch and ease. Locomotives have been placed in mines with absolutely no provision for the motorman, and others where the lever arrangements are so unwieldy as to make the quick control necessary to safe operation impossible. In large coal operations economy is often to a large extent dependent upon the rapidity with which the wagon trains can be moved. Heavy grades both in favor of and against the load are frequently to be found. In order to draw a large load and make quick time the design and control of the motor should be such as to give an unusually great draw-bar pull at low speed, and at the same time have points of comparatively high speed. This condition is not properly met at present by all of the mining locomotives in operation. In one mine, which has come recently under the writer's observation, a slightly different design and arrangement of control in the locomotive would permit the handling of much larger loads at a great saving.

(To be Continued.)

Electric Railways.

ELECTRIC RAILWAY PROJECT IN FRANCE.

Consul Skinner writes from Marseilles, July 12, 1899:

"I am advised that the Paris, Lyons, and Méditerranean Railway Company, headquarters at 88 Rue St. Lazare, Paris, has undertaken the construction and operation of an electric railway between Fayet and Chamounix, at the foot of Mont Blanc. The line is to be in operation within twenty months, and it is to be presumed that the company will be interested in propositions for machinery and equipment. Power is to be furnished by the River Arve. The cars are to be automobiles, each supplied with its own dynamo. The contract for building the road proper and providing the water power has been divided into two parts and awarded to Gagner & Freres, of Annency, and Richard & Meynard, of Avignon."

Business News.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING AUGUST 8TH, 1899, $75,027.

New York, N. Y., August 8, 1899.—The following exports of electrical material are from the port of New York for the week ending this date:

Antwerp.—5 cases electrical material, $655.

Argentine Republic.—165 cases electrical material, $13,076.

British Possessions in Africa.—123 packages electrical material, $8,036.

Brussels.—3 cases electrical material, $150.

British Australia.—28 packages electrical material, $1,446. 22 packages electrical material, $574.

British East Indies.—13 packages electrical material, $315.

British West Indies.—2 cases electrical material, $78. 35 packages electrical material, $560.

Berlin.—17 packages electrical material, $3,023.

Brazil.—3 cases electrical material, $83.

Cuba.—69 cases electrical material, $1,046. 4 cases electrical material, $110.

Central America.—135 cases electrical material, $1,901.

Dublin.—20 cases electric cable, $8,862. 4 cases electrical material, $245.

Dutch West Indies.—4 cases electrical machinery, $90.

Glasgow.—21 cases electrical material, $835.

Hamburg.—222 packages electrical material, $1,625. 11 cases electrical machinery, $2,015.

Havre.—3 cases electrical machinery, $200. 44 cases electrical material, $3,651.

Hong Kong.—4 cases electrical material, $60.

London.—88 packages electrical machinery, $16,200. 136 packages electrical material, $7,928.

Marseilles.—25 cases electrical machinery, $1,454.

Newfoundland.—2 cases electrical material, $100.

Southampton.—6,021 cases electrical machinery, $320.

U. S. of Colombia.—14 cases electrical material, $294. 3 cases electrical material, $54.

NEW INCORPORATIONS.

San Francisco, Cal.—Union Gas Light Co., incorporated by I. M. Bowen, M. B. Bowers, J. H. McCarthy and others; manufacture and sell gas and electricity. Capital stock, $11,000,000.

Los Angeles, Cal.—Electric Supply & Fixture Co., incorporated by M. Y. Kellam, A. W. Brode, J. North, J. Gayland, and T. Fowlkes; manufacture and deal in electrical supplies, etc. Capital stock, $25,000.

Boston, Mass.—The National Light Storage Battery Co. has been incororated under the laws of West Virginia by J. A. Sullivan, E. L. Tierney, S. L. Stackhouse, and others; manufacturing and dealing in storage batteries. Capital stock, $1,000,000.

Charleston, W. Va.—The Ohio Valley Electric Co. has been granted charter to build an electric railroad from Huntington to Catlettsburg, Ashland and Ironton. Capital, $1,000,000.

TELEPHONE CALLS.

Chicago, Ill.—The Illinois Telephone Construction Co. has been incorporated by A. G. Wheeler, E. J. Judd, and L. J. Behan. Capital stock, $500,000.

Meadville, Pa.—The Meadville Telephone Co., incorporated by W. W. Gelvin, R. E. Ashley, T. Roddy, O. Kohler, and J. Hay; construction and maintenance of telephone lines. Capital stock, $1,000.

Granville, N. Y.—Granville Telephone Co. has been incorporated by F. W. Hewett, W. H. Hughes, R. S. Bullock, and F. T. Pember; operate telephone line. Capital stock, $10,000.

New York, N. Y.—The Hobbs Telephonic District Messenger Electric Manufacturing Co., incorporated under the laws of West Virginia, by G. E. Brown, J. D. Hobbs, W. R. Brown, and others. Capital stock, $500,-000.

Hallsboro, Va.—The Chesterfield & Powhatan Telephone Co. has been incorporated by W. W. Baker, B. T. Watkins, Dr. J. B. Fisher, and others. Capital stock, $5,000.

Plattsmouth, Neb.—Plattsmouth Telephone Co., incorporated by T. C. Parmlee, C. C. Parmlee, T. H. Pollock; general telephone and telegraphic business. Capital stock, $50,000.

Plattsmouth, Neb.—Western Independent Long Distance Telephone Co. has been incorporated by T. C. Parmlee, C. C. Parmlee, T. H. Pollock, and T. H. Ewing; construct, operate and maintain general telephone line. Capital stock, $100,000.

STREET RAILWAY NEWS.

Trenton, N. J.—Mercer County Traction Co. has been incorporated by Henry C. Moore, Fred W. Roebling, John A. Rigg, Edward J. Moore, and Thomas C. Barr. Capital stock, $100,000.

Harrisburg, Pa.—The Tunkhannock Electric Railway Co. has been incorporated by John P. Russell, Henry M. Ives, and William E. Little. Capital stock, $15,000.

BUSINESS CHANGES.

Springfield, Ill.—The Sawyer-Man Electric Co., of New York, with a capital stock of $125,000, has been capitalized to do business in Illinois with a capital of $12,000.

Huntsville, Ala.—The Huntsville Electric Light & Power Co.,' property rights, franchises and contracts have been transferred to John H. Waters and T. C. Dupont, of Johnstown, Pa., for $40,000.

POSSIBLE INSTALLATIONS.

St. Petersburg, Fla.—The St. Petersburg Electric Light & Power Co., recently incorporated, already has a plant in operation; new machinery will be installed.

St. Augustine, Fla.—A. L. Rogers, interested in proposed establishment of a $20,000 electric light plant.

Dahlonega, Ga.—The North Georgia Electric Light & Power Co., recently incorporated, is engaged in the development of extensive water powers.

Abbeville, S. C.—The Electric Light Power Co. has leased the water power of Martin's Mill Shoals, on Little River, near Abbeville, and will construct a higher dam, to utilize all the water and develop seventy-five horsepower.

Bell Buckle, Tenn.—F. A. Mansfield is erecting an electric light plant.

Commerce, Tex.—The Commerce Electric Light Co., recently incorporated, will establish an electric light plant.

Jersey City, N. J.—Clark Electrical Co., incorporated by Clayton B. Clark, Edgar L. Ryder, John McNally, Edmund F. Sheehan and John Gibney; manufacture telephones, etc. Capital stock, $100,000.

Bellbuckle, Tenn.—F. A. Mansfield contemplates establishment of an electric light plant.

NEW YORK NOTES.

A. DUNLOP, of The J. Jones & Son Company, 64 Cortlandt St., has been hustling in some big orders for switchboards during the past week, one of which will carry four thousand lamps.

THE CO-PARTNERSHIP heretofore existing under the firm name of the Universal Electric Pull Socket and Switch Company, and doing business at 409-413 East 91st street, New York City, was dissolved on August 5th, 1899. The business will be continued under the name of Eschwei Electric Company, Charles Eschwei, proprietor, at 47-49 Centre street. All the liabilities are assumed and all collections will be made by Mr. Eschwei.

REPRESENTATIVES OF Pass & Seymour, Syracuse, N. Y.; R. Thomas & Son, Liverpool, Ohio; Brunt Porcelain Works, Liverpool, Ohio; Imperial Porcelain Works, Trenton, N. J.; Peru Electrical Manufacturing Company, Peru, Ohio, and the Electric Porcelain Manufacturing Company, Trenton, N. J., all manufacturers of porcelain for electrical purposes, met at 111 Broadway on August 10th and formed a combination to advance the price of their products. This was a necessary move, as the prices at which porcelain goods have been sold during the past few years have ruined a number of manufacturers. There was really no bottom, and buyers were unable to determine the price at which to set their goods. Notice should, however, be given to the trade by the combination before deciding upon what advance to make, as the advance in prices made by the electrical supply dealers and manufacturers last spring, without previous notice having been given to the contractors, resulted disastrously to a large number of the latter.

Tuttle Du Bois, an electrical and mechanical engeer employed in the electrical department of the Brooklyn Navy Yard, called at our office during the past week and reported but little activity, the loss of the machine shops through fire having made matters more slow. Work is progressing on the Detroit. As Mr. Du Bois is looking for a more favorable position, this an excellent chance to secure the services of an engineer and electrician. He is fully conversant with the installation of complete electric light and power equipments, etc., and writer can recommend him highly.

Gates & Randolph, 13-15 Manadnock Building, Chicago, Ill., engineers and contractors for electric railway light and power plants, have issued an attractive catalogue of the various lines of electrical apparatus which they handle. Among some of the apparatus are the well known Triumph and Warren generators, Empire instruments, Scheeffer transformers and recording wattmeters, Ideal and Victor circuit breakers, Sterling arc lamps, etc. Correspondence is solicited.

The Electrical Age.

VOL. XXIV—No. 9 NEW YORK, AUGUST 26, 1899. WHOLE No. 641.

Electric Railways.

Electric Street Railway Plant ; Vertical Engines ; Machinery Occupying Minimum of Floor Space.

MOTORS AND CAR EQUIPMENTS.

The expense of operating a street railway system is largely dependent upon the condition of the motors and the car equipments. The selection of these involves considerable forethought on the part of the engineer entrusted with such a responsibility. In the present stage of the art car equipments are delivered so complete that but little expert knowledge is required other than to assemble some few minor parts; but other questions arise regarding the relative efficiencies of one system over another. and, in addition, the durability of cars and motors. Fortunately, a choice of these can readily be made by a careful consideration of the conditions of service.

A review of these conditions shows us that motor and car equipments must be chosen in order to meet and overcome all the exigencies of city travel. First, cars must overcome grades, some of which exceed twelve per cent. Second, cars must overcome lesser grades in winter weather, when the slip calls for an effort from the motor greater even than that due to a twelve per cent. grade. Cars and equipments must be selected with reference to the length of the car and the position of the motor with respect to the trucks and axle. It is also necessary to consider the equipment with respect to the readiness with which motors and trucks can be replaced and interchanged. In fact, a car equipment purchased in the summer and operating as smoothly as could be expected would, under certain circumstances, become almost useless in severe wintery weather, thus causing a delay in every part of the road and the subsequent loss of large sums of money.

It is necessary to have on hand two classes of cars for summer service—one closed and one open—to meet the conditions of the weather. "If the grades are light one motor may, at the opening of warm weather, be transferred to the open cars, each car thus having for summer one motor of say twenty horse power capacity. If the grades be heavy, requiring even in summer much more than half the weight to be on the driving axles, then a double equipment of two motors per car may be had, each of say fifteen horse power capacity. If one motor can be successfully geared to the axles of a truck the shifting of one live truck from the closed to the open car would, for the lesser grade, produce the desired result of having both classes of cars in readiness during the summer months. If this condition be required on roads of heavier grade a complete independent equipment must be provided for open and closed cars. Companies in general prefer to run only the closed cars or to run the open cars with curtains down during summer rains or possibly to manent part of the car, that is to say, they consist of open and closed cars in conjunction with each other, generally called "combination cars." When trailers are at-

Types of Electric Railways.

run the open cars only as trailers."

In the present metropolitan system cars have been selected, designed and built with the trailer forming a per- tached to the driving car and the trailer is an open car the load on the motors is transferred in warm weather to the trailer and the difficulties in traction increased. It is therefore necessary to select motors and car equipments with respect to these conditions, so that not only can the cars meet the grades of the road in both winter and summer without difficulty, but also be prepared to carry the car readily and economically when the passenger weight is inappropriately distributed.

In the following illustrations are shown some of the conditions of service met with in a suburban road operating through districts not far removed from Greater New York. The general appearance of the engine room is also reproduced as well as the style of engine used for operating a series of generators. The station efficiency and equipment is of course another problem, entirely distinct from that of motor and car equipment, yet the two are so related that unless the utmost care and attention is paid to both there will be a constant financial leakage from the coffers of the company which will ultimately lead to a condition bordering on bankruptcy. After a road has been completely installed the labor problem becomes the most important one, but this is considerably

Conditions Met With in Surburban Electric Street Railway Service.

modified by the running conditions of the station and the style and system of electric traction in use.

HIGH-SPEED ELECTRIC RAILWAY SERVICE.

Many electric companies have been organized in the past for the purpose of building roads on which electric cars would operate, running at speeds of sixty, seventy, eighty and even over a hundred miles an hour. The final efforts of Crosby and Bell, who built an electric locomotive whose velocity at times exceeded one hundred miles an hour, prove that the practical solution of the problem of high-speed roads was only a question of time. The names best known in the connection with the experimental history of general electric railway work are F. J. Sprague, Leo Daft, Thomas A. Edison, Crosby and Bell, David G. Weems, and others.

The conditions to be met with in high-speed service are about the same as those inviting difficulties in low-speed service. According to Crosby and Bell, the difficulties in the way of high-speed service have been practically overcome. They say: "In the light of the experience of to-day no one of the competent engineers who has had to do with the electric railway work of the last few years would hesitate, if supplied with the proper amount of money, to undertake the successful installation of an electric rapid transit system, meeting all the requirements of the New York elevated railway or London underground service. The conditions are, in many respects, much simpler than those met with on the streets. Especially is this true in regard to placing the conductor system in the common street, where the convenience of the electrical engineer must be subordinated to every immemorial right of man, beast or tree."

They furthermore say: "Should there still be question in the minds of any as to .... speeds much higher than those commonly used, it may be stated that seventy-five amperes, at five hundred volts, have been continuously supplied to a car moving at more than one hundred and ten miles an hour. The reader may find, in a paper read before the American Institute of Electrical Engineers, February 24th, 1891, an article by O. T. Crosby, entitled "Report of High-Speed Electric Railway Work," which contains matter of the deepest interest to those engaged in high-speed service experiments.

Steam Generating Plant of Electric Railway Power Station.

In the above illustration is shown a half transverse section of an electric locomotive with which the enormous speed of one hundred miles an hour was obtained. As regards the efficiency of high-speed service, an electric locomotive, moving at seventy miles an hour, is working more economically, if supplied with efficient gearing, than a steam locomotive. But on roads for heavy traffic steam is cheaper than electricity when the resulting efficiency of the motor and gearing is less than seventy per cent. The unsatisfactory rails, the atmospheric resistance and a few mechanical difficulties at present stand somewhat in the way of success in high-speed service, but there is no ab-

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NEW YORK, AUGUST 26, 1899.

CONTENTS:

THE X RAYS AND M. LABORI.

The attempted assassination of M. Labori, counsellor to Captain Dreyfus, at Rennes, France, on Monday, August 14th, while on his way to the Lycée, brought to light a condition of affairs that can hardly be accredited to any part of civilized France. Excluding the negligence and dilatory action of the gendarmes in catching either of the two assassins the treatment of the victim calls forth considerable professional criticism, to be pardoned only now—in the eleventh hour, as it were—by the announcement that the distinguished patient has recovered from an injury whose nature was so much in doubt for days.

It is claimed that the injury was inflicted about 6 A. M. on the day mentioned; that the weapon used was a pistol of unknown make, fired at close range; that the ball entered posteriolly, penetrating the thorax to the right of the spinal column, on a line with the fifth of sixth dorsal vertebræ. Medical aid, consisting of four local surgeons, arrived at the scene of the shooting perhaps half an hour later. Considerable hemorrhage prevented practical exploration, which is, in cases of this nature, always a serious condition, so that the actual extent of the injury could hardly be ascertained within an hour. At 7.30 A. M. a diagnosis that predicted a fatal ending was made public. Naturally the medical profession of the entire civilized globe by this time awaited a confirmation of the sad prognosis. None came.

Apart from the general practitioner, the radiographer —and modern surgeon of America—was the most concerned. It is needless to say that no data came. Not until Wednesday was an X ray apparatus obtained, for the purpose of substantiating any prognosis, and that had to be sent for from Paris (according to cable). This certainly speaks very unfavorably of the standing of the general surgeon and more so of the military surgeons who have attended M. Labori. Although symptoms pointed to a possible recovery, there was no excuse whatever for such surgical negligence. If it were no more than a matter of cold history, a radiograph should have been made at least twenty hours after the injury was inflicted. We have been informed of the result obtained with the unfailing X rays, that a flattened ball was found lying laterally about the "costo-transversal joint," showing no fracture about the ribs whatever, which could indicate that perhaps the missile struck one of the vertebræ and glanced off through the muscular tissues overlying the bony thorax. This assures us there need have been no alarm felt for the patient.

The lack of an X ray apparatus at Rennes seems almost incredible, especially when we look over the long list of France's author-investigators and experimenters. Yet such is the startling truth, and all the more's the pity at this, the end of the nineteenth century.

LIGHTNING DISCHARGES IN CENTRAL STATIONS.

The vast amount of damage done by a lightning discharge in central stations have often aroused the curiosity of those who have made a special study of static discharges, yet could not account for the destruction and damage wrought by a mometary flash whose amperage was certainly limited to a comparatively weak current. The question has frequently been asked, though little or no reasoning has been done on the subject, how can lightning destroy a central station? As far as the electromotive force is concerned, experiments have shown that approximately two millimeters is bridged with a pressure of two thousand volts. Four thousand volts will spark four millimeters; six thousand volts ten millimeters, and fourteen thousand volts twenty-four millimeters. According to these figures a discharge many thousand feet long represents an enormous pressure which, operating in conjuction with even a small current, would reach thousands of horse power.

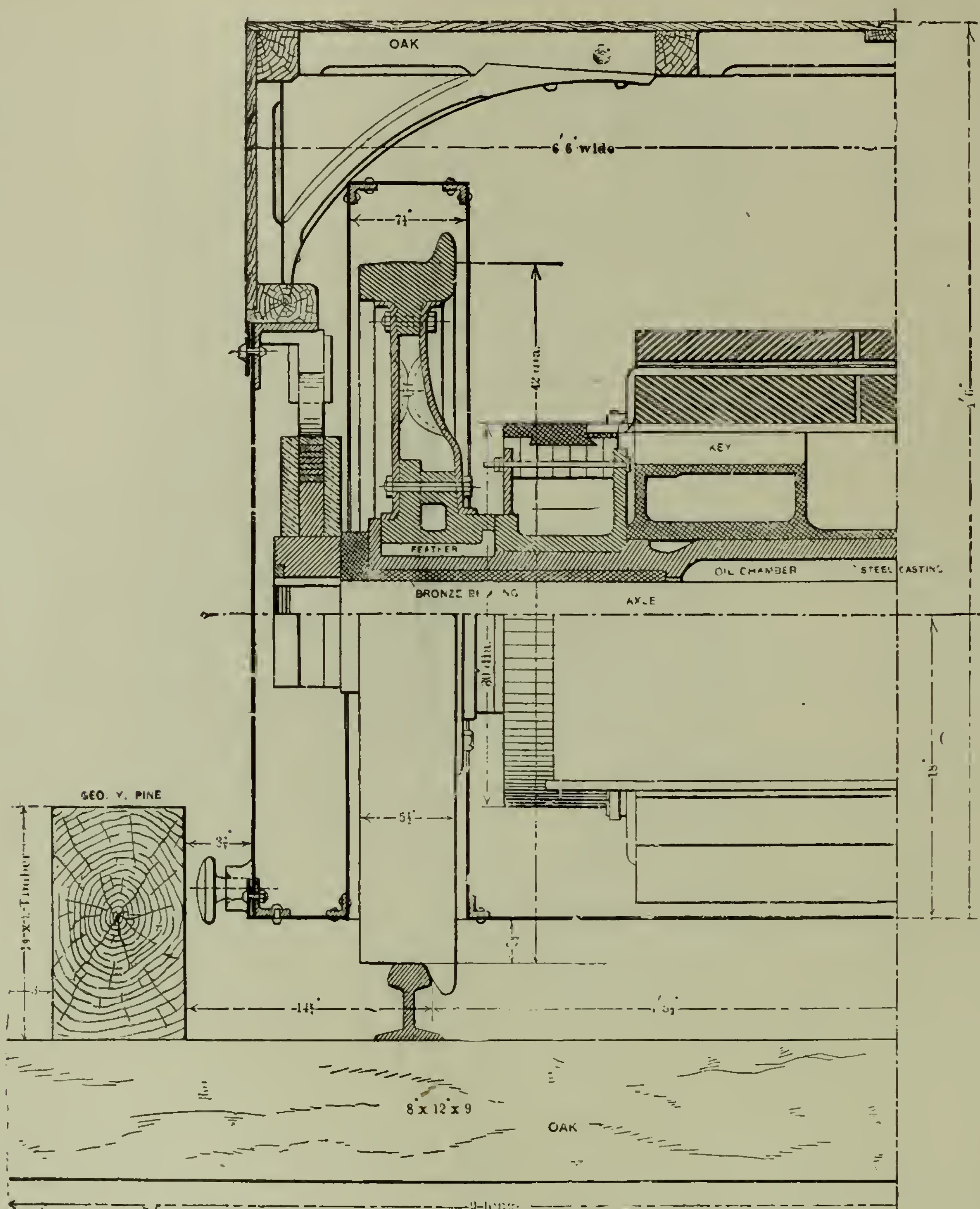
But the injury done to a station, as shown by the conflagration that generally follows in the path of a lightning discharge, cannot be due directly to the high electromotive force, but shows all the signs of having been caused by very heavy current; in fact, as though the power of the generators had been the cause of a combustion which involved themselves. In consequence of this phenomenon, investigations have been set on foot which show that, in the majority of cases, a station struck by lightning and injured by the same, except in special cases, represents a condition of affairs that cannot be traced, as far as the damage is concerned, directly to the lightning. The lightning in all probability travels along the leads into the station, reaches certain switches and generators and jumps through them, starting an arc through which the entire current of the generator passes, in many cases, setting the station on fire and causing widespread damage. The discharge in itself, unless very severe, causes but little destruction, yet the real danger is more in its jumping across wires between which a high potential difference exists, thereby starting an arc between them and causing fire. The necessity, therefore, is obvious, in all large plants or stations, for thoroughly reliable lightning arresters in which the discharge is safely conducted to the earth and absolutely prevented from reaching valuable machinery.

solute reason why, commercially and practically, electric locomotives could not be used at speeds exceeding eighty miles an hour.

ELECTROLYSIS FROM ELECTRIC RAILWAY CURRENTS.

When electrolysis from electric railway currents was first discovered, sweeping assertions were made as to the omnivorousness of the current in attacking, without respect, all metallic street structures, and laboratory experiments were cited to show that most minute differences of potential were sufficient to excite action. Practical experience has not fully sustained these early gloomy prophecies; contrariwise, it has been demonstrated that lead is the most sensitive metal, is attacked by the smallest difference of potential, and yields most readily and rapidly to corrosion. Wrought iron comes next, while cast iron, particularly those varieties that contain large amounts of carbon and silicon, known as white cast iron, are so little affected as to be almost exempt. The lead service pipes, therefore, from the water mains, and the sheaths of underground electric cables will be the first and chief sufferers. The wrought iron gas and water services, and the wrought iron pipes of the newer gas companies stand next, while the cast iron mains of the older installations, particularly those pipes made of chill iron, will practically escape injury.

The degree and rapidity of the corrosive action depends upon the quantity of current flowing, and the nature of the soluble salts contained in the surrounding soil. Chlorides or nitrates from the street wash in a clayey or loamy soil favor action, while in clean, dry sand, corrosion is a minimum. If corrosion were uniformly distributed over the entire surface of an exposed pipe, a measurement of the current and an analysis of the soil would enable a fairly accurate prediction as to the probable rate of injury, but as disintegration always proceeds by pitting, the damage is concentrated on particular spots, and the metal is perforated with comparative rap-



Half Transverse Section of a High Speed Electric Locomotive.

idity. As lead is most rapidly attacked, it is easy to test the probable maximum rate of action at any place by putting weighted test pieces of sheet lead in the street manholes and reweighing them after a lapse of time.

The greatest economy in a local protecting system is attained by making it as small as possible, and the system is a minimum under the following three conditions:—

1. The danger areas must be reduced to their least dimension.

2. They must be brought as close as possible to the power station.

3. The current escaping from electro-positive points must be reduced to a minimum.

It was formerly the practice to connect the positive pole of the station dynamo to earth, and the negative pole to trolley wire, with the result that the portion of the underground systems remote from the power house, covering a widespread territory, were rendered electro-positive, and the danger areas extended to the maximum limits, so the first step towards protection was taken by reversing the generator poles, rendering all the territory remote from the generators electro-negative and concentrating the electro-positive points in the immediate vicinity of the station. By this simple expedient the first two of the three conditions have been fulfilled with the most gratifying results.

As to the third condition, we know that in the metal of the track the railways have a conductor of magnificent proportions, far exceeding in electrical conductivity any feeder system in use. But in order to realize the full value of the rails, it is necessary to insure perfect electrical continuity,—that debatable ground upon which has been fought the battle of the bonds.—Arthur V. Abbott, in Cassier's Magazine.

Electric Mining.

ELECTRICITY IN COAL MINING.

By John Price Jackson and Frank F. Thompson.

(Concluded from Page 107.)

Coal Cutting.—Under suitable conditions under-cut coal cutters will permit a great saving of labor, and therefore of expense, in soft coal mining. But in a large number of cases such cutters have been thrown out as unsatisfactory and have been replaced by compressed air drills or other apparatus. In mines where curve veins abound they have ordinarily given much trouble. The cutter strikes the clay vein and sticks, or worse, bends, causing it to wedge tightly. This necessitates digging out with the pick axe and expensive repairs. The most serious difficulty seems to arise from poor mechanical design and construction, combined sometimes with electrical faults. It should be possible to overcome these difficulties. In one mine where great trouble of this nature was previously experienced a new set of machines is now giving great satisfaction.

Electric Pumps.—Electric pumps run by induction motors give very satisfactory service. The conditions met with in mining often necessitate frequent re-location of the pumps, and in this respect the electric pump is by far the most satisfactory. The attention required is certainly a minimum. A particular pump tested ran about ten hours per day, and the only attention required was that necessary for starting, stopping, and lubrication. Some mine owners have objected seriously to the electric pumps. In most cases these objections have been due to the compact arrangement of the pump and motor. In one mine which came under our observation, a 10-H. P. pump, which was bought with the motor, was replaced by the water end of a steam pump with a great improvement in the service. If electric motors were made to suit the pumps, and not the pumps to suit the motors, it would go far toward obviating the most serious objections. When the pump must be of large capacity and when it can be located within a reasonable distance of the steam plant, a steam pump would probably show greater economy.

Wiring and Pressure.—Wiring in mines is subject to certain restrictions which do not apply in ordinary wiring. There is no doubt that the 550-volts used for haulage is dangerous for horses. It is therefore customary in many mines to shut off the trolley current while the mules are being taken in or out of the mines. If a polyphase system is installed for operating cutters, pumps, etc., in the mine it should be run through the air courses and not through the main gangway. A pressure of 550-volts alternating is much more dangerous than the same direct-current pressure. The class of labor which is usually employed in the soft coal fields is of a low grade of intelligence, and many instances are recorded of serious personal injury or loss of life from accidental or intentional contact with the wires on both 500-volt A. C. and D. C. service. Although the mine laborers may have been repeatedly warned of the danger, they continue careless about the wires. When the mine roof is low enough to be reached by the men, the common practice is to run trolley wire along one side supported by the usual hangers. When feeders are necessary they should be run along the same side. The other side of the roof should be kept clear.

Ordinary bare wire is preferable in mine work. The best insulation, rubber compounds, deteriorate rapidly under the action of the sulphur water. Any other insulation soon becomes inefficient owing to the moisture which is always present in a mine.

In large operations such as those at Windber, where 20 miles of trolley are already in service, it is undoubtedly advisable to use at least 500 volts pressure for haulage. The polyphase power should preferably be used at a lower pressure for the sake of safety to employees. This could often be done without an undue expenditure of copper, by carrying high-pressure lines overhead to air ducts, or through unused passages to suitable points for distribution, where the pressure could be lowered by transformers When it is necessary to run wires down a shaft through which coal is to hoisted, the best practice would be either to use lead covered cable, or wire which has been insulated with rubber, heavily braided, and drawn into an iron conduit having the ends hermetically sealed. In many instances when wires have been installed without such protection, in old shafts, trouble has resulted from the breaking of the wires, caused by lumps of coal falling down the shaft, etc.

Skilled Employees.—Too much pains cannot be taken to employ careful men as motormen for the haulage motors. The mine track is far from being up to the street railway standard. To haul a long trip of wagons over a bad track requires careful handling of the motor. The motorman should be trained to study his track and his load, and know when and where to let his trip run slack and where to keep the couplings taut. A case came under the writer's observation where a careful motorman handled a trip of 15 loaded wagons, while another motorman stalled with 10 wagons on the same stretch of track. This matter is a very important one from the mine owners' point of view. The cost of driving gangways and shafts is considerable, and any method which will allow of an increase in the quantity of coal which can be taken from a single opening in a given time, adds very materially to the mine owners' profits.

Lighting and Signals.—As the lighting of a mine is a comparatively simple matter, it is scarcely necessary to consider it here. The universal method is to light up all switch points, and only other places of exceptional importance. In large mines using a number of locomotives an efficient system of signals should be used in the main headings. This should be an automatic block system. Mr. A. S. McAlister, of Windber, Penn., has worked out such a system, using incandescent lamps between trolley and rails, which is working admirably.

Efficiency.—The question of efficiency, from a fuel standpoint, is of comparatively small relative value, as the difference in actual cost in fuel in the different systems is insignificant when compared with other expenses. Data available seem to indicate, however, that the all-electric systems lead in this respect. As regards the total commercial efficiency, including maintenance, labor, interest, and depreciation, there can be no doubt but that the compound electric system using polyphase and direct currents, will give the best results.

General.—The data and statements presented in this short paper are gathered from personal experience in the mines, from mine superintendents, and from student thesis work carried on under the supervision of the Pennsylvania State College. In writing the paper it was not intended to give a complete detailed treatise on the use of electricity in mines, but to outline the most important conditions and facts bearing upon such utilizations.

Stray Currents.

UTILIZING THE POWER OF THE TIDES FOR GENERATING ELECTRICITY.

At Pont-L'Abbe, Finisterre, France, the tides are utilized during fourteen hours per day in generating power. At flood tides, the water flows through a canal two and a half miles inland, into a pond in rear of the power house receiving the water, which returns to the sea at ebb tide. The total fall is from 6½ to 7½ feet, and 80-hp are generated by means of turbines. It has been proposed to apply this means to generate electric power for industrial application.—Ex.

LORD KELVIN'S SUCCESSOR.

There is said to be a brisk competition for the Chair of Natural Philosophy in Glasgow University, which, thanks to Lord Kelvin, has become the most illustrious in the world for the time being. The post is worth £1,000 a year, with a free house close by. For many years Dr. J. T. Bottomley, F.R.S., a nephew of Lord Kelvin, has taught the class, and been a partial substitute for his lordship. Dr. Bottomley is among the applicants for election, and he has some distinguished rivals. —Ex.

UTILIZING GARBAGE.

Mr. R. Diesel, of Munich, the designer of the Diesel heat engine, has recently patented in England a new means of effecting ignition and combustion in internal-combustion engines. The method consists in compressing the combustible charge to a degree below that at which it attains its ignition temperature, and then forcing into it another combustible having a lower ignition temperature, such that it becomes ignited by the heat of the compressed charge and thereby effects its combustion. Again, by varying the manner of the introduction and the proportion of the charge introduced, the combustion of the working charge can be correspondingly varied. —Ex.

A NOVEL BURGLAR ALARM.

Catching bicycle thieves by electricity is now said to be one of the pastimes of Chicago. Bicycles are piled up outside of the door of most salesrooms and the bicycle thief usually takes the outside one and walks off with it before the alarm can be given. Now an electric bell is connected by wire with a button in the sidewalk. While the bicycle rests on this button all is safe. The moment the wheel is moved or raised the button is released and the bell rings steadily. No device could be better, for all the bicycles next to the outside one are protected by it, as they cannot be moved without disturbing the other one.—Ex.

A NEW WATER POWER PROJECT.

The Chicago Railway and Engineering Review draws attention to a scheme which is projected in Nebraska for utilizing a waterfall some 135 feet in height for the development of power to operate a 25,000 H. P. electrical plant. This waterfall is on the Platt River west of Fremont, and the energy is to be transmitted to Omaha, which is 35 miles distant. The valley of the river mentioned has a fall of 6 feet per mile for 27 miles west of Fremont, and, having a high bluff running parallel with it some distance south, a level crest is maintained for the whole length. It is proposed to make a canal which shall have a grade of 1 foot per mile along the crest of this ridge, into which the river water, by means of a dam, will be diverted. According to the Western Electrician, Chicago, General King, of Drayton, Ontario, together with a syndicate of New York and London capitalists, are concerned in the enterprise. The construction of the canal and reservoir is to cost $2,000,000.—Ex.

ELECTROLYTIC SEPARATION OF CADMIUM FROM IRON.

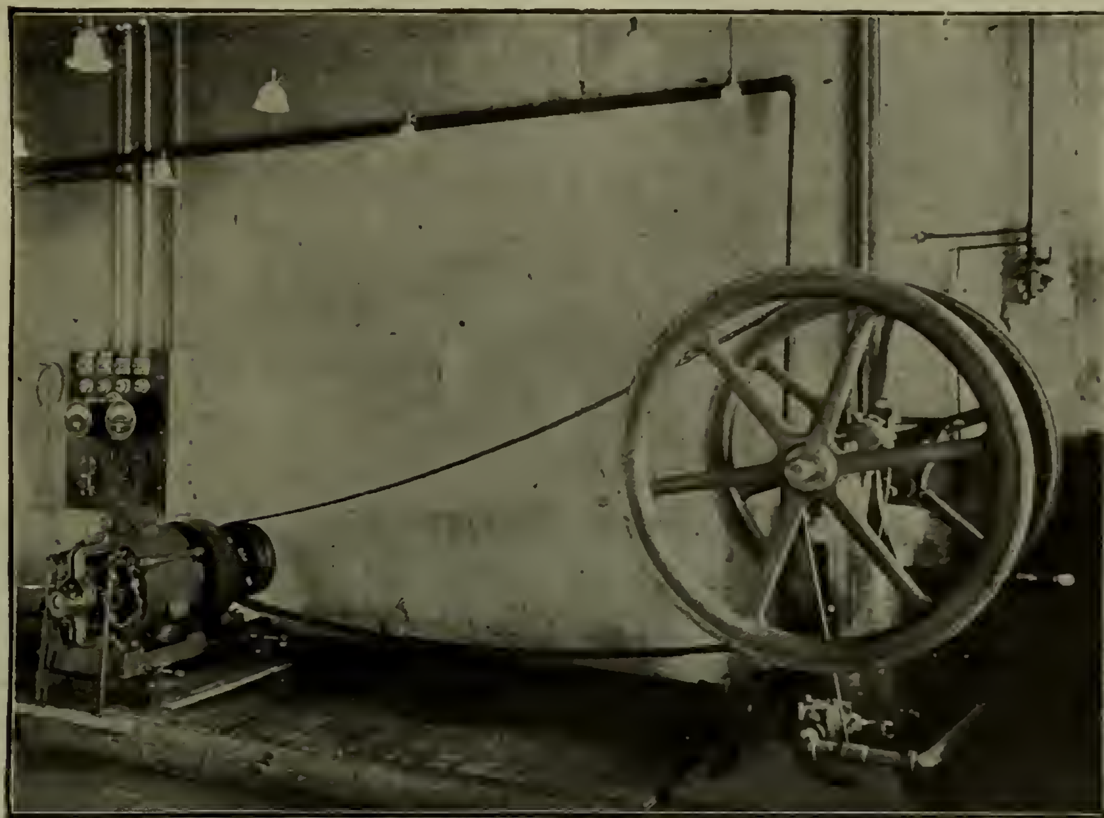
According to W. Stortenbecker, in the Zeitschrift fur Elektrochemie, a method for separating these two metals in slightly acid solution has already been described by Smith. As a cyanide solution gives the best deposits of cadmium the author has made certain experiments with the object of finding out whether such a solution could not be used for the electrolytic separation of iron from cadmium. When an excess of cyanide of potassium is added to a solution of a ferrous salt, a soluble ferrocyanide of potassium is formed. When solutions of ferric salts, hydrated peroxide of iron is produced, and only a very small proportion of iron passes into the cyanide solution. The method proposed by the author is based on the non-electrolytic decomposition of the soluble ferrocyanide of potassium. The mixed salts of iron and cadmium are dissolved in 100 c. c. of water very slightly acidulated with a few drops of dilute sulphuric acid; to this is added 2 or 3 grms. of pure cyanide of potassium, and the whole heated until the solution becomes perfectly clear. If this clarification requires too long a time a few drops of caustic potash may be added. The solution is then diluted to 200—250 c. c., and, after cooling, electrolyzed with a current of 0.05 to 0.10 ampere per square decimeter. The deposit of cadmium is perfectly coherent. If the solution contains but a small quantity of iron, the floating hydrated peroxide may be neglected; but if, on the contrary, the iron is present in any considerable proportion it becomes necessary to reduce this ferric salt to the ferrous state by means of a sulphurous acid; to effect this it suffices to add to the acid solution on a small quantity of sulphite of soda, and heat for a short while. —Ex.

A POSSIBLE RIVAL FOR THE GENERAL ELECTRIC COMPANY.

THE SCOTT-JANNEY ELECTRIC COMPANY.

At a meeting of the stockholders of the Scott-Janney Electric Company, held at Philadelphia, on August 21st, the following were elected directors of the company: Alexander of Philadelphia; William B. Hill; Edward A. Abbott, Concord, N. H.; J. F. Frank Le Bar, Providence Life and Trust Company, Philadelphia; Henry A. Sage of Ogdensburg, N. Y.; Gordon J. Scott of Philadelphia; Gen. Frank Reeder of Easton, Pa.; Robert, New York, James B. Dill, W. W. Wolverton, treasurer Bell Telephone Company; Charles W. Drake, former vice-president of the Missouri Pacific Railway Company; Allen D. Loney, New York; T. Quincy Brown, president o fthe Atlantic National Bank of Boston; Daniel O'Day of New York; Frank R. Hansell, George H. B. Martin, William S. Janney, R. F. Loper and Charles F. Walter.

The Scott-Janney Company was recently incorporated at Trenton, N. J., with a capital of $30,000,000, and intends to compete with the General Electric and Westinghouse Electric and Manufacturing Company. It is reported that a large plant will be erected at Philadelphia at once.



Three Horse Power Gas Engine Plant for Domestic Lighting.

TECHNICAL NOTES.

SMALL DOMESTIC PLANTS FOR ELECTRIC LIGHTING.

In the illustration is shown a small gas engine plant of about three horse power. The gas consumption does not exceed fifteen feet per hour when the engine is working properly; the electric lighting done with this gas consumption reaches as high as thirty sixteen candle power lamps. With gas at sixty cents per thousand cubic feet, is would only be possible with gas jets to run thirty five foot burners about seven hours, but by this arrangement thirty incandescent lamps of the same candle power as five foot burners can be operated for nearly twenty hours. This is about three times the efficiency, and of course one-third the cost by using the gas in an engine instead of merely burning it.

Conductors as determined by losses therein			Size	Weight	Cost
Incandescent Lamps. Two Wire System	General Cases.		$M=\frac{Tcp \times D \times 16000}{E \times V \times Chp}$	$T=\frac{D^2 \times Tcp}{V \times E \times Ch.p. \times 1000}$	$\$=\frac{D^2 \times Tcp \times L}{V \times E \times Chp \times 1000}$
			$M=\frac{Tcp \times D \times W \times 21.5}{E \times V}$	$T=\frac{D^2 \times W \times Tcp}{V \times e \times 746000}$	$\$=\frac{D^2 \times W \times Tcp \times L}{V \times e \times 746000}$
	For 100 volt Lamps 4.66 Watts per c.p.		$M=\frac{Tcp \times D}{V}$	$T=\frac{D^2 \times Tcp}{V \times 16.000.000}$	$\$=\frac{D^2 \times Tcp \times L}{V \times 16000000}$
	For 110 volt 3.1 Watt Lps.		$M=\frac{Tcp \times D \times 2}{3 \times V}$	$T=\frac{D^2 \times Tcp}{V \times 24000000}$	$\$=\frac{D^2 \times Tcp \times L}{V \times 24000000}$
Incandescent Lamps. Three Wire System	General Cases.		$\frac{1}{4}$ of corresponding	$\frac{1}{3}$ of corresponding	$\frac{1}{3}$ of corresponding
	For 100 Volt 4.66 Watt Lps.		2 wire case	2 wire case	2 wire case
	For 110 Volt 3.1 Watt Lps.				
	C. For any case		$M=\frac{C \times D \times 21.5}{V}$	$T=\frac{C \times D^2}{V \times 7460}$	$\$=\frac{C \times D^2 \times L}{V \times 746000}$
	For power at motor pulley.		$M=\frac{D \times R \times 1600}{V \times E \times P}$	$T=\frac{D^2 \times R}{V \times E \times 10 \times P}$	$\$=\frac{D^2 \times R \times L}{V \times E \times 1000 \times P}$
	For minimum total initial cost of plant.				$\frac{G \times E \times V}{(E-V)^2}=$; $\frac{G \times p \times 100}{(100-p)^2}=$ Dollars per R delivered by conductor
Generators for minimum total initial cost of plant					$\frac{100\,G}{100-p}=$ Dollars per R delivered by conductor

Conductors as determined by safe heating		Temperature	Formula
Bare Copper Wire.		15°C	$M=C^{\frac{4}{3}} \times 200.$
		35°C	$M=C^{\frac{4}{3}} \times 170$
		45°C	$M=C^{\frac{4}{3}} \times 100$
Average Insulated Copper Wire.		15°C	$M=C^{\frac{4}{3}} \times 150$
		35°C	$M=C^{\frac{4}{3}} \times 100$
Bare Iron Wire		45°C	$M=C^{\frac{4}{3}} \times 328$
Bare German Silver Wire.		45°C	$M=C^{\frac{4}{3}} \times 608$

E = E.M.F. of Generator in volts.
e = " " Device " "
C = Current in amperes.
cp = Candle power of lamps at normal E.M.F.
Tcp. = Total candle power of lamps
Chp = Candle power per electrical horse-power at normal E.M.F
M = Area of cross-section of wire in circular mils
D = Mean distance current is transmitted one way
V = Loss of E.M.F. in conductor in volts)
$ = Cost in dollars
L = Cost of copper per pound in cents
W = Watts per candle-power
T = Weight of wire in pounds.
P = Efficiency of device.
p = Percentage loss in conductors.
G = Cost of generator per R delivered by conductor

ELECT'L. AGE, N.Y.

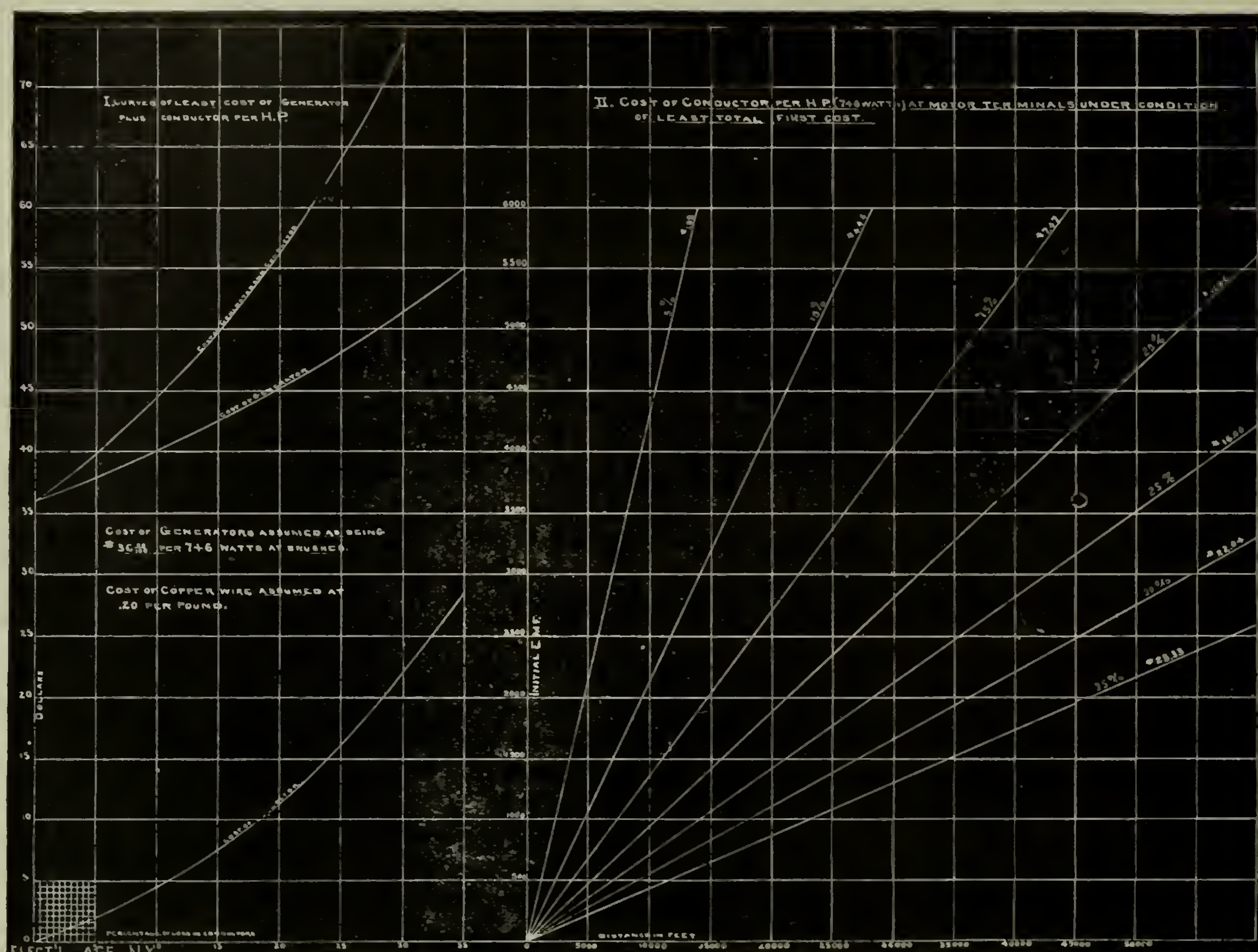
Formulae Relating to Cost, Size and Weight of Conductors.

COST OF CONDUCTORS FOR POWER TRANSMISSION.

In the following tables are shown the relations existing between the cost of conductors per horse power at motor terminals under conditons of least total first cost. Also the curves of least cost of generator, plus conductor per horse power. In addition, the cost of generators assumed as being thirty-six dollars per horse power at brushes. These tables, of which immediate applicatiol can be made, speak for themselves in expressing a relation between the absissæ and ordinates thus represented. The power transmisson handbooks, of course, give formulæ showing a further extension of the principle and including the cost of conductors, etc., for generators far removed from the extremity of the line.

between Gjedser and Walneumende. This is an opportunity for American cable manufacturers to seize.

The Dominion House of Commons recently unanimously adopted the Government resolution providing for Canada's contribution to the Pacific cable project. Mr. Mulock announced that the estimated cost of the construction of the line had been revised, and was now placed at £1,700,000. He confidently anticipated that the cable would become a paying enterprise in a few years. The annual cost of maintenance, repairs, sinking fund, and the interest would be £144,886, and he believed that, after these charges had been paid, there would be a surplus even in the first year's operations. Great Britain and Canada would contribute five-eighteenths each, and New Zealand, Queensland, New South



Curves Showing Relation Between Cost of Copper, Horse Power, Distance, Etc.

Business News.

FOREIGN TRADE NEWS.

(Special Washington Correspondence to the Electrical Age.)

Washington, D. C., Aug. 18, 1899.—The Secretary to the British Legation at Munich, Bavaria, reports to his government that the machinery trade is exceedingly good, and that the electrical engineering trade is also active and prospers.

The directors of the British Insulated Wire Company, Prescot, have declared an interim dividend on the ordinary shares at the rate of 10 per cent. per annum for the half year ending June 30th .

A British consul in Denmark reports that as soon as the Danish Government can obtain the necessary grants, it will take steps for the construction of a telegraph cable

Wales, and Victoria two-eighteenths each. The governing board would consist of eight members—three from Australasia, three from Great Britain, and two from Canada. Mr. Mulock paid a high compliment to Sir Sandford Fleming for the ability and energy with which he had advocated the project for many years. Sir Charles Tupper heartily congratulated the Government on its presenting the resolution, and said he believed that the cable would be of great benefit in developing trade between the different portions of the Empire.

Passengers to the number of 100,000,000 travelled last year on the electric railways in Canada, an increase of over 19 per cent. compared with the previous year, when the number was 83,811,306. There is a steady expansion of electric railway systems in Canada, and the figures for the present year will be larger. Statistics for 1897 show that the steam railways in Canada carried in that year 16,171,338 passengers. It is interesting to note this by way of comparison.

The directors of the Metropolitan Electric Supply Company, of London, announce an interim dividend for the past half year at the rate of 5 per cent. per annum.

The directors of the Bournemouth and Poole Electricity Supply Company, London, have declared an interim dividend on the preference shares at the rate of 4½ per cent. per annum for the half year ending June 30th, payable on August 15th.

CANADIAN ELECTRICAL NEWS.

(Special Correspondence to The Electrical Age.)

Montreal, Aug. 19, 1899.

Renfrew, Ont.—The Renfrew Electric Light and Power Company is being organized, with capital stock at $50,000. The company propose to develop the water power of the Bonnechere River.

St. Johns, Que.—A by-law to raise $20,000 to install an electric light plant for the town was defeated recently.

Wroxeter, Ont.—A movement is on foot to secure the installation of an electric light plant.

Victoria, B. C.—The electric light station is to be enlarged and an additional plant put in under the supervision of Engineer C. H. Topp.

Orillia, Ont.—The Engineering Contract Company, of New York, through their Canadian agency, have been figuring on the proposed power transmission scheme with a view of taking the contract abandoned by the Central Construction Company.

Almonte, Ont.—A by-law to raise $30,000 by debentures for the purpose of installing a civic electric light plant has been given its second reading in council. The rate-payers will vote on the question on September 25th.

Arnprior, Ont.—R. Anderson, of Ottawa, has submitted to the council a proposition to install an electric light plant, building a power house at Galletta, and it is expected that he will be given the contract and commence work at once on his proposed plant.

Shawville, Que.—Robert Surtees, C. E., of Ottawa, has estimated the cost of a waterworks system for this town at $1,000 and electric light plant at $4,000.

Baddeck, N. S.—It is probable that an electric light plant will be installed here.

Rat Portage, Ont.—A new company, promoted by D. C. Cameron, has made a proposition to the town for street lighting.

ELECTRIC RAILWAYS.

Kingston, Ont.—The Kingston Electric Railway Company will next winter erect at Lake Ontario Park a pavillion capable of seating 1,500 people.

Quebec, Que.—The British American Pulp and Paper Co., composed of R. Prefontaine, of Montreal, Jules Tesseir, of this city, and others, purpose constructing an electric railway from a point on the Lake St. John Railway round the lake to Roberval with branch lines.

Halifax, N. S.—F. A. Huntress, manager of the Halifax Tramway Company, has returned from a trip to the West Indies, where he was looking over the field with a view to securing railway franchises.

Woodstock, Ont.—Dr. S. Sitter Ickes, of the firm of Ickes & Armstrong, electric street railway promoters, Harrisburg, Pa., was again in the city last week in connection with the project to construct an electric railway connecting Woodstock with the neighboring towns. It is expected that the first line will be constructed to Hickson and Embro.

Hamilton, Ont.—The Cateract Power Company have taken over the Hamilton and Dundas Railway and will commence at an early date the construction of a line to Guelph. The company also contemplate the construction of the Hamilton, Ancaster and Brantford Electric Railway.

Waterloo, Ont.—J. Stewart Clark has written to the council regarding the proposed construction of an electric railway from Waterloo to Port Colborne.

Montreal, Que.—The Montreal Street Railway. have decided to equip their cars with fenders. The company has also purchased the right of way with a view to building a line round the foot of the mountain to Westmount.

Ottawa, Ont.—It is again stated that the Ottawa Electric Railway Company will build a branch line to Rockliffe ranges.

J. ALCIDE CHAUSSE.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FOR WEEK ENDING AUGUST 15, 1899, $42,725.

New York, N. Y., August 15, 1899.—The following exports of electrical material are from the port of New York for the week ending this date:

Antwerp.—3 cases electrical material, $200.

Argentine Republic.—7 packages electrical material, $123; 11 cases electrical material, $630; 1 motor current, $250.

Brazil.—23 cases electrical material, $2,559.

Bergen.—1 package electrical material, $21.

Bolivia.—6 packages electrical material, $141.

Bremen.—1 electric motor, $150.

British West Indies.—21 packages electrical material, $454.

Berlin.—1 case electrical material, $1,160.

Central America.—1 case electrical material, $29.

Chili.—43 packages electrical material, $1,136.

Copenhagen.—1 package electrical material, $25.

China.—33 cases electrical machinery, $1,175.

Cuba.—33 cases electrical machinery, $372; 12 packages electrical material, $398.

Havre.—36 cases electrical machinery, $2,089; 35 cases electrical material, $4,612; 17 boxes motors, $6,500.

Hamburg.—24 packages electrical machinery, $2,000; 10 packages electrical material, $1,312.

Hong Kong.—10 packages electrical machinery, $600.

Japan.—34 cases electrical machinery, $3,848; 10 cases electrical material, $652; 2 cases electrical locomotive, $3,000.

London.—10 packages electrical machinery, $979.

Liverpool.—87 packages electrical material, $4,836; 5 cases electrical machinery, $650.

Manchester.—2 packages electrical material, $35.

Mexico.—2 cases electrical material, $110.

Moscow.—1 package electrical material, $89.

Milan.—4 cases electrical machinery, $500.

New Castle.—1 package electrical material, $10.

Oporto.—3 packages electrical material, $363.

Odessa.—5 cases electrical machinery, $250.

Peru.—1 case electrical machinery, $555; 1 case electros, $10.

Porto Rico.—3 cases electrical material, $52.

Stockholm.—1 package electrical material, $34.

Stettin.—1 case electrical material, $39.

U. S. Columbia.—6 cases electrical material, $538.

Venice.—3 packages electrical material, $39.

POSSIBLE INSTALLATIONS.

Roswell, Ga.—The city council has granted franchises to the Roswell Electric Street Railway, Light and Power Co. for the construction of an electric line and operation of an electric light plant.

Uniontown, Ala.—The city contemplates establishing the electric light plant of twenty-five arc and 150 incandescent lights, to be operated in connection with the water works. Address L. A. Morgan, mayor.

Bennettsville, S. C.—The Bennettsville Light and Power Co. will erect an electric light plant. Address H. L. McColl.

Owenton, Ky.—Col. William Lindsay, J. M. Herndon and others are organizing a company for the establishment of water works and electric light plant.

Winchester, Va.—The Winchester Gas and Electric Light Co. will be awarded contract for lighting the city for five years, provided it erects a new electric light plant.

Elizabethtown, Ky.—David L. May, W. C. Montgomery and R. G. Phillips have incorporated the Elizabethtown Electric Light Co., with a capital stock of $5,000.

Cumberland, Md.—The Edison Electric Illuminating Co. will install two dynamos of 2000 candle-power each.

Dewitt, Ark.—R. A. Houston contemplates the erection of an electric light plant.

Cuero, Tex.—The city will probably issue bonds for the erection of an electric light plant to be operated in connection with its water works system. Address "The Mayor."

Great Falls, Md.—The Great Falls Power Co. of Washington, D. C., will construct a dam at Great Falls and a canal or sluice to convey the water to a power-house for the purpose of generating electricity, and will utilize the power of the Potomac river for the purpose of generating electricity, which can be used both for lighting and street railroad purposes.

TELEPHONE CALLS.

Baltimore, Md.—Plans for the seven-story fireproof steel structure to be erected by the Maryland Telephone and Telegraph Co., at a cost of $125,000, have been completed. An improved switchboard with a capacity of 6,000 telephones and costing $150,000 will be installed. Plans also include the erection of six supplementary exchanges in different parts of the city, each with a capacity of 1,000 telephones.

Morganton, N. C.—The Burke County Telephone and Telegraph Co. have been incorporated to operate telephone exchanges in Morganton and throughout Burke County; capital stock, $3,000; incorporators, George I White, Sinclair M. McDowell, of Marion, and W. C. Ervin, of Morganton.

Keyser, W. Va.—Chartered: The Union Telephone Co., with authorized capital of $50,000, by C. W. Siever and others.

Durham, N., C.—The Interstate Telephone Co. will establish a factory for the manufacture of telephones.

Crossville, Tenn.—The Gainesboro Telephone Co. has let contract for the extension of its line from Crossville to Whitwell, and is also arranging to put in an exchange at Crossville.

Sumter, S. C.—The Telephone Manufacturing Co. will erect a new telephone factory; Peter Blow, Knoxville, Tenn., president.

Lexington, Va.—Arrangements have been completed for construction of telephone system from Lexington to Lynchburg by the Lexington Telephone Co. and the Lynchburg Telephone Co.

Big Springs, Tex.—Mrs. J. E. Brewer will construct a telephone line.

PHONOGRAPH DEPARTMENT OF THE E. T. PAULL MUSIC COMPANY MAKING THE "CASEY" SERIES OF TALKING RECORDS.

E. T. Paull Music Company, of 44 West 29th St., New York City, have, in addition to the talent named in a previous issue, also made arrangements with Mr. Joseph R. Gannon to make for them the celebrated Casey series of talking records.

Mr. Gannon has included a number of new subjects, in addition to the ever popular old ones, and has no superior in making these wonderfully successful records.

As the E. T. Paull Music Co. are making only original master records, dealers in phonograph records will be able to obtain from this company the best and loudest talking records ever heard of this celebrated series. It will certainly pay any dealer in phonograph records to make a sample order, as they are among the greatest sellers on the market. The E. T. Paull Music Co. propose to furnish the best that can be obtained, and guarantee to supply original master records at a lower price than any one else. A special feature of their business will be piano solos of Mr. E. T. Paull's compositions played by himself. It has been very hard and almost impossible heretofore to get good piano solo records. With the improved appliances, however, that the E. T. Paull Music Co. have incorporated in their plant, they will be able to supply piano solos of a vastly superior quality to any heretofore obtained. Mr. Paull has a national reputation as a march writer, and several of his compositions are the best known pieces on the market. It will be quite a novelty to obtain piano solo records played by the composer. It will be well for dealers to write for the low prices this company propose to make on original master records.

NEW YORK NOTES.

GEBEREUX-FLYNN COMPANY, paper box manufacturers of 69-71 Wooster St., New York City, have closed a contract with the Northern Engineering Company, 39-41 Cortlandt St., agents for the Northern Electric Manufacturing Company, of Madison, Wis., to install a 40 K. W. dynamo, direct connected to a Russell engine, and five ceiling type motors, direct connected to line shafts. The Northern Engineering Company has shipped to Hawaii several direct connected dynamos and engines for light and power. The Northern Electric Manufacturing Company have arranged through their New York agents, the Northern Engineering Company, to have Messrs. Veritas, Limited, of London, handle their apparatus in Great Britain and the colonies.

The Electrical Age.

VOL. XXIV—No 10. NEW YORK, SEPTEMBER 2, 1899. WHOLE NO. 642.

Electricity in Mining.

Jeffrey's Electric Mining Locomotive.

ELECTRICITY IN THE MINE.

Since the days of Sir Humphrey Davey various efforts have been made to diminish the risk of personal injury in the mine. The dangers of fire damp, the injuries sustained from falling walls, and the difficulties in labor attending the transportation of the crude ore or coal are still subjects of which the novelists never tires.

In an article on the deep mines of Cornwall, whose subheading is "A Life of Poverty, Toil and Tragedy, Supported by Rare Piety," we find the following extract: "In the remote workings the heat is so great that the men strip themselves to the waist to battle with the granite rocks and terrible is their aspect, as seen by the flickering light of the tallow dips clinging to the walls. Their bodies stream with perspiration, their wet skins gleaming in the light. Red mud is splashed, like the blood of the wounded mine, from their murderous hands and arms. It stains their hair, their beards, and puts upon their faces, as it were, fantastic marks. Their eyes flash under the excitement of the tremendous effort; their knotted muscles revolt against the restraining skin.

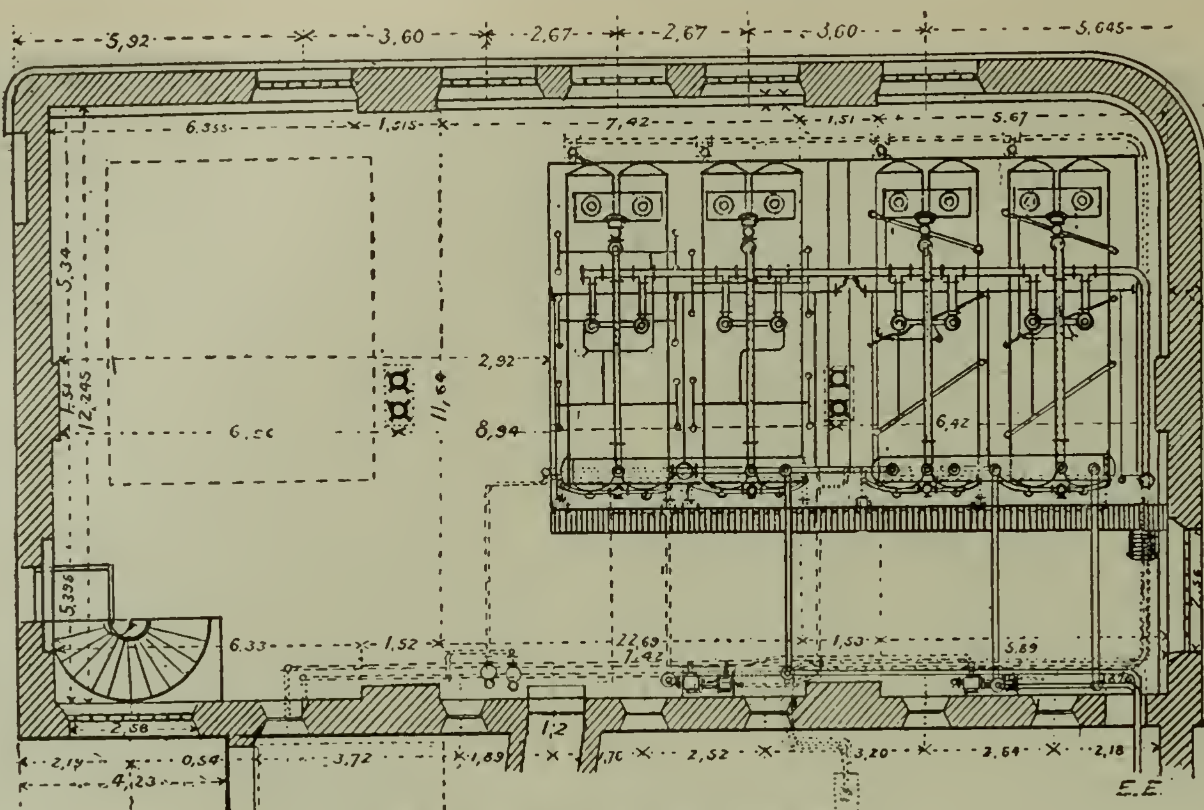
All day long the heavy silence of the mine is broken in upon by the sounds of blasting. The detonation varies, according to the distance, from the popping of a cork to the roar of thunder. Proximity to such an explosion is always for those unaccustomed to it a troubling experience but the miners do not mind it. What harasses them most is the smoke, the foul air which follows upon the blasting. They call it the "funk," and the "funk" in its effects upon their lungs, but mainly in its hindrace of their work is looked up by them as one of their worst enemies."

From this brief description of the tremendous physical effort which miners are called upon to exert it is seen that any labor saving device would be welcomed, not only by the miners but the proprietors to whom a machine, adapted to any specific purpose, means a direct saving of money and added facility in the removal or ore. In the illustration is shown a typical mine locomotive operated by electricity, manufactured by the Jeffrey Manufacturing Company, Columbus, O. This locomotive in its size, compactness and traction effort is admirably suited to the conditions of mining practice. By its aid not only is ore transported with the greatest readiness from point to point in the mine but the men employed generally for that purpose devote themselves freely to mining proper and thereby add greatly to the net profits earned by the end of the year. In addition to this the current is used for lighting the mine and motors are driven in its furthest recesses which operate large blowers, fans and ventilators, thereby almost annihilating the dreaded 'funk" or vitiated air.

Electric Light and Power.

A CENTRAL STATION AT STOCKHOLM, SWEDEN.*

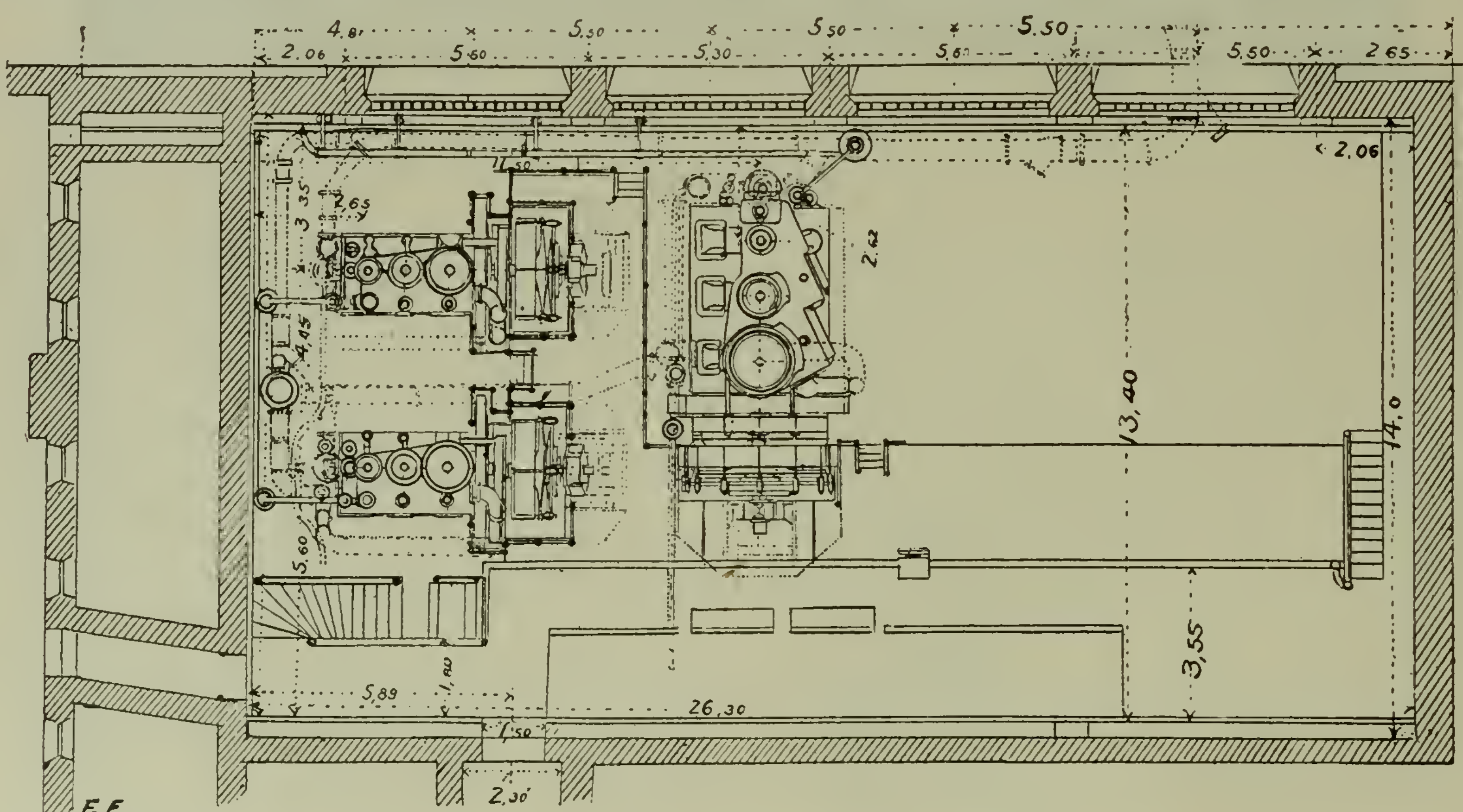
Some time ago it was our privilege to make a journey to Stockholm, and we then had the pleasure of making acquaintance with Mr. Decker, the genial engineer of the central station. We had promised ourselves a further visit to Sweden, for though Switzerland may perhaps pride itself upon being the pioneer of water-power installations, Sweden has not shown itself slow in following so admirable an example. Truly there is much to learn, not only in telephony, but in power and lighting work, and the practice of successful central stations is always worth consideration. If this were the place and if this were the time, we should delight in picturing to our readers the "Venice of the North"—Stockholm. Here nature and art have combined to produce one of the finest cities upon the face of this earth, and to the electrical engineer the lighting display at night as the vessel comes up to the quay must be pronounced magnificent.



Plan of Boiler Room—Stockholm Central Station.

(Through the Courtesy of "Electricity.")

The Stockholm central station belongs to the municipality. It was built in the years 1890-92 in accordance with a resolution of the City Council dated December 13, 1889. It will thus be seen that the municipal authorities of Stockholm were fairly early in the field in coming to the conclusion that electric lighting was a practical and indeed a necessary method of artificially lighting a large city. The site selected is in the center of the northern part of Stockholm, and as yet only that district has been supplied. The station was designed by Mr. A. Ahlsell and Mr. A. Decker, the latter having had entire charge as managing engineer



Plan of Engine and Dynamo Room—Stockholm Central Station. (Through the Courtesy of "Electricity.")

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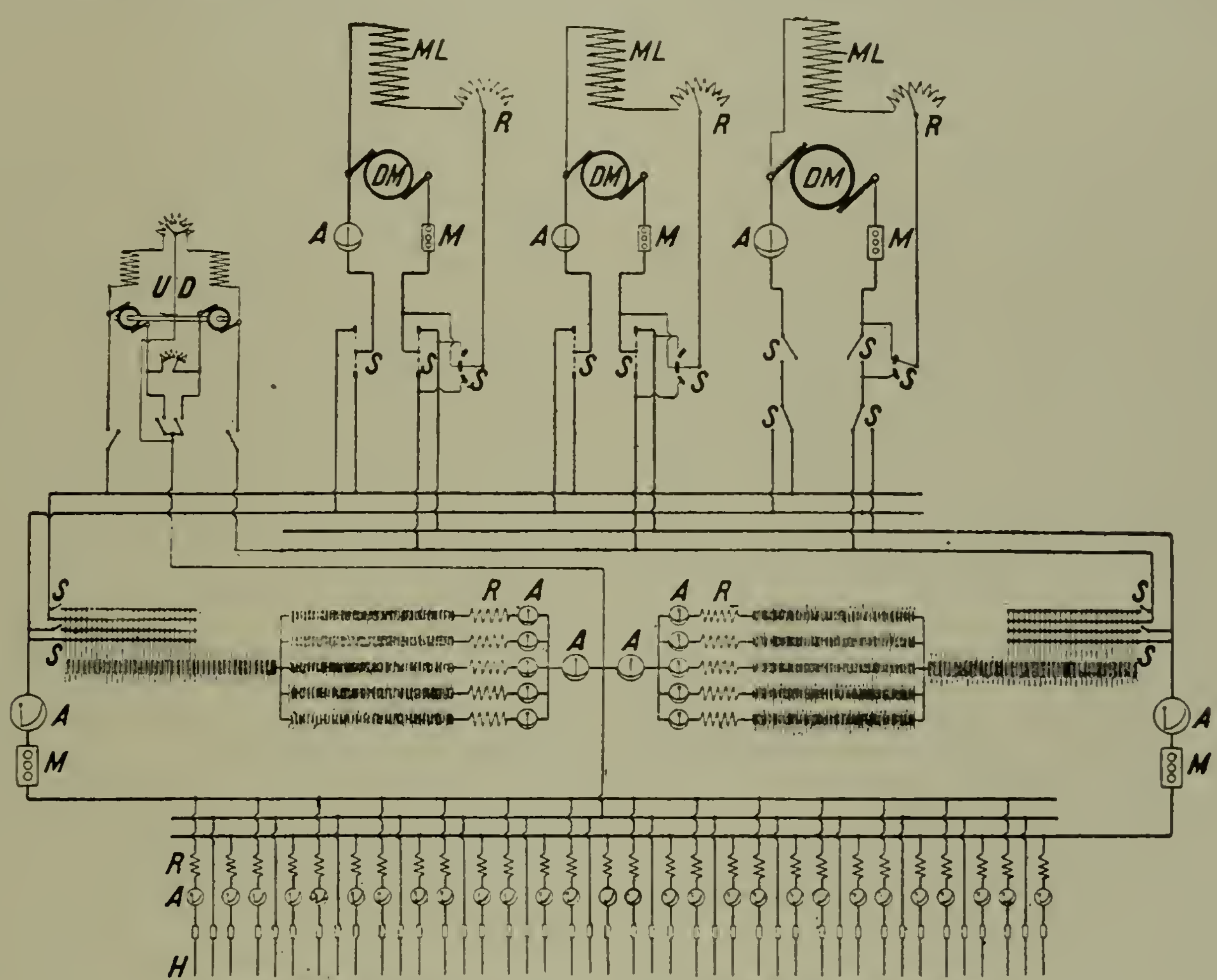
*From the "Electrical Engineer," London.

and having organized the whole system since the completion of the station—or, rather, since the completion of the first portion of it—for, as is usual, extensions are still in progress. When these are completed the station will have a capacity of 2,500 hp. The original installation was completed on July 16, 1892, and officially opened on September 1 of that year, since when an uninterrupted service has been given. The general arrangement of the station is shown in the accompanying drawings. These give a plan of the whole arrangement. The boiler and engine rooms are situated next the street, while the accumulator room occupies an inner portion of the premises. Between the engine and boiler house are coal bunkers, to which coal is carried by a conveyor from the yard. The floor of the bunkers slopes towards the boiler house, admitting of easy access to the fuel. Above the boiler house are placed the offices, the manager's room, drawing office, laboratory and workshops. The walls dividing these upper roms are built upon girders resting upon pillars.

The steam is generated in a battery of seven Babcock & Wilcox boilers, each of 170 square meters heating surface and 3.41 square meters grate surface. Two boilers at either end and three in the middle are connected by steam drums, from which are taken the steam pipes to the engines, each engine having its separate pipe. The drums are also connected so that any boiler may serve any engine. By this device the largest dimension of the steam pipes and valves is kept down to 150 mm. The steam engines are of the vertical triple expansion type. Four are installed, and the fifth is at present in process of erection. The two small engines have respectively 371 mm., 594 mm., and 965 mm. cylinder diameters and 643 mm. stroke. By a steam pressure of 11 atmospheres, 100 revolutions per minute and normal cut off, the power developed is 250 effective hp.; by maximum cut off it is 320 effective hp. The high pressure cylinder valve is of the piston type, the two others are common slide valves; the one on the intermediate cylinder being balanced. The high pressure cylinder valve derives its motion from the connecting rod, and the cut off is automatically regulated from the governor by means of a steam piston acting on a movable guide plane, which, by different inclinations, varies the cut off. The intermediate and low pressure valves are operated by eccentrics. The bearings on each side of the flywheel are kept cool by means of running water. The third engine has cylinders respectively of 460 mm., 750 mm., and 1,210 mm. diameters and 910 mm. stroke. By 11 atmospheres steam pressure, 100 revolutions per minute, and normal cut off, the power is 500 effective hp., and by maximum cut off 640 effective hp. This engine differs principally from the former in the manner by which the steam is distributed. The high pressure cylinder valve is of Ryder's type, the intermediate and low pressure cylinders having slide valves and valve gear of King's system. All steam valves are balanced and slide planes changeable. The governor of this engine regulates the cut off indirectly by means of a steam piston acting on the valve gear. The fourth and fifth engines are of the same power as the preceding, and are of the same type as the small engines. All engines are fitted with jet condensers, the necessary water being taken from a well placed in the engine house. The cylinders are jacketed, and in the intermediate receivers are placed radiators heated by live steam. Careful tests have shown the steam consumption to be 5.92 kg. (13 lb.) per indicated hp. Before entering the engines the steam passes through a steam trap. The feed water, which is taken from the condensing water, passes through a purifier of Dervaux's system before being admitted to the boilers, the water in the well containing carbonate and sulphate of lime in solution, besides carbonic acid.



Arrangement of Switch Gear, etc., to work the Dynamos and Batteries in Parallel at Stockholm.

(Through the Courtesy of "Electricity.")

The dynamos are direct coupled, and are of Siemens & Halske's internal pole type. Two are of 250 hp. to 320 hp., with six poles; and three are of 500 hp. to 640 hp., with twelve poles. The former generate 670 amperes and 220 to 340 volts, and the latter 1,300 to 1,800 amperes at a pressure of 320 to 230 volts. The dynamos are worked in parallel with an accumulator battery in the way shown in the accompanying diagram. The storage battery is of the Tudor type. It consists of two sizes of cells, of which 27 on either side are regulating cells. The neutral cable enters in the middle of the battery, dividing it into two equal parts. The main charging current is 1,320 amperes, and the discharging current amounts to 1,585 amperes with a capacity of 2 x 5,283 ampere-hours by normal load. A balancer is provided, consisting of two machines mounted on the same bed-plate and coupled together.

The cables and mains are single-cored, lead covered, and iron armored. The voltage loss in the mains is allowed to 2 x 1.1 volt, and the greatest loss in the feeders is 2 x 17 volts. The working pressure is 2 x 110 volts, the network being of the three-wire system. The total length of the network was 174.5 km. (about 108 miles) at the nd of last year, and the house frontage that could be supplied 48.7 km. (about 30 miles).

On account of the northern climate (latitude 59 degrees 20 minutes) the difference between winter and summer consumption is very great. The minimum consumption during 1898 occurred on June 24, and was 545 kilowatt-hours. The maximum load of the same day was 630 amperes at 12.30 p.m. The maximum consumption occurred on December 22, and amounted to 7,691 kilowatt-hours, with a maximum load of 6,420 amperes. The maximum load of the same year happened on the 21st, and was 6,660 amperes at 5 p.m.

Stray Currents.

TELEGRAMS TO THE KLONDIKE EL DORADO.

The Canadian Government has been pushing forward the work on the telegraph line to Dawson City with great energy this summer. The line has been completed as far as Five Fingers for some time, and it is hoped that it will be completed to Dawson City by the middle of next month. Further extension may then be made from Skagway to Vancouver by cable.—Ex.

NEW METHOD OF OBTAINING A VACUUM.

According to Mr. W. de Fonvielle, the production of liquid hydrogen on any large scale may offer a ready means of manufacturing vacuum electric lamps. If a tube containing air is dipped in liquid hydrogen, the air is all frozen and condenses as snow; then if the lower part of the tube be separated from the upper by means of a blow-pipe flame, the bulb so formed presents a Crookes vacuum.—Ex.

RAISING CROPS BY ELECTRICITY.

Theodore Steine, Long Island City, has secured a patent on his invention for raising crops by electricity. Mr. Stein claims that he can mature flowers, fruits and vegetables from two and one-half to three weeks earlier than they can be brought to maturing in hotbeds or hothouses. He has raised a crop on his own land by his electrical process, and demonstrated that it is all he claims for it. He is now corresponding with a number of agricultural associations, the officers of which are greatly interested in his discovery.—Ex.

THE NORTHERN LIGHT.

The object of the expedition which recently left Copenhagen for Iceland under the direction of Herr Adam Paulsen, chief of the Danish Meteorological Institute, is to investigate the nature of the northern lights. In this expedition quite a number of instruments of special construction are being used in connection with photography and the measurement of electrical currents.—Ex.

CHEMICAL EFFECTS OF X RAYS.

When photographic plates that have been exposed to the action of X rays are afterwards exposed to light, the image undergoes reversal in the same way as if both exposures had been made to light, and the precise character of the phenomena depends on the relative magnitudes of the exposures. Plates exposed for some time to X rays show increased sensitiveness to the less refrangible rayys. An interesting communication on this subject was recently made by P. Villard in the Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, Paris, Vol. 128, pages 237-239.—Ex.

WIRELESS TELEGRAPHY AT THE NATIONAL EXPORT EXPOSITION.

The Baltimore Telegram says: "Wireless telegraphy will perhaps have its first great test during the holding of the National Export Exposition to be held in Philadelphia from September 14 to November 30. No effort will be made to duplicate the Eiffel Tower, but a structure of some kind is being considered that will hold up a copper wire 1,000 feet in air. It is claimed by Marconi, the inventor of wireless telegraphy, that if this is done by the Exposition people he will telegraph by flashes of electricity from the top of the Eiffel Tower in Paris. A feat of this kind, successfully performed, will be the wonder of the world and worth crossing the ocean from Europe to see."

APPARENT DARK LIGHTNING FLASHES.

Lord Kelvin writes from Aix-les-Bains: "Last night, during a thunderstorm of rare severity, in which brilliant flashes—single, double, triple or quadruple—followed one another at intervals often of not more than a few seconds of time, I was surprised to see, with great vividness, on a suddenly illuminated sky, two nearly vertical lines of darkness, each of the ordinary jagged appearance of a bright flash of lightning. I remembered to have seen two real flashes of just the same shapes and relative positions, and I concluded that the black flashes were due to their residual influence on the retina. I turned my eyes quickly from the dark sky outside to an illuminated wall inside the house, and I again saw the same double dark "flash," which verified my conclusion in an interesting manner. The fatigued part of the eye failed to perceive the sudden brightness of the sky in the one case and of the wall in the other."—Ex.

ENAMELS.

With electrical cooking and heating apparatus great difficulty has hitherto been experienced with cast or wrought iron objects coated with enamel due to the unequal expansion and contraction of the two substances, this causing a splintering of the enamel. M. Sagliot lately brought before the French Societe d'Encouragement pour l'Industrie Nationale the results of his experiments in this connection, that have enabled him to produce a whole series of enamels having various degrees of expansion. It appears that enamels containing cryolite, fluorspar, and a little rutile, or native titanic acid, possess very high degrees of dilatation, and that cast or wrought iron, coated with calcareous enamels containing no lead, which are not at all injurious, may be formed by using boric acid. This hint should be very useful to electrical manufacturers who use wires of high resistance buried in enamels for electrical heating apparatus.—Ex.

INDIA RUBBER FROM THE SOUDAN.

The following information, extracted from a report by Sir William Garstin, K.C.M.G., is taken from the Board of Trade Journal: On the White Nile, in the Bongo and Rohl districts, the india rubber creeper (Landolphia florida) is found in great profusion. If the rubber yielded by this creeper be not of quite so good a quality as that obtained from the Assam india rubber tree (Ficus elastica), it is still of sufficient value to be counted as an important asset in the future trade of the Soudan. This plant, which has large laurel-shaped leaves, and a white flower resembling a jasmine, requires several years to mature before yielding rubber in any quantity. The natives obtain what they require by tapping the stem, usually in such a reckless manner that the creeper dies under the operation. Although this tree takes from twenty to thirty years to arrive at a girth sufficient to permit of regular tapping, its yield is so valuable (about $15 per tree per annum) that its introduction into the country is well worth attempting.—Ex.

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NEW YORK, SEPTEMBER 2, 1899.

CONTENTS:

THE ADVANTAGES OF THE UNDERGROUND TROLLEY.

The relative costs of traction systems in large cities have been the subject of careful study by many experts. The conclusion they drew from their plans and specifications were such that no definite opinions were arrived at as to whether the horse car, cable car, overhead or underground trolley system was the best. Not many years ago the Chicago cable road was carefully tested and it was discovered that about eighty per cent. of the driving power was lost. In other words a ton of coal burnt in the cable station gave so poor a return that one of the largest items in connection with the running of that road was the fuel question.

Apropos of this the following extract may be found in an article written by Gisbert Kapp, which shows how unreliable information is, not based upon absolute experience. "The transmission of energy by wire rope, invented in 1850 by M. Hirn, is the most simple and, up to reasonable distances, the most economical of all the known means of transmitting energy. The principal source of losses of energy are first, friction in the bearings of the rope pulleys; second, air resistance; and third, stiffness of ropes. From data obtained with wire rope transmissions actually installed over distances varying between three hundred and three thousand feet calculations show the following efficiencies; for twelve miles thirteen per cent. efficiency; for six miles thirty-seven per cent; for three miles sixty per cent., and for one-half a mile ninety per cent. It will be seen that for distances less than three miles wire rope transmission is the most economical, while for distances greater electric transmission is the best."

These facts, of course, show that the Chicago cable system, and, in fact, any other cable system, cannot pretend to be efficient to a marked degree, when extending over three miles. The cable, of course, succeeded the horse car, and in a similar manner the overhead trolley usurped the position occupied by the cable, or at least which would have been occupied were not the underground trolley introduced. The general efficiency of an overhead trolley system averages about forty per cent. Calculations show that the commercial efficiency of a six mile electric road is over fifty per cent., the efficiency dropping as the road extends further. In other words, the ultimate conclusion reached is that the advantage of an electric transmission or railway system for long distances over a wire rope system is due to the fact that the cost of wire, tracks, etc., is in direct proportion to the distance, the loss of electricity increasing very slowly with an increase in the mileage of a road.

In a wire rope system the increased mileage of the road means not only additional expense for tracks, etc., but a loss of power too great in proportion to the distance for a long run to make a cable road possible unless divided up into sections. This practice was followed in New York City on the Third Avenue road as well as the Broadway line, the efficiency of a three mile wire rope system being only sixty per cent., though falling in actual practice much below this. The slight gain in efficiency by the use of an overhead trolley system is offset by the care entailed in connection with the exposed conductors, feeders, supporting appliances, etc. The underground trolley, however, possesses distinct advantages which are numerically shown in the September issue of the "Street Railway Journal." The facts, as shown by the figures, are that on June 30, 1899, the Metropolitan Company had 25.3 miles of cable system, 82 miles of underground trolley and 113 miles of horse railway. In a short while the horse and cable roads will be disposed of and the electric subway system will prevail. In 1898 the receipts per car mile on cable road were $34.42; in 1899 there were $35.43. The cost of maintaining the road per car mile was $16.42 in 1898 and in 1899 $18.00. The underground trolley brought an income per car mile in 1898 of $26.99, which increased in 1899 to $31.23, while the operating expenses were only $10.23 in 1898, and in 1899 little greater—$11.95. The horse roads brought an income in 1898 per car mile of $27.35 and in 1899 of $25.72, the operating expenses per car mile reaching as high a figure in 1898 as $17.87, and in 1899 of $17.96.

Then comes the point of greatest importance, the report furthermore showing that the cost for care and maintenance of the cable road was forty-three cents per car mile, forty-nine cents per car mile on the horse roads and falling as low as thirteen cents per car mile on the underground trolley. The total receipts exceeded $10,000,000 in 1898 with obvious financial advantages shown by the use of the underground trolley. The cost for power per mile of the cable road was $2.39 and rising as high for the horse car of $6.69 per mile; the underground trolley, however, costing only $1.77 per car mile.

The advantages derived from the use of the electric road have been admitted by every passenger on any of the cars of the Metropolitan Traction Company. The high rate of speed, the brighter light and the greater internal comforts in winter are admitted by all. Not only have the general public been benefited by the change, but the stockholders have shares of greater value, more gilt-edged as security with the chance of receiving heavier dividends in the future.

INCANDESCENT LIGHT AND EDISON SYSTEM.

The electric light systems of this country may be divided up into two general branches:

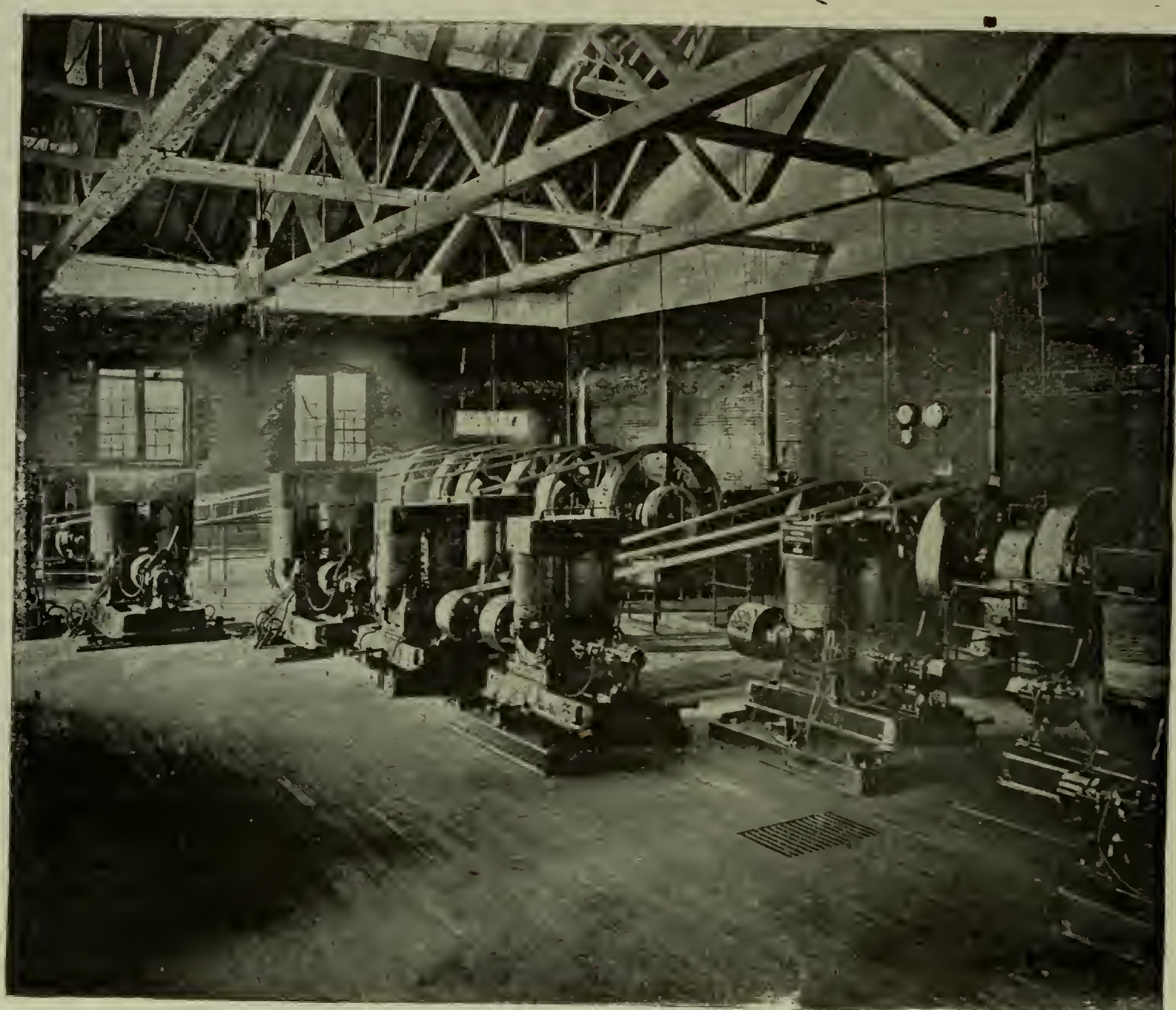
Incandescent lighting.

Arc lighting.

Incandescent lighting may be done by a 110 volt current or by a high tension current with the lamps being in series, similar to the Heisler system. Incandescent lamps are also supplied with current by alternators. The series incandescent light system is not installed to any extent at present but is convenient in connection with an arc light system, the lamps taking ten amperes, but only a few volts.

Incandescent lighting is therefore possible with a low tension continuous current, a low tension alternating current and a high tension direct current. Arc lighting is done with a low tension continuous current, a high tension direct current and a low tension alternating current. The introduction of the closed globe in connection with arc lamps is applicable with continuous current, direct current and alternating current lamps.

KINDS OF LIGHTING.—The most common system of incandescent lighting is known as the Edison system. The superiority of this system is due to the fact that all the wiring represents a net work of conductors, arranged in such a manner that all points are of equal potential. An incandescent lamp calls for a certain pressure and current. When these are supplied the lamps burn with normal brightness



Belt Driven Edison Plant.

and the problem of incandescent lighting, as long as the conditions remain the same, is complete.

BASIS OF LIGHTING SYSTEM.—Any wiring system which will allow a uniform pressure to prevail throughout

Thomson-Houston Arc Lighting Plant.

is valuable in two respects.

(a) Lamps are saved.

(b) Light is constant.

Under the conditions mentioned the long life of a lamp is assured. There is no greater cause of breakage in lamps than the rising or fluctuating pressure in the lamps. Again, from a purely commercial standpoint, the constancy of the light is so important that unless some means is taken to keep it constant, customers cannot be retained, and the damage caused by this double difficulty becomes irreparable.

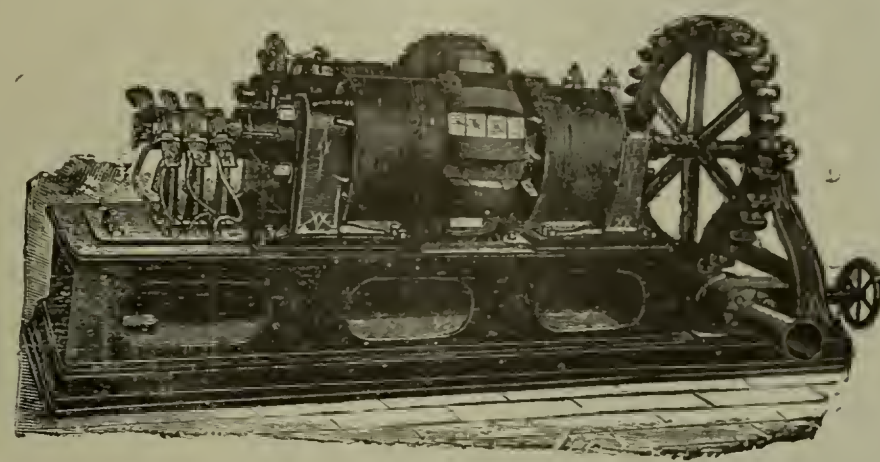
thrown on the pressure may fall to 105 volts, due to the

Drop in line.

Armature reaction.

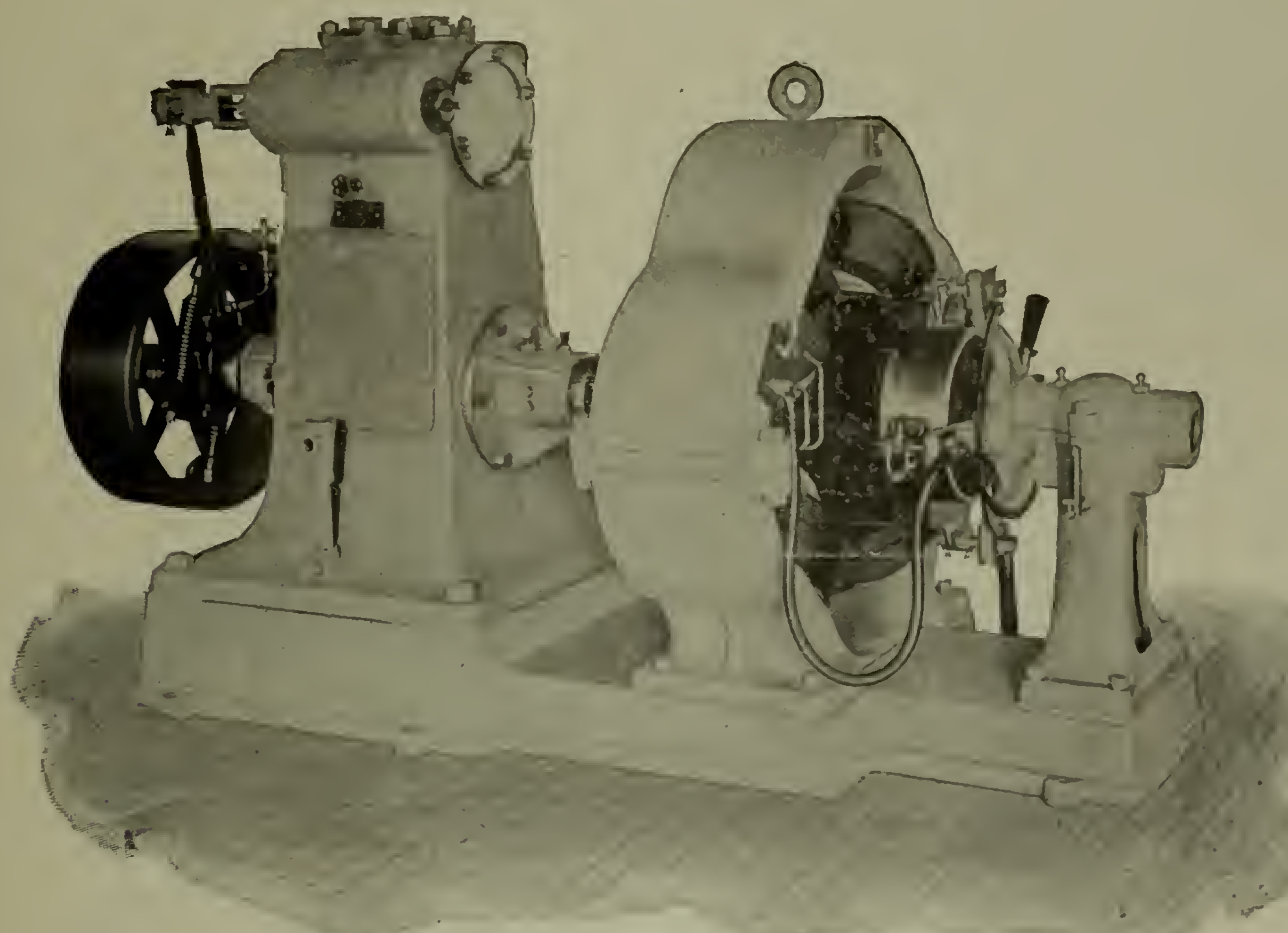
Drop in armature.

Conversely, if the dynamo is laboring under full load and



Brush Arc Light Dynamo Driven by Pelton Water Wheel.

FUNCTION OF THE DYNAMO.—To keep the pressure constant in the line the dynamo itself must preserve a uniformity of pressure or at least within very slight variations. The line depends upon the dynamo, but by means of the lamps to a large extent are removed the pressure will rise from the point it is at and perhaps cause serious injury to the remaining lamps. A regulating device is therefore necessary when circumstances cause such rapid changes as



Case Engine Direct Connected to Generator.

an ingenious arrangement the dynamo can also be made to depend upon the line. By the two affecting each other we have a system sensitive to outside changes. Compound winding enables us to retain the pressure about constant, or, at least, to raise or lower it when so required. This at once brings us to a consideration of the cause of such changes.

REGULATION.—The dynamo would not require any extra device if the load upon it were constant but the continual changes affect the dynamo as follows: when the dynamo is supplying 110 volts and a load of lamps are these. If these changes are automatic the dynamo will adjust its potential to the number of lamps and always be high enough to keep them at normal candle-power. The ease with which this arrangement works is surprising. It is in popular use in every isolated as well as central station plant. The success of incandescent lighting depends upon the wiring system that causes as little loss as possible with the greatest variations in current. The Edison network is the nearest approach to perfection of anything we have. It consists in the main of three parallel webs of wire; between each two adjacent webs there is a 110 volts pressure and for electric lighting and power transmission. The use of an between the two outer 220 volts. The economy of saving one wire and yet having two lighting circuits that are independent yet in close combination is obvious. The two

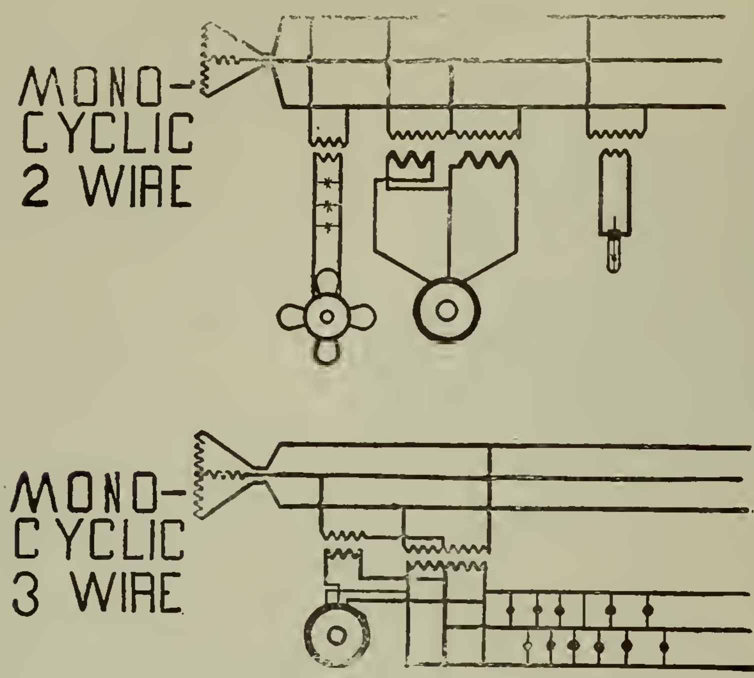
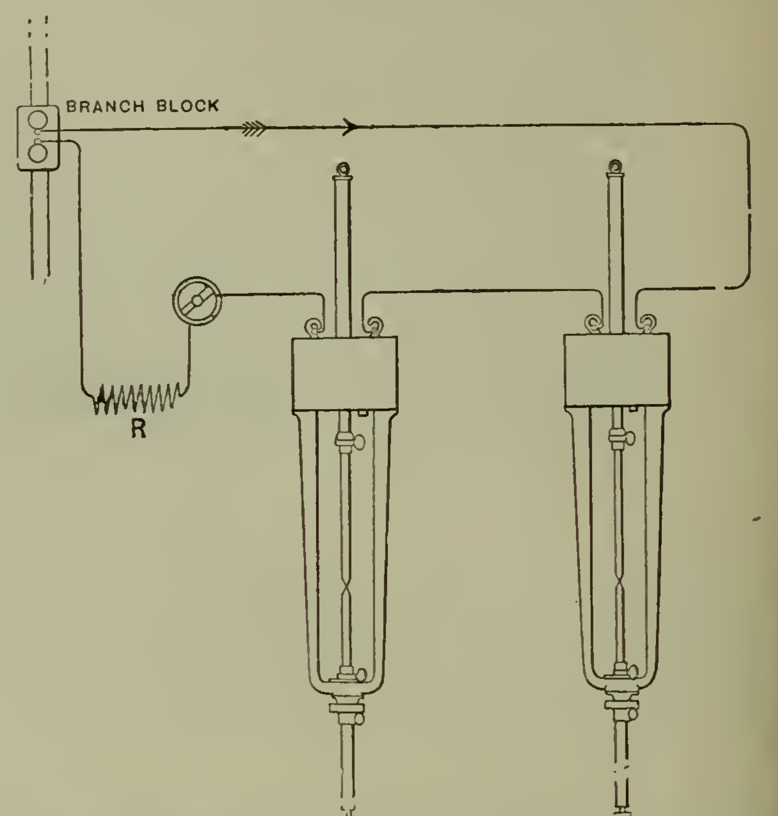


Diagram of Connections for Monocyclic and Three Wire Systems.

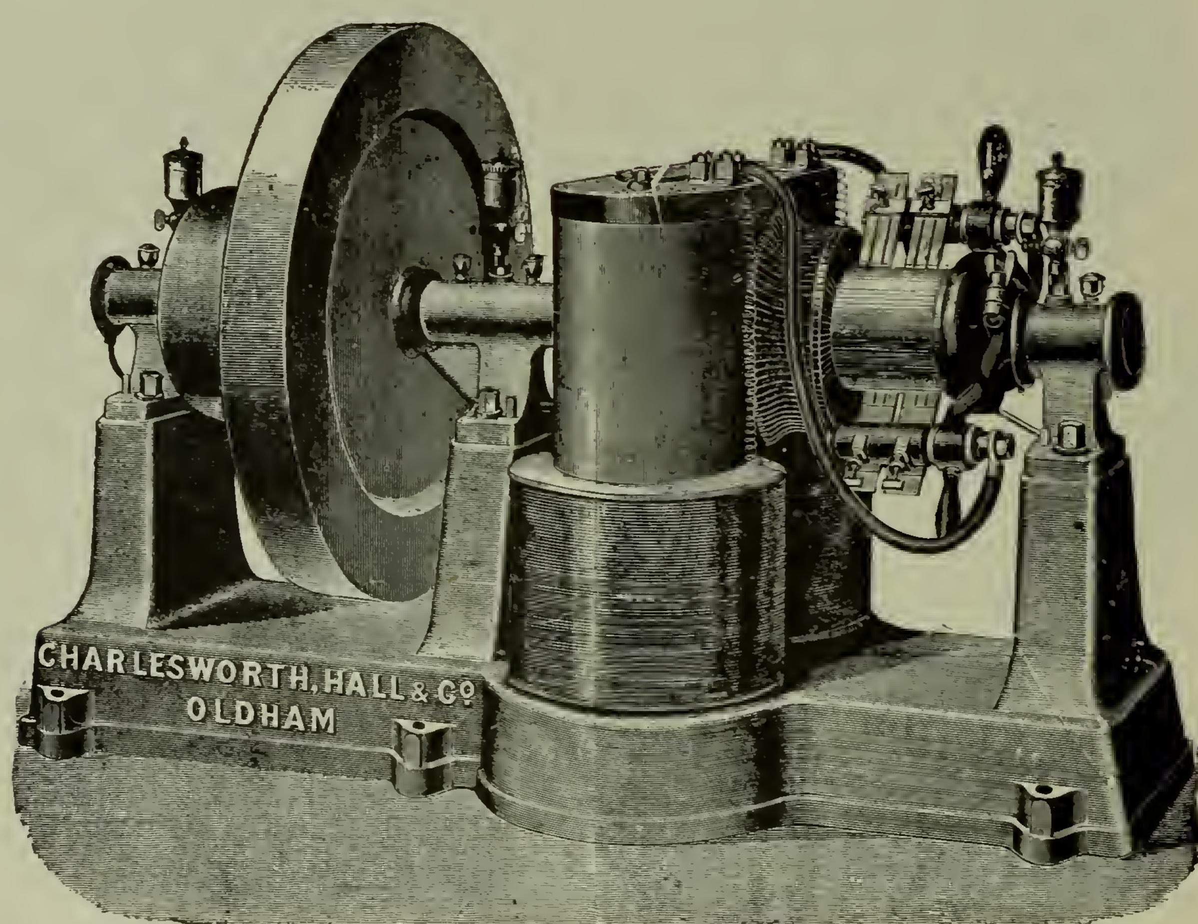
outer circuits, between which there is always 220 volts, are greatly used for motors.

In the illustrations are shown an arc lighting plant containing Thomson-Houston machines and alternators; in addition a belt driven Edison plant with high speed engines and bi-polar dynamo. In country plants the use of water power calls for the addition of a Pelton wheel which may be used for direct connection, as shown in sketch, with a Brush arc machine. The system of direct connection, thus obviating belt transmission, finds general application not only in the larger plants, central stations, etc., but in private residences where only a hundred lights or so are required. A model plant of this description is shown with Case engine direct connected to generator. For many purposes gas engines are convenient for electric lighting and frequently a very heavy fly wheel is attached to the dynamo



Arc Lamps Connected in Series on Low Tension Continuous Current Circuit.

which then remains unaffected by the irregularities in speed of the gas engine. Of course, gas engines have been perfected to a high degree, but it is still advisable to utilize fly wheel, as shown in the illustration. The monocycli two wire and three wire systems have earned a reputatio



Gas Engine Direct Connected to Dynamo.

alternating current has been the means of developing two great systems bearing the names of the two phase and the monocyclic for either two or three wires, as shown. In this latter system, developed greatly by the General Electric Company, copper is saved, lights burn uniformly and motors are self-starting and efficient. The most popular system, however, in this country is based upon the patents of Stanley, Tesla and others.

Conventions.

ANNUAL MEETING OF THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.

The Street Railway Association of the State of New York, Office of the President.

Binghamton, N. Y., Aug. 21, 1899.

Editor "The Electrical Age,"
New York City.

Dear Sir—The Seventeenth Annual Meeting of the Street Railway Association of the State of New York will be held at Ithaca, Tuesday and Wednesday, September 12 and 13th, 1899.

The street railroads of the State are already evincing a wide-awake interest in the event, and it is expected that the forthcoming convention will surpass all former ones in point of interest and attendance.

Supply men are earnestly and cordially invited to participate in the benefits and pleasures of the meeting and will be pleased to have you send one or more representatives.

The programme of entertainment, arranged by the Ithaca Street Railway Company, is varied, and comprises an inspection of Cornell University, a trolley ride to the picturesque environments of Ithaca, a trip through Cayuga Lake with lunch served on the boat, a special entertainment and band concert at Renwick Park, and the customary banquet Tuesday evening, September 12th, to which supply men are invited. The usual charge of $5 will be made.

Ample space (in close proximity to the place of meeting) for the exhibit of supplies, models, etc., will be furnished free of expense to those who desire to avail themselves of the privilege.

Please advise promptly the name or names of your representatives, the number of banquet tickets desired, also the space required for exhibit, in order that the necessary arrangements can be completed.

Yours respectfully,
G. F. ROGERS, President,

TOPICS FOR PAPERS AND DISCUSSION AT THE SEVENTEENTH ANNUAL MEETING OF THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK, TO BE HEID AT ITHICA TUESDAY AND WEDNESDAY, SEPTEMBER 12TH AND 13TH, 1899.

Rail Welding—Track Bonding—The Third Rail—Storage Battery—The Repair Shop—Induction Motors—Care of Dynamos—Car Mileage Record—Indemnity Insurance—Municipal Ownership—"The Metallic Circuit." —The Three Phase System—Street Railroads vs. State—Loss of Current in Returns—General Track Construction—Inspection of Car Equipment—Transfers, their Use and Abuse—"Receipts from Other Sources"—Street Railways vs. Automobiles—Points on Overhead Construction—Long Distance Power Transmission — Impracticability of Reduction of Fare—Suggestions on Financial Organization—Maintenance and Repair of Car Bodies—Pleasure Resorts as Traffic Stimulators—Signal Systems for Single Track Roads—Air and Power Brakes for Electric Cars—Care and Inspection of Wheels and Axles—Local Railway Employes' Benefit Associations—Fuel Economy of Railroad Engines. (Allotted.)—How Can We Increase the Efficiency of Employes—The Power Station, from an Economic Standpoint—The Proper Instruction of Motormen and Conductors—Compressed and Liquid Air for Street Car Operation—Fenders and Other Means for Prevention of Accidents—Experiments on Resistance of Rail Bonds. (Allotted.)—Freight and Express Service on Interurban Electric Lines—The Mutual Relations of Municipalities and Street Railroads—Statistics of Street Railway Construction and Operation. (Allotted.)—Polyphase Equipment Used in Cornell University; illustrated by Polyphase Apparatus. (Allotted.)

Auto-Mobiles.

THE GROWTH OF THE AUTOMOBILE INDUSTRY.

The following table, prepared by the Evening Post, gives some idea as to the rapid advancement of the automobile industry. This table, while not embracing all electric vehicle companies incorporated, includes only those having the largest capital:

	Authorized Capital.
The Automobile Company of America.....	$5,000,000
The International Vehicle Co. of New York.	5,000,000
The Chicago Electric Vehicle Company..	2,000,000
The Woods Motor Vehicle Co. of Chicago..	10,000,000
The White Motor Wagon Company......	10,000,000
The Lewis Motor Vehicle Company.......	10,000,000
The Columbia Automobile Company......	3,000,000
The Illinois Electric Vehicle and Transportation Company	25,000,000
The New England Electric Vehicle and Transportation Co....	25,000,000
The New York Electric Vehicle and Transportation Company	25,000,000
The Pennsylvania Electric Vehicle Co......	6,000,000
The General Carriage Co. of New Jersey....	20,000,000
Sixteen companies incorporated for $100,000 each, by the so-called Electrical Vehicle Syndicate, to operate in Tennessee, Georgia, Ohio, Kentucky, New Jersey, Louisiana, Delaware, California, Michigan, Minnesota, Iowa, Maryland, Wisconsin, Indiana, Missouri and Virginia.	1,000,000
The Canada Lewis Motor Vehicle Company.	1,000,000
The National Bicycle and Motor Company..	2,500,000
The Riker Electric Vehicle Company......	7,000,000
The Leads Motor Vehicle Company.......	5,000,000
	$163,100,000

Transmission of Power.

SNOQUALMIE FALLS' POWER BROUGHT INTO SEATTLE.

The following account, taken from the Seattle, Wash., Post Intelligencer, describes the opening of the Snoqualmie Falls power transmission plant, one of the most important plants of its kind in the West:

By the slight movement of the hand of a tiny tot of a girl of 10 1-2 months, the immense power of the Snoqualmie falls was turned into Seattle, and the first sign of the completion of one of the most powerful, if not the most powerful, plants in the West was marked by the silent motion of delicate electric machinery. Thus, machinery for transmitting electrical energy to the extent of 12,000 horse power is put directly within the reach of Seattle consumers, and the way opened for handling all the power that will be needed in this vicinity in many years.

At the plant at the falls there is a cavity 250 feet below the surface of the water, where the water wheels and electric generators are located. A steel pipe ten feet in diameter leads the water there through a shaft, and thence it passes into and through the wheels, going finally into a tunnel and entering the river again several hundred feet below the falls. There are four water wheels, each of 3,000-horse power capacity, each of which drives an electric generator of corresponding capacity.

The current is led up through the shaft, down which the water power goes, on aluminum conductors into the transforming house, where the voltage is raised to 30,000 volts. It passes from the power house over twelve aluminum conductors, equally divided between two lines of poles. These two lines run twenty miles to Renton, and are there received at a station erected for the purpose, where there is a switch board. From Renton six wires come to Seattle, and the others go toward Tacoma.

Delivered here, the electricity is received on a high tension switchboard in an absolutely fireproof room, and then turned into transformers where the voltage is reduced to the extent required by the customers. Some is converted through the agency of a rotary transformer into a direct current of electricity, it being understood that the transmitted electricity is of the alternating current type. The direct current is for the street car service and electric lighting in the thickly settled portions of the city. The other not transformed goes for lighting in more remote quarters and for large power purposes.

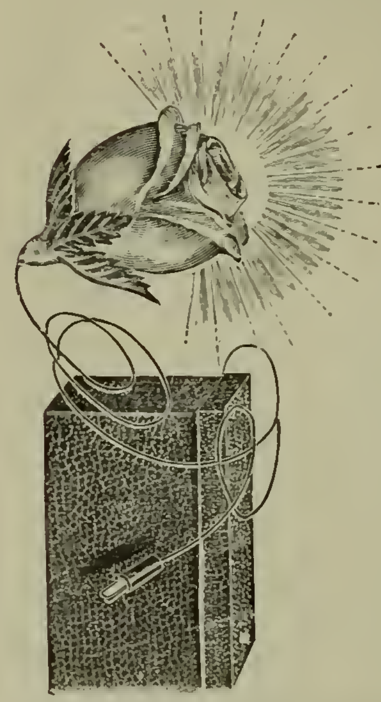
The plant is unique in two essential features. One is that a new type of water wheel has been adopted that gives the greatest satisfaction. The other feature, the use of aluminum wires for transmission, is perhaps of more general interest, in that their introduction here brings this remarkable metal as an electric conductor into full competition with copper. The aluminum from which these wires were made is from ore beauxite mined in Northern Georgia, and shipped to the Niagara falls for conversion electrolytically into aluminum. When it is understood that the present output of aluminum is 4,000,000 pounds a year, against 600,000,000 pounds of copper, the beginning of its use here is considered of the more importance.

By the end of this month it is hoped to have the machinery installed and in working order at the new brick building on South Second avenue and Main street. With the realty it occupies this structure will have a value of $55,000. It has a frontage of ninety feet, is 115 feet deep and has two stories and a basement.

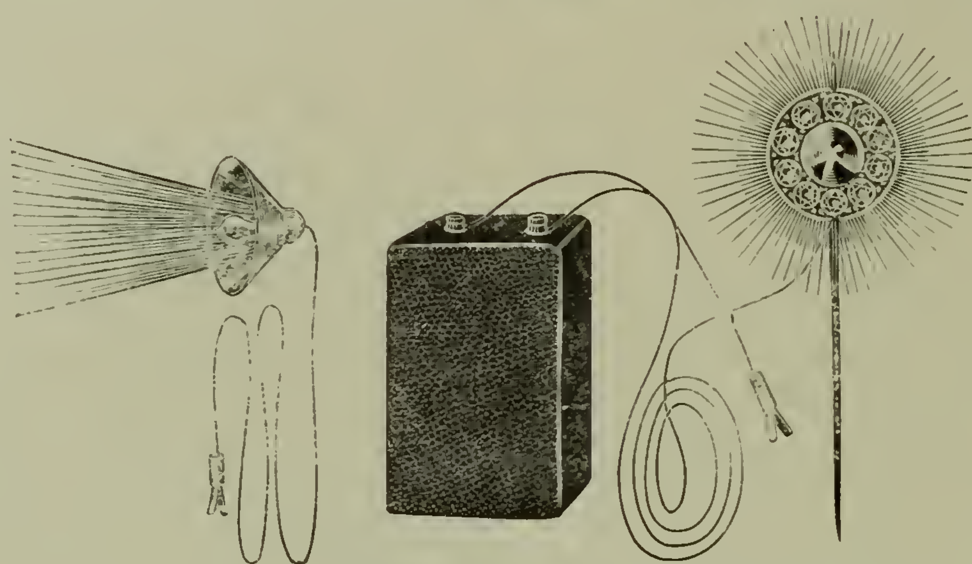
The existence of this enterprise is due to the work of William T. Baker, of Chicago, whose son is president of the company, and who has been instrumental in causing the investment already of $850,000 in the scheme, which will be increased to $1,000,000 as soon as the plants are finished.

Electrical Novelties.

A NEW PORTABLE ELECTRIC LIGHT.



In the illustration is shown an electric scarf pin or button hole reflector with dry battery, giving a powerful, intensely brilliant, incandescent light. Heretofore all attempts to produce an electric scarf pin have been attended by many disagreeable features, such as wet acid batteries which were apt to spill and ruin the clothes, or inferior dry cells which would give only a weak light for a few minutes. The H. E. Plass Electric Construction & Supply Company have combined three "Extra Special" miniature, double strength, perfectly dry cells in one battery, particularly adapted for this work. They are contained in a handsome black leatherette sealed case to fit the pocket and will give five hours of strong, brilliant light or about ten thousand to fifteen thousand flashes. There is nothing to spill and it is always ready and can be used in all emergencies to illuminate dark rooms, cellars, etc. It is particularly valuable for either amusement or practical purposes. When fitted with the patent reflector it becomes a serviceable night light for the house and is adapted to all uses where it is desired to concentrate a brilliant beam of light on any object. Physicians, postmen, watchmen, and general inspectors will find this device an indispensable article. It is manufactured and sold by the H. E. Plass Electric Construction & Supply Company, Barclay and Church streets, New York City.



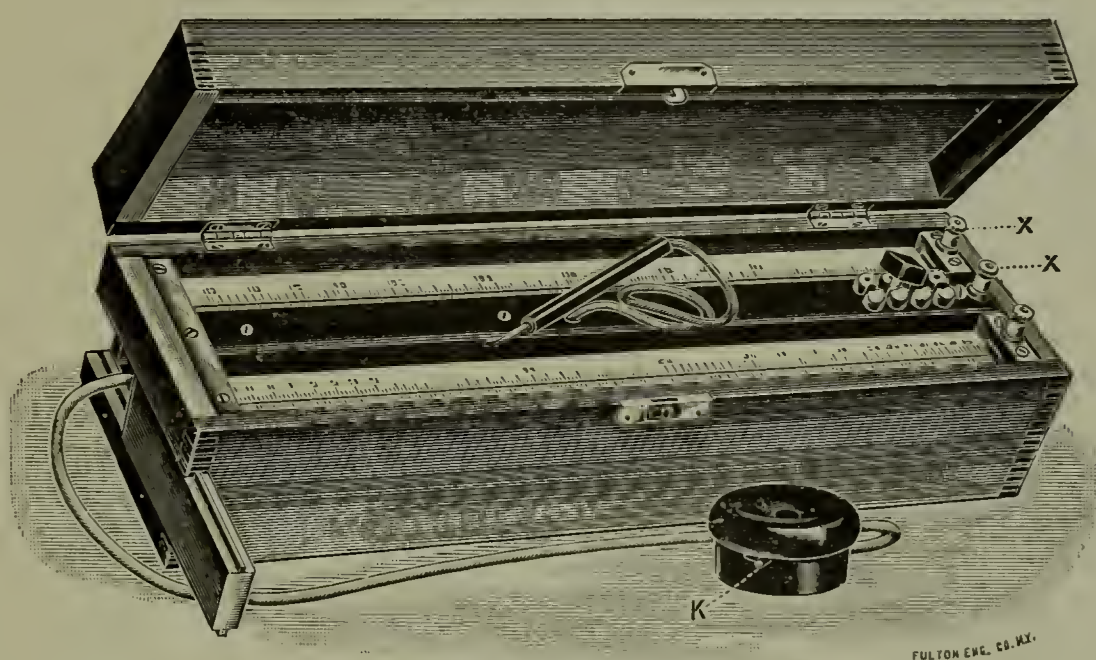
Electric Scarf Pin and Button Hole Reflector.

Electrical Measurements.

A DIRECT READING OHMMETER.

A meter for meausuring ohms is most unique to electrical engineers. The advantages of such an instrument which is portable, readily opened and applied for the puropse in view hardly require enumeration. Until volt and ammeters were properly constructed it was impossible to really make tests and measurements. The same is almost true with regard to resistance tests. The Wheatstone bridge implies more than a mechanical knowledge of the instrument and tests satisfactory in a scientific sense can only be made in the laboratory. Hence the introduction of an instrument through which such difficulties disappear will and has been welcomed by the electrical fraternity.

This instrument depends upon the well known Wheatstone bridge principle and therfore the strength of the battery in no way affects its accuracy. It consists of two wires of special alloy which are stretched over suitably graduated scales. Several independent resistances are provided which are connected in the proper way by means of a plug which will fit in any one of the four holes provided for it on the right hand end of the instrument. Thus there is only one plug in circuit and the possible error from poor plug contract is very remote. Two binding posts are provided across which the resistance to be measured is connected. These posts are marked x x. A telephone receiver suitably connected to the device is held to the ear and the little key K is pressed shut with the thumb. This closes the battery circuit. A stylus is provided which is held in the hand in much the same manner as a pen and this is touched at various points along the wire until a point is found at which no click will be heard in the telephone receiver.



Direct Reading Ohmmeter.

The first step is to touch each of the two outer binding posts; two clicks will be heard of different intensity and the post which gives the faintest click is on the scale on which the point of silence will be found. The brass connecting block at the end of this scale is then touched with the stylus and the end which gives the faintest click is nearest to the point of silence. In three touches of the stylus therefore the desired point is located on a given quartet of the total scale. This quarter is rapidly traversed by the stylus and the point of silence is soon found. After a few trials ten or twelve seconds will suffice for this operation. The scale under the point of silence is read directly and gives the desired resistance in ohms.

The scale is lettered in several colors and may have three or four sets of letters according to the instrument. The plug holes at the end of the instrument are correspondingly colored and it is therefore obvious that if the plug is inserted in the blue hole, the blue figures should be read and so on. It will be readily seen that the modus operandi of this instrument can be comprehended in a few minutes by a boy who can very soon obtain results comparably with those of an expert.

This piece of apparatus is manufactured and sold by the American Electric Specialty Co., of 123 Liberty street, New York,

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FOR WEEK ENDING AUGUST 23d, 1899, $60,385.20.

New York, N. Y., August 23, 1899.—The following exports of electrical material are from the port of New York, ending this date:

Antwerp.—43 cases electrical material, $3,819.

Aberdeen.—9 cases electrical material, $401.

Brazil.—15 cases electrical material, $401.

Berlin 2 cases electrical material, $925; 2 cases electrical machinery, $175.

Bremen.—6 cases electrical machinery, $140; 1 case electrical material, $10.

British West Indies.—59 cases electrical material, $668.

Cuba.—9 packages electrical material, $169; 615 packages electrical machinery, $15,949.

Central America.—2 cases electrical material, $820.

Hamburg.—69 packages electrical material, $3,456; 20 boxes motors, $3,770.

Hull.—5 cases electrical machinery, $460.

Havre.—120 packages electrical material, $8,769; 5 cases electrical machinery, $200.

Japan.—67 packages electrical material, $3,750.

Liverpool.—96 packages electrical material, $10,329.

London.—17 cases electrical material, $892; 4 cases electrical machinery, $3,850.

Mexico.—1 package electrical material, $70.

New Zealand.—1 case electrical material, $15.

St. Petersburg.—4 cases electrical material, $285.

Santo Domingo.—4 cases electrical material, $53; 1 case electrical machinery, $310.

Venezuela.—8 packages electrical material, $694.

Zurich.—7 packages electrical material, $113.

NEW INCORPORATIONS.

Cleveland, Ohio.—The Exchange Construction Company has been incorporated to construct and operate telephone and telegraph lines; capital, $5,000; incorporators, W. G. Beck, S. H. Crowl, E. D. Foster, E. J. Rosecraus, all of Cleveland, and others.

New York, N. Y.—The Colon Consolidated Company has been incorporated to operate electric and ice plants; Capital, $30,000; incorporators, H. McCulloch, J. Machado, J. G. Peoli, M. G. Peoli, G. E. Wentworth, all of New York city.

Vincennes, Ind.—The City Electric Lighting Company has been incorporated; capital, $75,000; directors, John H. Brown, George and B. O. Mayer.

Providence, R. I.—The New England Lighting Company has been incorporated; capital, $1000,000; incorporators, C. T. Daniels, C. A. Babcock, H. C. Babcock, all of this city.

Buffalo, N. Y.—The New Motor Company has been incorporated to manufacture and sell steam, air, gas, gasoline and other motors, trolley bases, trolley heads and trolley whels; capital, $25,000; directors, Samuel Wilkinson, E. L. Pixley and William M. Hoffman, of Buffalo.

St. Catharines, Ont.—The St. Catharines Hydraulic Company, Limited, has been incorporated, with the object of producing and distributing electricity. Thomas R. Merritt, William Hamilton Ingersoll, provisional directors.

Albany, N. Y.—The Empire State Power Company, with the principal office at Amsterdam, has been incorporated with the Secretary of State, with a capital of $1,000,000.

Knoxville, Tenn.—The Knoxville Electric Company has been incorporated to supply light, heat and power; capital, $1,000; incorporators, J. P. Moore, C. D. Lockwood, W. Adams, J. Moss, A. Caldwell, all of this place.

Richmond, Tex.—The Richmond Electric Co. has been incorporated, with a capital stock of $4,000, to construct and operate an electric light plant, by C. A. Beasley, A. A. Bailey and R. F. Ransom.

POSSIBLE INSTALLATIONS.

Birmingham, Ala.—The Consolidated Electric Light Co., F. H. Armstrong, secretary, will hold a meeting on September 5 to pass upon the question of whether or not it will increase its capital stock from $500,000 to $550,000.

Manistee, Ala.—W. H. Lamont wants to correspond with manufacturers of electric motors for the transmission of power to take the place of belts.

Big Springs, Tex.—William Dereiny wants the addresses of firms who handle or manufacture supplies for electric light plants.

Lake Mary, Fla.—F. G. Perkins, president Planters Mfg. Co., wants catalogues, etc., on 10-horse power electric plant, etc.

Louisville, Ky.—The Kentucky Heating Co. is figuring on the erection of a plant to supply electricity in the central part of the city, power to be furnished by gas engines driven by natural gas; Donald McDonald, president.

Clarksdale, Miss.—The city will hold an election on August 28 to decide the issuance of $37,000 of bonds for water works and electric light plant mentioned during the week. Address Walter Clark, mayor.

De Witt, Ark.—R. A. Houston wants to purchase electric light plant, including 300 or 400 16-candle-power lamps and four arc lights of 300 candle-power each; 11,-500 feet of wire and 3,000 feet of insulated wire.

TELEPHONE CALLS.

Huntsville, Ala.—The American Telephone Co., recently organized, has been granted franchise for establishment of a system.

STREET RAILWAY NEWS.

Frederick, Md.—The Frederick, Thurmont & Northern Electrical Railroad is seeking a franchise to run on the principal portion of Market street, Frederick.

New Albany, Ky.—The New Albany Electric Street Railway Co. proposes to make extensions through the city to the fair grounds.

Savannah, Ga.—Arrangements are being made to place the Suburban & West End Street Railroad in running order as a trolley line.

NEW YORK NOTES.

SIEMENS & HALSKE ELECTRIC COMPANY have removed their New York offices to 319-320 Havemeyer Building, 26 Cortlandt street.

THE MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, are sending out their new price list, installation and specification hand book and facts regarding their cable.

The installation book is complete, inasmuch that it not only describes the cable and shows how to install it, but also gives forms for making estimates and methods of making out proposals, so that there is nothing which the installing electrician desires to know in regard to the installation of the cable, but what it can be found in this book. It is intended to be comprehensive, and to put the installing electrician in a position to do business in the new insurance field afforded by the product of the Montauk Multiphase Cable Company. The price list No. 3 supersedes all others.

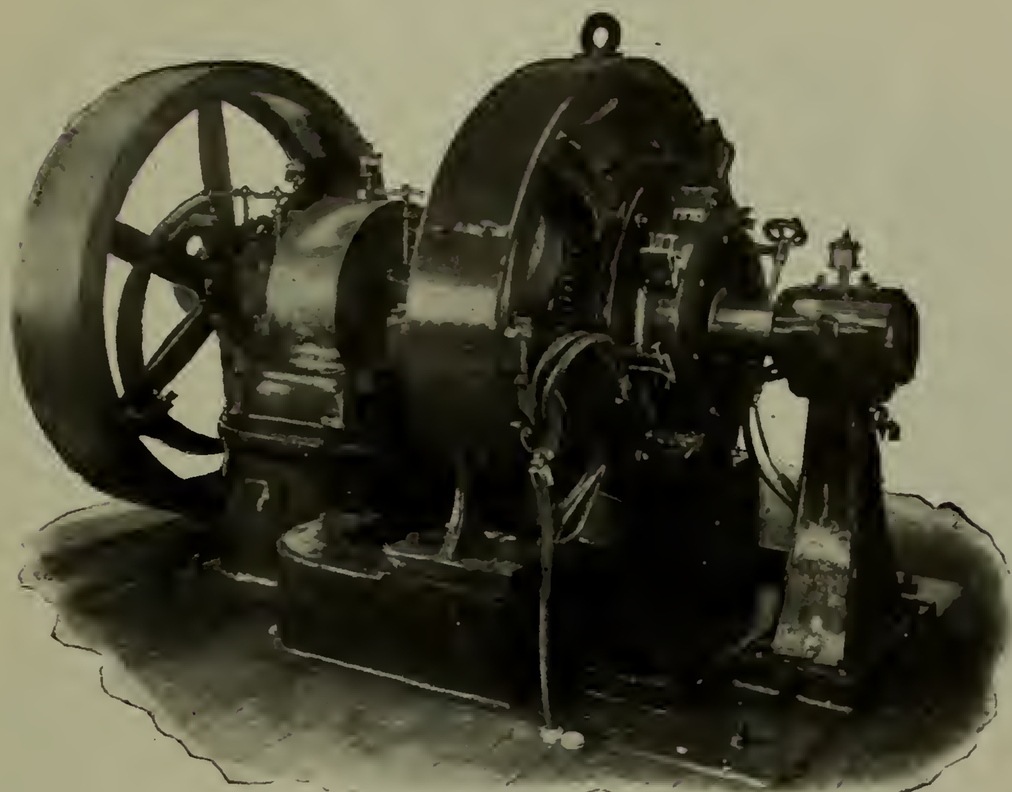
J. JONES, Jr., of the J. Jones & Son Company, manufacturers of and dealers in electric light, power and general supplies, 64 Cortlandt st., together with fifteen other representatives of the company gave a dinner in honor of Mr. Tom Watson, at Avoca Villa, Bath Beach, on August 28th. Mr. Watson, who has been connected with the above firm ever since its inception some years ago, was married on the 30th ult., and is spending his honeymoon at Old Point Comfort, Va. The affair was the occasion of much jollity, speaking and singing being enjoyed for several hous after the dinner. In commemoration of the event, Mr. Watson presented each one of his colleagues with handsome silver watch safes. Everyone wished him the blessings which should come to one as ambitious as Mr. Watson. He enjoys the utmost confidence of his employers, and Mr. Jones' attendance at the banquet testified to the esteem in which he is held. We unite with his friends in wishing him many years of happy wedded life and success in all his undertakings.

G. F. AFFLECK, 109 Liberty st., expert in machine tools and iron and brass working machinery, is actively engaged in fitting out several large works with new and second-hand tools. He buys new and second-hand machinery, paying the highest market prices, cash down, and is an expert in buying equipments of new factories at special rates. Mr. Affleck's responsibility is unquestioned, and he enjoys the confidence of all whom he comes in contact with.

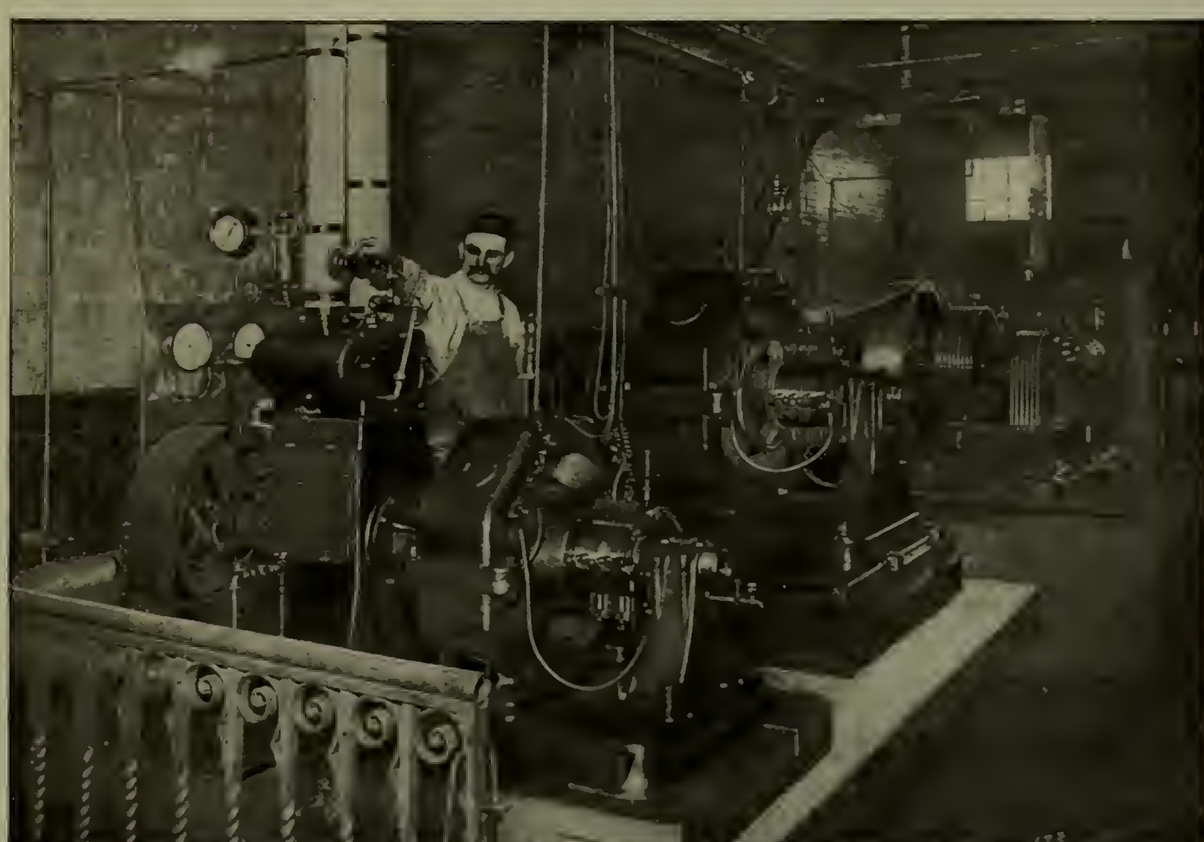
The Electrical Age.

VOL. XXIV—NO. 11. NEW YORK, SEPTEMBER 9, 1899. WHOLE NO. 643.

Electric Light and Power.



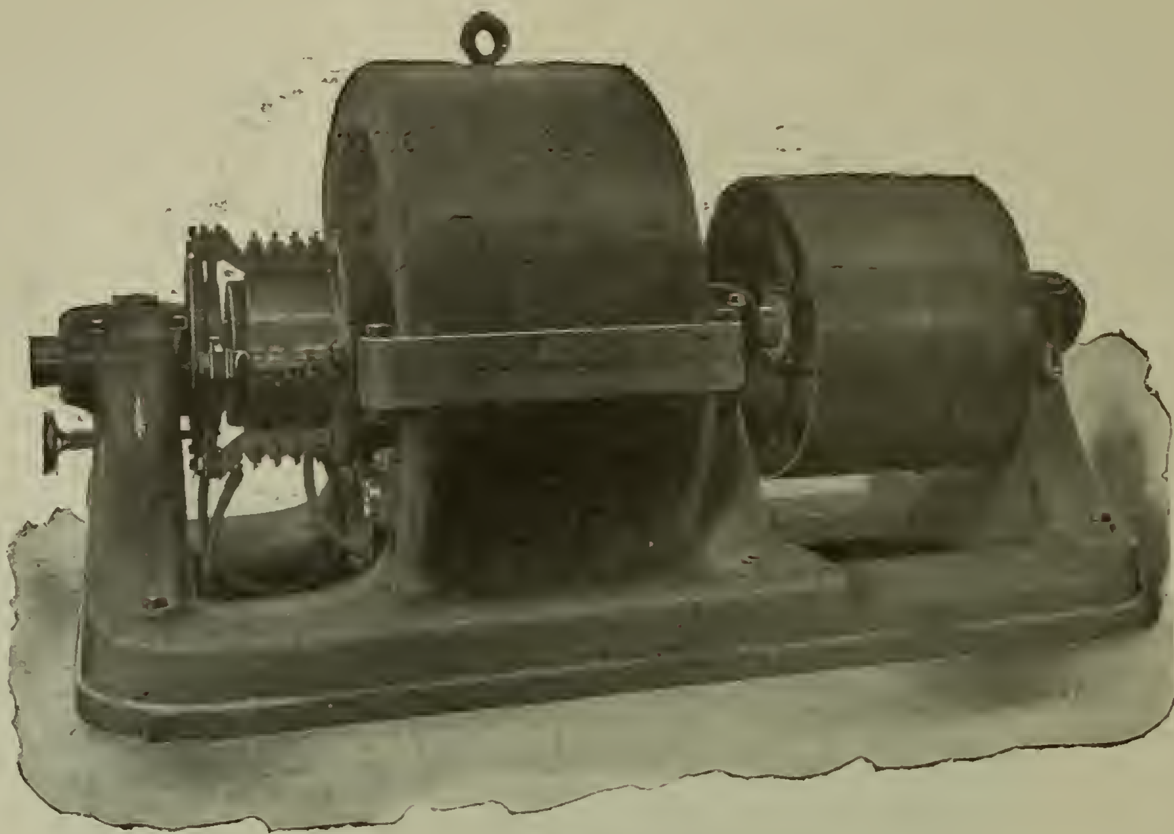
C-W. Dynamo, Direct Connected to Shaft of 150-Horse-Power McIntosh and Seymour Engine.



Power Plant at the Iron Works of Messrs. Post & McCord, Brooklyn, N. Y.

DIRECT CONNECTED LOW SPEED PLANTS.

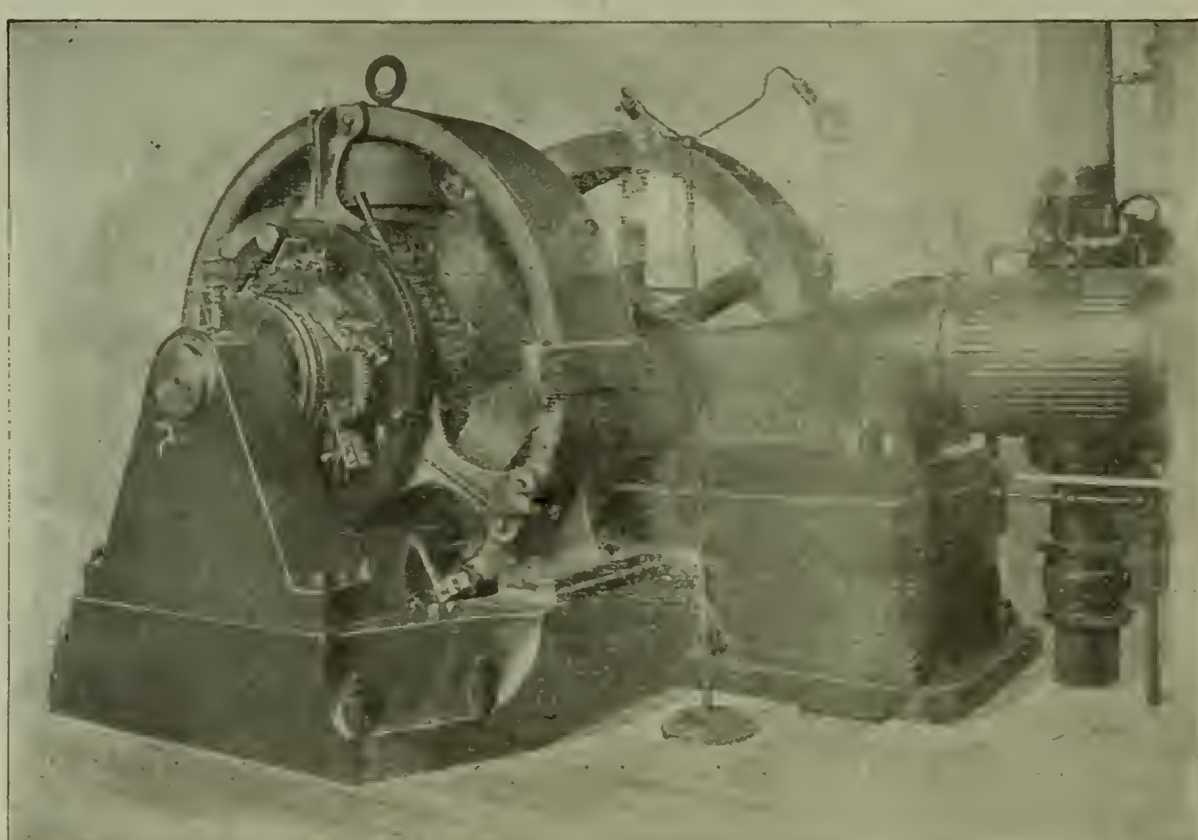
The first steam engines built by Newcomen and afterwards by other English builders were inherently low speed machines. After an interval of fifty or seventy-five years had elapsed Edison developed the dynamo which called for a change, not only in the speed of the steam engine but also in its regulation. Eventually the high speed engine and dynamo, belt driven, crystallized sufficiently to show the trend of electrical engineering as it then existed. The motor being recognized as a highly economical piece of mechanism naturally increased the demand for electric power. The installation of wires and lamps in many buildings and on the public highways represented several thousands of horse power which was supplied by the electric light stations in various parts of the city.



C-W. MACHINE.

Output at 115 or 230 volts: Motor, 225 horse-power at 400 revolutions per minute; Dynamo, 200 kilowatts at 450 revolutions per minute. Output at 500 volts: Motor, 225 horse-power at 450 revolutions per minute; Dynamo, 200 kilowatts at 500 revolutions per minute. Shipping weight, 16 tons.

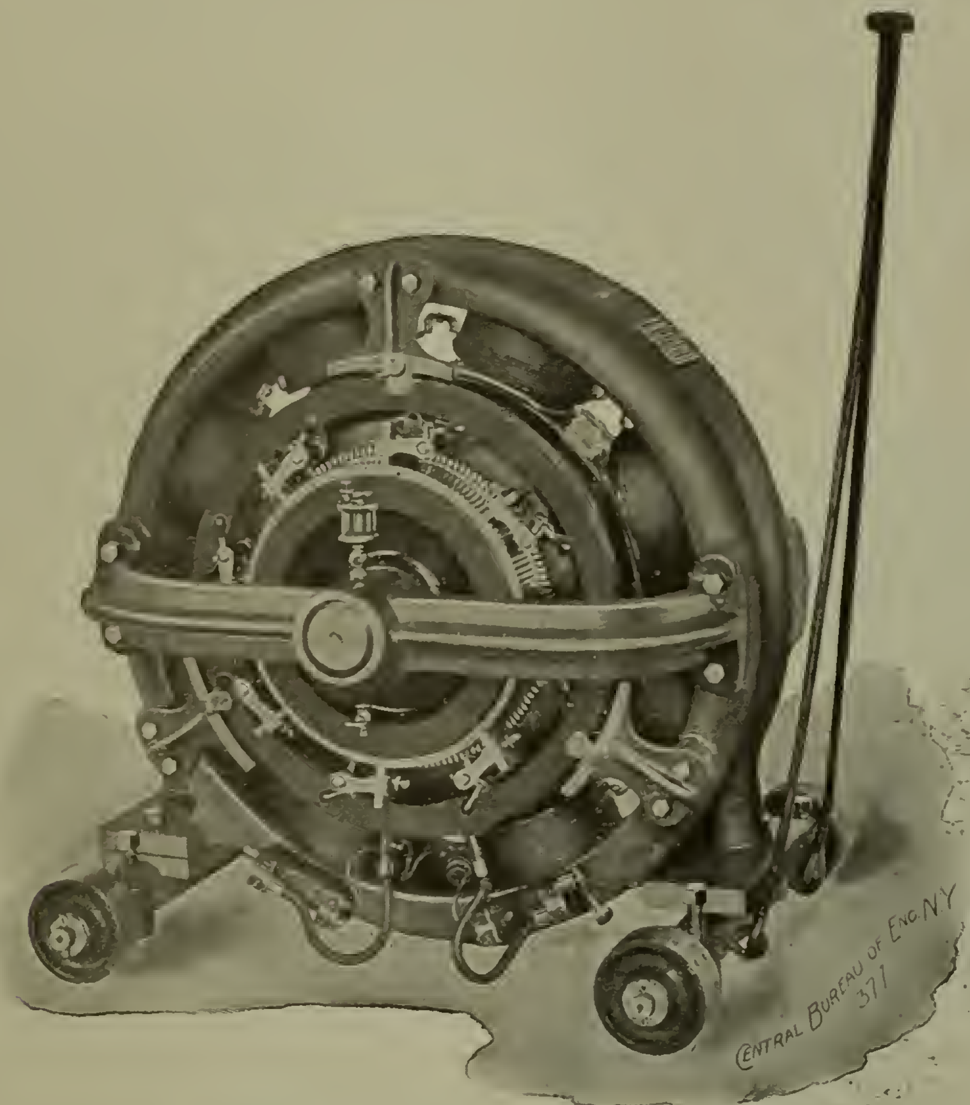
Eventually the dynamo underwent such changes in its construction that it began to be recognized, when of large size, as being well adapted for slow speed instead of high speed. In consequence of this the multipolar dynamo running at exceedingly low speeds came into existence and naturally forced the manufacturers of steam engines to reconstruct them sufficiently to run slowly with good regulation and the same efficiency. This was immediately desirable because of the rapid development of electric railways in and about the various large cities in the United States as well as Europe. The sudden demands for power on a street railway line and the frightful irregularity with which in the beginning this demand came caused experts to examine into those conditions which called for the best distribution of power and the best speed and construction which could supply it.



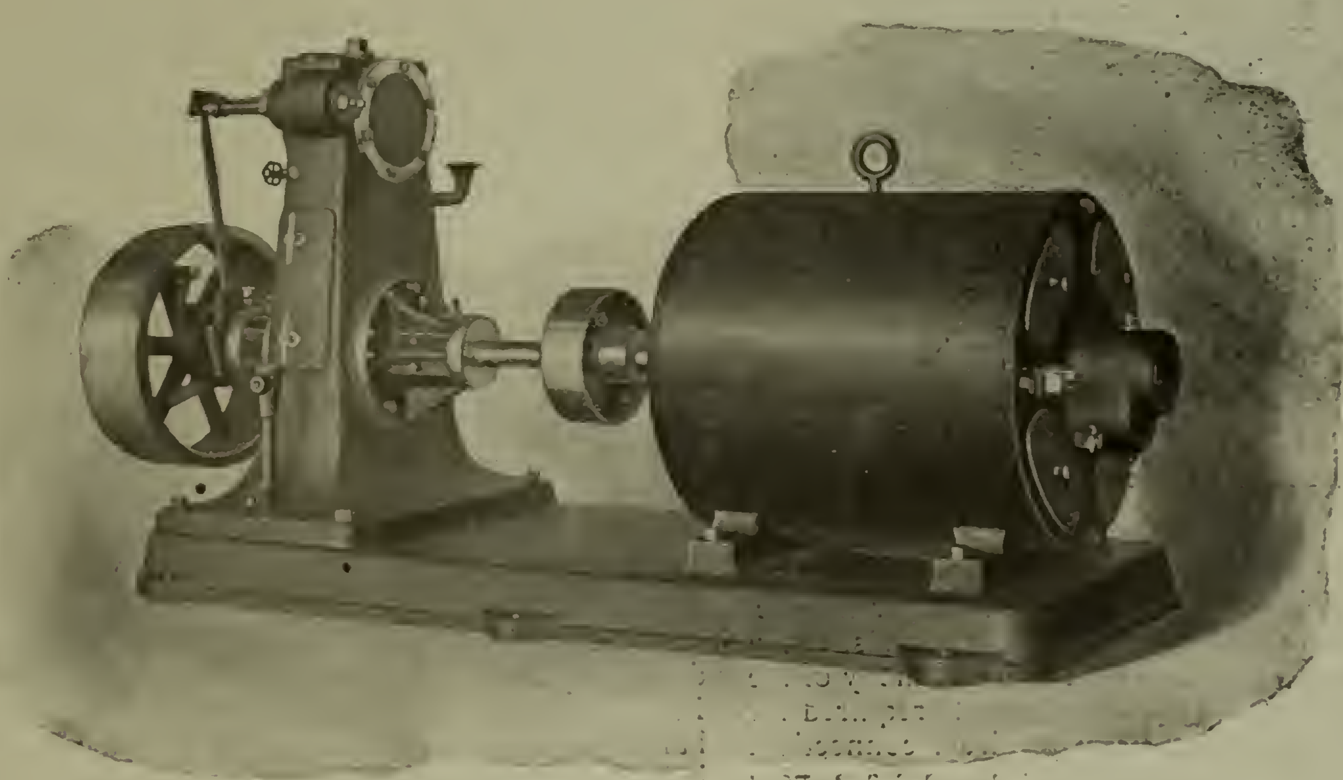
C-W. Dynamo, Direct Connected to Shaft of 80-Horse Power Ames Engine.

Thus, in brief, the decision was arrived at that low speed dynamos and low speed engines gained nothing by being belted to each other and were therefore direct connected. This practise, after many careful tests of each machine separately and then of the plant as a whole, showed the great advantages arising from the features of compactness, saving of power due to belt drive and the saving of floor space. It soon became the general practise, not only to use low speed machinery wherever central station service was required, but in all cases, even where the plant was comparatively small, the machines were direct connected.

In the illustrations are shown several plants, direct connected, occupying a minimum of floor space and possessing on the average a high efficiency, both electrically and mechanically. In the illustration showing the power plant at the iron works of Messrs. Post & McCord, Brooklyn, N. Y., two generators are shown, one direct connected the other belt driven. It will be perceived that both engine and dynamo in the direct connected plant occupy but a trifle more space than the gen-

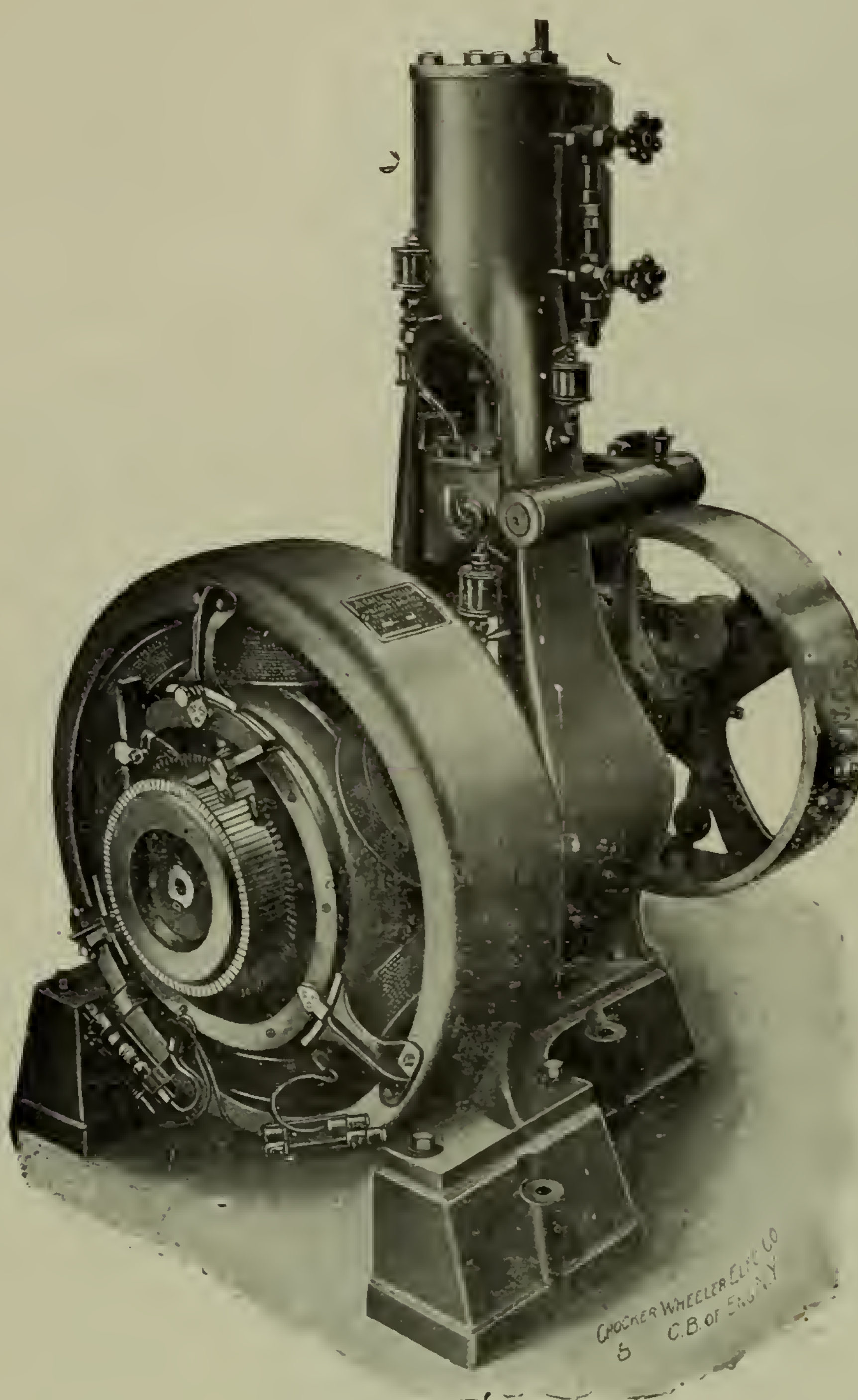


C-W. Direct Motor, Portable Arrangement on Rollers.



Iron Clad Motor Direct Connected to Case Engine.

erator alone of the belt driven plant. In another illustration is shown a Crocker-Wheeler generator direct connected to a McIntosh & Seymour engine. In addition are shown illustrations of two multi-polar generators or motors depending upon their use, made by the same company, which possess all those features of compactness, lightness and efficiency previously mentioned. The 225 H. P. motor at four hundred revolutions per minute will give its quota of power at 115 or 230 volts, for either of which pressures it may be wound; as a dynamo it will give 200 K. W. at 450 revolutions per minute. If wound for 500 volts it will deliver 225 H. P. as a motor at 450 revolutions per minute, and as a dynamo 200 K. W., which is about 266 H. P. at 500 revolutions per minute. The total weight over all is about 32,000 pounds, ready for shipment. In this machine are embodied many of the features which collectively represent what is required for low speed running and, if necessary, direct connection. For power transmission very heavy motors are now in general use but differ in no respect from a machine serving the opposite purpose, except possibly as regards weight.



C-W. Dynamo, Direct Connected to Vertical Engine.

Certain authorities have given the figures which are supposed to represent the ultimate efficiency of a well installed generating plant, line and motors; loss due to friction of steam engine ten per cent; loss in belting between engine and generator three per cent; if directly connected this is not figured; loss in generator ten per cent.; loss in line ten per cent. to twenty per cent., depending upon its length, size of conductor, care in building line, etc., loss in motors twelve per cent. to twenty per cent., depending on kind used and service required of them; five per cent. to ten per cent. loss between the brake horse power and the machine to be driven, to which may be added the loss in the machine due to friction. Total efficiency fifty per cent., taking the lowest estimate of loss. Where the distance is short and great care is taken in making the installation the actual efficiency may be increased to sixty per cent. The latest types of motors and the fact that direct connection is used at the generating end would lift the efficiency from fifty to seventy per cent. At least seventy-three per cent. was arrived at in Europe and a higher percentage in the Niagara Falls plant. The obvious gain due to direct connection is more than five per cent. and by the employment of high class motors at least ten per cent. over the figures given.

Stray Currents.

COMBINATION TELEPHONE AND TELEGRAPH APPARATUS.

A patent has been granted to R. M. Bailey, of Williamsport, Pa., for a combination telegraph and telephone apparatus. It consists in the combination, with a telegraph sounder, of the electrodes of a microphone in a telephone circuit, the said telegraph sounder and one or both of the electrodes of said microphone being mounted upon the same base or plate.—Ex.

NIAGARA POWER IN TORONTO.

It is interesting to learn that Prof. George Forbes has again been consulted in connection with work at Niagara. In this case the Canadian Niagara Falls Company have been taking his advice on the practicability of transmitting power to Toronto. As a result of the conference held on the question it is proposed to commence work at once, and to spend about $3,000,000 in developing about 100,000 H. P. It is probable that overhead wires will be used to transmit the current to Toronto.—Ex.

ELECTRIC IGNITION OF FIRE DAMP.

The results of experiments on the ignition of fire damp and coal dust by means of electricity were given in a paper by Herr Heise and Dr. Theim, recently read before the Institution of Mining Engineers. The sum of the results obtained show that in general the amount of electrical energy capable in certain circumstances of igniting fire damp need be extremely small. This amount cannot be definitely fixed, however, as it depends not only on the quantity of energy, but on the mode of its application and other attendant circumstances. In any case, all visible sparks may be looked upon as dangerous. Explosions of coal dust alone appear to be impossible of production by electricity, unless special classes of coal dust behave differently from those tried.—Ex.

ELECTRICIAN'S INSULATED SCREWDRIVER.

The American India-Rubber World describes a screwdriver, a patent for which has been applied for by Messrs. F. E. Ducharme & Son, of Shelbourne Falls, Mass. The handle of the tool is insulated with hard rubber, the latter being made to surround entirely the portion of the blade in the wooden handle. The whole is said to be so well fitted, and the rubber is so fastened that no part can become loose or pull out from use. It was designed for use by electricians, though it is adapted for all purposes for which a screwdriver is desired, the cost being only a very little more than for the ordinary non-insulated screwdriver.

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CONTENTS:

ELECTRIC WELDING.

The commercial value of electric welding as practiced in various large factories can only be estimated in terms that convey but a poor idea of its permanence and utility. In fact, it is most likely that some few industries are absolutely dependent upon electric welding processes for their present and future success. Certain classes of work in which welding by electricity is possible, have become the means of making money for those engaged, largely through the ease, convenience and saving and through the adoption of an electric welding system. Since developed by Prof. Elihu Thomson in 1886 it has been widely adopted wherever sufficient current was available. With the increased cheapness of current and, as a result, the ready adoption of the welder by manufacturers and machine shops considerable time spent at the forge is now absolutely saved. The breaking of shafting, of files, chisels, tools, etc., is immediately remedied by the use of the practical welder. In the bicycle trade, in the manufacture of wheel tires and link chains and for general blacksmithing the electric welder finds no competitor.

To adapt the welder to different kinds of work its primary circuit is connected in series to an auxiliary converter of special construction, by which the electro-motive force can be more fully controlled. In general, as far as its practical application is concerned the ends to be welded together are rounded so that contact shall be first made at the centre of the piece of metal, and the welding being from the centre outwards, oxydized particles and other impurities are forced out as the ends are pressed together, making a perfect joint, superior to any which can be made by forging; and the entire process being thus open to the inspection of the operator flaws cannot easily escape observation. Manual pressure can be employed in ordinary cases, but for more difficult welding, calling for special care and skill, and where greater accuracy is required, pressure by hydraulic or other power is preferred.

In welding the greatest heat is developed at the centre of the weld, which extends only a short distance on either side and varies directly as the resistance which is governed by the rise of temperature. Quoting from practical tests made by experts: "Bars of inch iron become red hot for a distance of one and a half inches on either side of the weld but are comparatively cool at a distance of two and one half inches; the operation being completed in forty seconds the time is too short for diffusion of the heat by conduction; hence waste of energy from this source is reduced to the minimum. The time varies for metals of different kinds and sizes; from one or two seconds for fine wires to two or three minutes for heavy bars; wrought iron bars two inches in diameter requiring an average time of about ninety-seven seconds; two and a half inch iron pipes one-quarter inch thick sixty-one seconds; the average time for copper bars being about five-eighths that required for wrought iron bars."

One great advantage of the welder which makes its use in the factory unattended by objections of any description is the fact that the electro-motive force is very low, thereby making the heavy currents required harmless as far as life and limb are concerned. The physiological effect of a current of ten thousand amperes and a few volts is imperceptible, although its heating qualities are such that iron or brass, as thick as one's thumb, is reduced from red heat to vivid incandescence and can be, if necessary, melted and vaporized.

It is therefore seen that electric welding possesses peculiar advantages as regards convenience, readiness of application, inexpensiveness and freedom from danger, which do not exist even in the simple process of welding on an anvil by hand. The bicycle trade carried on in America and abroad is making use of electric welders and the electrician who generally provides others with labor-saving machine now finds that stranded wire cables of steel or other metals are readily joined and permanently knitted by the electric welding machine. In fact, for repairing the broken machinery on ships and for general repair work the electric welder has become an indispensable piece of machinery.

GROWTH OF THE CARBON INDUSTRY.

The carbon industry in America has developed from a very modest beginning to enormous proportions. In 1889 it began to be realized that the arc light industry, the demand for carbons for dry cells, and the increased demand for carbon for the brushes of dynamos called for a little more care in the manufacture of this valuable material. The European supply of carbon was inexcusable inasmuch as American dealers only bought it because they believed the carbon manufacturers of this country incapable of delivering the high grade of goods they desired. Since that period, however, careful experiments have resulted in the production of a fine grained carbon that compares most favorably with the carbon coming in from abroad. As a result of this the importations of carbon in its various forms for electrical purposes diminished and the carbon manufacturers readily supplied the increasing demand. The carbon industry now supplies the calcium carbide manufacturers as well as other allied industries which have collectively increased the demand for carbon almost to the limit of the manufacturers' output.

Miscellaneous.

THE FIELD OF EXPERIMENTAL RESEARCH.*

BY PROF. ELIHU THOMPSON.

Physical research by experimental methods is both a broadening and a narrowing field. There are many gaps yet to be filled, data to be accumulated, measurements to be made with great precision, but the limits within which we must work are becoming, at the same time, more and more defined.

The upper ranges of velocities, temperatures and pressures, which manifest themselves in the study of the stellar universe, are forever beyond the range of experiment. But while the astronomer must wait for opportunities to observe, the experimenter can control his conditions and employ his methods and his apparatus at once to the question in hand. Still this work must be done within a certain range or must be limited to conditions more or less easy to recognize. In spite of this fact, however, the progress made during the past century is not likely to cease or abate in the next, and the ever increasing number of workers bodes well for the future enrichment of our science.

Whatever may be our ideas of fundamental entities, as expressed in various theories; whether, as an example, we regard the ether as like an infinitely mobile fluid, or as a jelly; or whether we incline to think that being an electro-magnetic medium, it may be without mechanical properties, which properties depend in some way upon the electro-magnetic nature of the ether, we can not reach sure ground without the experimental test.

The development in the field of research by experiment is like the opening of a mine, which, as it deepens and widens, continually yields new treasure, but with increased difficulty, except when a rich vein is struck and worked for a time. In general, however, as the work progresses there will be needed closer application and more refined methods. We may, indeed, find our limit of depth in the mine of experiment in inordinate cost, in temperatures too high, or in pressures beyond the limits of our skill to control.

It is but a few months since Professor Dewar, by the evaporation of liquid hydrogen in a vacuum, closely approached, if he has not yet reached, our lower limit of possible temperature. Investigations of the effects of low temperature upon the properties of bodies must, from the present outlook, be forever limited to about 20 degrees centigrade above absolute zero, unless a lighter gas than hydrogen be discovered upon the earth, the actual existence of which it is, of course, impossible to conjecture. Before the actual experimental demonstration of this limit the limit itself was known to theory, at least, approximately, but the spur of the experimenter is the overcoming of difficulties and the possibility of new discoveries which come as surprises. In the case in question a liquid of extremely low density, only one-fourteenth that of liquid nitrogen, was produced, while still defined by clear and well marked refracting surfaces.

When we turn to the consideration of the field for research work at high temperatures we are not confronted by the fact of a physical limit existing which may be approached but never reached. We can imagine no limit to possible increase of temperature, such as is the absolute zero a limit of decrease. While we may actually employ in electric furnaces temperatures which, according to Moissan, have a lower limit of 3,500 degrees centigrade, we can realize the possibility of temperatures existing in the stars measured by tens of thousands of degrees of our temperature scale.

The moderate increase of working temperature given by the electric furnace enabled Moissan and others to reap a rich harvest of experimental results, and the natural inference is that much more might be expected from further extensions of the limits. These limits are, however, already set for us by the vaporization of all known substances. Our furnace itself keeps down the temperature by melting and volatilizing. We may indefinitely increase the energy in an electric arc and thus add to the heat evolved, but the addition only goes to vaporize more material. The limit of work then seems to be readily reached in the electric furnace, no materials for lining being available, not subject either to fusion or vaporization, thus using up the energy which would otherwise go to increase the temperature.

A suggestion as to a possible extension of temperature range may be made here. It may be requisite to work with closed receptacles under pressure, and to discharge through them electric currents of so great energy-value as to attain almost instantaneously the highest temperature, to be maintained for only a very short time. We may imagine a huge condenser charged to a potential of, say, 10,000 volts as discharged through a limited body of gas contained in a small space within a strong steel tube which has a lining of refractory non-conductor. The energy may thus possibly be delivered so suddenly to a very limited body of material as to result in a momentary elevation of temperature passing all present known limits and capable of effecting profound changes in molecular constitution. We need all possible extension of the limits of research in this direction in order to discover some clue to the relations which the chemical elements bear to each other. The limit of possible strength of the containing receptacle, or some unforeseen factor, would probably set the new bounds. The point to be here enforced, however, is that far beyond any increase of working range in temperature, obtained in any way, there must still exist a further range unattainable by our best efforts and possibly forever outside of the field of experimental research. Our knowledge of this higher range can alone be derived from a study of the actions going on in the stars and nebulae.

As with the temperature range so it is with the pressure range. We may easily work under conditions which involve no pressure, but when we attempt to conduct our inquiries with increase of pressure we soon find a limit to the tenacity of our strongest vessels or to our ability to produce and maintain extreme pressures. We may work, not easily it is true, with pressures up to a few tons to the square inch, but this is as nothing compared to the conditions which we know must exist within the larger celestial bodies, without reference to their condition, solid, liquid or gaseous. Can we ever hope to experimentally reproduce the condition of a mass of gas so compressed that in spite of a very high temperature its volume is less than that of the same mass cooled to solidification? Yet this extreme of condition must be the normal state within the bodies of many of the stars.

It has been aptly said that many, and perhaps most, of the important discoveries have been made with comparatively simple and crude apparatus. While this may be true, yet it is probably true also that future advance work is likely to require more and more refined means and greater nicety of construction and adjustment of apparatus. The expense or cost, if not the difficulty of the work, may become so great as to effectually bar further progress in some fields. When instruments require to be adjusted or constructed, to such refined limits as a fraction of a wave-length of limit, but few can be found to undertake the work. The interferometer and echelon spectroscope of Michelson involve such minute adjustments that a

*Address before the American Association for the Advancement of Science, at Columbus, Ohio, August, 1899.

wave-length of limit is relatively thereto a large measure. It is well known that this comparatively coarseness of light waves imposes a limit to the powers of optical instruments, as the microscope and telescope, such that no perfection of proportion, construction and correction of the lenses can remove.

In most fields of research, however, progress in the future will depend to an increasing degree upon the possession, by the investigator, of an appreciation of small details and magnitudes, together with a refined skill in manipulation or construction of apparatus. He must be ready to guide the trained mechanic and be able himself to administer those finishing touches which often mark the difference bettween success and failure. There must be in his mental equipment that clear comprehension of the proper adjustment of means to ends which is of so great value in work in new fields. He must also learn to render available to science the resources of the larger workshops and industrial establishments.

The application of physical principles upon a large scale in such works has frequently, in recent years, resulted in great gains to science itself. The resources of the physical laboratory are often relatively small and meagre compared with those of the factory. Experimental work in certain lines is now frequently carried on upon a scale so great and under such varied conditions as would be almost impossible outside of a large works.

In no field has this been more true than in that of electricity during the past few years. We need only instance the progress in alternating currents and in relation to the magnetic properties of iron. In large scale operations effects which would be missed or remain masked in work undertaken upon a more restricted scale receive emphasis sufficient to cause them to command attention. The obstacle of increasing costliness of equipment, which in some fields might act as a bar to further progress, can only be overcome by more liberal endowments of laboratories engaged in advance work. Even those in the community who can only understand the value of scientific work when it has been put to practical use may find in the history of past progress that many discoveries in pure science which had not, when made, any apparent commercial importance or value have in the end resulted in great practical revolutions.

(To be continued.)

Auto=Mobiles.

AUTOMOBILE RAILWAY TO THE FOOT OF MONT BLANC.

The Paris, Lyons and Mediterranean Railway Co., headquarters at 88 rue St. Lazare, Paris, has undertaken the construction and operation of an electric railway between Fayet and Chamounix, at the foot of Mont Blanc. The line is to be in operation within twenty months, and it is to be presumed that the company will be interested in propositions for machinery and equipment. Power is to be furnished by the River Arve. The cars are to be automobiles, each supplied with its own dynamo. The contracts for building the road proper and providing the water power has been divided into two parts and awarded to Gagner & Freres, of Annency, and Richard & Meynani, of Avignon.—Ex.

THE AUTOMOBILE SITUATION.

In public city service, it is obviously necessary that a cab, in order to be successful, must be absolutely controllable in heavy traffic even in comparatively unskilled hands, free from unpleasant odors and the general mechanical disadvantages usually inseparable from an engine, and this, added to the limited requirements of cab service as to mileage, makes it easy to understand why the electrical system has been the most successful. How long this state of affairs will exist depends entirely upon what is accomplished with the other systems. As improvement in the capacity per pound of storage battery is, to all appearances, advancing more rapidly than improvement in gasoline, steam or other systems, it does not seem likely that electricty for cab service will very soon be supplanted. In the case of the private motor vehicle, the requirements are not as uniform as with the public cab, but nevertheless there has been enough experience to permit classification of the different requirements and to understand their limits. It does not seem to be generally understood that the intentions of the owner regarding his motor carriage invariably determine the best system for this purpose. Other things being equal, the electric carriage is generally preferred on account of its extreme simplicity of operation, its ability to meet most ideal æsthetic demands, and its instantaneous availability. The limitations of the best electrical carriage on the market to-day are, therefore, an index of the status of the electric carriage. If the requirements are such that all runs will be limited to 30 miles in length and the load to be carried will be under 1,000 pounds, the electrical system is the best for carriage or delivery wagon. In practice, these limits are found to include almost all city physicans' service, city pleasure driving, general running about, and city delivery service. As an example of taking a carriage out of its field, the writer might refer to an attempt at touring in an electric carriage which he made at one time. He succeeded in covering a distance of something over a hundred miles through country districts, but at the expense of all sorts of inconveniences and delays, which completely removed all pleasure from the trip.

If one wishes to make runs exceeding 20 miles in length, to carry less than 1,000 pounds, and to avoid the necessity of having any definite base of supply, either the gasoline carriage will be chosen, thus following the example of 75 per cent. of those who use long distance carriages in the United States, or the steam carriage, which represents the remaining 25 per cent. If he follows the practice in Great Britain, the user will buy a gasoline carriage, and the same is the case in France. While the steam carriage is able to fill the unlimited distance requirements as well as the gasoline vehicle, its peculiarities are decidedly different, and there are very few successful light steam vehicles in daily use, as compared with the number of successful gasoline vehicles in daily service. For weights exceeding 1,500 pounds and distances exceeding even ten miles, however, steam has proven more successful than anything else. In Great Britain there are several vehicles in regular use for carrying heavy loads of general merchandise. In France the same conditions exist.

The motor vehicle situation, then, as we have to face it to-day, offers three different practicable systems for the propulsion of road vehicles. All three are eminently successful and satisfactory in their field, but none of them completely fills all fields. Instead of the broad statements which we see continually that this or that system is the best for all services, we find that it depends entirely upon the requirements and limitations of the particular case in question.—Hiram Percy Maxim in Cassier's Magazine.

THE LAYMAN AND ELECTRICITY.

Mr. Justjoined—What on earth are you trying to do?

Mrs. Justjoined—I was reading about cooking by electricity, so I hung the chops on the electric bell and I've been pushing the button for half an hour, but it doesn't seem to work.—Ex.

The Storage Battery.

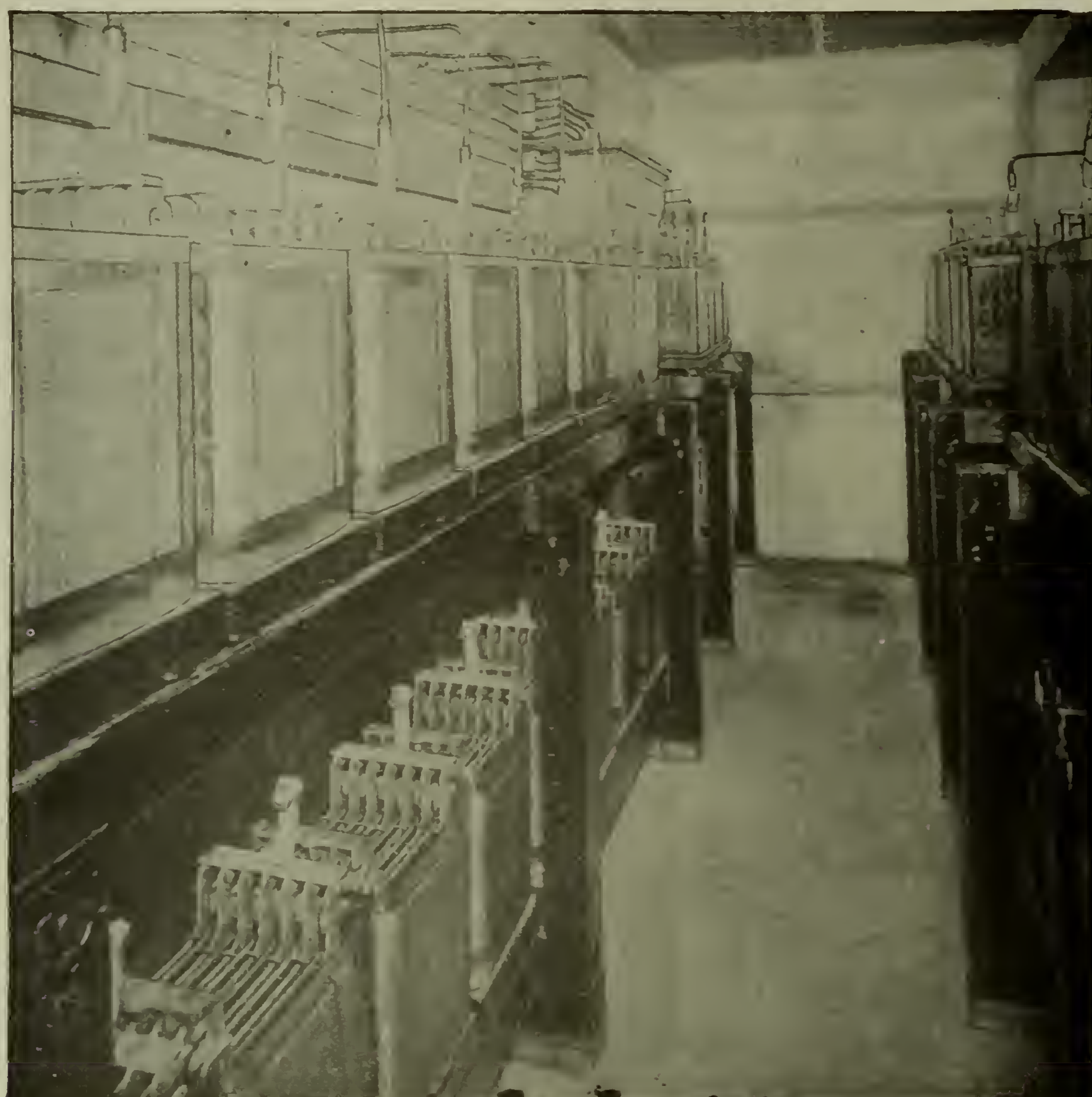
SOME NOTES ON STORAGE BATTERIES.*

The tedious expensive process required for the electric formation of the Plante plates led to the construction by Camille A. Faure, about 1880, of plates prepared by covering sheet lead with a paste made of red lead and sulphuric acid. They were placed in a glass jar, in water acidulated with sulphuric acid, and the coating subjected to electrolysis, by which the red lead was changed in a few days to lead dioxide and spongy lead on each plate respectively, and the cell was ready for practical use.

CHEMICAL REACTION.—According to Gladstone and Tribe, on the immersion of the plates in the acidulated water, there is at first a purely chemical reaction by which the red lead on both plates is gradually changed from the surface inward into a mixture of the dioxide and sulphate of lead with evolution of water. But oxygen and hydrogen being liberated by the electric current, the oxygen goes to the anode and changes the sulphate into dioxide and sulphuric acid. The hydrogen goes to the cathode, changing the dioxide to spongy lead with evolution of water and changing the sulphate to spongy lead and sulphuric acid. The chemical reaction of the discharge is the formation of lead sulphate on both plates and that of subsequent charging the reconversion of this substance to dioxide and spongy lead as before.

*Philip Atkinson, A.M., Ph.D., in "Dynamic Electricity and Magnetism."

DEFECTS OF THE FAURE CELL.—While the Faure cell could be produced much more economically than the Plante and was equal to it in electric energy, it had many serious defects which proved fatal to its practical success. The coating failed to adhere properly, sloughing off and falling to the bottom and the free circulation of the fluid interfered seriously with systematic electrolysis. The investigation of Brush, Swan, Sellon, Volckmar and others proved the possibility of practical success by the adoption of a special method of construction. The result of these investigations was the production about 1886 of an improved cell the feature of which, due to subsequent improvement, that style of plate illustrated. It consists of a composition lead grid, having openings filled with a paste or tablet, consisting of lead in a finely divided state. The plates give a firm support to the plugs and the free circulation of the fluid allows of perfect electrolysis.



Storage Batteries in Position for Charging.

THE SOLUTION.—These plates are immersed in water acidulated heavily with sulphuric acid, the degree of acidity varies from twenty to thirty-six per cent. The use of glass jars invites the easy examination of the plates and a discovery of loose plugs, short circuitings, etc., likely to occur.

ELECTRIC PREPARATION OF THE PLATES. Each set of plates, positive and negative, is electrolysed separately before they are combined in the cell intended for practical use; special sets of temporary plates or dummies of each kind being used for this purpose, which makes the old process by reversal of current unnecessary. The negatives, if filled with litharge, require six days for its reduction to spongy lead. In positive plates filled with red lead a period of only twenty-four hours is required to reduce it to dioxide.

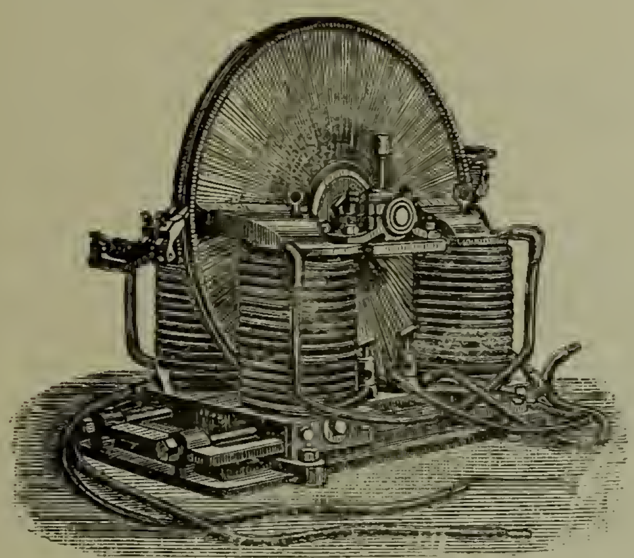
DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of "Answers to Inquiries."*]

THE DISK DYNAMO.

The simplest and cheapest dynamo bears the name of the disk machine and fulfills in its construction all of the principles originally set forth by Faraday. It merely consists

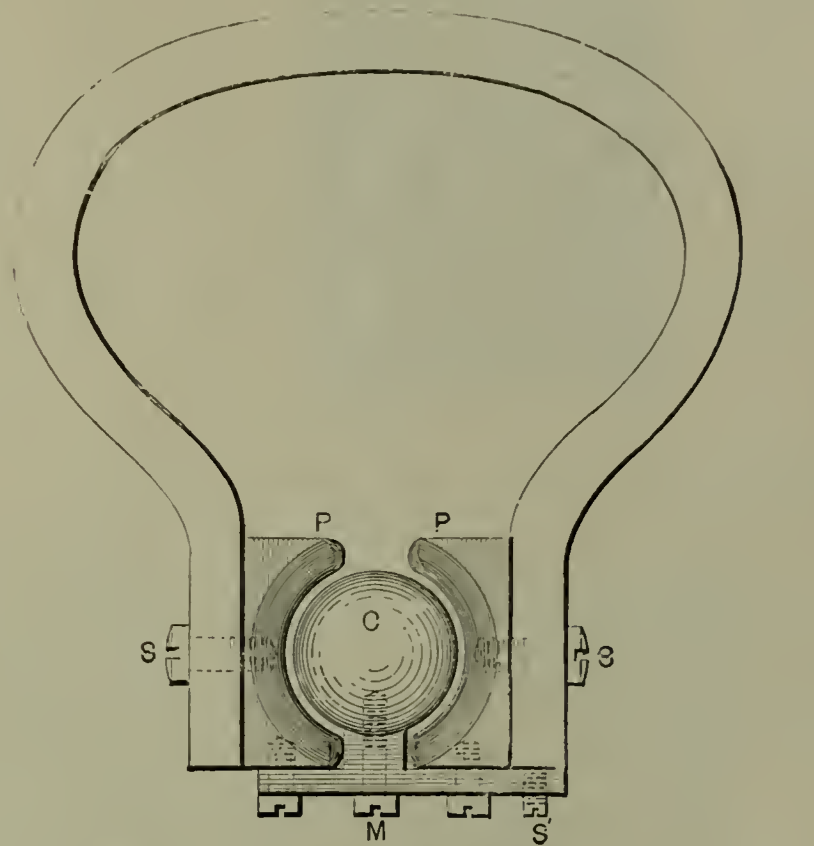


Disk Dynamo.

of a pair of electro magnets between which revolves a disk of solid metal. A connection or contact is made at the centre of the disk and the rim and a current collected when the disk is rotated. From a machine of this description, which is, of course, exceedingly simple, a very strong current is obtained, but a rather weak E. M. F. For electroplating purposes a disk dynamo is of immediate value and importance, although, strange to say, manufacturers have taken but little interest in it. By winding the wire of an armature in a flat, circular frame the machine bears the name of disk dynamo, as shown in the illustration. For experimental purposes a small generator of this description will give quite a useful current and its ease of construction might make it of some importance to the novice.

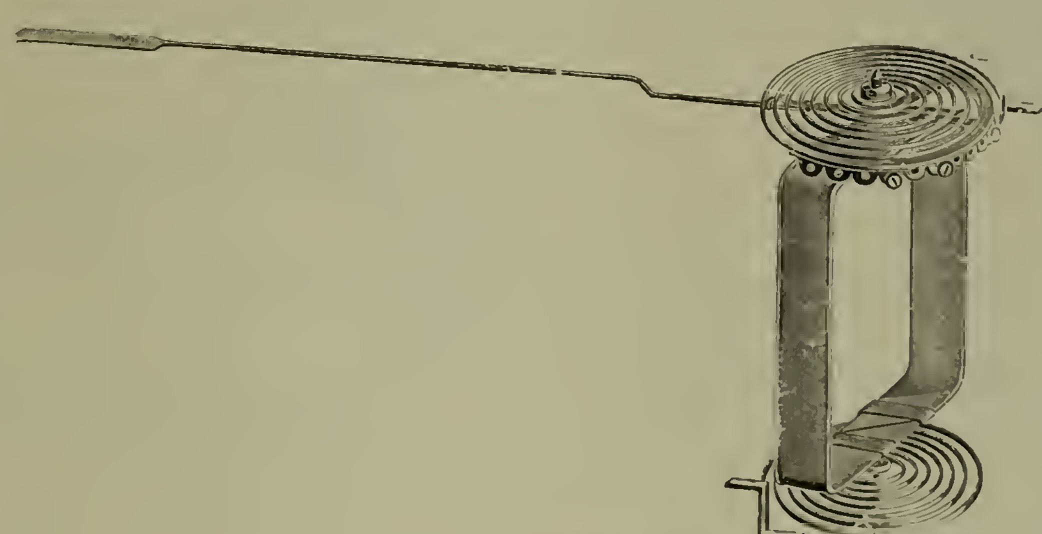
THE WESTON FORM OF THE D'ARSONVAL GALVANOMETER.

The Weston measuring instrument represents the D'Arsonval galvanometer reconstructed to meet the conditions of practice. The two great classes of galvanometers might be regarded as first, those in which the magnet moves and the coils remain stationary, and second, those in which the magnet is stationary and the coils move.



Magnetic Circuit of Weston Instrument.

The Weston instrument belongs to the latter class. In the original D'Arsonval galvanometer a permanently magneized horseshoe is used with its poles pointing upward and between them a coil is suspended which governs the swing of a small mirror. Instead of the mirror reflecting a beam of light the modern Weston instrument moves a slight aluminum dial over a graduated scale, as shown in illustration.

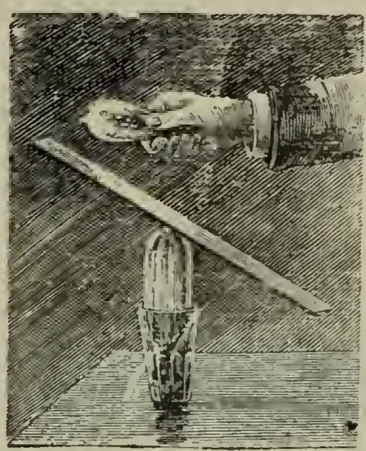


Coil and Spring, Weston Meter.

The coil swings between the poles of the permanent magnet, the current being conveyed to it by two springs which slightly unwind when the needle moves. Separate shoes are attached to the permanent magnet by means of the screws SS, the shoes being marked PP. The permanent magnet is artificially aged before it is used. The ageing is a process of shaking, boiling, etc., which ultimately leaves the magnet of constant strength. Fairly good registering instruments can be built by amateurs along the same lines of fair accuracy and easy construction.

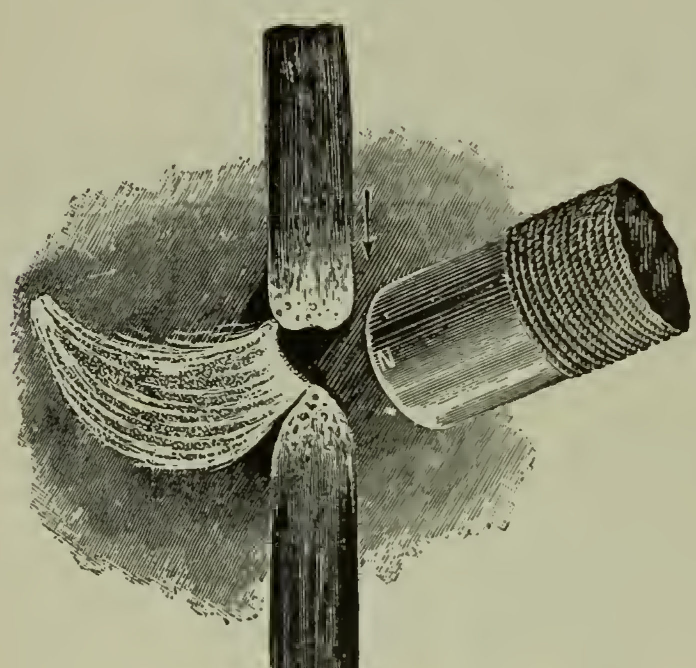
USING AN INCANDESCENT LAMP AS A MAGNET.

By carefully balancing a light, steel, permanent magnet upon a suitable supporting medium, so that it is free to



Experiment Showing Attraction of Magnet for Incandescent Lamp Filament.

move at the least touch, the following experiment can be performed. Take an incandescent lamp, connected by a flexible cord, selecting a lamp whose filament is coiled, and slowly bring it near the balanced magent. At the approach of the lamp it will either be attracted or repelled. This is due to the magnetic influence of the filament which, being



Repulsion of Arc by Magnetic Pole.

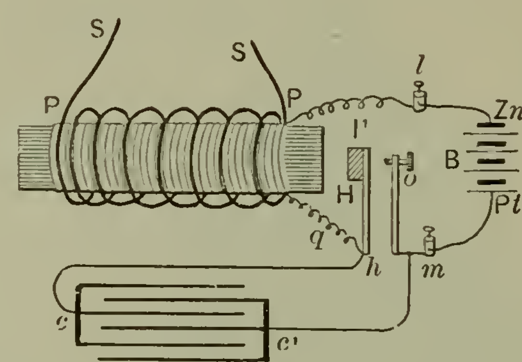
coiled and carrying a current, exercises all the functions of a solenoid. The same experiment can be tried with a compass or a magnetized knitting needle, suspended by a thread instead of the permanent magnet.

MAGNETISM AND AN ARC LAMP.

A simple experiment can be tried with an electro-magnet and a low tension arc lamp which will prove that the electric arc is a source of magnetism. This is accomplished by approaching the arc with a magnet built by winding a coil of wire around a rod of wrought iron. When current enters the coil the magnet, being previously held in position, the arc is immediately affected as though blown upon by a strong wind. This is caused by the magnetic field of the electro-magnet reacting against the magnetic field caused by the flow of current between the two carbons. The principle of the magnetic "blow-out" is well illustrated by this experiment.

CONNECTIONS OF A SPARK COIL.

The connections of a spark coil are shown in the illustration, where B is the battery, and C is the condenser. The battery primary coil, PP, and condenser are connected in series. The vibrator OH, occupies such a position that it cuts the condenser in and out when operating. The terminal, SS, leads to the tube or discharge knobs. The core of the spark coil is built up in the regular manner of wrought iron wire, the two coils surrounding it being carefully insulated from each other by paraffine containing no air bubbles. By means of the condenser the electro-motive force of a spark coil is almost doubled. Its function is to take

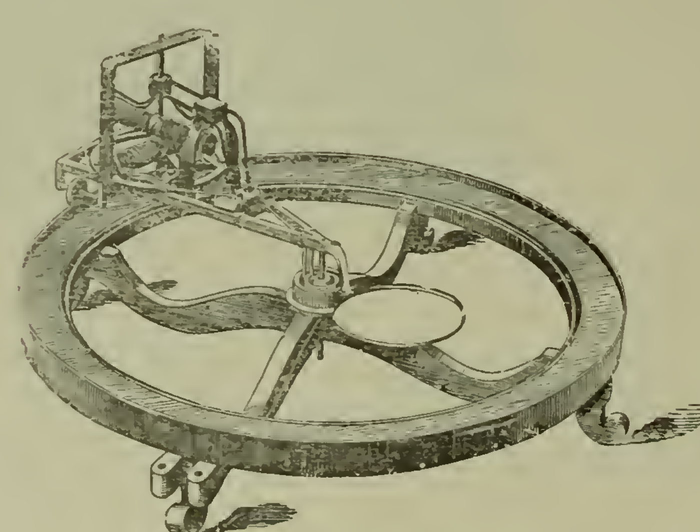


Parts of a Spark Coil.

up the self induction of the primary when the contact is broken and add to the magneto-motive force to such a degree that the sparkling distance is visibly increased. The condenser is built up experimentally until of the proper proportions to give the maximum effect.

THE FIRST ELECTRIC RAILWAY.

The first electric railway built in America was constructed by Davenport, a Vermont blacksmith. It was a circular railway of rather limited dimensions, appearing very much like the illustration. The current was supplied from a battery and mercury contacts connecting from the centre to



Davenport's Electric Railway.

the motor. The model contained all the elements of the modern electric road and deserves to be classed as an historical curiosity of national, if not universal, importance. An American built the first electro-magnet to be used and likewise the first electric road that attracted any considerable attention.

HEAT DEVELOPED BY ELECTRIC TRANSMISSION.

According to the best evidence we have electricity and heat are different kinds of molecular motion and the transmission of either is simply the extension of this motion through a material substance connected with the generator, known as the conductor. When electricity is thus transmitted its transmission is always attended by the evolution of heat which must be considered a legitimate part of the work done, whether useful or otherwise, and not a mere adjunct. This heat is found to be always in direct proportion to the electric resistance encountered; hence if the useful work to be done is the production of heat or its concomitant, light, the resistance is increased at the point where the heat or light is required; but if other useful work is to be accomplished the heat is suppressed by lessening the electric resistance as required. Thus the ratio of heat work to other work can be made to vary by varying the resistance. The analogy to this is found in the friction attendant upon mechanical action which may produce heat for a useful purpose or be suppressed by the use of a lubricant when the mechanical energy is to be otherwise expended.

JOULE'S LAW.—To determine accurately the relations between the electric current and the heat developed by it, Joule, who made this branch of electric science a specialty, passed a battery current through a fine wire coil, inclosed in a vessel of alcohol in which was also inserted a thermometer. The conclusions he reached were embodied in the following law: the heat developed in a conductor by an electric current passing through it varies as the conductor's resistance, the square of the current strength and the time the current lasts. Representing the heat by H, the current by O, the resistance by R and the time by T we get H=CxCxRxT, as the algebraic expression of this law by which the heat developed in any electric circuit can be ascertained.

Transmission Line In the Rockies.

Business News.

SPECIAL EXPORT COLUMN.
TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR THE WEEK ENDING SEPT. 2., 1899, $54.236.00.

New York, N. Y., Sept. 2, 1899.—The following exports of electrical material are from the port of New York for the week ending this date:

Antwerp.—39 packages electrical material, $1 875.

Argentine Republic.—51 cases electrical machinery, $1,830; 43 cases electrical material, $1,536.

Alexandria.—4 packages electrical material, $534; 5 cases electrical machinery, $1,271.

Aden.—4 cases electrical material, $172.

Berlin.—19 packages electrical material, $1,027.

British West Indies.—38 packages electrical material, $1,032.

British East Indies.—1 case electrical material, $80.

British Guiana.—14 cases electrical material, $300.

British Possessions in Africa.—115 packages electrical material, $4,415.

Central America.—9 packages electrical material, $104.

Cuba.—15 cases electrical machinery, $484; 34 cases electrical material, $1,034; 3 cases electric light plant, $508.

Genoa.—2 cases electrical material, $5.

Glasgow.—83 packages electric motors, $6,550; 4 packages electrical material, $172.

Hamburg.—19 packages electrical material, $625; 38 packages electric material, $3,533.

Japan.—9 packages electric material, $758; 9 cases electric machinery, $983.

Liverpool.—6 cases electric machinery, $267; 77 cases electric material, $3,819; 1 case electric machinery, $50.

Mexico.—17 packages electric material, $14,863; 4 cases electric machinery, $582; 6 cases electric material, $320; 12 cases electric material, $500.

Marseilles.—4 cases electric material, $282.

Newfoundland.—1 package electric material, $28.

Piraeus.—3 cases electric material, $45.

Rotterdam.—2 packages electric material, $65.

Swansea.—40 cases electric material, $800.

Southampton.—47 cases electric material, $2,040; 36 packages electric machinery, $238.

Siam.—49 packages electric material, $884.

Trieste.—9 packages electric material, $238.

U. S. Colombia.—11 packages electric material, $304.

Uruguay.—1 case electric material, $8.

Zurich.—1 case electric tape, $75.

TELEPHONE CALLS.

Pensacola, Fla.—The Southern Bell Telephone Co. will install an entire new plant at Pensacola; C. Sims, superintendent, Montgomery, Ala.

Danville, Ky.—C. R. McDowell, of Louisville, and B. T. Woods, of Perryville, have incorporated the Boyle Citizens' Telephone Co., to operate in Boyle and adjacent counties; capital stock $2,200.

Murray, Ky.—The Calloway Telephone Co. has been organized, with Dr. J. R. Coleman, president; Dr. J. G. Hart, manager; company is constructing a toll telephone line from Murray to Mayfield; authorized capital $4,000

Morristown, Tenn.—The East Tennessee Telephone Co. has received franchise and will put in exchange.

Lexington, Va.—The Lexington Mutual Telephone Co. and the Lynchburg Telephone Co. have as yet signed no contracts for construction of the system.

POSSIBLE INSTALLATIONS.

Birmingham, Ala.—The Consolidated Electric Light Co. will increase its capital stock from $500,000 to $550,000 to be used for extensions.

Cullman, Ala.—Moore & McCrary, of Atlanta, Ga., have contract at $4,900 for erection of electric light plant, without engine; also for construction of water works.

ensacola, Fla.—The Electric Street Car Co. is receiving bids for the construction of a new electric light and power house under a franchise granted at last session of legislature; will also extend its present electric car system.

Milledgeville, Ga.—J. F. Wilson, of Milledgeville, and the American Pipe Manufacturing Co., Philadelphia, Pa., are reported to be interested in the proposed building of an electric power plant at Furman's Shoals; about $400,000 will be expended on the plant and the erection of factories.

Albany, Ga.—The power company has applied for charter, and proposes to build a plant on the Kinchafoones creek to develop 1,000 horse power.

Augusta, Ga.—Nesbit Wingfield, commisioner public works, has submitted a report for a municipal plant to cost about $101,000.

Douglas, Ga.—The city will construct electric light plant and water works. Address J. J. Walker, mayor.

Natchitoches, La.—The city will hold an election to decide the issuance of bonds for construction of water works and electric lights to cost $9,000. Address John C. Trichel.

New Orleans, La.—The Fire & Police Telegraph Co., Louisville, Ky., has been awarded contracts to put in a fire alarm telegraph system at New Orleans to cost $73,340.

Odessa, Mo.—The city will hold an election September 12 to decide as to $10,000 in bonds for erection of electric light plant. R. B. Stitcher, of Louisiana, Mo., will prepare plans and spcifications. Address "The Mayor."

Columbia, S. C.—W. B. Smith Whaley and associates have purchased the property of the Columbia Street Railway, Light & Power Co. for $257,500, and will begin at once the renovation and reconstruction of the plant, installing new machinery for applying additional power, etc.

Hampton, Va.—Henry Brauns, of Baltimore, has completed plans for the power house and ice plant of the Newport News & Old Point Comfort Railway & Electric Co.; plans call for a brick building 109x172 feet, to have boiler capacity of 2,000 horse power and generators and dynamos having capacity of 3,000 horse power; this plant will furnish power for the railway and supply the surrounding towns with electric lights and power; in connection an ice plant will be installed, with daily capacity of forty tons.

Beeville, Tex.—It is reported that a representative of the Dudley Machinery & Supply Co., of San Antonio, Texas, has purchased the water works plant at Beeville from J. M. Brownson, of Victoria, Texas, and will put the plant in operation. It is stated that the plant will be improved and extended and an electric plant installed: also contemplated is the erection of an ice factory.

STREET RAILWAY NEWS.

Columbia, S. C.—It is reported that $50,000 will be spent improving the Columbia Electric Street Railway lines.

Kansas City, Mo.—The city council has passed ordinances granting three franchises for electric line extensions to the Metropolitan Street Railway Co.

BUSINESS CHANGES.

Albany, N. Y.—A certificate of reduction of the capital stock of the Pacific Postal Telegraph Cable Company, of New York city, from $1,000,000 to $100,000, was filed at Albany, N. Y., on August 14.

NEW YORK NOTES.

ROBERT STEWART, E. E., has resigned his position as superintendent of telegraph of the Central Railroad of New Jersey, a position which he has filled with great honor for the last fifteen years. Before his connection with the Central Railroad Mr. Stewart was general superintendent of the elevated roads in New York city, superintendent of telegraph of the B. & O. R. R., superintendent of construction of the Nickle Plate R. R., general manager of the Peoria & Pekin R. R., and occupied a number of positions on western roads equally as important. He thoroughly understands practical railroading in all its details, a proof of which is the confidence which he inspired in the Central Railroad officials ever since his occupancy of the position of telegraph superintendent. Mr. Stewart is very popular among railway officials and is also held in high esteem by the electrical trade. We know that whatever position he may occupy in the future he will make himself a necessity to his superior. It is with much regret that he resigned his position with the Central Railroad and it is our belief that the officials of that road will remember him with some distinctive recognition after his long and arduous services.

The Electrical Age.

Vol. XXIV—No. 12. NEW YORK, SEPTEMBER 16, 1899. Whole No. 644.

Hydraulics.

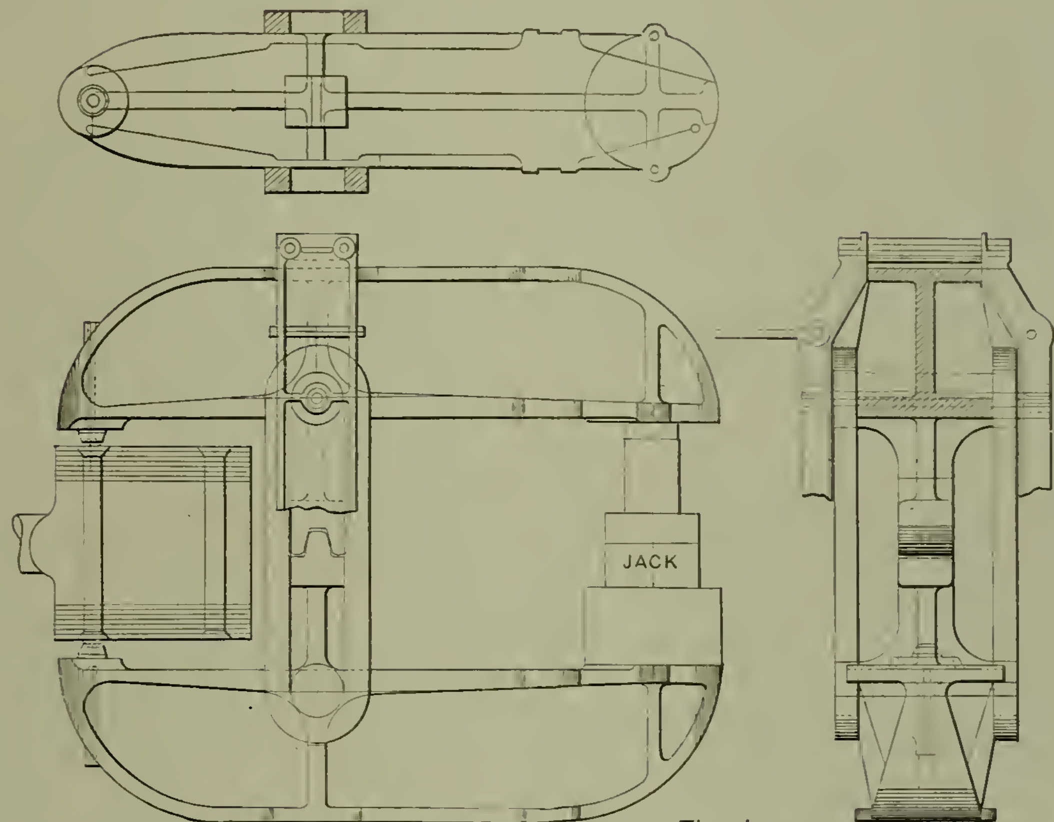
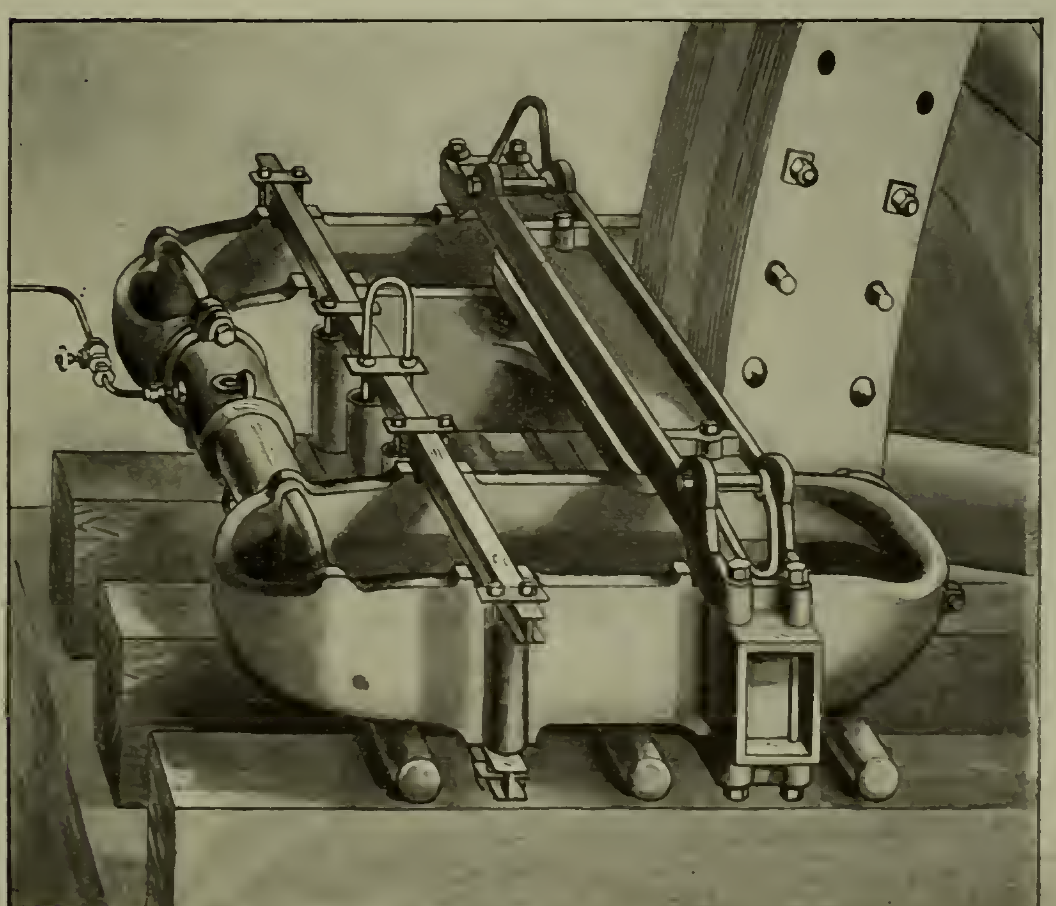


Fig. 1



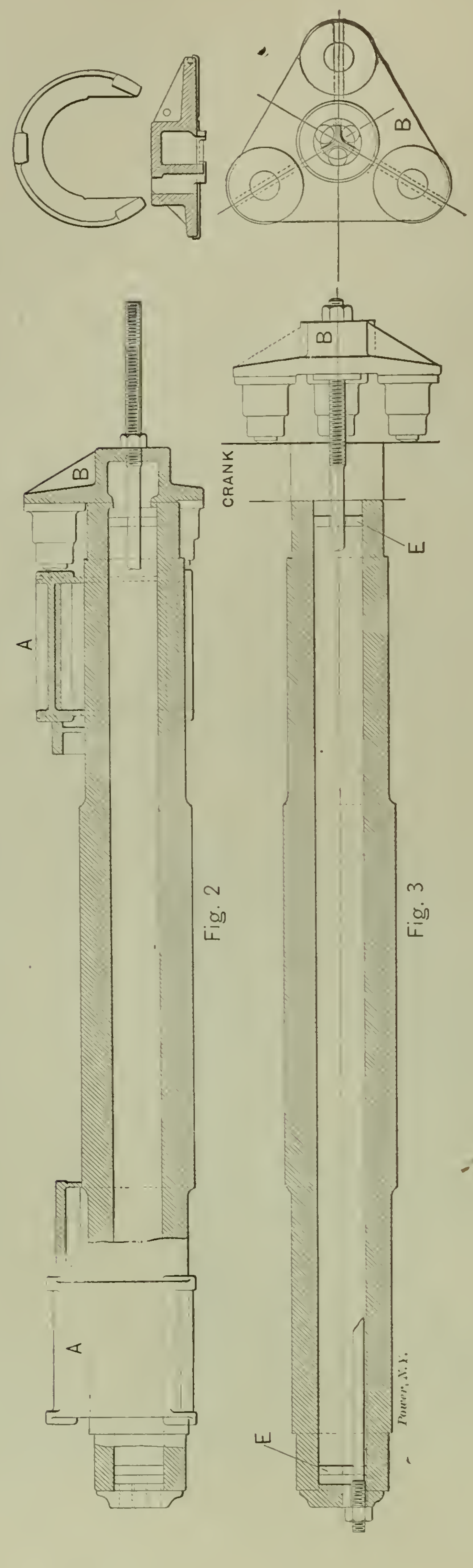
Apparatus Employed for Driving Rivets.

USE OF HYDRAULIC PRESSURE IN ENGINE ERECTION.*

At the Ninety-sixth street power house of the Metropolitan Street Railway Company in New York, the E. P. Allis Company are erecting a number of large vertical cross compound engines direct connected to electric generators. Upon each of the main shafts, which are 34

*Through the courtesy of "Power."

inches in diameter in the bearings, 37 inches in the center and 27 feet 4 inches in length, it is necessary to force



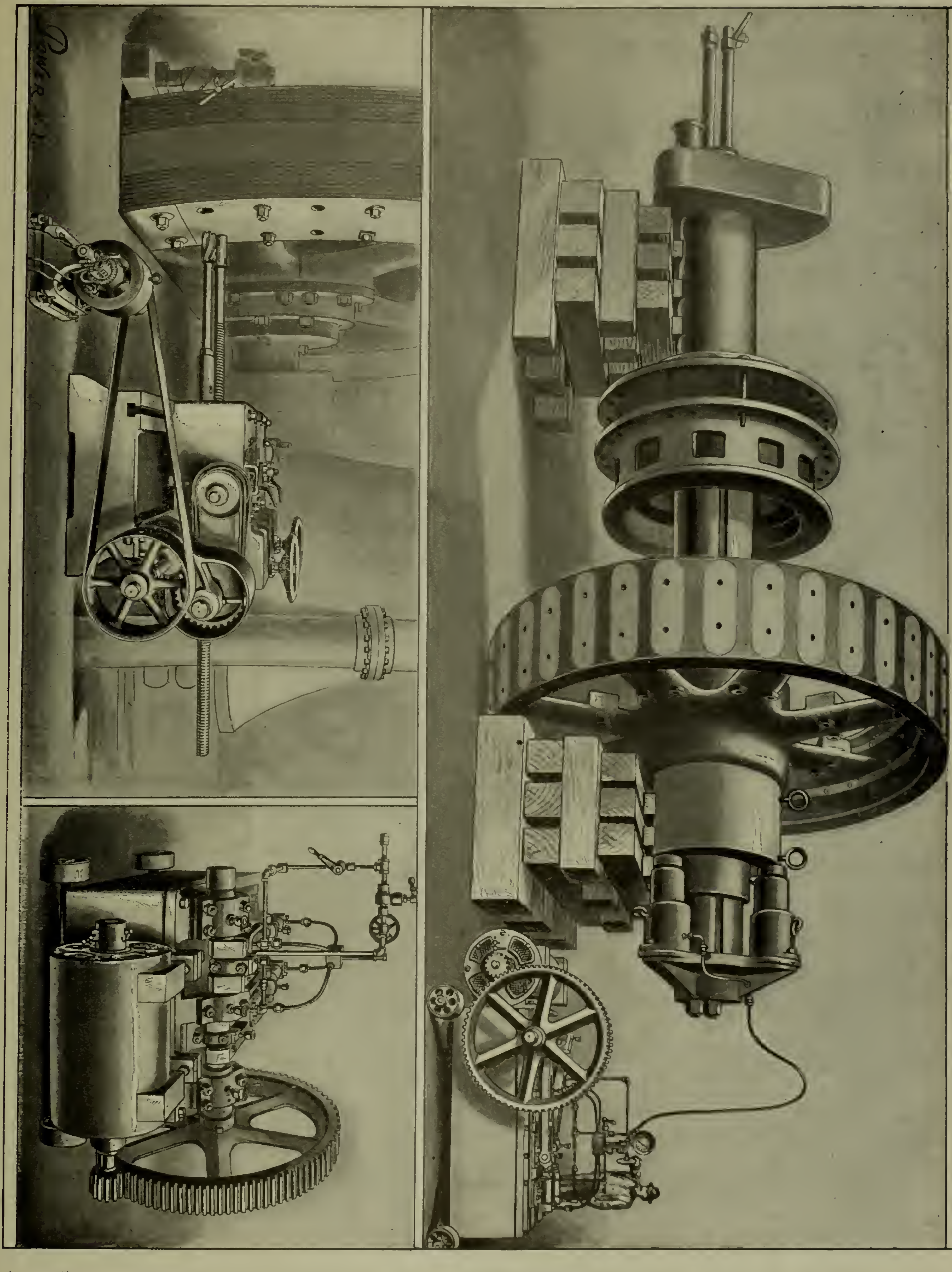
the spider of the generator, the two pieces of the fly-wheel hub and the two cranks. This must be done in the field, and on account of the massiveness of the work presented no mean problem for the erecting engineer.

In the central panel of the accompanying engraving the shaft is shown ready for the operation of forcing on the spider. The caps AA, Figs. 2 and 3, as shown on page 2, are drawn together by three 4-inch bolts passing through the hollow shaft, holding in place the triangular frame B at the right-hand end, as plainly shown in the drawings. EE are circular plates of cast iron, with notches 120 degrees apart to support the rods. Upon the triangular plate are mounted three 8-inch hydraulic jacks, giving an aggregate plunger area of over 150 square inches. Oil is forced into the jacks under a pressure of 11,000 pounds per square inch, giving an aggregate pressure of 1,650,000 pounds, or 825 tons. For the spider and fly-wheel hubs the jack is applied as in Fig. 2, the triangular plate being centered in the end of the hollow shaft as shown, and distance pieces of a horse shoe shape being inserted between the plungers and the piece which is being forced on as the latter moves beyond the working range of the jack. To force the cranks onto the end of the shaft the apparatus is arranged as in Fig. 3.

The pressure of 11,000 pounds per square inch is obtained by a 4-plunger pump built by Watson & Stillman Co., after having been dismissed as impracticable by one of the regular steam pump manufacturers. It is shown in the lower right hand panel, and consists of four cylinders with plungers one-half inch in diameter, operated by a 13-horse power electric motor geared 5.6 to 1. The pump is mounted upon a tank which carries the oil, and which is itself mounted upon trucks. The time required to force on the spider, upon which work was about to commence when our photograph was taken, was one hour and a half, the movement under pressure being 6 feet. The cranks are put on in about one-half hour. Something of the magnitude of the work can be comprehended when it is said that the shaft weighs 70,000 pounds; the spider, which is 15 feet 2 inches in diameter, weighs with rings 32,000 pounds, and the cranks 24,000 pounds apiece. After all five pieces are in place and keyed on, the shaft, with its mountings, weighing in the aggregate 196,150 pounds, or over 98 tons, is rolled over by jacks and placed in the immense babbitt-lined bearings, 34 inches in diameter and 60 inches long, which are waiting for it at about the point from which our picture is taken.

The fly-wheel, 28 feet in diameter, is made up of a cast steel rim 2 feet 5 inches deep and 2 feet 4½ inches wide, to which are riveted 8 1½-inch steel plates at each side, as shown in the upper panel and in the lower left hand panel; 160 plates in all. The cast steel rim is in 10 segments, each carrying an arm at its center, the segments being joined together by steel links shrunk in at the sides. These links are 30 inches long, 10 inches wide and 5 inches thick. After the wheel has been assembled and the steel plates bolted in place by temporary holding bolts, the 3-inch rivet-holes, of which there are two rows, as shown in the engravings are bored true, reamed and countersunk by the portable boring mill shown in the lower left hand panel.

The driving of the rivets constitutes another interesting application of hydraulic pressure. The operation is shown in the upper panel. The apparatus shown in outline in Fig. 1 is blocked up in front of the wheel with the die-carrying jaws spanning the rim, and one of the 8-inch jacks between the other jaws. When the rivet is in place, with each end in one of the dies, the jack is operated, forcing the back jaws apart with an available pressure of 800,000 or 1,000,000 pounds, or 400 to 500 tons, on each end of the rivet. The pressure upon the dies is increased by the leverage of the arms, and the immense steel rivets are headed up cold, as though they were of putty. After the rivets are driven the wheel will be turned up in its bearings. The segments weigh 11,200 pounds each, and the 10 links 5,500 pounds, the steel reinforcements 142,500 pounds, making the total weight of the main shaft and its completed mountings 456,150 pounds.



The Use of Hydraulic Pressure in Engine Erection at the 96th Street Power House, New York.

Miscellaneous.

THE FIELD OF EXPERIMENTAL RESEARCH

BY PROF. ELIHU THOMPSON.

(Continued from Page 139.)

Could Volta, when he discovered the pile one hundred years ago, have had any idea of its importance in practical work? Or, did Davy or his contemporaries at the time of his experiments with arc of flame between the charcoal terminals of his large battery have any suspicion that in less that one hundred years the electric arc would grow to such importance that more than 100,000 arc lamps would become a single year's production in this country alone. Faraday, when he made his researches upon the induction of electric currents from magnetism, could not have had any idea of of the enormous practical work in which the principles he dealt with as facts of pure science would find embodiment. When he wound upon the closed iron ring the two coils of wire which enabled him to discover the facts of mutual induction he had begun, without any suspicion of the fact, the experimental work which gave to science and to practice the modern transformer, now built of capacities ranging up to to 2,500 horse-power each, and for potentials of 40,000 to 60,000 volts.

These examples, and many others which might be given, should convince even the most arrogantly practical man of the high value of scientific research, not alone as adding to the sum total of knowledge and for the admirable training it gives, but because it can not fail to have an ultimate practical effect. Discoveries which at first seem to have no useful nor practical outcome are often the very ones which underlie development of the greatest importance in the arts and industries.

The work of Hertz upon electric waves was to the physicist a grand experimental demonstration, tending to prove the truth of the electro-magnetic theory of light, and subsequent progress was profoundly influenced by it, though no practical use followed at once. The physicist to-day may see in the wireless telegraph only an extension of Hertz's original work, for he need not consider the commercial or economic outcome. He may, however, recognize the fact that in the wireless telegraph, as developed by Marconi, practice calls for a broader theoretical view. Certain elements of construction and adjustment of apparatus, at first used and regarded as essential from a theoretical standpoint, have already been laid aside. The radiator, with its large polished brass spheres and special spark gap, has been found of no more effect than the simple pair of small balls ordinarily constituting the terminals for high-potential discharges. It has been found that the transmitting and receiving apparatus do not require to be attuned, and that the receiving coherer is not the true recipient of the electric wave or disturbance in the ether.

These later developments are, in fact, departures, more or less wide, from the principles underlying the Hertz demonstration. A vertical wire is charged to a high potential and discharges to earth over a spark gap. During the discharge the wire becomes a radiator of electromagnetic pulses or waves, regardless of the spark radiation. The receiving vertical wire is likewise alone relied upon to absorb the energy. Being in the path of the electro-magnetic wave conveyed in the ether from the transmitting wire, it becomes the seat of electro-motive forces which break down the coherer. This, in substance, may be considered as a series of small or microscopic spark gaps, which can be crossed by the comparatively low potentials developed in the receiving wire. We are thus taught to recognize the fact that the refinements in methods and apparatus needed for a delicate physical demonstration, as of the Hertz waves in this instance, may often be laid aside in practical application, where the end to be achieved is different. The sudden discharge of the Marconi transmitting wire may possibly give rise to a series of oscillations or high-frequency alternating waves in the wire, but since the first half of the first wave at each discharge will have the greatest amplitude, it is doubtful if those which follow in the short train have any decided effect upon the receiver. According to this view, the fact of the discharge being oscillatory may, indeed, have no essential relation to the work done, but may be an unavoidable incident of the very sudden discharge which itself would set up a single pulse in the ether sufficiently intense for the work even if unaccompanied by lower amplitude oscillations following the first discharge pulse.

Before leaving the consideration of this most fruitful field of experimental research opened by Hertz, it may be stated that the one gap in the work yet to be filled is the actual production of electric waves of a wave-length corresponding to those of the spectrum. If this could be done by some direct method, no matter how feeble the effect obtained, the experimental demonstrations of the electric nature of radiant heat and light would be fitly completed. Several years ago it occurred to me that it might be possible to devise a method for accomplishing the end in view, and so close the existing gap. Many years ago an observation on sound echoes showed clearly the production of high-pitch sounds from single pulses or lower-pitched waves. A bridge over a mile in length was boarded at the sides, and vertical slats regularly and closely placed along its side formed, for a sound wave incident thereon, a series of reflecting edges or narrow vertical surfaces—a kind of coarse grating. It was found that a loud sound or pulse, such as that of a gun-shot, emanating from a point near one end of the bridge and 200 to 300 feet in a line from the structure, was followed by an echo which was in reality a high-pitch musical tone. The pitch of this tone corresponded to the spacing of the slats in the bridge considered as a reflecting grating for sound.

Following this principle, it seems possible that a very sudden pulse in the ether or electro-magnetic wave, incident at an angle upon a reflecting grating having from 20,000 to 40,000 ruled lines to the inch, if the plane of incidents were at right angles with the rulings, might be thrown into ripples of the wave-length of light and yield a feeble luminosity. If the color then varied with the angle through which the reflection passed to the eye the experiment would be conclusive.

(To be Concluded.)

AN INTENSE SOURCE OF MONOCHROMATIC LIGHT.

MM. Ch. Fabry and A. Perot, in a communication to the Academie des Sciences, propose a new source of monochromatic light of great intensity. It consists of the electric arc produced between two surfaces of mercury in vacuo. The mercury is contained in two concentric glass tubes, of which the inner one divides the two surfaces of mercury. A slight shake given the tube will start the arc, which requires a potential of about thirty volts and a current of two or three amperes for stability. The light emitted is not perfectly monochromatic, but can be easily made so by the interposition of appropriate absorbing screens. A good one is a tank containing a solution of chloride of didymium and bichromate of potash. This intercepts all the rays except the green ones, and these are the most useful in most cases.—Ex.

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CONTENTS:

PROTECTION AGAINST LIGHTNING.

The modern lightning arrester, upon which so much dependence is placed in electric light stations, is not absolutely reliable. The history of modern electric light and power stations shows that, with few exceptions, they all have to undergo the sad experience of having machinery burnt out, or at least rendered incapable of further work. It is impossible to prevent lightning from striking installations of this kind unless shielded from its influence by the neighborhood of many steel frame buildings and having but short lines leading from it. The nature of a lightning discharge is so inherently erratic that absolute protection is impossible but, in a relative sense, devices can be employed which will be the means of preventing many of its most destructive features from appearing. The use of lightning rods and lightning arresters are at present indispensable elements of a first-class electric station, and in the performance of their functions give a degree of satisfaction unequalled by any other suggested appliance.

But protection from lightning, as far as the building is concerned, is the least part of the problem. The protection which is needed most is the hardest to obtain, namely, that of insuring the machinery within the station from serious damage. In the average plant, with its many outside circuits, a ground is considered criminal, and, in consequence, the most perfect insulation, consistent with practical engineering, is secured. As a result of this, an electric light plant is practically in the position of a brass sphere, used in electrostatic experiments, the same sphere being mounted on a glass pedestal for the purpose of illustrating the insulating effects of air and its support. A lightning discharge striking this well insulated system of circuits and machinery is bound to play havoc in the majority of cases even though a few wires are connected with the earth, on the style of the so-called "grounded lightning arrester plan." The lightning discharge in itself in its erratic movements may strike at a point where it is free to wander as it pleases through the armatures and field at its disposal. In jumping from point to point it is apt to start an arc between any two such, if they happen to be of opposite potential and sufficiently near to each other to support one. In other words, a lightning discharge, even though its amperage be low, can do sufficient damage in this manner to annihilate at least one piece of machinery.

The complete grounding of the outside circuits, along which the static charge generally passes, is entirely out of the question. The only remedy seems to be that of supplying the circuit at various points with lightning arresters of the most modern construction. In a recent case that came before an expert, the insulation was perfect, prior to the stroke, the lightning arresters were in good working order and the plant had been pronounced by the Fire Underwriters and the inspectors of a rather large electric light company to conform in every respect with the requirements familar to every electrician and to be thoroughly protected, by the devices employed, from lightning discharges. But the lightning did strike and ripped the insulation out of a long cable, practically destroying it, and danced around inside among the machinery, refusing a close acquaintance with the arrester proper. From the experts survey of the premises he realized that the insulation was complete in the original installation; the lightning arresters would have operated had they had a chance, but the damage done seemed to be due to the fact that more arresters were necessary at various parts of the line.

In this case little machinery was involved, the installation being rather small, but the arrester used was reliable and scientifically constructed. In fact, as good an arrester, if not identical with those used in larger plants. The conclusions to be drawn from this series of conditions are, that first, the number of lightning arresters are insufficient; second, they are not always placed to the best advantage; and third, that scientifically constructed laboratory tests, with their general successful termination, cannot always be compared with the frightful outbursts which nature in her wildest moments is apt to subject them to.

FRANKLIN STATUE FOR PARIS.

The citizens of Philadelphia will present to the city of Paris a statue of Benjamin Franklin for next year's exhibition. When the Franklin statue, recently presented to the city by Justus C. Strawbridge, was unveiled, United States District Attorney Beck suggested that the United States ought to present to the French people a statue of the great philosopher, in return for Bartholdi's statue of Liberty. The suggestion has taken shape, and a committee has been appointed to carry out the idea. It is proposed to raise the money and have the work begun as soon as possible, so that the statue can be shipped to Paris in time to unveil it before the exposition closes. It is intended to place the statue in Passy, where Franklin resided when he was Minister to France one hundred years ago. Passy is in the centre of the exposition grounds. The statue will be a replica of the one in Philadelphia, which cost about $14,500.—Ex.

Electric Railways.

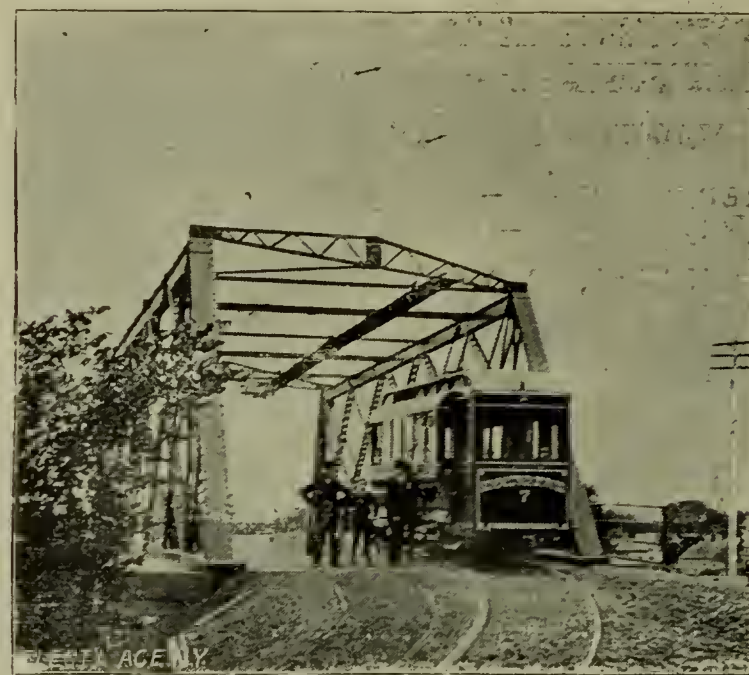
CONDITIONS OF STREET RAILWAY PRACTISE.

With respect to the conducting system of a street railway and its influence upon the cost of operation certain authorities believe that many tons of coal, so to speak, might be saved by employing bonds, feeders, etc., of the highest quality. In other words, the overhead and underground conductors of a trolley road may in various ways be a source of expense that only continual repair can remedy, unless installed at the outset according to the most modern practise. According to Crosby and Bell the conducting system of an electric railway may be con-

Double Feeder Supports.

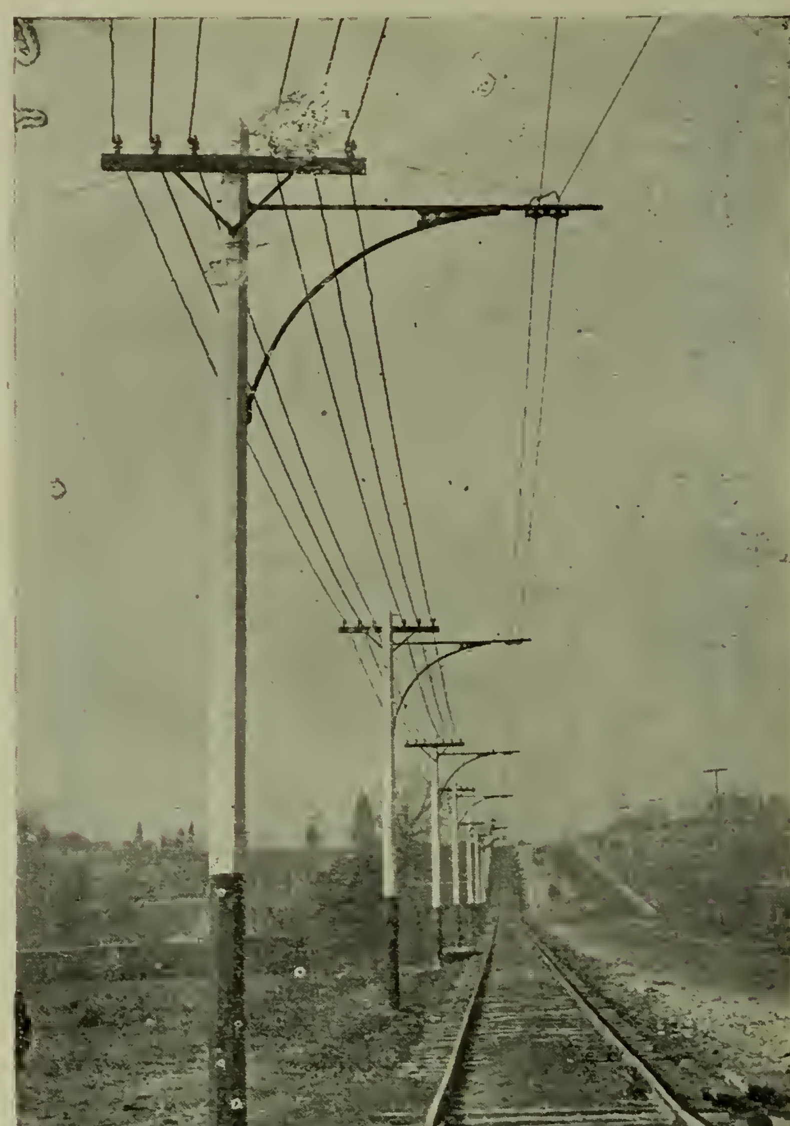
sidered first, merely as a conductor; second, as a conductor that requires insulation. This is, of course, a direct reference to the trolley line, and not to the various other conducting parts of the system familiar to the reader. In considering the overhead line we really consider the feeding system because the points of greatest load, or at least where traffic may be choked and cars stalled, will call for the most current in a given time and therefore the greatest number of feeders. Any grades which cars are to ascend and upon which there is apt to be a stall must be allowed for in the distribution of the feeders.

"The predetermination of the average or maximum load cannot be made with exactness. Given a certain schedule to be observed by a given number of cars the



Overhead Line Across Bridge.

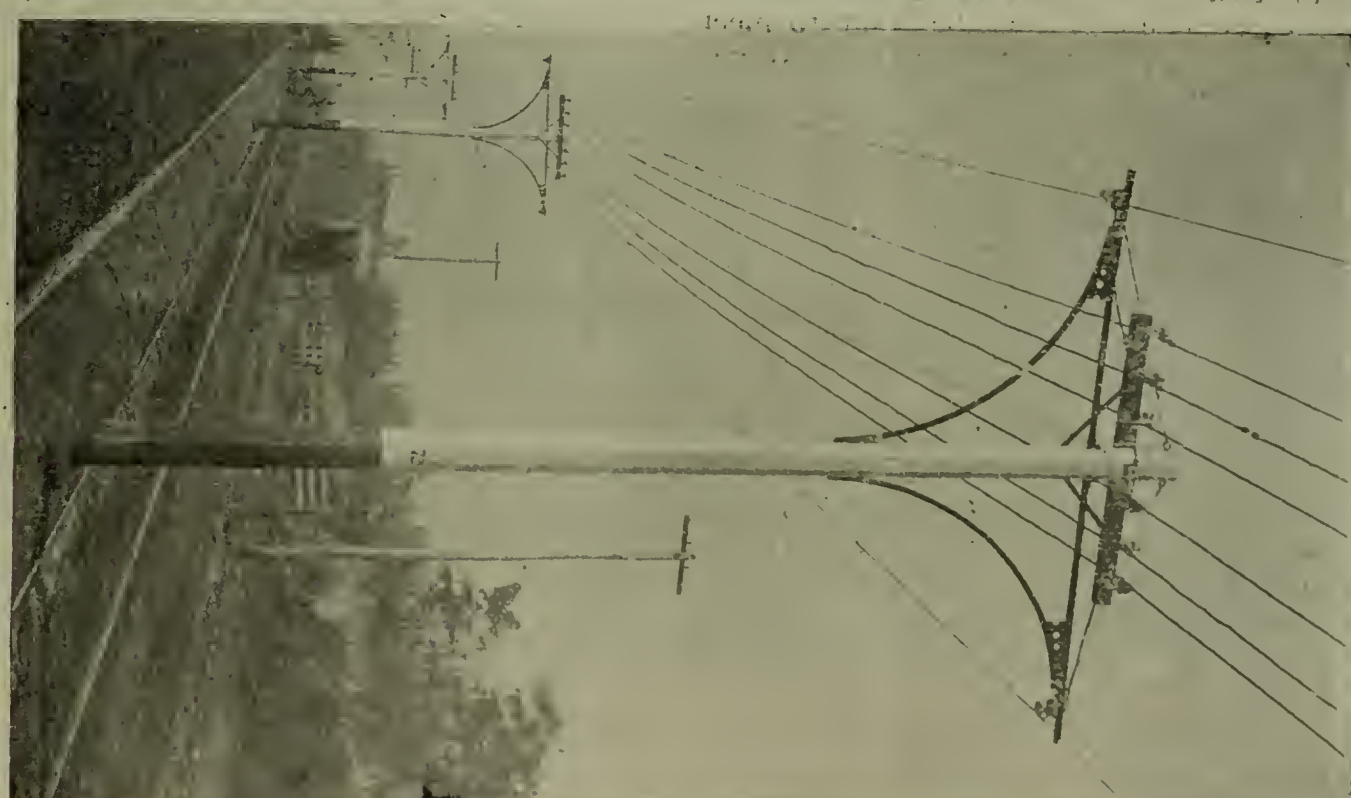
power required to perfom that service varies with the



Single Track Overhead System; Separate Feeder Support.

condition of the track and the running gear, the efficiency of the motors used, the skill of the motorman, the weight of the cars and passengers, the magnitude of the grades and curves, the number of stops and the relation between the number of cars simultaneously ascending and descending grades. And again, eve[n] if all the variables may be given particular values fo[r] a given schedule we must recognize the fact that quite frequently the schedule itself is not maintained. Thus let us suppose twenty-

Construction Work on the Metropolitan Traction Company's Lines, New York City.



Feeders Supported Separately.

five cars on the line of which there are ascending grades, averaging five per cent., and at the rate of five miles per hour; ten are moving down grade requiring no current: five are on the levels making ten miles per hour. We will suppose each car and its motors to weigh ten thousand pounds and the passengers of each car also ten thousand pounds. The work to be done is of two kinds: first, that against gravity; second, that against the friction of the running gear. Atmospheric resistance at street car speeds is small and may be neglected or be considered combined with that of friction.

The work done against gravity is thus calculated: weight lifted=10 cars x 20,000 pounds=200,000 pounds. Height of lift per minute equals the rise per foot on the grade, multiplied by the number of feet traveled per minute. Now five miles per hour is equivalent to 440 feet per minute; hence the total rise per minute will be 440 x .05=22 feet. The work done against gravity per minute will then be 200,000 x 22=4,400,000 foot pounds, a rate of 133.3 horse power. For the track in question let us assume that a horizontal effort of 30 pounds per ton will overcome friction. Then for the 10 cars we have 100 tons x 30 pounds x 440 feet per minute=1,320,000 foot pounds per minute, a rate of forty horse power; also for the five cars on the level we have 50 x 30 x 880 feet per minute=1,320,000 foot pounds per minute, a rate of 40 horse power. Thus for keeping all the cars in motion we need 133 + 40 + 40=213 horse power. This power however is that actually needed at the axles, while that delivered to the motors must include all lost in the motors and the gearing.

Suppose this to be twenty-five per cent. of the power delivered to the cars. Therefore we must supply 213 divided by .75=284 horse power. Since we premise that the pressure under which the current flows is about 500 volts and since 746 watts equals one horse power, we may with sufficient accuracy state that one and one-half amperes on the line will be equivalent to one horse power. Then for the total current we shall have 284 x 1.5=426 amperes. But it is usually sufficient to allow 10 to 15 horse power as the maximum per car for service over considerable grade."

From these facts and the conclusion arrived at the size of the copper conductor and the number of feeders required may be estimated without difficulty. The proper allowance for drop can be made so as to meet all conditions of practice, including overload. The illustrations show not only the feeder systems prevailing in all suburban trolley roads but various other problems met with, most characteristic of which is crossing a bridge spanning a broad stream, the bridge being disconnected at times. In this case contacts must be made to meet and tracks to present a continuous surface. Arcing is likely to occur if the feeder system is deficient, although one of the best plans is to run a cable through the water and feed from it into the moving tracks, likewise, if necessary, into the overhead line.

Stray Currents.

COPPER.

The Mining Journal says that owing to the development of the electrical industries in Germany, the increase in consumption of copper and lead appears to be greater than in any other country. In 1897 the consumption of copper was 92,148 tons, and that of lead 133,239 tons, whilst in 1898 the consumption of copper was 98,160 tons, and that of lead 159,229 tons. Germany produces 7 per cent. of the world's supply of copper, and consumes 22½ per cent., whilst its production of lead is 17½ per cent. of the world's supply, and its consumption 20 per cent.—Ex.

WATER POWER AT NICE.

A commencement was made last year towards utilizing the considerable water power of the Nice District for electrical purposes. A company was formed which at once took in hand the Var, at the point called La Mescla, where it is confined in a narrow gorge. A tunnel was pierced through the solid rock of some 600 m. in length into the Vallon de Fenouillet, where a large reservoir has been formed, and whence the considerable fall thus obtained is about to be utilized by the Electric Tramways Company, which is literally taken possession of the whole littoral.—Ex.

CORPUSCULAR THEORY OF ROENTGEN RAYS.

B. Walter advances the theory that instead of regarding Roentgen rays as intermittent waves, they may be regarded as discharged kathode particles. Then the absence of magnetic deflection would follow as a matter of course. They penetrate the walls of a tube with greater ease than kathode rays on account of the absence of electric charge. They are undoubtedly much smaller than the electro-chemical ions. That their absorption should vary as the density of the absorbent is easily understood. Their power of ionizing gases must be attributed to the destruction caused by their impact upon gaseous molecules.—Ex.

ELECTRICALLY HEATED THEATER.

The first theater in the world to be heated by electricity is the Odeon in Buenos Ayres. A short time ago the proprietors asked a local company if it would undertake to heat their premises by electricity, writes a correspondent of the Chicago Record, and, although the management had many misgivings as to the possibility of being able to do so, so sanguine was the electrical engineer of the concern, an American, that he could advise a practical and satisfactory system of electric-heating apparatus for the purpose, that he was given carte blanche and immediately proceeded to work out his scheme, which he has done successfully.—Ex.

A NOVEL SYSTEM FOR LIGHTING A TUNNEL.

The Revue de l'Electricite publishes a description of the way in which it is proposed to light the Batignolles tunnel near Paris. A line of incandescent lamps of 10 c.p. will be placed a meter distance apart along the side of the tunnel. These lamps will be fixed at the height of the windows of the carriages, and will be automatically lighted and extinguished by the passage of the train. A number of pedals which will be depressed by the rims of the wheels work the switching gear. In this way, any train stopping in the tunnel will be lighted fairly well from the outside, and much less electrical energy will be used than if the tunnel were continually lighted. The first installation will consist of 150 lamps only, but if the system is deemed successful by the traveling public and the authorities of the line, the full length of the tunnel will be lighted.—Ex.

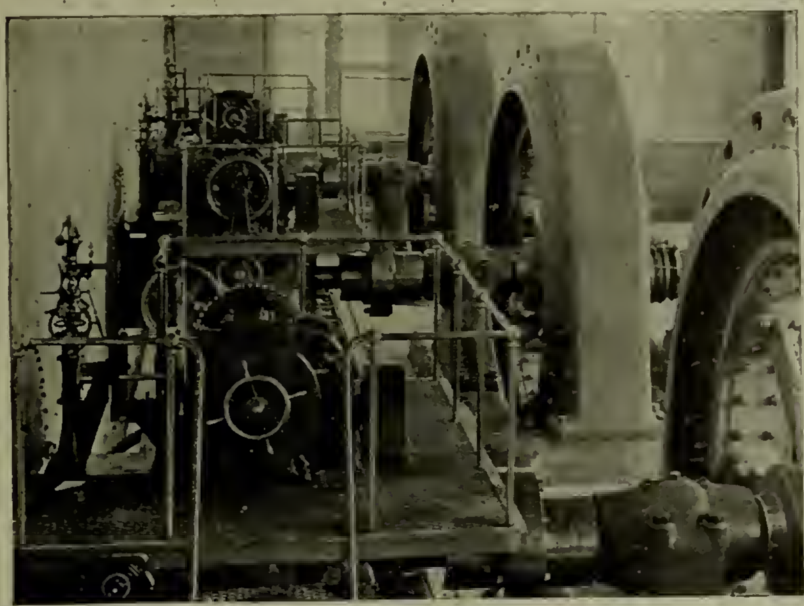
MAKING GLASS BY ELECTRICITY.

A lamp chimney manufacturer at Anderson, Ind., has accidentally discovered a new process of melting the sand used in glass making. While passing through his plant recently he saw a globe on an arc light break, and a piece of glass fell on the carbon. It was only a second until it was reduced to a liquid and dripped to the ground. This gave him his clue, and he directed the construction of a big vat, with sides and bottom composed of carbons, over which he could turn a lateral and longitudinal current. An arrangement was made to run the sand through this vat. It worked perfectly, and the best molten glass is being turned out in as many seconds as it required hours for the old fuels to melt it. The process has been patented.—Ex.

Electric Power.

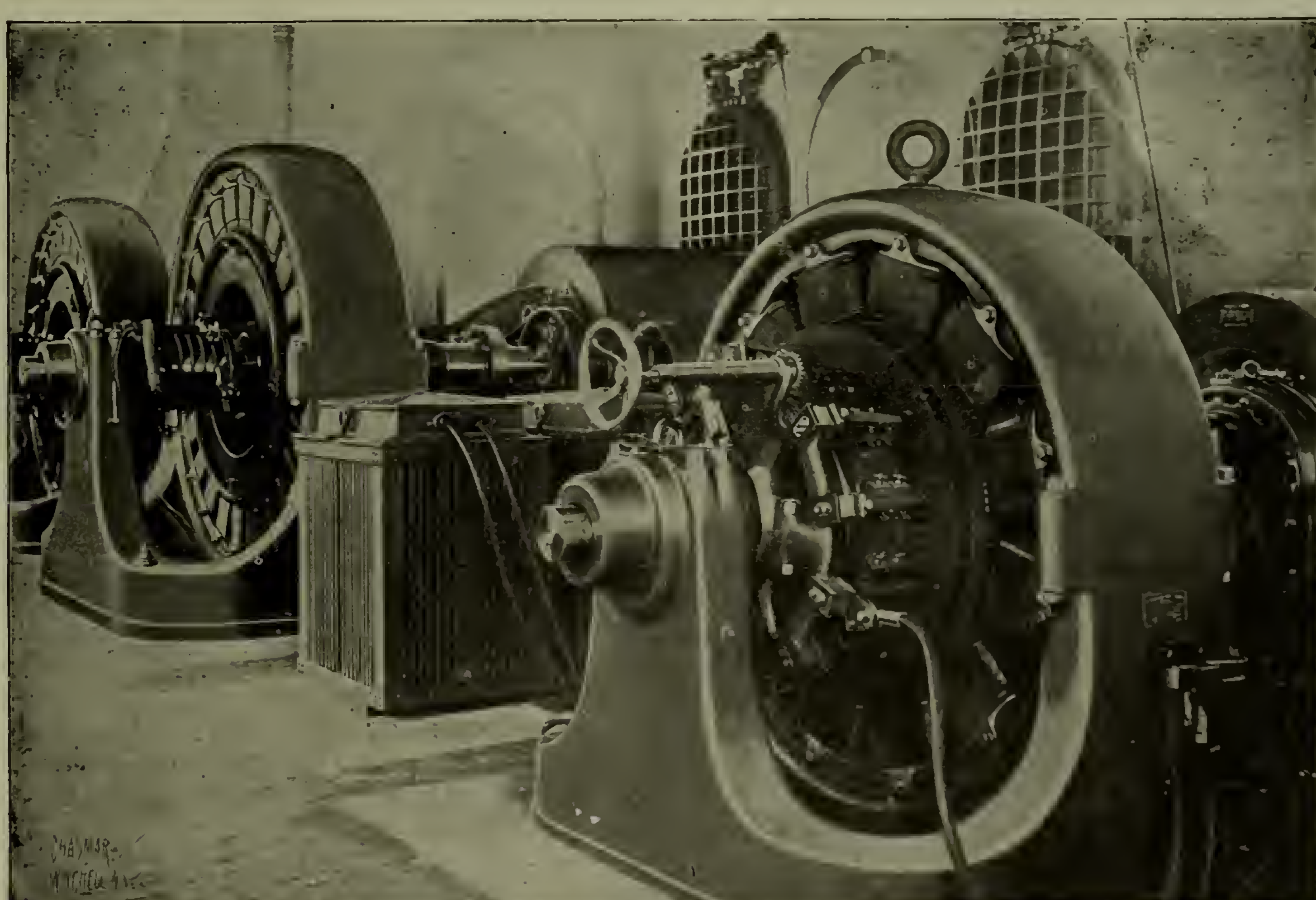
ELECTRIC POWER: ITS GENERATION AND DISTRIBUTION.

Power and distribution plants differ. In a distribution plant transmission is only incidental. Power plants and power distribution, however, involve the transmission of energy. In mining districts the transmission may be the most important process, but in those cases where distribution is first considered electric lighting is more difficult than transmission of power, because variations of from one to two per cent. must be obviated. In transmission, however, a variation or loss of from twenty to twenty-five per cent. may cause no ill effects, and, in fact, certain railway systems have voltage variations of thirty and forty per cent. The variations are immaterial in power work because increased or decreased speed in the car itself is not noticed. In the generation of electric power the best load is about seventy-five per cent. of the full capacity. Can this average be held during the day and 365 days in the year, the management is ably conducting its business. The economy of an electric power plant is settled by having the voltage as high as allowable. This, of course, is a question of insulation and personal safety. If a very high voltage is allowed a great saving is made. When we tend to high voltages we are fortunately or unfortunately, as the case may be, limited by State legislation, etc. In alternating current work static capacity is a serious matter, although many of the difficulties of transmission and insulation have been conquered.

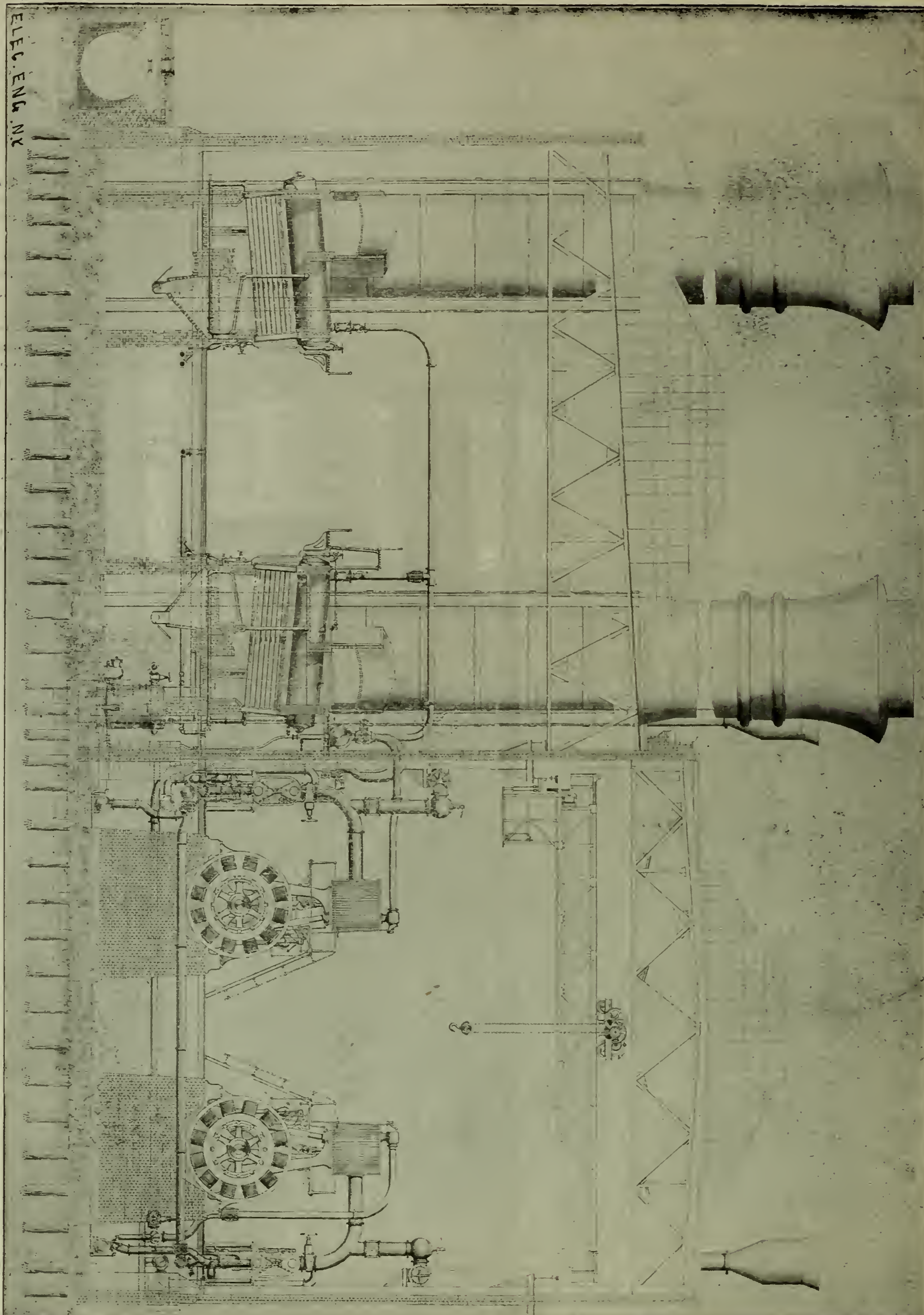


Direct Connected Station Plant.

The generation of continuous currents, if heavy distribution is to be expected, must be carried on in a well-equipped, up-to-date station, fitted with labor-saving appliances and occupied by a maximum of machinery in a minimum of floor space. In the illustrations are shown plants of recent installation in which this idea is faithfully carried out. The larger cut shows engines and generators, direct connected, in the near neighborhood of the boilers. The vertical engines, supported on brick foundations, tower into the air and occupy a limited floor space. The boiler system is on one side of the building and the generating plant on the other. Every convenience is made use of in this station for the ready transportation of parts of the machines or a heavy weight which may require moving. A travelling crane is shown which performs this service. This plant was designed for continuous work, operating without cessation to supply current to various consumers. The boiler plant installed is systematically arranged with sufficient room be-



The Application of Rotary Transformers to Distant Power Distribution.



Modern, Fully Equipped Power Plant.

tween each battery to allow of easy coaling. Most of the conditions are found here which appeal to the instincts of a well-trained engineer, and from such an installation there is every expectation of obtaining an efficiency of the highest figure.

The generation of power and its distribution is not limited to that class of machinery above described, but may be carried on successfully even over limited distances with the rotary transformer. The electric light and power station, considered as a unit in which the power to be distributed is to be generated, may have leading from it lines carrying current of 5,000 volts, which by means of rotaries is sent into the lines at the station and retransformed at the further end. The distribution of power, therefore, from a low pressure electric light station is carried on a distance of two or three miles away by the three-phase system, which in this application performs its functions best. The generation of power and its distribution has been developed to a point of such high efficiency that electrically, mechanically and even architecturally there is little room for improvement, except in minor details of mediocre importance.

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of " Answers to Inquiries."*]

CALCULATING MAGNETIC LEAKAGE.

An approximation bringing us to within fifteen or twenty per cent. of the true value of leakage, as recommended by one writer, is not now regarded as accurate enough. By a careful consideration of the surfaces lying

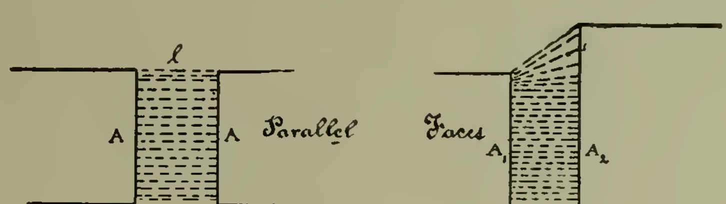


Fig. 1.

near to each other and the proper determination of the magnetic pressure acting between them the predetermination of the leakage factor becomes a matter of great certainty, though involving some labor of a somewhat

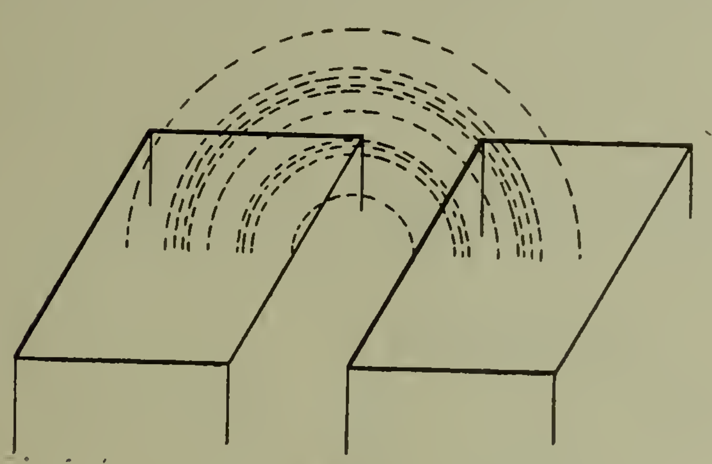


Fig. 2.

empirical character. All parallel surfaces can have their reluctance determined by a very simple method. If two sets of surfaces be considered, as represented in figure 1, the reluctance is equal to the distance between them divided by the area of surface. If the two faces are parallel, but are of unequal size, the mean surface is taken. In the second case, figure 2, the two surfaces lie in one plane, and may be of equal or unequal area.

The distance between surfaces in this position may vary, that is to say, the distance between them measured in the same plane in which they lie. This would naturally vary the reluctance and bring into existence an infinite number of cases to be considered. It is not the object of the writer to recommend these methods as being the best because tables, representing much that need be known and is generally called for, have been supplied in a leakage table used in this article. The leakage tables giving the reluctance of two parallel cylinders of equal length have been calculated out on the basis of the ratio B divided by D, where B is the distance between the axes and D is the diameter of the cylinders. In the following tables, representing a great variety of tests, the leakage factors are given for all styles and sizes of machines up to 2,000 kilowatts.

In designing a generator calculation might aid in giving figures of value, but much doubt would arise in the end on account of the permeability of the iron and the

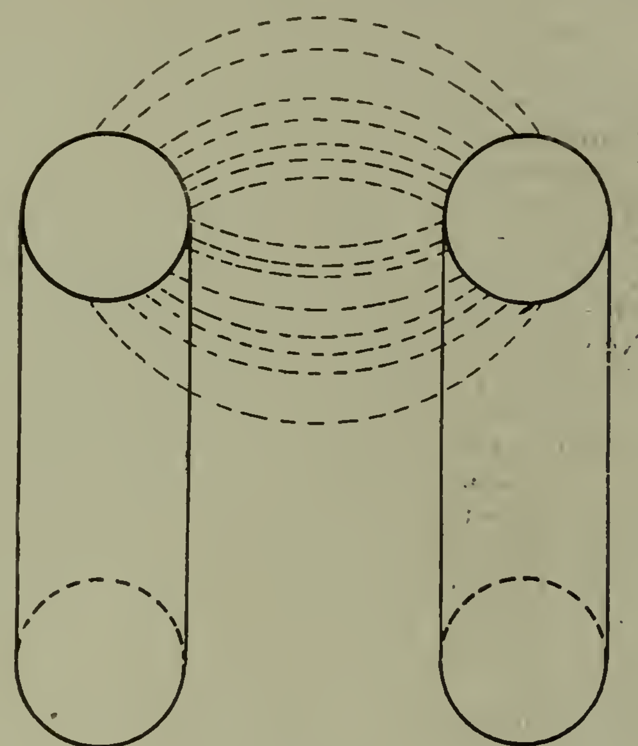


Fig. 3.

point of saturation being absolutely known. The factor of magnetic leakage is a quantity determinable with respect to the size and shape of the machine, primarily, and then with respect to the conditions above mentioned. The principle it seems that should be greatly observed in the design of frames is to use pole piece and core as one and have them as nearly in line as possible, so that if leakage does occur it is included under the second class of conditions, leakage between surfaces in the same plane. Machines with radial poles and a common keeper, or of the horseshoe type with two cores diverging, should not have a very great leakage because with a varying magneto motive force we have in such cases a correspondingly increasing distance.

Business News.

SPECIAL EXPORT COLUMN.
TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING SEPT. 9TH, 1899, $49,617.

New York, N. Y., Sept. 9, 1899.—The following exports of electrical material are from the port of New York for the week ending this date:

Antwerp.—45 packages electrical material, $3,632.

Athens.—18 packages electrical material, $307.

Argentine Republic.—4 cases electrical material, $250.

British Possessions in Africa.—11 packages electrical material, $1,145.

British East Indies.—22 cases electrical material, $1,200.

British West Indies.—17 packages electrical material, $544.

British Australia.—160 packages electrical machinery, $22,000.

Brazil.—11 packages electrical material, $1,441; 7 cases electrical machinery, $400.

Bremerhaven.—1 case electrical machinery, $31.

Berlin.—1 case electrical material, $11.

Cuba.—39 cases electrical material, $2,181; 7 cases electric light material, $398.

Constantinople.—3 packages electrical material, $51.

Central America.—47 packages electrical material, $384.

Copenhagen.—5 cases electrical material, $250.

Glasgow.—4 packages electrical material, $770.

Havre.—10 cases electrical machinery, $517; 44 packages electrical material, $3,092.

Hamburg.—2 cases electrical material, $25.

Liverpool.—49 packages electrical material, $3,447.

London.—69 cases electrical material, $4,752; 7 cases electrical machinery, $388; 9 cases electrical motors, $450; 16 packages electrical motors, $500.

Mexico.—21 packages electrical material, $393.

Newcastle.—1 package electrical material, $60.

Newfoundland.—2 cases electrical material, $32.

Peru.—3 packages electrical material, $18.

Southampton.—3 cases electrical material, $148; 26 cases electrical machinery, $280.

St. Petersburg.—5 cases electrical machinery, $278.

Uruguay.—7 cases electrical material, $242.

NEW INCORPORATIONS.

Milledgeville, Va.—The Oconee Electric & Power Company has been incorporated with a capital stock of $50,000, by J. A. Horne, Samuel Evans, L. H. Andrews, L. C. Hall and others. The company proposes to develop 5,000 horse power and transmit it to factories.

Charleston, S. C.—The Charleston Electrical Construction Co. has been incorporated, with a capital stock of $7,500, by Charles F. Middleton, J. Lamb Perry, Wm. H. Jones, John E. Torbert and George E. Hazelhurst.

Greenville, S. C.—The Greenville Traction Co. has been incorporated, with a minimum capital of $200,000, maximum $1,500,000, to operate a system of electric railway in Greenville.

Painted Post N. Y.—The Imperial Engine Company has been formed, with a capital stock of $20,000. Directors, Charles M. Morse, J. R. Rand, Jr., and F. W. Parsons.

Chicago, Ill.—The Guarantee Electric Company has been incorporated to manufacture electrical appliances and supplies; capital, $50,000; incorporators, R. S. Wait, H. W. Hawkins, C. L. Hawley, all of Chicago.

Milwaukee Wis.—The Johnson Service Company has been incorporated with a capital stock of $300,000.

Madrid, Iowa.—The Madrid Electric Light and Power Company has been incorporated. It has a capital stock of $10,000. A. P. Wosterbery, J. G. Hammond, J. W. Carlson, C. G. Johnson, J. P. A. Anderson and Oscar Oakleaf, incorporators.

TELEPHONE CALLS.

Earlington, Ky.—J. T. Alexander and the North Electric Co. of Cleveland, Ohio, have petitioned the city council for franchise for establishment of telephone system in Earlington and Madisonville.

Kansas City, Mo.—The Missouri & Kansas Telephone Co, will increase its capital stock from $1,250,000 to $2,500,000 for the purpose of making extensive improvements; $150,000 will be expended in putting its wires under ground.

Wilmington, N. C.—The Interstate Telephone Co. contemplates the erection of a line to Lumberton in the near future.

Trinity, Tex.—John H. Traylor and J. T. Elliott of Dallas, Texas, and James H. Allen of St. Louis, Mo., have incorporated the Southwestern Texas Telephone Co. for construction of a line from Trinity to Corrigan; work on it has commenced.

Wills Point, Tex.—L. D. Bannon of Commerce is establishing a telephone exchange at Wills Point.

Farmville, Va.—W. P. Venable and S. P. Vandersloe, previously reported as to construct telephone system, have incorporated the Farmville Telephone Co., with a capital stock of $5,000.

STREET RAILWAY NEWS.

Birmingham, Ala.—The Birmingham Railway & Electric Co. and the Birmingham Traction Co. have consolidated and will expend $500,000 in improvements.

Charlotte, N. C.—Books have been opened for subscriptions to the stock of the City & Suburban Electric Railway Co. Mr. J. A. Durham and others are incorporators of the company.

Kansas City, Mo.—It is announced that work will begin at once on extensions of the East Side Electric Railway Co.

POSSIBLE INSTALLATIONS.

Florence, Ala.—Capt. R. T. Simpson has made a proposition to the city for the establishment of an electric light plant.

Tallahassee, Fla.—The city will hold an election on October 10 to decide the issuance of $16,000 of bonds for the establishment of an electric light plant. Address "The Mayor."

Bay St. Louis, Miss.—The Gulf Coast Ice & Manufacturing Co., if successful in its bid for lighting the city, will install an entirely new electrical equipment costing several thousand dollars.

Clarksdale, Miss.—The city has decided by popular vote to issue the $37,000 of bonds for construction of electric plant, water works and sewerage system, previously mentioned. Address Walter Clark, mayor.

St. Louis, Mo.—Scott Van Etten, Harry E. Lyons, Amy Carter and Arthur B. Donnelly have incorporated the Van Etten-Lyons Electric Co., with a capital stock of $5,000.

Chattanooga, Tenn.—The Narrow-Gauge Railroad Co., operating on Lookout Mountain, will erect an electric power plant. Address J. T. Cross, president.

Wadesboro, N. C.—It has been decided by popular vote to issue $25,000 of bonds for electric light plant and water works, recently reported. Address "The Mayor."

Sumter, S. C.—The Sumter electric light plant has been purchased for $10,000 by R. O. Purdy, representing the bondholders, C. T. Mason and R. M. Wallace, who will operate the plant and consolidate with it their ice factory, installing a new 30-ton ice machine to increase the output.

The Electrical Age.

VOL. XXIV—No. 13. NEW YORK, SEPTEMBER 23, 1899 WHOLE No. 645.

Miscellaneous.

THE FIELD OF EXPERIMENTAL RESEARCH.

BY PROF. ELIHU THOMSON.

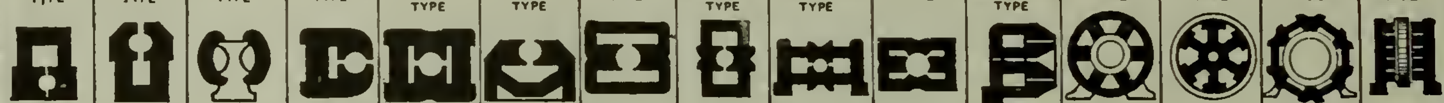
(Continued from page 148.)

Despite the diligent studies which had been made in the invisible rays of the spectrum, both the ultra red and the ultra violet, a work far from completion as yet, the peculiar invisible radiation of the Crookes tube remained unknown until the work of Leonard and Roentgen brought it to the knowledge of the world. The cathode discharge, studied so effectively by Hittorf and Crookes, and by the latter called "radiant matter," was but a part of the whole truth in relation to the radiation in high vacua. It is needless to recount the steps in the discovery of Roentgen rays. We now know that these rays come from the impingement of the "radiant matter," or cathode rays. We know also that the higher the vacuum, and, therefore, the higher the electric potential needed to effect the discharge, the more penetrating or the less easily absorbed is the resulting radiation. Rays have been produced which in part pass through cast iron nearly an inch thick. The iron, acting as a filter, absorbs all rays of less penetrating power. A question may here be put, which it will be for future experiment to answer: Can we by increasing the degree of vacuum in a Crookes tube by the employment of enormous potentials for forcing a discharge through the higher vacuum, produce rays of greater and greater penetrating power? What, in fact, may be the limit, or is there any limit, to the diminution of wave-length in the ether, assuming for the moment that this invisible radiation is somewhat of the same nature as light, but of higher pitch, though it may be unlike light in not representing regular wave-trains.

Roentgen radiation, while spoken of as invisible, is in reality easily visible if of great intensity. The parts of the retina which respond, and so give the sensation of luminosity, are apparently thus around the eye and not directly opposite to the iris opening. Those parts of the retina sensitive to the rays are characterized by the preponderance of "rods," giving the simple sensation of illumination, apparently white in the case in question. The "cones," or those portions of the retinal membrane whose function is believed to be the recognition of color or differences of wave-length, appear not to be excited by the Roentgen radiation, or only very feebly. If this be true, it would account for the less intensity of the luminous effect upon those portions of the retina near the optic axis of the eye. All this favors the view that the Roentgen radiation is without sustained pitch or wave-trains, and resembles more a sharp noise or crash in sound.

For pressing experimental work in the highest vacua to its limit, as above suggested, we already have means at command for the production of the most complete exhaustions, requiring extremely high potentials to pass an electric discharge. We have, also, in well-known forms of high frequency apparatus, the means for producing electro-motive forces limited only by our means for insulation. A recent apparatus, devised by me and called a dynamostatic machine, gives equal capability of producing high potentials of definite polarity, positive and negative. It should not be long, therefore, before work is undertaken in this suggested direction of pressing this matter of rays of high penetrating power much farther than has been done. The question arises, whether calcium tungstate. It will be important to determine definitely whether the rays diffused by different substances are lowered in pitch or penetrating power as compared with the rays exciting the diffusion; whether, in other words, the rays from a tube with quite high vacuum excite similar rays by diffusion, or rays more absorbable; and, if a lowering takes place, whether it occurs in like manner and degree from all diffusing media.

The phenomenon may be akin to fluorescence, as when quinia sulphate converts the invisible ultra-violet rays of the spectrum into lower rays or visible light. This action may be at its extreme when barium platinocyanide, excited by Roentgen rays, so lowers the pitch as to produce rays within the visible spectrum, for this compound gives very little or no Roentgen-ray diffusion Are there substances which under Roentgen rays fluoresce with invisible rays of the order of the ultra-violet of the spectrum? If, as is the case with solid paraffine, the irradiated substance gives rise to considerable dif-



CAPACITY IN KILO WATTS	1 UPRIGHT HORSESHOE TYPE	2 INVERTED HORRESHOE TYPE	3 HORIZONTAL HORSESHOE TYPE	4 SINGLE MAGNET TYPE	5 VERTICAL DOUBLE MAGNET TYPE	6 HORIZONTAL DOUBLE MAGNET TYPE	7 BIPOLAR IRON CLAD TYPE	8 VERTICAL DOUBLE HORSESHOE TYPE	9 HORIZONTAL DOUBLE HORSESHOE TYPE	10 FOURPOLAR IRON CLAD TYPE	11 SINGLE MAGNET MULTIPOLAR TYPE	12 RADIAL MULTIPOLAR TYPE	13 INNER-POLE TYPE	14 TANGENTIAL MULTIPOLAR TYPE	15 AXIAL MULTIPOLAR TYPE	CAPACITY IN KILO WATTS
	FACTOR OF MAGNETIC LEAKAGE, λ															
1	2·00	1·75	....	1·90	....	1·50	1·50	....	....	....	....	....	....	....	....	·1
·25	1·80	1·60	....	1·75	2·00	1·40	1·40	....	....	....	....	....	....	....	....	·25
·5	1·70	1·50	2·00	1·65	1·90	1·35	1·35	1·80	1·90	....	....	....	....	....	....	·5
1	1·65	1·45	1·90	1·60	1·80	1·30	1·30	1·70	1·75	....	....	....	....	....	....	1
2·5	1·60	1·40	1·80	1.55	1.70	1·28	1·28	1.60	1·65	1·75	1·60	1.50	1·40	1·90	2·00	2.5
5	1·55	1·35	1·75	1·50	1·65	1·25	1·25	1·55	1·60	1·65	1·50	1·40	1·85	1·80	1·90	5
7·5	1·50	1·30	1·70	1·45	1·60	1·22	1·22	1·50	1·55	1·60	1·45	1·35	1·32	1·70	1·80	7.5
10	1·45	1·28	1·65	1·40	1·55	1·20	1·20	1·45	1·50	1·55	1·40	1·82	1·30	1·65	1·70	10
25	1·40	1·25	1·60	1·35	1·50	1·18	1·18	1·40	1·45	1·50	1·35	1·80	1·28	1·60	1·65	25
50	1·35	1·22	1·55	1·32	1·45	1·15	1·15	1·85	1·40	1·45	1·80	1·28	1·25	1·55	1·60	50
100	1·80	1·20	1·50	1·30	1·40	1·12	1.12	1·80	1·35	1·40	1·25	1·25	1·22	1·50	1·55	100
200	1·25	....	....	....	....	....	....	....	....	1·34	1·22	1·22	1·20	1·45	1.50	200
300	1·20	....	....	....	....	....	....	....	....	1·35	1·20	1·20	1·18	1·40	1·45	300
500	....	....	....	....	....	....	....	....	....	....	....	1·18	1·15	1·35	1·40	500
1000	....	....	....	....	....	....	....	....	....	....	....	1·16	1·12	1·30	1·35	1000
2000	....	....	....	....	....	....	....	....	....	....	....	1·15	1·10	1·25	1·30	2000

Complete Table of Leakage for All Frames. (A. E. Wiener, E. E.)

any such rays can exist which are not appreciably absorbed in passing through dense substances. They would probably not effect a photographic plate nor a fluorescent screen. If they lost also the property of ionizing a gas and causing electric convection, we might not even be able to discover them. That some influence or action in the ether does actually penetrate the dense masses in space is evidenced by gravitation, the mystery of mysteries. We are, however, not justified in going beyond the proved facts which can only be the result of experimental work and close observation. All else is speculation. The energy source of the Becquerel rays is another mystery apparently far from being cleared up, and, if it be true, as recently announced, that a substance named radium has in reality 900 times the power of emitting these rays than is possessed by uranium and thorium, and that the radiation is able to cause visible fluorescence of barium platinocyanide, the mystery but deepens and makes us again think of the possible existence of obscure rays only absorbed and converted by a few special substances.

The diffusion which takes place when Roentgen rays pass through various media is another phenomenon which needs more attention from investigators. This effect seems to be produced by all substances in a greater or less degree. It, however, appears to be nearly absent in the case of those substances which give out light or fluoresce under the rays, as barium platinocyanide and fusion it can, as I have noted, produce a secondary diffusion in other masses of the same substance, or of other substances as indicated by feeble fluorescence of the sensitive barium salt, thoroughly screened from the direct source of rays and from the first or primary diffusion. It is probable that Tertiary diffusion could be found if we possessed a far more powerful or continuous source of the rays for exciting the diffusion. The ray emission, even in the most powerfully excited tube, is probably so intermittent that the active period is but a fraction of the total time. It may easily be that the limit of intensity of Roentgen ray emission has not yet been reached, especially when artificially cooled anti-cathode plates are available.

(To be continued.)

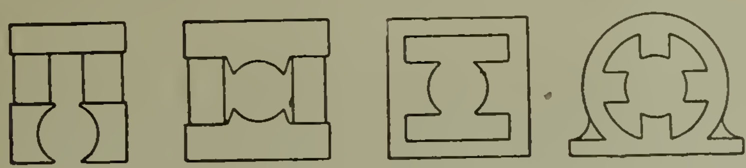
DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of "Answers to Inquiries."*]

LEAKAGE AS EFFECTED BY FIELD FRAMES.

It is a mistaken idea to believe that leakage depends entirely upon the shape of the field frame and not upon its size. In the illustrations are shown four types of field: the upright horse show type, the Manchester type, the two-pole ironclad and the multipolar type. The leakage factors for one kilowatt are 1.65, 1.80, 1.30 and approximately 2.0 for the last, the multipolar. With a 10 kilo-



Four Important Types of Frames.

watt size the leakages reduce to 1.45, 1.55, 1.2 and 1.65. This shows that with the increasing size of the machine the leakage diminishes.

THE UNIT POLE AND LINE OF FORCE.

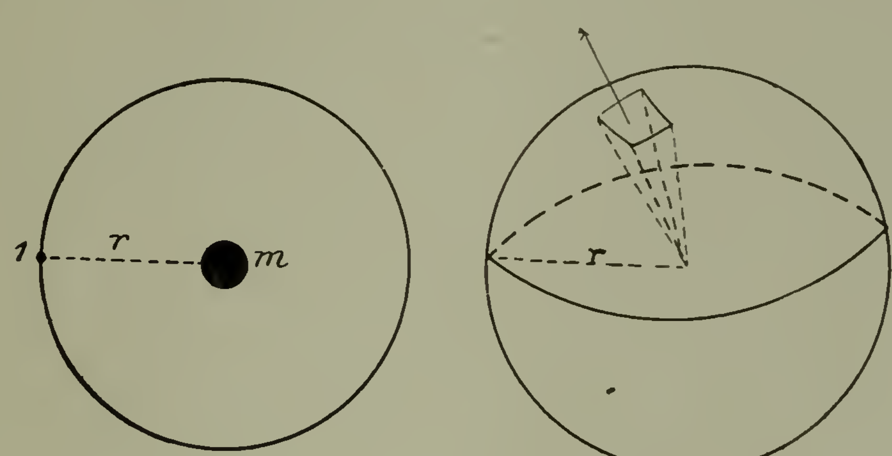
By Gisbert Kapp, C. E.

If we find experimentally that an unequal force is exerted in all points of a certain portion of the field, as in the case with the magnetic field of the earth within certain limits, we say that this particular portion of the field is of uniform magnetic intensity. A uniform magnetic field of unit intensity is therefore one in which every square centimeter of transverse section is traversed at right angles by one unit line. Since in a uniform field the force exerted upon unit poles in the direction of the lines is equal to their density, we conclude that through each square centimeter of surface on the sphere there passes, with a radius of one centimeter, one line of force. As the surface of the sphere is equal to 4x3.1416 a unit pole produces 12.57 lines of force.

Obituary.

GASTON TISSANDIER.

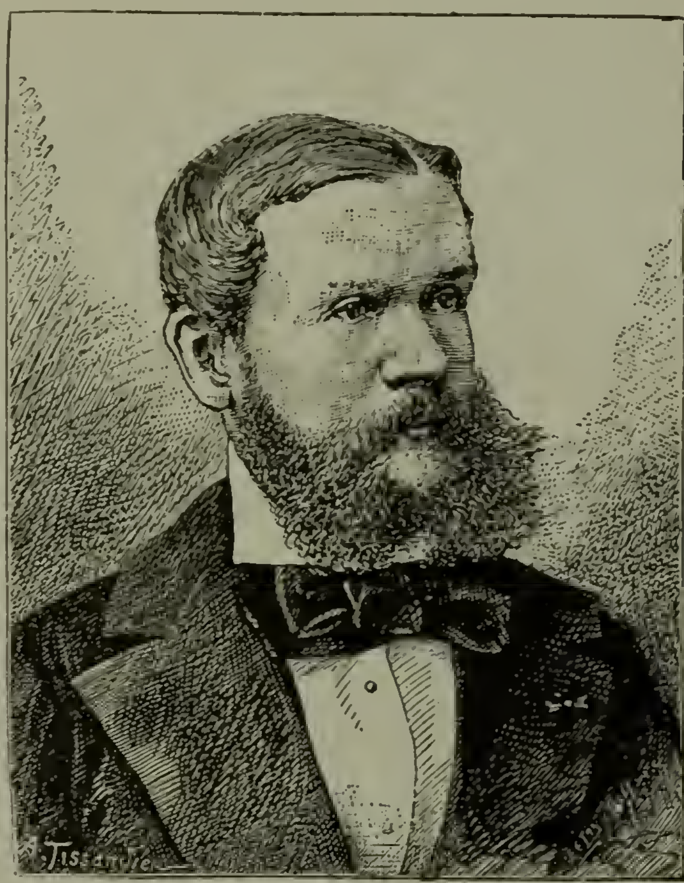
Gaston Tissandier, the Famous French aeronaut, chemist and author, died in France on September 8th. He was born in Paris, November 21st, 1843, and, after having completed his education at the Lycee Bonaparte, took up the study of of chemistry and meteorological investigations. He was best known through his experiments in aeronautics, having made over twenty-five balloon ascensions, during one of which he escaped from Paris while it was being besieged by the Germans, with his brother. M. Tissandier was well known to the electrical profession through one of his works entitled "The Application of Electricity to Aerial Navigation," and also through his editorial connection with the well-known French scientific journal, "La Nature."



Unit Pole and a Line of Force.

AN ELECTRICAL BANK CHECK PROTECTOR.

A curious invention for the protection of bank checks has recently been patented. It consists of a number of disks, so that any combination of numbers may be formed. The characters are heated to branding temperature by means of electricity, and, on being pressed to the surface of a check or similar paper, the amount named thereon is burned by a process which defies the usual methods resorted to by check raisers.—Ex.



Gaston Tissandier.

WIRELESS TELEGRAPHY THROUGH CLIFFS.

Signor Marconi has been able, with perfect success, to send his wireless messages through the cliffs of Dover. At any rate, communication passed between Dover Town Hall and the East Goodwin Lightship, and the currents must, therefore, have gone through the intervening hills, unless perchance they went over. The fact is, we understand, that the former was the route of the message. The earth and the mountains thereof present no obstacle to the mysterious force which the distinguished Italian inventor can drive without reins. It is clear that this penetrating power must have an important bearing upon the future developments of wireless telegraphy. As long as it was supposed that an uninterrupted expanse was necessary for the successful operation of the Marconi system, houses present any difficulty? The more one learns of its employment seemed limited to arms of the sea or possibly its great channels. But if cliffs fail to intercept the flying message on its noiseless invisible track, why should the marvels of electricity, the more certain does it appear that the half has not yet been told.—Ex.

Magnetism.

SOME FORMS OF MAGNETIC SEPARATION AND THEIR APPLICATION TO DIFFERENT ORES.*

BY H. C. M'NEILL, ASSOC. R. S. M.

The first application of magnetism as an agent for the separation of a magnetic from non-magnetic substances was probably the permanent hand-magnet used in the machine shop for separating iron or steel trimmings, etc., from brass or gun-metal sweepings. Similarly, foreign oats and grain are freed from bits of wire, pieces of cutter blades, needles, etc. The railway companies and other large employers of horse labor have found it necessary to subject all the materials utilized for horse food,

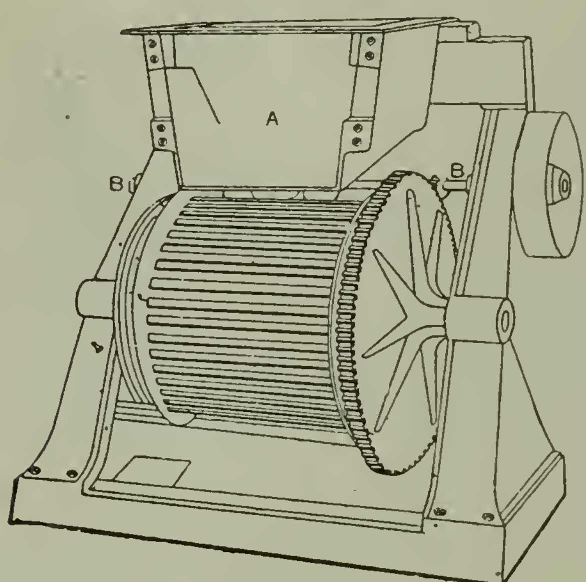


Fig. 1.

such as maize and oats, to rigorous mechanical and magnetic cleansing, for which purpose a permanently magnetized steel plate about 4 ft. long, 6 in. wide and 1-8 in. thick, with the long edges horizontal, is placed transversely, and inclined at an angle of about 35 degrees to a continuous stream of grain fed from a hopper. An automatic scraper, in the form of a belt revolving round pulleys at each end of the magnet, and provided with a brush of leather, removes any accumulation every two minutes. This is pushed to the end of the magnet and drops into a separate compartment; the grain which passes on is jigged on a three-bottomed perforated tray, by which means not only is the corn or maize separated, but the oats are freed from mixture of smaller seeds, bits of stone and dust.

With the introduction and wider application of electro-magnetism, not only have machines been devised whereby naturally magnetic iron ores are freed from admixtures of other minerals, but by a preliminary roasting, i. e., the artificial production of magnetic oxide of iron, other ores may be rendered suitable for a magnetic separation treatment. Mr. R. . Commans mentions** that Sella, in Piedmont, in 1855, was the first to use an electro-magnetic separator, but to free the magnets the current had to be broken; also that in 1881 Heberle, at the Friedrichssegen mine on the Lahn, introduced a continuous current machine for separating blende from spathic iron ore after a preliminary roasting. In addition to the separator which bears his name, and which is dealt with in this paper, Mr. Heberle also designed that part of the dressing floors at the Gellivare Company's Works at Lulea, where the apatite, after being separated from the magnetic iron ore with which it occurs, has to be freed from a small percentage of hematite before being converted into soluble phosphate. Other workers, both in Europe and America, including Wenstrom, Ball and Norton, Chase, Conkling, Hoffmann, Kessler, Buchanan, King, Edison and Wetherill, have all designed machines suitable to treat certain classes of ore which have come under their particular observation, and have successfully dealt with the problems presented by local conditions and peculiarities.

In the summer of 1898 the author had the opportunity of seeing some of the principal magnetic concentration plants in Sweden, and the present paper is mainly confined to these. He is indebted to the various managers of works, engineers and others for the information freely accorded in every case. The endeavor has been to present an outline of the machines and ore treatment processes. The sketches are entirely diagrammatic, and have been prepared from the author's hand sketches.

I.—THE WENSTROM MACHINE.

This is probably the simplest, and, for the particular purposes which it is intended to fulfil, the most efficient separator at present in use. Unlike most other designs, it is capable of treating ore of fairly large size, and it is not necessary that the stuff treated should be previously dried its chief use is in such cases where the magnetite iron ore contains inclusions of rock, or where, as in open cast workings, portions of the containing walls of the ore body get mixed with the ore in blasting, and like operations. As a general rule, it is found to be more economical to pass the whole of this material collected

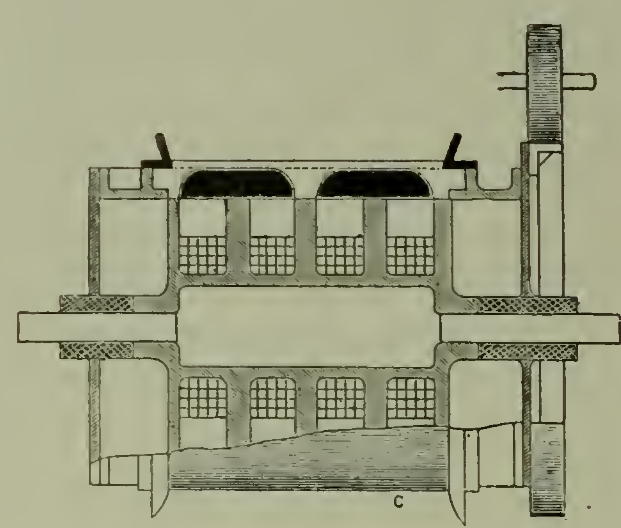


Fig. 2.

together over a Wenstrom machine, after the "best" of a blast has been dealt with, than to attempt further hand selection in the quarry or underground. In addition there are other uses to which this separator may be put, such as the treatment of cupola residues and foundry loam and sand; also the recovery of cast iron, shot entangled in blast furnace slag, etc.

Fig. 1 gives a general view of this machine. The material to be treated is fed through a hopper A, and on to a jigging tray, which receives its motion from a cam arrangement placed on the shaft BB. This tray is inclined, and at each recoil a line of ore is left on the drum. Figs. 2 and 3 show part sections of the drum in directions at right angles to one another. C is the armature barrel, consisting of a series of soft iron bars, each separated from the other by a bar of wood. D is a stationary field magnet, placed eccentrically with regard to the armature barrel. Non-magnetic end plates, carefully fitted with "jointing," so as to be water-tight, bind up the whole

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*Abstract of a paper read at the annual meeting of the Iron and Steel Institute. From the London Electrician.

**Proceedings of the Institution of Civil Engineers, Vol. CXVI, 1893, p. 63.

Editor's note. Cuts used through the courtesy of "Electricity."

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CONTENTS:

ORE REFINING BY ELECTRICITY.

The use of electricity in the arts and sciences has led to a recognition of its value in connection with other allied industries. At present experiments are being tried for the purpose of discovering whether iron ore cannot be put through a rapid, efficient and economical process of refining, thereby avoiding the intermediate process, during which it is converted into highly impure pigs. The idea is not a new one though it does not lose value through this fact. Yet success in that direction would mean a complete and radical change in the present methods in vogue for the reduction of iron ore. A thorough appreciation of the fact that a large percentage of the heat is wasted in the smelting process has led many inventors acquainted with that subject to attempt to utilize the hot blast escaping from the furnace.

By the use of electricity a large percentage of power will be saved, an increased rapidity in the production of iron will be gained, and in all liklihood a superior grade of metal will result. According to a foreign contemporary "a report from Vienna states that the Prague Iron Company has commenced a series of experiments, with a view to testing the commercial practicability of a new process for the extraction of iron from its ores by means of electricity. The idea of replacing the blast furnace by an electric furnace has not hitherto been successful, trials having been made in this direction in Germany in recent years. The new process being tested at Prague may prove a financial success and of great benefit to the iron trade in general."

The electrical reduction of iron ore calls to mind the success of an experiment on similar lines, tried by an inventor who succeeded in producing glass from its constituents by means of electricity. There may be technical objections to the employment of two huge carbon electrodes between which the crude ore may be placed and it may take some time to discover how to produce the best output in the least space of time, yet the ultimate success of an intelligent and scientific effort seems to be not difficult to imagine. The inventor who made glass by carbon electrodes and a quantity of sand, soda, etc., had probably less hopes of succeeding than those now working in the same general direction.

THE INCREASING INDUSTRIAL IMPORTANCE OF NIAGARA.

Niagara Falls is destined to become one of the greatest industrial centres of the Union. This is readily indicated by the rate of sudden progress and the quickness with which manufacturers are grasping the opportunities there presented to them. With unlimited power at their command, sold at a rate so low that no questions are asked, large chemical works, aluminum concerns and a large and increasing variety of general manufacturers are settling at convenient points. The latest news on the subject, other than the further extension of the electric power plant by the Niagara Falls Power Company for about fifty thousand additional horse power, is the new factory for the electric decomposition of salt of the Acre Process Company. The Niagara Power Company will supply these people with eight thousand amperes at three hundred volts, direct current, which in its way is enormous though not sufficiently large to call for comment from other large users of electricity on the grounds. Several very large iron manufacturers are considering the feasibility of building establishments at Niagara, thus leading to the belief that at the present rate of development Buffalo will be adjacent to the busiest centre in the United States.

ELECTRICITY IN THE WESTERN ALKALI PLAINS.

Certain spots on the earth's surface are occasionally brought to notice by the efforts of certain well known pioneers, who recognize the value of ground as mining property, the site of a settlement, or a possible source of wealth as an agricultural centre. The English section of South Africa, now darkened by a British war cloud, owes a large percentage of its development in every direction to the untiring efforts of Cecil Rhodes. In our Great West many a desert alkali plain, with every evidence of mineral wealth on its borders, could, under the influence of healthy enterprise, become transformed into a garden spot and the scene of many manufacturing interests.

An agricultural society, whose members consist of men from New York and adjacent towns, is at present operating in the far Northwest and are digging a fifteen mile trench with which they expect to irrigate the section of land marked out by themselves for future homes, farms and fields. In order to facilitate efforts of this description it seems that electrical machinery can be made to play an important part in lighting the scene of operations at night and carrying supplies over a roughly constructed road from the nearest civilized settlement to the pioneers. There is no region more arid, more forbidding, as regards conditions required for the preservation of life, than West Australia, particularly a few hundred miles from the coast. Yet, according to the latest reports, a company has been formed whose lines will radiate into these centres for the operation of a trolley system and the once desert spot which is rich in auriferous quartz and placer deposits will be the scene of activity and life.

into the form of a drum. The bars of soft iron are internally shaped so that each successive bar becomes oppositely magnetized, a combination of greater power being thus exerted on a piece of ore large enough to bridge the distance between two adjacent bars.

The magnetic portion of the ore adheres to and is carried round on the drum until beyond the influence of the magnetic field, when it drops away down a shoot at E, whilst the non-magnetic portion passes down in front of the drum into a shoot at F.

A machine with a drum of 2 ft. $2\frac{1}{2}$ in. diameter and 2 ft. in length, revolving at 30 revolutions per minute, will

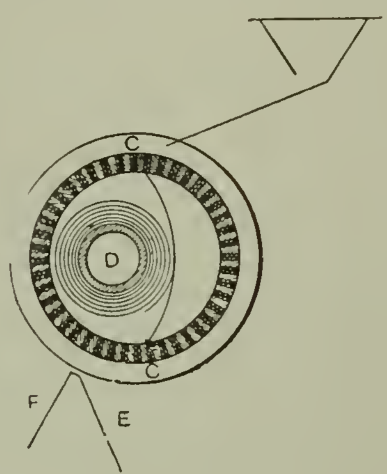


Fig. 3.

treat about 5 tons of mixed material per hour. Such a machine is capable of dealing with ore of any size up to pieces that will pass through a screen of 4 in. mesh, and requires a current of 15 amperes, the tension at the dynamo terminals being 110 volts. Although the machine may be and is used on ore which is quite wet, the greatest efficiency is obtained when the material to be treated is dry, and in some cases, as at Dannemora (Sweden), care is taken to treat only that ore which is fairly dry, without incurring the expense of artificial drying, whilst in other instances (Grangesberg and Grangen)

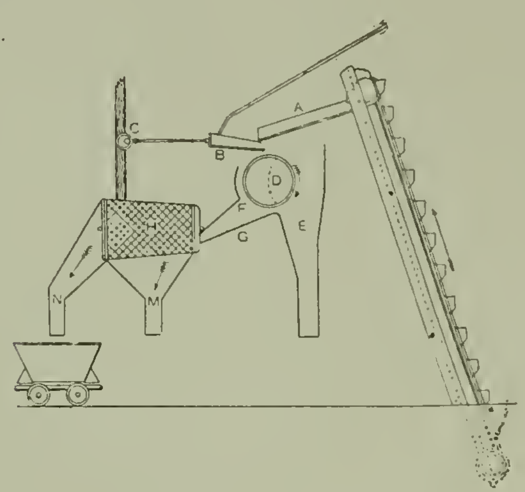


Fig. 4.

the ore is treated directly after being washed, and whilst quite wet. This separator requires but little care and attention when working, whilst the cost of maintenance is practically nil.

Generally the most efficient plants are also the simplest. The process usually consists of either a rough preliminary sizing by means of revolving or flat screens, with or without washing, followed by treatment on the separator, or the uncleaned ore may be passed on to the magnetic machine direct and subsequently screened into different market sizes. At Dannemora the latter method is adopted, and I am indebted to Captain Hammerschal for placing at my disposal the particulars given in the following short description of the plant used there. The ore on arrival at surface is first subjected to a rough hand selection on sorting floors conveniently arranged near the shaft. Between 50 and 60 per cent. of the total quantity of ore raised is rich enough to be taken direct to the furnaces. The remainder, which is of any size up to 2 in. diameter, is trammed from the sorting floors to the separation plant or to the ore heaps for future treatment by the separator. Fig. 4 represents the plant in use.

By means of the elevator shown, the ore is lifted and dropped to the inclined shoot A, and so on to the reciprocating table B, which delivers it to the Wenstrom separator, D.

The tray B receives its motion by means of the small eccentric C. The unmagnetic, and in this case worthless, portion falls at once down the shoot E. The magnetic portion is carried round on the drum of the separator in the manner already described, and passes down shoot G into the revolving trommel or screen H. This trommel is of $\frac{1}{2}$ in. steel plate, provided with $\frac{7}{8}$ in. punched holes pitched $1\frac{3}{8}$ in. apart, so that everything under $\frac{7}{8}$ in diameter passes through and down the shoot M, the stuff above $\frac{7}{8}$ in., which does not pass through the holes of the trommel, being delivered down the shoot N, two marketable products being thus obtained.

An example where preliminary sizing and washing before separation is found to be advantageous is at Grangesberg (Sweden), and no doubt many of the members of this institute will remember seeing the actual plant at work. Three commercial products are obtained there: (1) Ore between $1\frac{1}{2}$ in. and 5 in. diameter; (2)

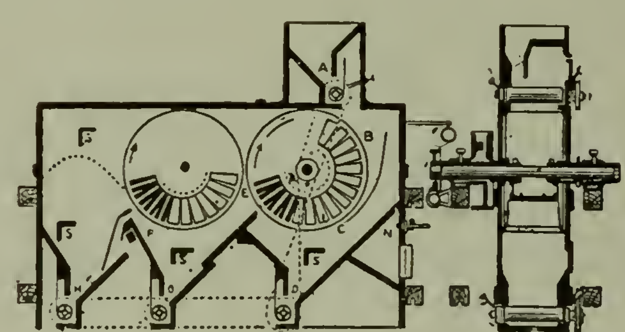


Fig. 5

ore between $1\frac{1}{2}$ in. and $\frac{1}{4}$ in. diameter (3) ore anything up to $\frac{1}{4}$ in. diameter. The Grangesberg plant was designed to meet the particular requirements at the mine; the ore contains a considerable amount of specular iron, which somewhat easily crumbles, also hematite, and differs from that of Dannemora, where the ore is compact and very hard and there is little or no tendency to crumble, hence probably the difference in the methods of treatment and the primary washing, in order to save and eliminate the fine material.

At both Dannemora and Grangesberg the uncleaned ore averages 38 per cent. to 42 per cent., and the concentrates 58 per cent. to 62 per cent. metallic iron. The rejected portion of the material consists of quartz, pegmatite (from inclusions and veins running through the magnetite ore bodies), schistose material, etc.

II.—THE MONARCH SEPARATOR.

The Monarch separator may be regarded as a Wenstrom with the single drum duplicated; it is, however, of a rather more delicate construction, and is a modification of and improvement on the original Ball and Norton machine, a class which includes the most successful machines of the eccentrically placed internal electromagnet and the revolving drum pattern. Fig. 5 shows a sectional elevation of this separator. It is necessary that the ore treated should be quite dry, and in both cases where the author was enabled to see the machine at work in Sweden the best results have been obtained upon material crushed to pass through a one millimeter screen.

The ore of the size mentioned after drying is fed in an even stream into the machine by means of the roller at

A, the feed being capable of adjustment, as shown. The mineral falls on the revolving drum B, which moves over the fixed electromagnets, all the material being compelled to pass close to the drum by means of the bent shield BC. Having passed the point C, the non-magnetic portion or tailings fall into compartment D, and are fed out at that point by a similar roller. At or near the point E the particles hop across to the next drum in consequence of a stronger current being employed in drum No. 2, and are possibly helped by an induced current of air caused by the superior velocity of this second drum, the relative speeds being as 6 : 1. Those particles containing a little magnetite are whirled off drum No. 2 at about the point of F, the centrifugal force being the stronger force of the two, and drop into the compartment G, constituting "middles" or "middlings;" the wholly magnetic particles are whirled off drum No. 2 at about the end of the electro magnets, and are flung against the end of the machine, and are fed out at H The "middles" may be re-crushed and re-treated, if necessary. A combination of three such machines, where the middles from two of them are passed through a third, is said to be capable of treating 200 tons of uncleaned ore per day of twenty-four hours.

One of the later improvements on this separator is the introduction of drums made of german silver, which has been found to increase the efficiency of the machine.

This form of machine, when used after a careful preliminary treatment, such as drying, crushing, screening, etc., is applicable to two classes of ore: (1) Those in which magnetite is more or less intimately associated with worthless material; (2) and those in which the magnetic portion is of secondary importance. To both of which cases the machine is successfully applied.

III.—THE DELLVIK-GRONDAL SEPARATOR.

This machine is designed to treat those ores in which the magnetite exists in a state of intimate admixture with other and in general worthless minerals. At present it is at wor, and is successfully treating low-grade magnetic ores. The preparation that the ore has to undergo before it is passed to this form of separator will be described when dealing with a plant now working at Ragga in Sweden. For present purposes the material may be described as a slime. Fig. 6 shows a sectional elevation and part plan of the machine. AB is of cast iron, and consists of a series of rings. In the spaces between each of two is placed the copper wire conveying an electric current. This drum is rotated by means of the bevel gearing DE and the pulley-shaft H. CC is a solid drum of wood caused to revolve three times faster than AB by means of the gearing shown at FG, and is studded with soft wrought iron bolts or pegs, each ring of which revolves exactly opposite to the rings on AB. It will be noted, as indicated by the arrows, that AB revolves from right to left in front, and CC from the left to right in front. The slime is carried to the machine by means of the launder N, which terminates in the circular launders QQQQ, which enclose the drum AB for about one-third of its circumference, as seen in plan, and offer a larger area of the slime to be acted upon. Further water is supplied by the pipe L. The magnetite particles thus brought under magnetic influence attach themselves to the rings on AB, and are carried round. Those particles which escape the first ring are caught lower down, and

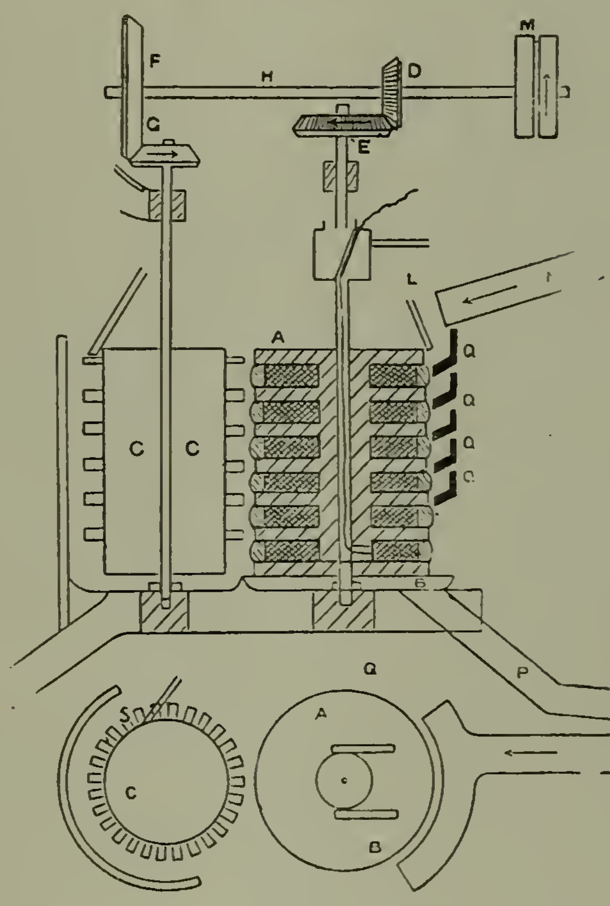


Fig. 6.

so on, each successive ring being more strongly magnetic than the one above. The unmagnetic portion of the ore, being unattracted, is washed down and into launder P, together with the excess water. As each peg of the drum CC is successively presented to the rings of the drum AB, magnetism is induced therein, and the magnetite hops over and forms in tufts on each peg, and is thus carried out of the magnetic field, where most drops away, and the rest is washed off by a strong jet of water from the pipe shown, this separated magnetite being run by the launder into settling pits, from which it is dug out. The copper wires conveying the electric current are protected by carefully fitted brass rings and special jointing. The necessary fine crushing before treatment in the separator is accomplished by means of a ball-mill. Professor G. Nordenstrom in a paper read before this Institute at the Stockholm meeting last August, mentions the fact "that the Dellvik-Grondal separator has been advantageously used at Pitkaranta, in Russian-Finland, since 1894 for concentrating poor iron ores."

IV.—THE HEBERLE SEPARATOR.

There are two distinct types of machine, each of which is shown in separate figures. Fig. 7 is a type designed for the separation and concentration of low grade magnetic ores only. Fig. 8 is designed for the treatment of galena blende ores when occurring with magnetic oxide of iron, also the separation of roasted spathic iron and blende, etc., or in the treatment, which will be described below, of a complex ore, consisting of galena blende, magnetic oxide, pyrrhotine and quartz.

In Fig. 7, the ore to be treated after reduction to size of about thirty mesh, is fed in at A with water. BB is a continuous gutta-percha belt traveling round the pulleys CC and over the fixed electromagnets placed in the casing shown, the whole machine being enclosed in a wooden box, which is kept full of water to a height a little above the highest of the magnets. The magnetic portion of the ore attaches itself to the belt, and is carried down with it until, arriving at D and out of the field, it falls away into E, and is withdrawn through F. The worthless portion falls into G, and is withdrawn through pipe H. The width of the belt may be from 1 ft. 8 in to 2 ft. 6 in., and a machine of the latter size is capable of treating 35 tons of crude ore per day. These separators may with advantage be used in series where a favorable percentage of the magnetic iron might be obtained from the ore by a primary crushing of from six to three millimeters and treatment in the first separator, the rejected portion being further reduced in size to say three to two millimeters, and treated in the second separator, and so on with intermediate crushing between two such separators.

At Saxburget in Sweden, where by the kindness of Mr. Wenstrom I was permitted to see their mill, they were treating an ore consisting of approximately:

	Per cent.
Lead	11
Zinc	22
Magnetic oxide	14
Pyrrhotine (magnetic pyrites), Fe_6S_7	2 to 5
Silica	15 to 20

which is obtained from the adjacent Langfallsgrufvan mine. The ore is fed, in the form of slime, into a Heberle separator, of the type shown in Fig. 8 at A. The magnetic portion is carried down on the belt, and deposited into chamber C, and withdrawn by a pump through D. The coarser portion of the remainder of the mixture accumulates in E, and is withdrawn through the pipe F, the outer case of the separator being kept full of water up to launder B by means of the water pipe G, the finer portions of mixture, consisting mostly of the blende and silica, together with about 3 per cent. magnetite, in a state of suspension are carried away by the overflow B to settling pits for subsequent re-treatment as fine slimes. The magnetite after withdrawal from C, here disappears from the process, as, although it contains a little zinc and lead, it is found unprofitable to treat it further. The material which collects in chamber E then goes forward to a four compartment jig, whereby the coarser gelena becomes a separated and sized product, and the other products are re-ground in a special form of mill designed by Heberle, and consisting of two fluted plates rotating concentrically against each other, after which as much as possible of the other minerals is separated by means of pointed boxes, continuous revolving buddles, and Rittinger side recoil tables, etc.

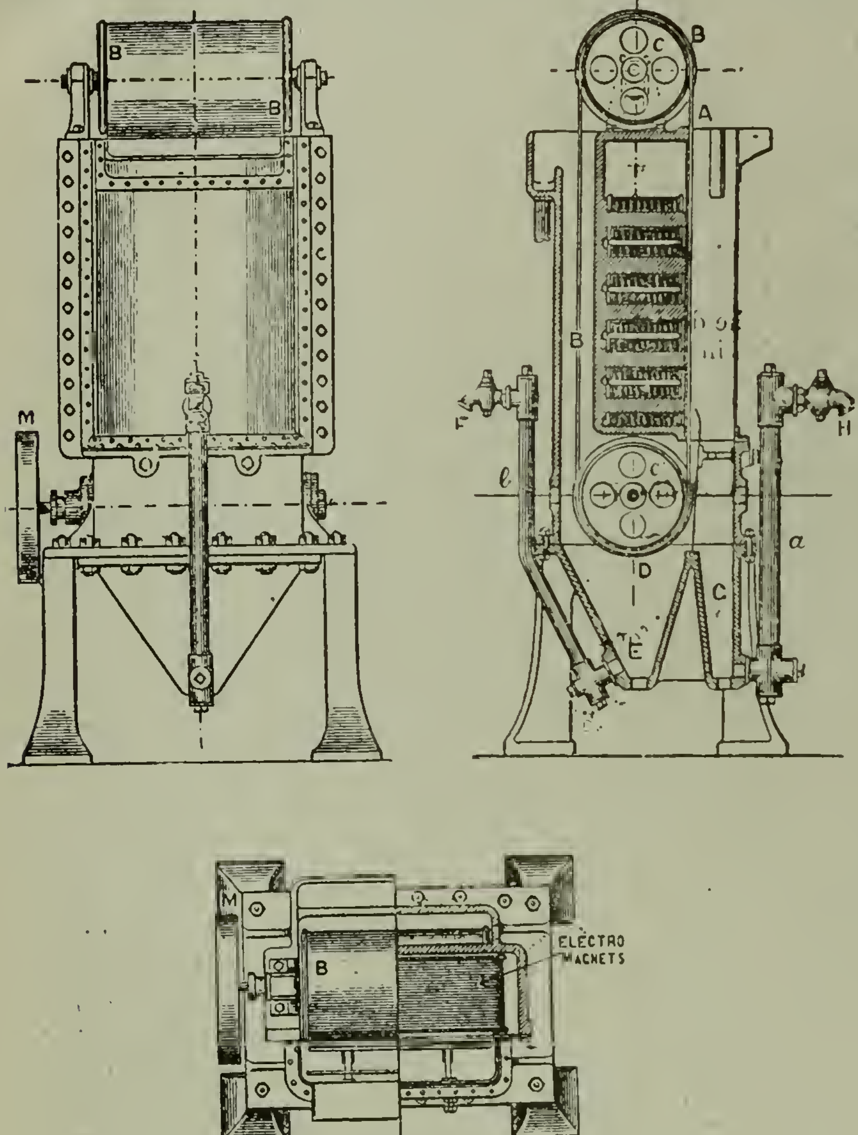


FIG. 7.

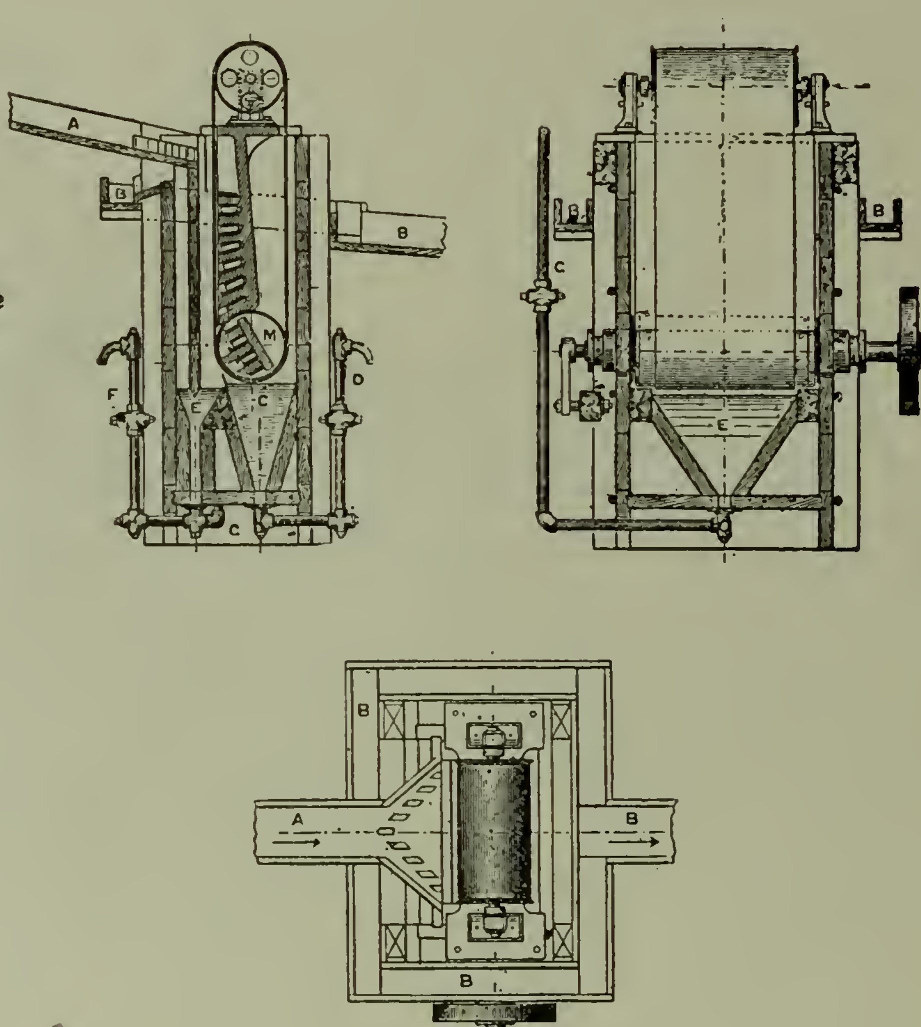


FIG. 8

V.—THE WETHERILL MACHINE.

This machine has been designed to treat the ores met with at the Franklin mines, New Jersey, which contain franklinite (the chief iron and maganese bearing mineral) intimately mixed with zinc oxide and willemite (zinc silicate) in a limestone matrix. The problem was to utilize the natural and slightly magnetic properties of the franklinite, separate it from the admixture of the other ores, and so concentrate the zinc minerals sufficiently high to admit of their reduction in the Belgian spelter furnaces. The original treatment was to roast the ore with anthracite, so increasing the magnetic propertices of the franklinite, and treat the roasted product on a

Wenstrom separator. Mr. J. P. Wetherill found on experiment that, by concentrating his magnetic field, the franklinite, described by Dana as slightly magnetic, could be separated without preliminary roasting. There are two types of Wetherill separator for treatment of ores of different grades. Messrs. H. A. J. Wilkins and B. H. C. Nitze, in a paper read before the American Institute of Mining Engineers at the Pittsburg meeting, February, 1896, gave sketches and some detail of these machines, from which it appears that the crushed and dry ore is subjected to the selective action of a highly concentrated magnetic field.

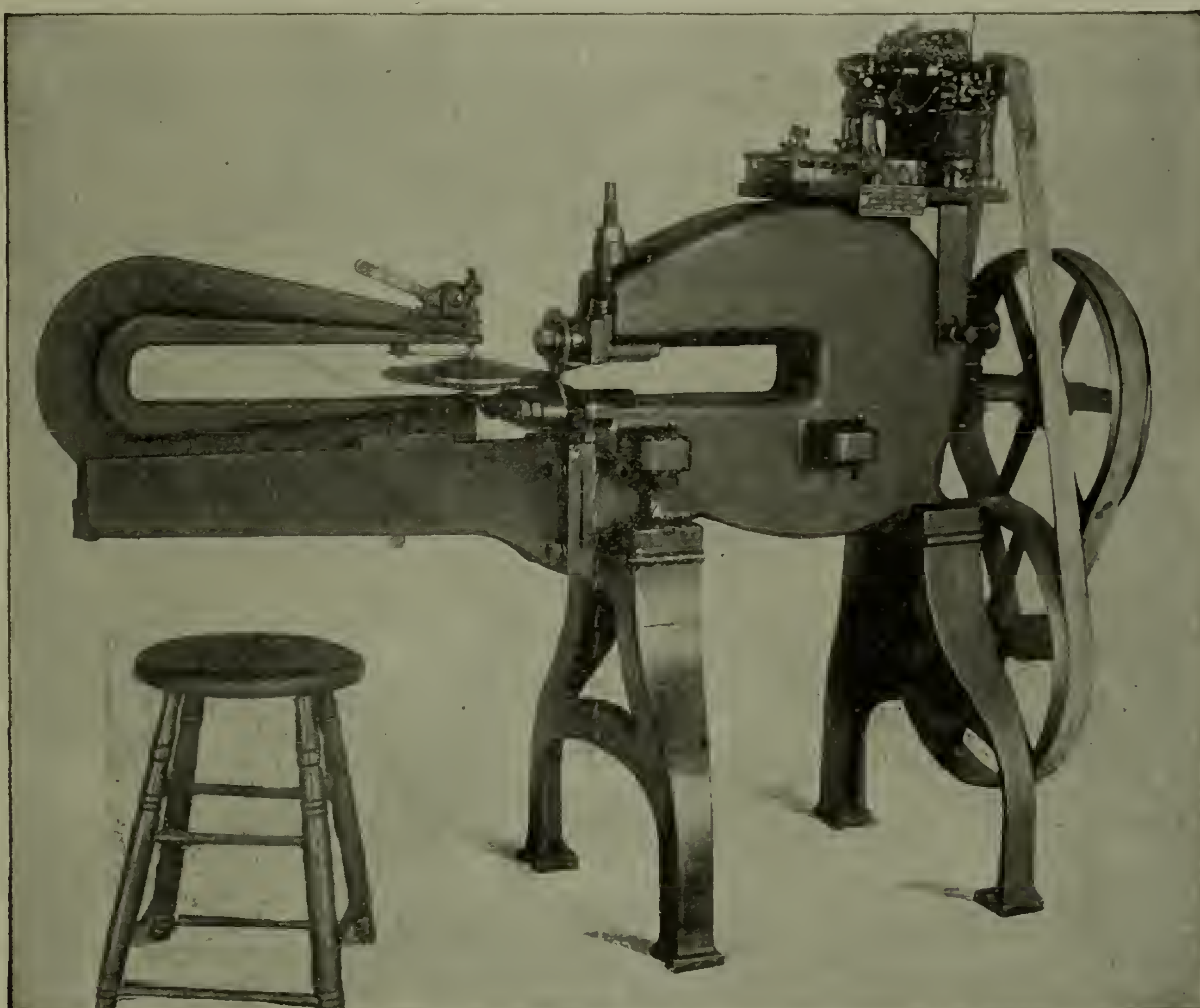
The author has had no experience with this type of machine, but there is little doubt that, in the treatment of complex ores, many of which consist of minerals described as "feebly" or "slightly" magnetic, considerable possibilities are opened up in the direction originated by Wetherill. Messrs. Wilkins and Nitze mention "That amongst the minerals which have been susceptible of attraction by the condensed magnetic power of these machines may be mentioned red and brown hematite, siderite, chromite, menaccamite, rutile, franklinite, pyrolusite, etc.; in fact, almost all minerals containing iron or manganese, or both, also salts of iron, manganese and chromium; and with the introduction of still higher magnetic powers, it is hoped that even iron pyrites will come within the scope of successful separation treatment."

In conclusion, attention may be drawn to the increasing utilization of magnetic iron ore, not only in this country, but to a still greater extent on the Continent, and to the growing importance of magnetic concentration as a branch of technical industry. There is undoubtedly a large field open both to the inventor and for the remunerative employment of capital, and the author hopes that these notes, as describing more particularly the Swedish practice, may not have been without interest.

Electric Power.

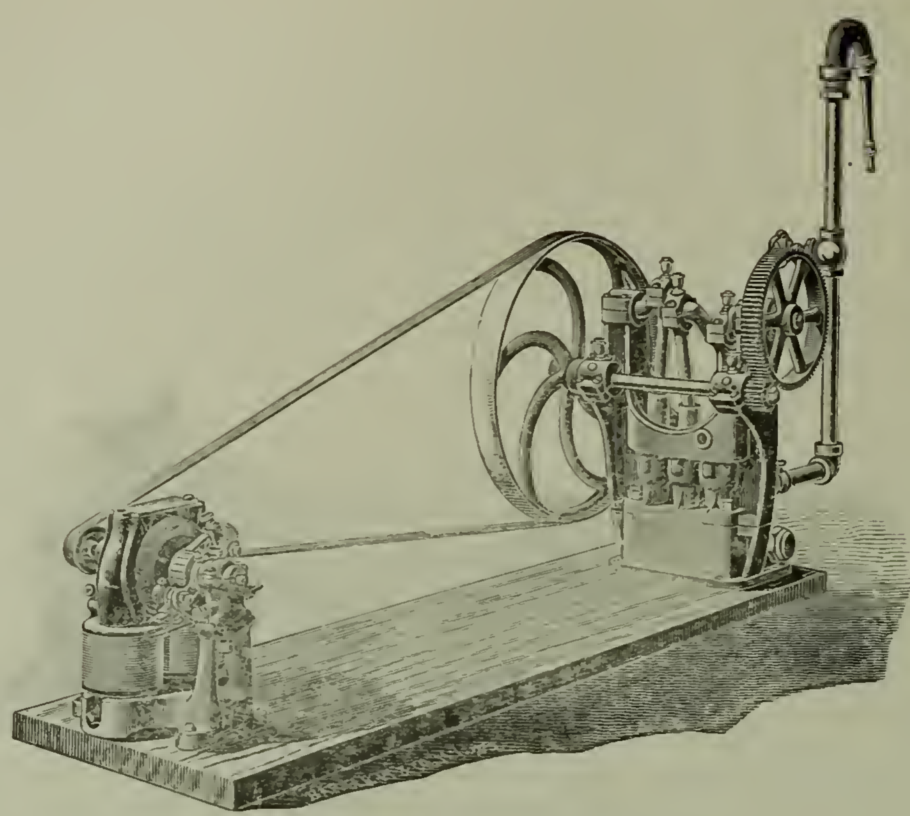
APPLICATION OF SMALL MOTORS.

Since the introduction of small motors in the household and factory many unique applications have been made of them which, viewed from the standpoint of convenience, make the small motor a permanent addition to the above named establishments. In "In Electricity in Daily Life," published in 1890, we find the following statement: "The beginning of the general introduction of electric lighting by incandescent lamps, supplied by central stations, which may be fairly considered to date from about 1883, had the almost immediate effect of creating a demand for small electric motors. It was at once perceived that the electric lighting conductors, if introduced into every building in a town and supplying a constant electric current at an expense ordinarily not exceeding eight or ten cents per horse power per hour, could be utilized to great advantage in driving sewing machines, lathes, ventilating apparatus and innumerable other sorts of machinery for domestic purposes or for the higher class of mechanical industry. Quite an assortment of neat little motors of this character of different patterns and of capacities ranging from one-tenth to one-half a horse power were exhibited in 1884, at the Industrial Electrical Exposition, at Philadelphia, where they attracted much attention."

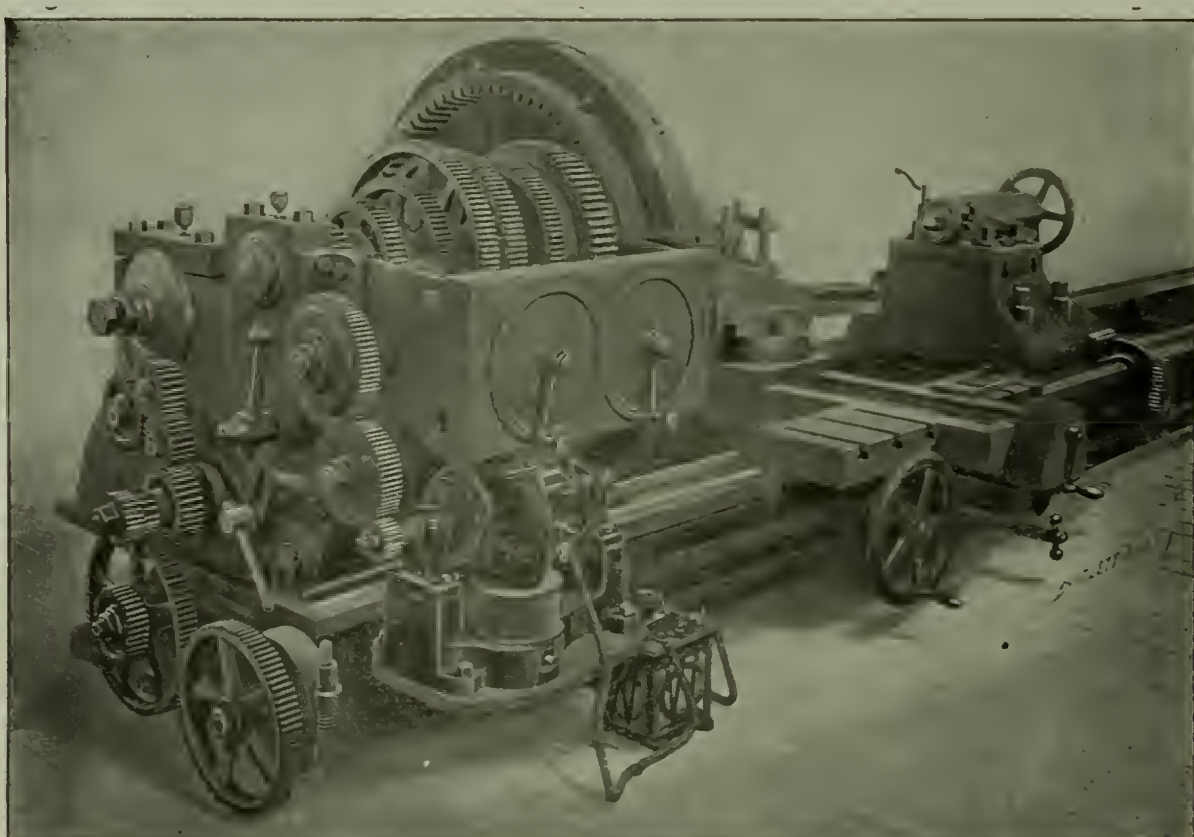


C.-W. Motor Belted, Double Reduction, to Circular Shears.

Since the above period the demand for small motors has increased on every side and in the following illustrations we give the reader an idea of some few applications shears, operating a pump and a large engine lathe. Two of these applications are valuable to those living in apartment houses or even in private homes, the other two are only found in the factory. The convenience of using a motor for hat polishing was exemplified in the business district of New York on many occasions this summer. Not only were high hats resurrected and brought back to their original splendor but the unchastity of straw hats was removed by means of the small motor and they were once more allowed to adorn the heads of their proud (?) owners. For shoe brushing and ice cream making the motor is certainly unequalled and the readiness with which it can be attached to such devices. For pumping water to the roof it is already finding many applications and it is surprising to realize how small a motor will pump a large quantity of water, equivalent only being done by a comparatively gigantic gas engine. The machinist in charge of a lathe or cutter receives little or more wages, if the machine he is entrusted with is driven by electricity or not, but the absence of overhead belts and various other items in his favor make his work less dangerous and to the employer less expensive and, of course, more satisfactory. Modern manufacturing is now carried on in many cases solely by the aid of small and large motors. Certain industrial developments have occurred and in fact many manufacturers owe their business and fortune entirely to the use of electricity for driving machinery.



C.-W. Motor Belted to Triplex Pump.



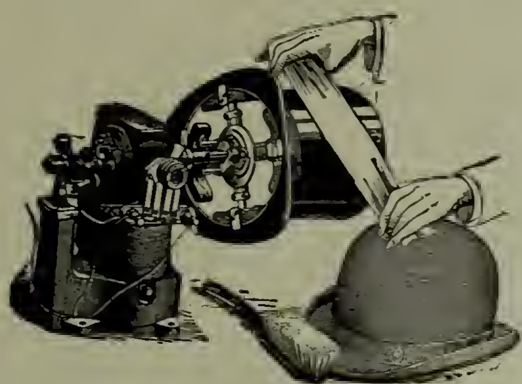
New Haven Engine Lathe. C.-W. Motor. Speed Changes Made Through Nest of Gears.

Electro-Metallurgy.

POWER REQUIRED IN THE ELECTROLYTIC REDUCTION PROCESS.

In an article published in the Revue Universelle des Mines et de la Metallurgie M. P. Chalon gives the following figures as to the power required to reduce 1 kilogramme of the following metals by electrolysis:

	E.H.P.H.
Gold, platinum, silver	0.70
Mercury, lead	0.90
Bismuth, palladium, tin	1.20 to 1.60



Electric Hat Polisher. (See page 166.)

Cadmium, antimony	2
Copper, chromium, iron, nickel, cobalt, zinc	3 to 4
Manganese	5

For such metals as are reduced by electhermal methods the power needed is as follows:

	E.H.P.H.
Sodium	25
Calcium	26
Magnesium	31
Aluminium	35
Lithium	43

One of the most interesting applications of electrometallurgy is the Siemens-Halske process of reducing slimes as practiced in the Rand. M. Chalon states that such slimes, containing only 100 grains of gold to the ton are now successfully treated, the gold being first obtained in solution by means of cyanide, and the solution then electrolysed. As each ton of slime is treated with 6 to 8 cubic meters of water, the solution actually electrolysed contains only 12 to 16 grains of gold per ton. With such weak solution it is found that filtration or other method of clarification is necessary before electrolysis, if good returns are to be obtained.

A NEW FILAMENT FOR INCANDESCENT LAMPS.

A better result than the ordinary carbon-filament incandescent lamp is claimed for a new lamp, the invention of M. Langhane. The lamp, by reason of the refractory character of the material forming the filament consisting of silicon-carbid, enveloped with a layer of silicon and carbon, assures an economy of 25 per cent.—Ex.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING SEPT. 16, 1899, $127,733.

New York, N. Y., Sept. 16, 1899.—The following exports of electrical material are from the port of New York for the week ending this date:

Antwerp.—177 packages electrical machinery, $2,861. 29 cases electrical material, $1,307.

Aden.—3 cases electrical material, $89.

Argentine Republic.—334 packages electrical material, $19,760; 16 cases electrical material, $29,013.

Brussels.—5 cases electrical machinery, $750.

Barcelona.—6 packages electrical material, $165.

Berlin.—14 packages electrical material, $9,540.

Bordeaux.—4 cases electrical material, $85.

Brazil.—1 case electrical material, $60.

British West Indies.—36 packages carriage material, $1,237.

British East Indies.—77 cases electrical material, $2,-924.

British Australia.—15 packages electrical material, $521.

British Possessions in Africa.—75 cases electrical material, $7,269.

British Guiana.—10 packages electrical material, $200.

Cuba.—42 packages electrical material, $2,395; 2 boxes electrical material, $33.

Chili.—9 packages electrical material, $132.

Central America.—2 packages electrical material, $11.

Dutch East Indies.—2 cases electrical material, $150.

Dunkirk.—11 packages electrical machinery, $1,500.

Ecuador.—9 cases electrical material, $146.

Hamburg.—35 cases electrical material, $750; 2 cases electrical machinery, $297.

Havre.—80 cases electrical material, $18,873; 9 cases electrical machines, $469.

Japan.—4 cases electrical material, $753.

London.—86 packages electrical material, $3,568; 22 boxes electrical machinery, $660.

Mexico.—1 case electrical material, $12.

Manchester.—22 packages electrical material, $2,013.

Marseilles.—36 cases electric motors, $18,000.

Madrid.—3 packages electrical material, $86.

Porto Rico.—9 cases electrical material, $373.

Rome.—3 cases electrical material, $37.

Uruguay.—6 cases electrical material, $99.

U. S. of Colombia.—29 packages electrical material, $1,466.

Venezuela.—33 packages electrical material, $119; 1 case electrical machinery, $10.

NEW INCORPORATIONS.

St. Augustine, Fla.—The Miami Power and Water Co. has been incorporated, with a capital stock of $50,-000, to construct and operate electric plants and water works.

Cumberland Falls, Ky.—The Cumberland Falls Power Co. has been organized, with a capital stock of $500,-000; C. W. Banta, president; L. H. Morgan, Louisville, Ky., treasurer; James C. Allin, Louisville, secretary; to erect an electric plant at a cost of $150,000.

Trenton, N. J.—The Southern Light and Traction Co., with an authorized capital of $2,500,000, has been incorporated. The articles of incorporation confer the power to purchase bonds, mortgages and other debts, as well as the capital stock of other companies. The incorporators are Charles N. King, N. R. Vanderhoff and Augustus C. Kellogg, all of Jersey City.

Kansas City, Kas.—The Standard Electric Light Co. has been incorporated; capital, $25,000.

Jersey City, N. J.—The A. A. McCreary Co. has been incorporated to manufacture electric lighting apparatus; capital $25,000; incorporators, A. A. McCreary, Philip Hathaway, Clifford W. Perkins.

St. Louis, Mo.—The Van Etten-Lyons Electric Co., to manufacture electrical apparatus and machinery, has been incorporated; capital, $5,000. Incorporators, S. Van Etten, H. E. Lyons, A. Carter, A. B. Donnelly, all of St. Louis.

Newark, N. J.—The Monroe Light and Power Co., office, No. 765 Broad street, has been incorporated to manufacture electricity or gas for light, heat or power; capital, $10,000. Incorporators, John S. Day, George S. Day, Newark, N. J.; Rosie Jacobs, Ignatius Weltner, New York City.

Barton, Va.—A. H. Meyer, B. S. Ragland and A. W. Martinstein have been appointed a committee to prepare plans and specifications for the erection of the proposed electric light plant and water works. Address the mayor.

TELEPHONE CALLS.

Lake Mary, Fla.—The Planters' Co. will construct telephone line to Sanford.

Sedalia, Mo.—J. W. Lobb is organizing the Citizens' Mutual Telephone Co. for the establishment of a telephone system.

Waverly, Tenn.—The Cumberland Telephone and Telegraph Co. will construct a branch line from Waverly to Linden.

Independence, Tex.—A telephone company has been organized by W. T. Wyatt, to construct a telephone line from Independence to William Penn, and from there to Whitman.

Navasota, Tex.—The Navasota Telephone and Construction Co. has been incorporated, with a capital stock of $10,000, by T. C. Foster, Ward Templeman and A. H. Ketchum.

Frankfort, Ky.—The Flemingsburg Telephone Co., of Fleming County, has been incorporated. The capital stock of the company is fixed at $2,500. The incorporators are Charles S. and J. H. Powell and J. M. Baldwin, all of Richmond.

New York, N. Y.—The International Telephone and Switchboard Co., with an authorized capital of $1,000,000, has been incorporated. The company is to make telephones and switchboards. The incorporators are L. B. Grant and Thomas S. White, New York, and J. C. Pope, Plainfield, N. J.

Centerville, Ind.—The Centerville Telephone Co. has been incorporated, with a capital stock of $10,000. The directors are T. J. Clevenger, F. M. Clevenger, John E. Burris, Walter McConaha, Thomas G. Dunbar and J. E. King.

Mifflintown, Pa.—The Tuscarora Telephone Co. has been incorporated, with a capital stock of $40,000. The company will erect lines through Adams, Bedford, Blair, Centre, Clinton, Cumberland, Dauphin, Franklin, Fulton, Juniata, Lycoming, Mifflin, Northumberland, Perry, Schuylkill, Snyder, Union and York counties. The directors are A. B. Schall, Carl F. Espenschade, Mifflintown; I. N. Grubb, Thomsontown, N. J.; J. C. Moorehead, Port Royal; E. A. Garman, Richfield.

Penn Yan, N. Y.—A new telephone company has been organized under the name of the Syracuse, Rochester and Lake Ontario Telephone Co. It is a consolidation of the Wayne County anti-Bell companies, and its main office will be at Lyons.

STREET RAILWAY NEWS.

Denver, Col.—The Cripple Creek Railway Company has been incorporated; capital, $1,000,000; incorporators, G. D. James, W. E. Stiffel, T. F. Brett, H. W. Twombly, W. R. Bron, A. A. Crocker, G. H. Proctor, all of Denver.

New Albany, Ind.—The New Albany Street Railway Company, with a capital of $50,000, has filed articles of incorporation.

Goshen, Ind.—The Goshen and Indiana Traction Company to run an electric line from this place to Angola. The capital is $200,000. The directors are John F. Shuman, Sol A. Wood, W. W. Hatch, M. E. Griswold and F. S. Roby.

Covington, Ky.—The Covington, Cincinnati and Erlanger Street Railway Company has been incorporated, with a capital stock of $250,000.

POSSIBLE INSTALLATIONS.

De Witt, Ark.—An electric light plant will be erected by R. A. Houston.

El Dorado, Ark.—The city will issue $14,000 of bonds for construction of water works and electric plant, to cost $15,000. A. L. Dyke, Hope, Ark., is preparing plans and specifications. Address H. W. Miles, secretary board of improvement.

Havre de Grace, Md.—John H. Record of Bel Air, Md., has purchased site and awarded contract for erecttion of the electric light plant at Havre de Grace, to W. L. Plack, 1403 Filbert street, Philadelphia, Pa.

Tupelo, Miss.—An electric light plant will be erected by the city. Address the commissioner, V. C. Kincannon, Odessa, Kas. The city will erect a 35 arc and 1,200 incandescent light plant. Address E. T. Blake, mayor.

Aiken, S. C.—The plant of the Aiken Light and Power Company has been purchased by J. G. Evans, representing a new company. The plant will be greatly improved.

Charleston, S. C.—The city is considering the advisability of establishing a 300 arc light plant. Address the mayor.

Mt. Pleasant, Tenn.—A proposition for the establishment of an electric light heat and power plant has been made to the city by H. D. Ruhm.

Christiansburg, Va.—An election will be held to decide the establishment of a water power electric light plant by the city. Address the mayor.

Columbia, S. C.—The city is contemplating the erection of a 200 to 300 arc light plant. Address W. H. Gibbes, chairman Lighting Committee.

Honey Grove, Tex.—The Honey Grove electric light plant has been leased and will be operated by E. E. Blocker and T. N. Cole.

Flemington, W. Va.—The Flemington Coal and Coke Company is installing a $75,000 electric coal mining plant, with a capacity of 4,000 tons per day. Address S. L. Simpson, president.

NEW YORK NOTES.

The Western Selling Agency of the well-known gas and electric fixture house, W. C. Vosburgh Manufacturing Co., Limited, 269-281 State St., Brooklyn, formerly conducted by the Chicago General Fixture Company, of Chicago, Ill., has been discontinued, the Vosburgh Company having concluded that they could better serve the interests of their customers in the way of prompt shipments by doing their business direct from Brooklyn than to have a branch or selling agent at Chicago.

The Electrical Age.

Vol. XXIV—No 14. NEW YORK, SEPTEMBER 30, 1899. Whole No. 646.

Novel Application of Electric Power.

Electric Typewriter and Perforator.

AN ELECTRIC TYPE-SETTING MACHINE.

Were Guttenberg alive at the close of this century he would realize that his simple idea of using movable type for obtaining uniform impressions has given rise to machines remarkable in construction and wonderful in the rapidity with which they automatically make and set type. The age of automatic devices has certainly been reached if machines now exist exercising all the complicated movements and functions of an intelligent compositor. The time is certainly fast approaching when the setting of type by hand will become an art but little practiced by the modern printer or his associates. Machines in which ready-made type can be automatically set up are common, but they are giving way to another great class of machines which are manufacturers of type, casting it and preparing it in properly justified lines for the press. So far the problem of setting or casting type automatically has been peculiarly interesting to the mechanical mind. Infact, type-setting machines and all their derivatives have belonged to the purely mechanical world for at least a score of years. The ordinary type-setting machine involves the use of a typographical keyboard operating a system of levers which control the movements of intaglios on the face of the type and a casting device for preparing each separate letter. These intaglios, each of which is called a "matrix," in technical phraseology, are automatically selected from the keyboard, the same as a letter in a typewriter. They are then used in conjunction with an apparatus from which issues a flow of type metal utilized in the manufacture of newly cast type. The purely mechanical side of this problem has been long manifested in the construction of a series of interesting and ingenious type-setting machines in which type already made may be automatically sorted and arranged for the printer's use in familiar galleys. In other words, there are four general classes of type-setting machines at present in vogue.

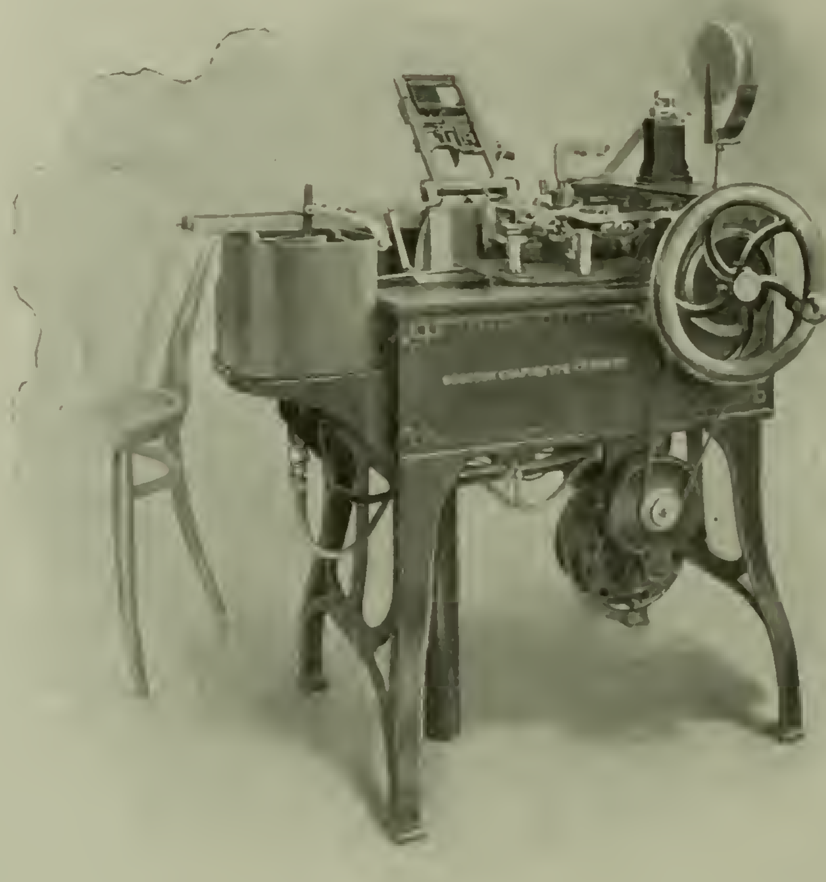
In the first class we find a mechanism which takes ordinary type and automatically sets it up in lines which require to be justified by another operator. This, of course, adds to the speed of hand composition, doubling it but calling for the aid of an assistant for the process of justification. The same type is used over and over again until worn out, when it becomes valueless as in any other case. This type of machine deals with no other problem than that of setting made type, which is generally nicked in a peculiar manner to allow the selective apparatus to pick out the different letters of the alphabet without mistakes. The letters are guided through a groove in response to pressure from a keyboard and approximately enough letters to make a line removed and justified.

A second class of type-setting machines inherit all the characteristics of the first, but with the addition that they make their own type and after it has been once used melt it again. In this class of machines the manufacture of type calls for little more expense than the actual cost of metal and a stock of letters is laid away in the cabinet for future use. When the machine is in operation its magazines are filled with the various letters of the alphabet, each particular letter occupying a separate groove in the magazine, each groove containing more than one hundred letters at a time. The operator merely taps the keyboard ,thereby calling for each special letter, as required, but is able to automatically justify at the same time through the aid of an additional device. In other words, but one man is required to operate the machine, although for quick work another would be kept busy filling the magazines as required and possibly in manufacturing new types.

The first type of machine, therefore, simply sets type without justifying it and the second machine sets type but makes it and subsequently justifies it although the manufacture is a distinct process from the setting and justification. A self contained machine in which the entire process is practically done at one and the same time without the inconveniences of either of the two previous methods is found in a third class of type-setting and type-making machines.

The third class of type-setting machines are operated by a keyboard which is an integral part of the machine through which a variety of matrices are thrown into their proper position instead of type ,they are then automatically carried back to the casting end of the machine where a single slug is made perfectly justified and representing a line of letters. In this machine an error requires the recasting of the entire line of letters or slugs which is an objection overcome in the fourth class of machines. It is impossible to automatically repeat any given copy without operating the keyboard, and consequently loses certain qualities which may be found in the fourth class of type-setting and type-making machines.

In the fourth class of machines we have two distinct parts; one consisting of a keyboard apparatus, thereby making it entirely distinct from any previous construction, the other consisting of a machine compactly built and automatic in action which makes, sets and justifies the type as rapidly as the mechanism will operate. In the keyboard section which can be placed wherever convenient for ready dictation, if necessary, a perforated paper tape is produced. This tape calls for no limit in the speed of perforation, that being entirely a question of the operator's skill. Consequently copy can be prepared with the utmost rapidity. The tape after having received these perforations corresponding to different letters, sentences, etc., is simply placed on a roll in the second and separate part of the machine. Inthis second machine all operations are carried on automatically, the galleys of type issuing with perfect justification, each letter being separated from its neighbor, thereby allowing ready rectification of all errors. The duplication of any copy can be carried on by simply putting the tape through once more. The speed of casting is practically limited far above the rate of any other type-making or type-setting machine previously constructed.



The Goodson Graphotype With Tape In Position.

To the reflective mind it is not a difficult undertaking to imagine the ideal type-setting machine as one which is operated by electricity and so controlled that a touch of the finger and a turn of the switch allows the electric current to cast, jusify and in other ways prepare the metal in galley form for the press. A machine representing the fourth class but operated by electricity has been evolved from the brain of an inventor and bears the name of the Goodson Graphotype. In accordance with the above analysis it consists of two separate parts, one a typewriter, the other a separate piece of apparatus from which the galleys of type mysteriously issue, new, shining and perfectly justified. In the first machine, the typewriter, a touch of any of the keys operates an electro-magnet which in its turn by a movement of the armature punches a hole in a long strip of paper tape which is automatically fed forward. This tape which is filled with a long line of curious perforations, each one of which corresponds to a letter, dash or symbol on the typographical keyboard is then placed in the form of a roll in the second machine. This device is about three feet by one foot in size, is about a foot high and rests on an iron table supported by four legs. The paper tape is guided through a short pathway by means of which the holes in the tape allow contact to be made and broken through the medium of a series of pins in a set of electro-magnets, corresponding to those operated in conjunction with the keyboard in the first machine. As the tape is fed along, this series of little pins reminding an observer of a system of nerves make contact through the tape whenever a perforation occurs. Each of the little metal pins controls the movements of a copper plate containing intaglios of the letters. The little pins operate directly electro-magnets which guide the copper plate back and forth over a steel surface. There are twenty of these small contact pins which allow a copper block containing impressions of the various mechanism moves guiding the copper block to its various positions. An iron pot holding type metal is contained in the machine, the metal kept molten by a system of gas burners. It also contains a small pump which forces the hot metal through a copper tube into the metal mould in which the type is cast. The copper tube carrying the molten metal is kept hot by a current of electricity, great enough in strength to keep it molten independent of its original supply of heat. The object of this is also to prevent the metal from clogging up the pipe by cooling. Around the adjustable mould in which each type is made water is circulated which aids greatly in the speed with which type can be delivered. The operation of casting and setting type in this machine is reduced to a minimum and simply calls for familiarity with the typographical

Lord Kelvin.

type used to move ten spaces forward and ten sideways. The intaglios of each letter in the small copper block are arranged in squares like a checkerboard so that whatever position the copper block is forced to assume by the control of the electro-magnets means the casting of a new type. The copper face containing the various impressions is carefully fitted against a steel surface in which is a groove through which hot type metal is pumped. The sudden forcing of this molten metal through the rectangular groove against the copper face means a casting of a type. The position of the copper plate containing the various faces of type is controlled with absolute accuracy by the pins making and breaking contact through the tape. When a letter is about to be made a small steel pin presses down the back of the copper plate thereby aligning it or forcing it to assume exactly the position required for the making of a true and perfect type. In this machine type can be cast and set up fully justified at a speed only limited by the time it takes for the letters to cool after having been made. This speed is controlled by an electric motor which governs the rate at which the keyboard attached to the first machine.

The Goodson Graphotype Company, with offices at 13-21 Park Row, New York City, exhibit this machine and invite all interested in the typographical art to witness its marvelous operation.

Miscellaneous.

THE RETIREMENT OF LORD KELVIN FROM THE UNIVERSITY OF GLASGOW.

The University Court, of the University of Glasgow, adopted the following resolutions on the occasion of Lord Kelvin's retirement from the university:

The Court have received with the deepest regret Lord Kelvin's petition for leave to resign the chair of natural philosophy. In granting that petition, as they feel it their painful duty to do, the Court desire to record the sorrow with which they anticipate the close of a service that for more than half a century the university has seen growing in influence and usefulness, and in beneficent application of the inventions of science to the wants of life, to the lightening of labor, to the comfort of the dwelling, to the safety of the traveler by land and sea, to the promotion of the facilities of commerce and the means of human intercourse.

They recall with pride the renown which Lord Kelvin's scientific triumphs have reflected on the university, of which he has so long been the illustrious ornament. They grieve to think that the circle of colleagues and fellow-workers, to whom he has been endeared by the kindness of his heart, the uprightness of his character and the honorable simplicity of his life, must lose the immediate offices of a friendship so highly prized as his. And they beg him to carry with him into his retirement from academic life the assurance of their warm personal regard, of their sincere respect for the fidelity with which he has discharged his duty to the university, of their gratitude for the luster which his achievements have shed upon it, and of their hope that the evening of his days may, under the blessing of God, be prolonged and peaceful.

In replying Lord Kelvin stated:

I am deeply touched by the kind expressions regarding my duty to the university during my 53 years' tenure of the chair of natural philosophy. I can truly say that I have always endeavored to the utmost of my ability to act for the good of my students in my class and to maintain the honor and the usefulness of the university; but I feel keenly conscious of many shortcomings, and it is a most valued solace to me on the occasion of my retirement to receive such an assurance of approbation as is now given to me by the University Court.

The happiness which I have enjoyed during 67 years' residence in the university and my treasured recollections of the intercourse and of association in work with colleagues and students make it peculiarly painful to me to cease to be professor and to cease living in the university. But I hope that this double change will not imply anything like total loss either of intercourse or of association in scientific work, and I look forward with some degree of satisfaction to being permanently connected with the university in an appointment as research fellow, for which I have made application to the Senate.

Consular Reports.

ELECTRIC PLANTS IN GERMANY.

A most interesting feature of this Empire's development is found in the number of electric plants in course of construction and projected. French writers, notably Emile Gautier, Charles Bos and J. Lafargue, are trying just now to arouse French emulation. It seems to me that American manufacturers might obtain contracts to furnish some of the materials needed in the plants. A large company has been organized here to build an electric railroad from this city (Chemnitz) to Burgstaedt, 12 or 15 miles away. As projected, the road is to be run through many large and important villages. If continued to Mitweida, as some think it will be, should no rival concern open an opposition line, the distance covered will amount to 30 or more miles. There is also a project to build a central electric plant for supplying the road with power and the villages through which the road is to pass with electricity for light. Chemnitz has a population of nearly 200,000 souls the towns included in the plans referred to contain about 75,000. The company expects to expend $357,000 on the road, and a similar amount on the buildings. Besides this, a cable road is being surveyed to Augustusberg, a well-known resort a few miles outside the city. While the proposition to patronize home industries is very strong here, I cannot help thinking that we must have certain things which, once seen, would win their way to favor.

An interesting question is: How can an American house hope to obtain concessions or contracts? The best way, it seems to me, would be to send one or two experts, familiar with electric plants and their needs, to study the situation. What is true of Chemnitz is true of almost every city in the Empire. In the month of June there were 330 railroads projected in the Empire. Of these, 73 were electric roads; 122 electric plants were projected during the same time. It would be easy for an expert to keep himself posted, by visiting or communicating with the United States consuls-general in Berlin, Frankfort and Dresden. Patriotism has seldom been pushed so far as to force private companies to take inferior or dearer home products.

The market here just now is so large—consequently so important—that an effort should be made to sell in it, even at the risk of not making a great deal of money at the outset. The methods that have helped at home must help here. A report made by an expert who has gone carefully over the ground would supply specific details in a way not possible to consuls.

J. C. MONAGHAN,
Consul.

Chemnitz, July 25, 1899.

GERMANY'S INDUSTRIAL PROGRESS IN RECENT TIMES.

Emile Gautier says:

A 500-page book, just out, puts Germany's position in electricity in a very bright light. The book is entitled The Distribution of Electrical Energy in Germany (Die Verteilung der Elektrischen Energie in Deutschland). Charles Bos, an ex-Parisian city councilor ,an electrical engineer of Paris, and one J. Lafargue tell of their travels in Germany. The people in this Empire lent willing hands to make help the book as perfect a piece of advertising as possible, by lending excellent illustrations and photographs. One can notice that it is only the French who believe in industrial and military secrets. Almost everywhere else, manufacturers are so sure of themselves that they scorn petty and annoying regulations. They open wide their doors to visitors.* "That is the rule in Germany," continue the writers referred to. Germany does not lose by this boldness. The progress in electricity is astonishing. One can count not less than 40 companies with a capital of at least $90,000,000. These pay dividends running from 7 to 25 per cent. The field of their activities is not bounded by the borders of the Empire; the whole world is full of their fame. It is all the more astonishing when one remembers that the year 1891 saw the beginning of the large plants. Since then one company alone, the Allegemeine Elektricitaets-gesellschaft, turned off and delivered, from 1896 to 1897, 5,189 machines, erected more than 100 central stations, and equipped and started 65 railroads.

TRADE OPENINGS IN SOUTH AFRICA.

Consul-General James G. Stowe, at Cape Town, states that Pretoria and Cape Town have decided to extend their electric plants by purchase of additional machinery. A new electrical street railroad, 11 miles in length, will be built from Cape Town to the suburbs. The street car lines in Durban will be taken over by the municipality and electricity substituted.

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CONTENTS:

SCIENTIFIC KNOWLEDGE AND ITS UTILIZATION BY ENGINEERS.

The old axiom still holds true, "it is not what we know that counts but the use we make of it," as far as the success of engineers is concerned. The experience of a large majority of professional men is wholly unsatisfactory. Men who pride themselves upon the thoroughness of their knowledge as well as its extensiveness incline to the pessimistic belief that education has no value. A further consideration will bring to light the idea that neither experience nor the possession of knowledge leads to success, but largely a full comprehension and grasp of those circumstances which lead in successive steps to worldly advancement. This inherent quality born in some and developed by hard knocks in others is somewhat tersely expressed as 'business ability.' It is not the power to scalp your neighbor, nor its full equivalent, the legal right which sometimes comes in a man's way to avail himself of a client's weakness, but largely a knowledge of the best direction in which to apply various elements of education so as to give them commercial value. Could Helmholtz or Lord Kelvin have founded and successfully managed the Krupp Iron Works abroad or the rolling mills of Andrew Carnegie in our own country? Yet, on the other hand, neither Krupp nor Carnegie could be kept even by force in a quiet laboratory, there to pursue investigations through tortuous channels of abstract thought with the aid of a few odds and ends of philosophical apparatus. The truth of the matter is that the most prominently successful men are those that have hit upon the right idea concerning themselves ;they have worked along the lines of least resistance, applying the knowledge they possessed and acquiring more as it was needed or buying it. The question is often raised "how can a college produce engineers?" and those that scoff at such institutions point to self-made and comparatively uneducated men whose names have been immortalized. They point to Edison and Morse and Howe, claiming that such men as these became great simply because their minds were not lumber houses nor high-class storage warehouses. All successful men, whether educated or uneducated, have had their setbacks; many that the world knows of and quite a few that remain unknown. In the engineering profession the graduate of a large college with a degree strapped to his back finds a moderate amount of appreciation awaiting him at the very beginning. And in no other profession can ability be so clearly demonstrated and so well paid for, except perhaps the genius in literature, than the normal engineer. The lawyer, the doctor ,the artist, all must bide their time, but the engineer with some business training represents to a large extent the means through which this country has developed along broad lines and in a manner so progressive as far as inventions and their applications are concerned that the hitherto greatest manufacturing nation on the face of the globe has been awakened from its state of slumbering indifference.

In the engineering profession we find two classes of men, one who evolve ideas capable of future development through the possession of an inate power of invention, the other who crystallize the idea, organize large companies, and generally possess all they require, living or dead. The situation is very clearly set forth in an article found in the "Engineering Record:" In most cases it is considered that a scientific or professional education rather unfits a man for a business career. Now, while an engineer should not be expected to be a business man in the fullest sense of the term yet the very nature of his work makes many demands of a business nature upon him. How often we find men of high professional attainments earning far less than their abilities warrant just for lack of the business knowledge and training, by possession of which some otherwise inferior man reaps the fruit of the other's skill and labor. It is not only scientific knowledge that should be acquired but the art of utilizing it as well."

THE COPPER TRUST.

The high price of copper which now prevails will be subject to fluctuations if certain interests which are now concentrating produce the desired results. Three new copper companies were organized in the office of the New Jersey Corporation Agency within the last two weeks. They represent an aggregate in capital stock of $16,000,000.00, and in all probability represent a rather well defined nucleus around which other aggregations will be made. The Amalgamated Copper Company, with a cornerstone in the person of John D. Rockefeller, may not enjoy the sinecure it had in prospect. This combine which was to have had a capital of more than a billion dollars has declined to the pitifully small sum of $75,000,000.00. This includes such mines as the Anaconda, Colorado Smelting, Santa Rita, Parrott and Washoe. In Arizona the cost of producing copper is about three cents a pound, and if sold here for ten or eleven cents it brings in a pretty fair return for an investment of three. Yet the latest quotation is in the neighborhood of eighteen cents a pound. With the development of the new mines the price put up by the copper trust will be pulled down and this uncalled for rise suppressed. Certain mines in North Carolina have been opened up and by the beginning of next year will deliver some two hundred thousand pounds a day at the limited price of ten cents per pound.

THE FIELD OF EXPERIMENTAL RESEARCH

BY PROF. ELIHU THOMPSON.

(Continued from Page 158.)

There is much room for experimental work in this fascinating field. We need for it the means for the production either of a continuous electric discharge at from 60,000 to 100,000 volts or a high-frequency apparatus capable of giving an unbroken wave train; that is, a succession of high period waves of current without breaks or intermissions.

The ordinary high-frequency apparatus for obtaining discharges of high potential from alternating currents gives only a rapid succession of discharges, each consisting of a few rapidly dampened oscillations. These discharges occupy but a small fraction of the total time. This is very different from a continuous sustained wave train, with the successive waves of equal amplitude following each other without break. Such sustained waves will, doubtless, be of use in research, especially in vacuum-tube work, and they would, of course, convey much more energy than the usual broken or interrupted discharge known as a high-frequency discharge.

Some six or seven years ago I endeavored, while working upon the subject of high frequency, to fill the gap. The result was an apparatus which, with its modifications, deserves more study and experiment than I have been able to give to it. A brief description may not be out of place. A large inductance coil, with a heavy iron wire bundle for a coil, a coil of relatively few turns with no iron core, and a condenser of variable capacity, were connected in series across the mains of a 500-volt electric circuit. The smaller coreless coil and the condenser were arranged to be shunted by an adjustable spark gap with polished ball terminals. By simply closing for a moment the spark gap so as to form a low resistance shunt around the condenser and the small coil, and afterward slowly separating the balls, the local circuit of the condenser, small coreless coil and shunting gap become the seat of sustained oscillations, the frequency of which depends upon the relation of inductance and capacity in the local circuit. The energy supplied is that of a continuous current through the large inductance coil with the heavy core. The action of the apparatus is easily comprehended by a little study. The oscillating current in the local circuit may be made to induce much higher potentials in a secondary circuit inductively related thereto. In this case the turns of the secondary, in relation to the primary, are, as usual, such as to step-up the potential. In other words, the potential developed in the secondary is determined by the transforming ratio.

We have thus a high-frequency apparatus in which the waves are sustained in an unbroken series, and we employ as the source of energy a continuous current circuit. It shows that we may continuously supply energy to an oscillating system and so keep up the amplitude of electric oscillations, the frequency of which is that due to the capacity and induction of the part of the circuit in which oscillations are set up.

While, in the forms of high-frequency apparatus alluded to, we may obtain almost any differences of electric potential up to millions of volts, assuming the apparatus large enough for the work, we do not get a sustained separation of positive and negative charges, as in the static machine, or in a less complete degree with the inductive coil. Professor Trowbridge of Harvard has, however, made use of the Planté rheostatic machines, the condenser plates of which are charged in parallel from 10,000 small storage cells connected in series. The discharge of the condenser plates is effected after they are connected in series by a suitable connection changing frame moved for the purpose. Very high potential dischages are thus obtained and the polarity is always definite. It is manifest that the size of the apparatus and the perfection of its insulation determine its possible performance. The objection to such an apparatus for experimental research or demonstration is the large number of cells required and the complicated arrangements of circuits for charging them. I have, however, recently succeeded in removing all necessity for the presence of charging cells, and have produced what may be termed a dynamostatic machine, which is worked by power or by current from a lighting circuit, either continuous or alternating, and may replace a static machine. It is, of course, not dependent upon the weather. I trust it may be of sufficient interest to merit the following brief description: A small electric motor has in addition to its commutator a pair of rings connected to its armature winding for obtaining alternating currents. The shaft of the motor drives synchronously a revolving frame bearing connections which, as in the Planté rheostatic machine, connect a series of condenser plates alternately in parallel for charging and in series for discharging at high potential. A small oil-immersed step-up transformer has its primary connected to the brushes bearing upon the two alternating-current rings of the motor, and its secondary, giving say 20,000 volts, is periodically connected to the condenser plates while in parallel by means of the revolving connection frame. The adjustment is such that only the tops of the alternating waves or their maxima are used to charge the condenser plates, while, also, those halves of the waves which are of the same polarity are alone used, the others being discarded or left on open circuit. The apparatus may be driven by power, in which the electric motor becomes a dynamo, exciting its own field and supplying alternating current to the primary of the step-up transformer, or suitable alternating currents may drive it as a synchronous motor. Such a machine, run by continuous currents and having only 11 plates, gives sparks between its terminals over twelve inches long in rapid succession. It can be built cheaply, and is a highly instructive machine from the transformations it illustrates.

The machine is also arranged by a simple attachment, so that it may be used to charge insulated bodies, or to charge Leyden-jar condensers or the like, replacing the ordinary static machines. It might, in fact, be used to charge a second range of condenser plates in another rheostatic machine to a potential of 100,000 volts, for example. These, after coupling in series or cascade, might be made to yield potentials beyond any thus far obtained.

(To be Concluded.)

PORTABLE ELECTRIC MOTORS.

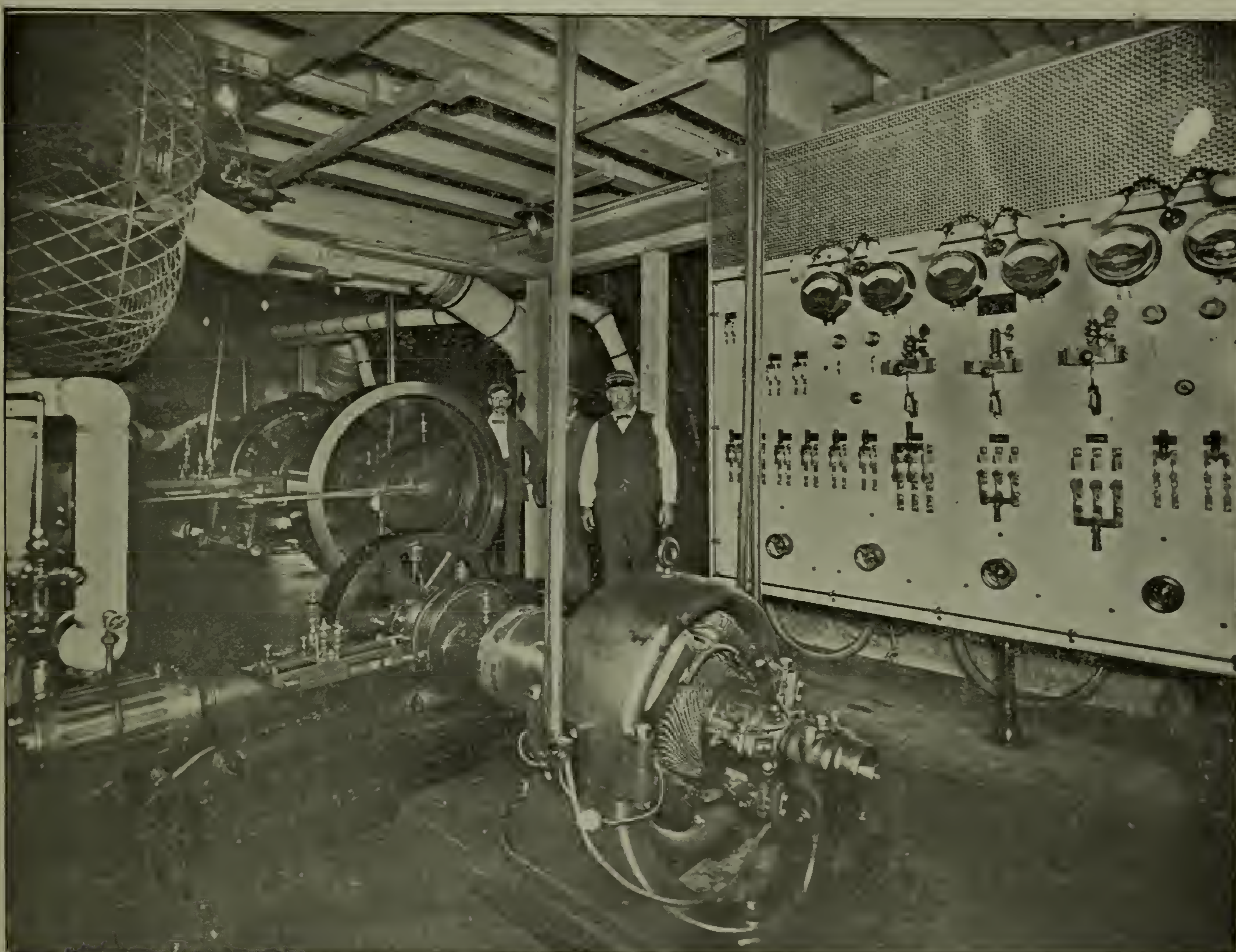
Electric motors are so light that those of considerable power may be moved from place to place with the tools to be operated, but it has not been easy to provide a suitable source of electric current that can also be easily transported. The portable generator of M. Albert Collet is claimed to solve the problem. This consists of a 4 horse power gasoline engine connected by gear wheels with a small dynamo, the whole being mounted on a frame having a pair of wheels at one end and a pair of handles and legs at the other. By means of the handles, the apparatus, weighing about 1,100 lbs., can be readily moved about by one or two men. While intended for supplying energy to the electric motors of light machine tools, the generator is found to be well adapted for electric lighting in out-of-the-way places, for charging the storage batteries of automobiles, and many other purposes. It lights from 4 to 6 arc lamps and 30 or 40 incandescent lamps.—Ex.

Electric Light and Power.

ELECTRIC PLANTS; ISOLATED AND MUNICIPAL.

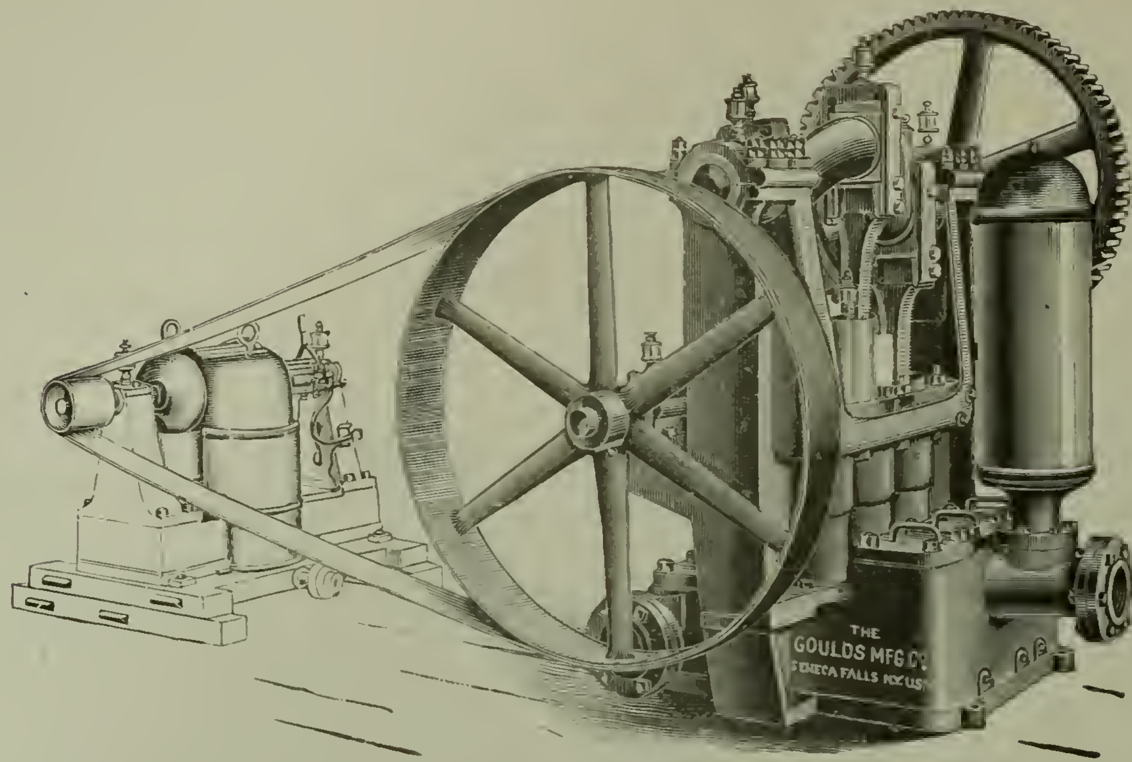
Since 1884, when the first great volume on electric lighting appeared, electricians, as the saying goes, kept their light hid under a bushel, but to-day, in contrast with that period, everything is changed. In 1884 Mr. J. E. H. Gordon produced a very bulky volume entitled, "A Practical Treatise on Electric Lighting," which described pretty thoroughly all the electrical machinery then in vogue. To-day not five per cent. of that machinery is in use; it has been relegated to the scrap heap and the methods employed then are now only a recollection.

The great landmark in electric central stations, the Pearl Street Station in New York City, was operated continuously from the fall of 1882 until about '92, when fire removed this historic electric landmark. In that early plant Jumbo dynamos were used, each direct connected to its own engine. In the new station at the corner of Pearl and Elm streets, triple expansion engines and colossal generators co-operate in the production of Niagaric flows of current. In the figure we show an illustration of one of the Edison installations with the new type of dynamo, dating back to '91, in operation. The station was then incomplete, was belt driven from a central line of shafting, yet became one of the most successful installations of its kind. This central station fairly represents the type which has been used for a number of years in great cities. In the smaller cities and towns, where land is not so valuable, it is usual to place the boilers on the ground floor, with the engines and the dynamos placed either upon the same floor or upon the floor above. One arrangement of a central station with the boilers, engines and dynamos all on the same floor is shown in the cut. Two engines are shown, with a dynamo driven by a belt from each fly wheel and beside the engine a shaft is coupled so that additional dynamos may be belted from its pulleys. In another illustration is shown the dynamo and engine room of a small power house. The switchboard of this station is shown and a large collection of feeders radiate from it. On the upper section are the ammeters, automatic circuit breakers, switches, etc., and on the lower the main switches for lighting and power distribution. The main busbars have been attached to the back of the switchboard.



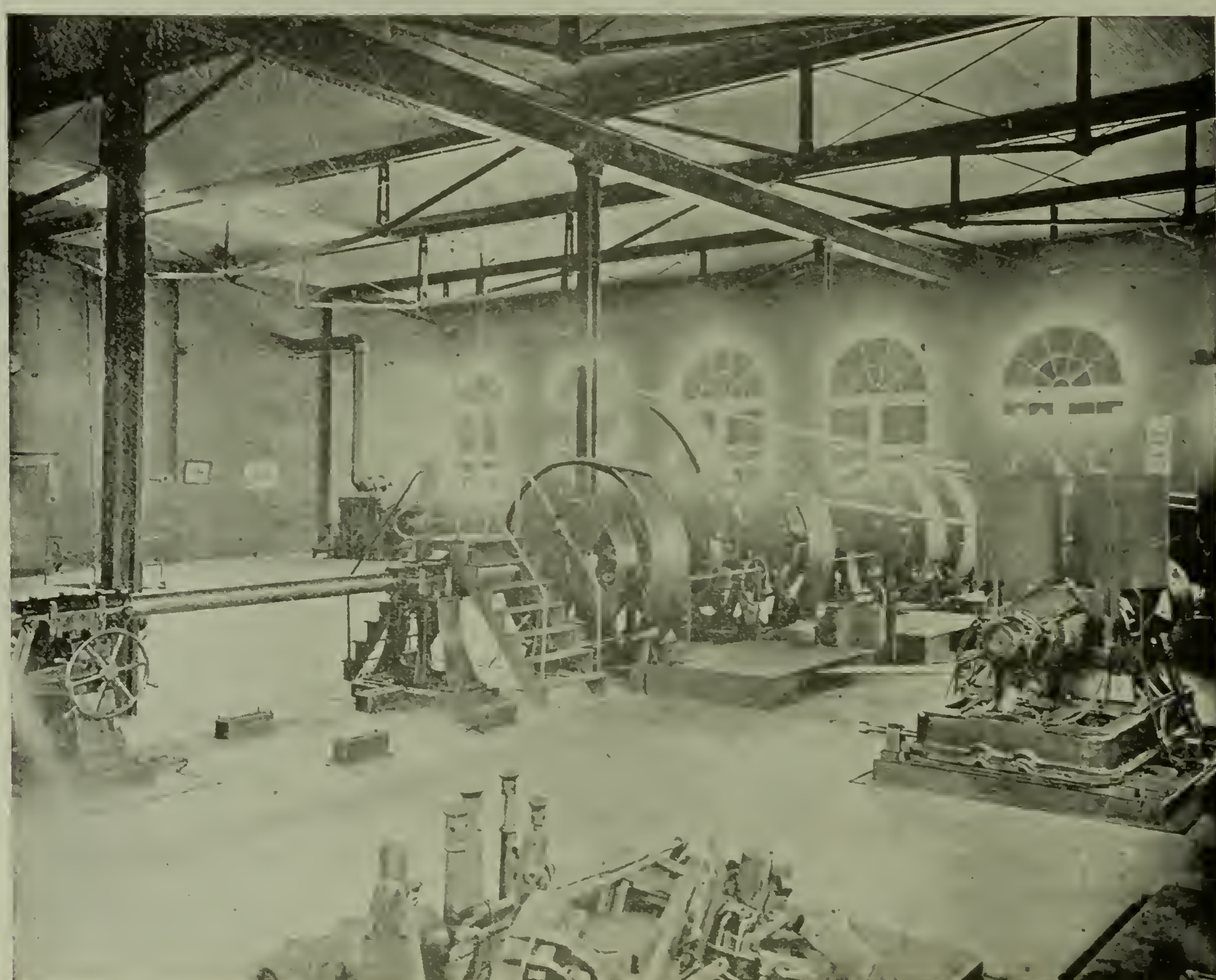
Small, Up-to-Date Street Railway Plant.

The present prevailing system of metering and registering power dispenses entirely with the zinc-sulphate meter of earlier days. The Edison Illuminating Company, by the installation of these registering meters, have supplied an excellent antidote for arguments relating to power consumption, advanced by the consumer,



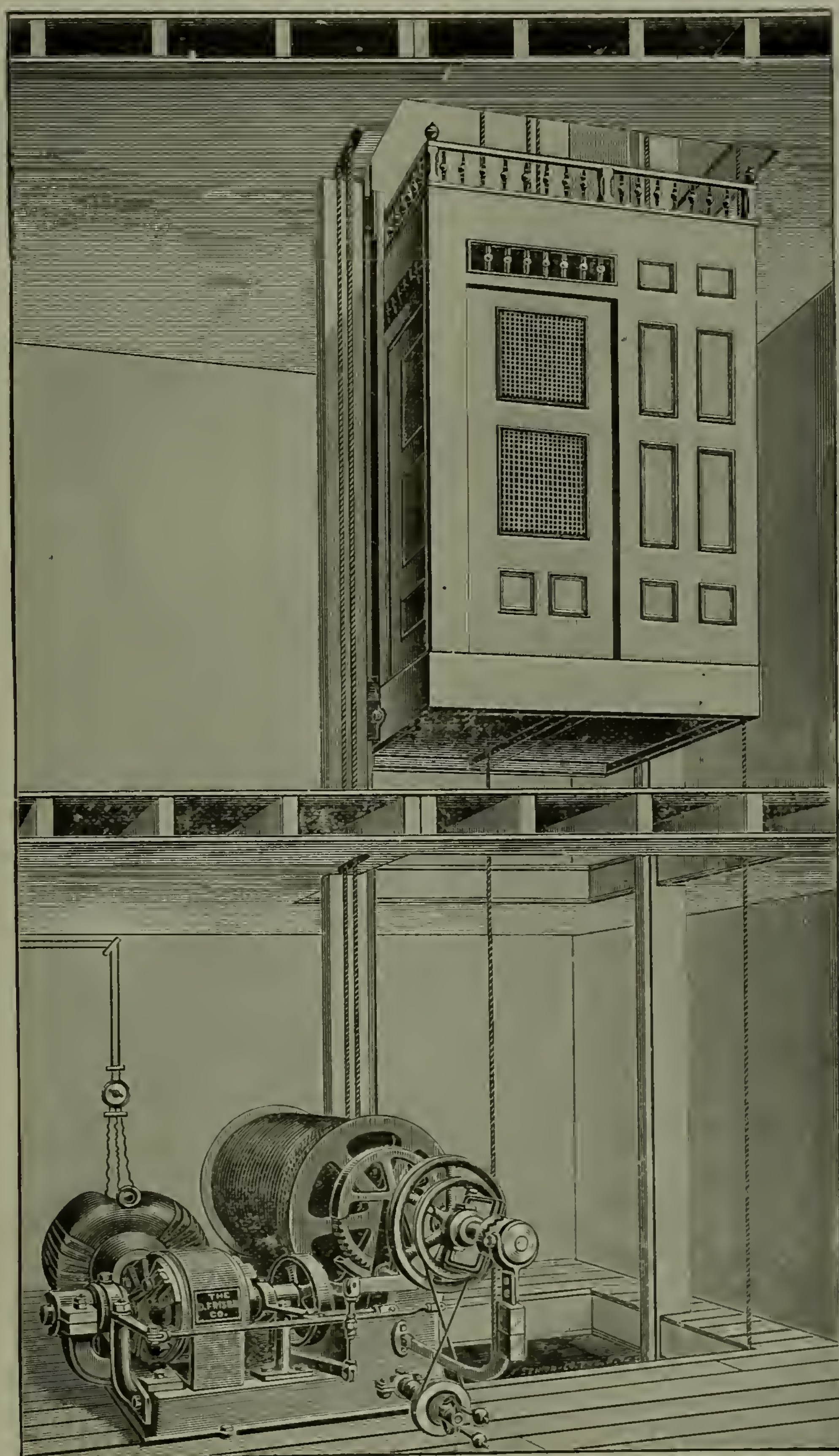
Goulds Pump, Direct Connected to Electric Motor.

as he now reads off the power as it is being used. During five or six years past electric motors have come to be



Belt Driven Plan, Edison Bi-Polar Dynamos.

almost a necessity to people living in small cities who use small amounts of power. The number of electric motors used in the United States in 1889 barely reached one thousand horse power. In 1894 the Edison Illuminating Company supplied power to motors in New York and Chicago, exceeding a total of eight thousand horse-power. Large numbers of fans and ventilators, pumping and elevator motors are now used in all the large cities. In fact, electric motors are as necessary to the small users of power who live in American cities as gas engines are to the citizens of Paris. An interesting use of fan motors is made on the electrically lighted trains of the Pennsylvania Railroad and the Chicago, Milwaukee & St. Paul road. Nearly all the large theatres and places of public amusement in all large cities are similarly provided.



A Recent Type of Electrical Elevator Installation.

The use of motors instead of belting and shafting has proven that from one-third to three-fourths of the power of an engine is actually wasted in making shafts revolve and running belts and gears. In the Baldwin Locomotive Works eighty per cent. of the power is lost; in the Yale & Towne Company forty-nine per cent; in the Union Iron Works twenty-three per cent. Not only is this a large figure for coal alone at the end of the year, but shafting, belting and overhead machinery transmitting this power are expensive to install. With a properly arranged electrical distribution as much as one-half or three-fourths of the power developed by the engine may be delivered at the point where it will be of use. Some of the most successful elevator plants in this city are now operated by electricity and the introduction by the Goulds Manufacturing Company of electrically driven pumps has caused the proper recognition to be made of this new and interesting application of electric power.

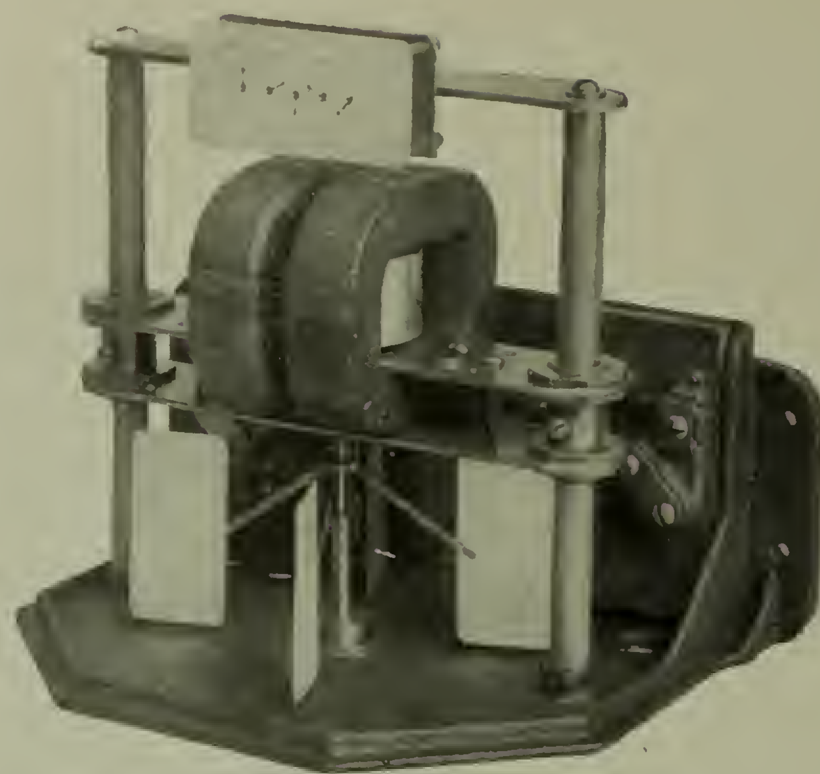
DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

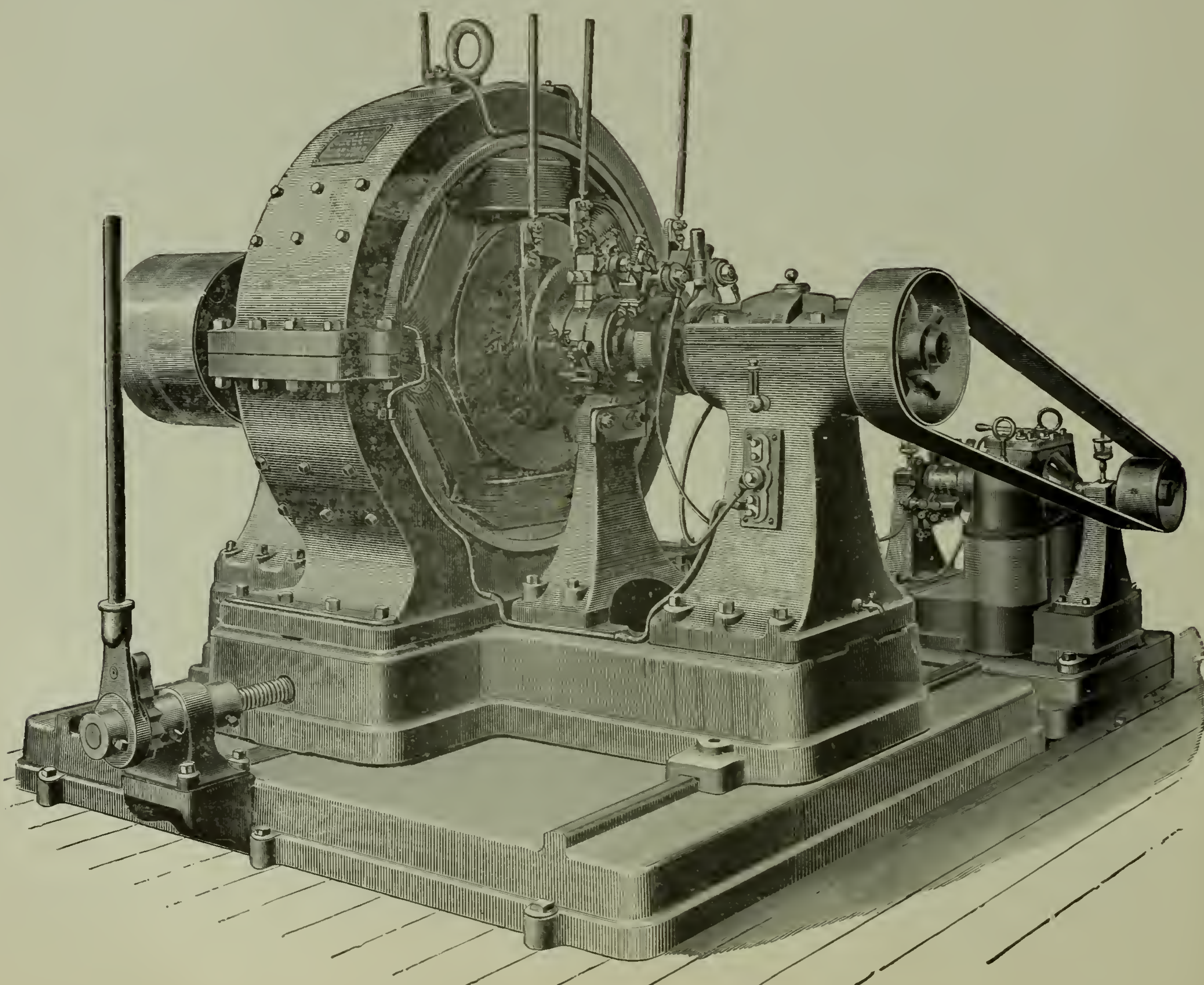
[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of "Answers to Inquiries."*]

POINTERS IN ALTERNATOR DESIGN.

The rapid spread of three phase and two phase transmission plants, the use of inductor alternators and their accessories, has detracted from the interest which was once taken in the alternator of an earlier period. The separately excited alternator, as shown in sketch, is found mainly outside of our large cities. In small towns and villages of four or five hundred families electric lighting, aside from its cheapness and convenience, is regarded by the authorities as an indication of progress. From an economic standpoint the stockholders realize that the absence of restrictions as to pressure and poles enables them to carry the current cheaply to the doors of consumers. In the alternator of good construction and design little trouble is ever experienced from heating although it frequently happens that a celestial sky rocket would injure the prestige of the village for a few days, due to the absence of efficient lightning arresters. When the external circuit to which an alternator is connected is inductive the number of armatures turns which gives a maximum active pressure is smaller than when the outside lines are free. It is impossible to put so many turns on commercial alternator armatures that they give the greatest output, because the regulation in constant pres-

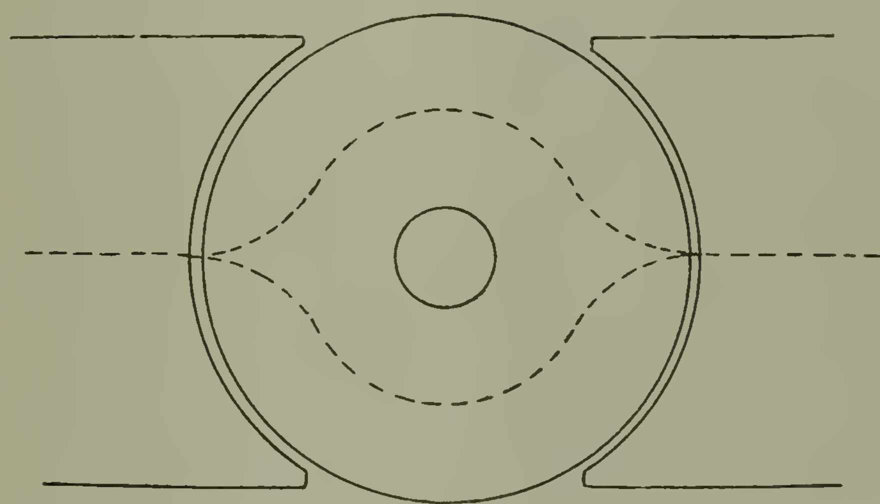


Power Registering Meters for Consumers' (See Page 187.)



Six Pole Alternator. Constant Potential; Separately Excited.

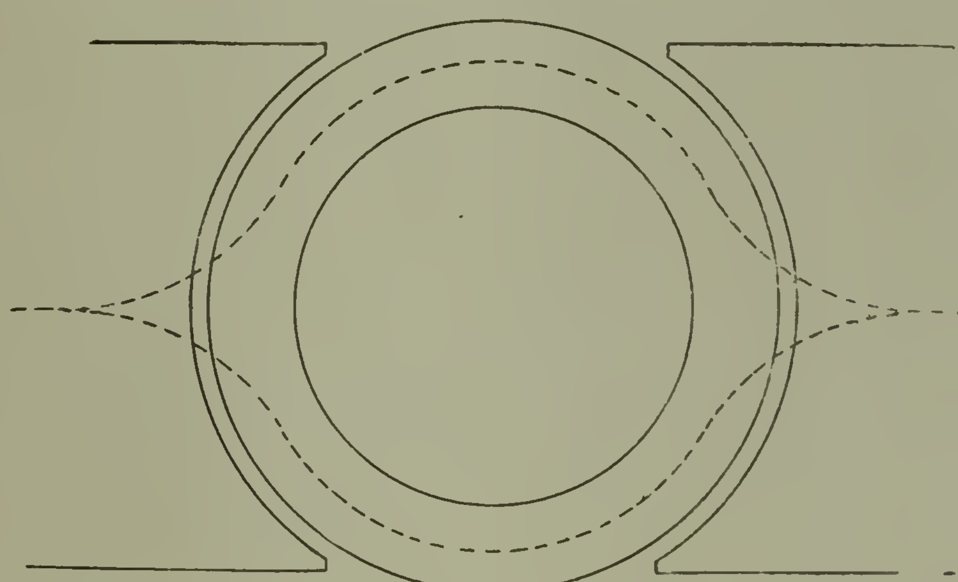
sure alternators demands that the fall of pressure in the armature shall be as small as possible. In a fifty kilowatt alternator of one thousand volts terminal pressure and fifty amperes, for a frequency of sixty with a smooth core armature with pancake coils, we will have the following: eight poles, diameter of armature core two feet; coil generates one hundred and forty volts; each pole will be four and three quarter inches by two inches. The cross section of armature conductors will be 26,000 circular mills or a number 6 B. & S. wire. There will be two hundred and fifty-eight conductors or sixteen turns per coil. The other details of construction are largely mechanical. The above figures can be verified in "Alternating Currents," by D. C. and J. P. Jackson.



Magnetic Circuit Through Drum Armature.

MAGNETIC CIRCUIT IN DRUM AND RING ARMATURES.

The amateur designer is frequently prevented from making rapid progress in estimating the length of a magnetic circuit through a dynamo due to his lack of knowledge regarding the mean path through drum or ring armatures. In the accompanying illustrations the drum armature is shown with the path traced in dotted lines. Either the entire cross section of the armature can be taken, with the path equal to the dotted line running through above or below, or one-half the cross section can be taken and one single path considered as the mean length. In other words, if the dotted line above and below measures five inches that is the mean path for the entire cross section of the armature. In the Gramme ring, also represented, the same holds true, the total cross section being equal to twice the cross section of the ring. Therefore, if the cross section of the Gramme ring is ten square inches the total cross section is equal to twenty square inches and the mean path is equal to that of one dotted line, either above or below.



Magnetic Circuit Through Ring Armature.

USING THE KINETOSCOPE IN THE AGRICULTURAL DEPARTMENT.

The Agricultural Department has pressed the moving picture machine into the service of science. The division of vegetable pathology now has a device in operation in one of its greenhouses, photographing the growth of a small oak tree. The machine works automatically, taking a picture each hour. At night an electric light is thrown into circuit as the exposure is made. The machine has been running about two weeks, and will be kept going about two weeks longer on its present subject. When the series of pictures are completed, it will be possible to reproduce with the stereopticon the growth of the plant from the time the first shoot apeared above ground till the tree is in full leaf and a foot or more high.—Ex.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FOR WEEK ENDING SEPT. 23, 1899, $55,106.

New York, N. Y., Sept. 23, 1899. The following exports of electrical materials are from the port of New York for the week ending this date.

Antwerp.—30 cases electrical material, $4.

Amsterdam.—8 cases electrical material, $450.

Argentine Republic.—117 cases electrical material, $8,920.

Brazil.—Cases electrical material, $191.

British East Indies.—1 package electrical material, $15.

British Possessions in Africa.—101 cases electrical material, $5,750.

Bremen.—1 case electrical material, $49.

Bristol.—2 cases electrical material, $44.

Central America.—96 packages electrical material, $497.

Copenhagen.—3 cases electrical motors, $87.

Dutch West Indies.—2 packages electrical material, $46.

Ecuador.—1 case electrical material, $13.

Glasgow.—79 cases electrical material, 7,025; 2 electrical machines, $210.

Genoa.—2 cases electrical material, $16.

Havre.—81 cases electrical material, $9,578.

London.—48 packages electrical material, $5,309; 26 cases electrical machines, $4,210.

Liverpool.—135 packages electrical material, $7,528; 3 packages electrical machines, $49.

Mexico.—260 cases electrical material, $1,491; 4 cases electrical machines, $778; 1 case electrical machinery, $779; 1 case electrical machines, $27.

New Zealand.—1 package electros, $180.

Peru.—7 packages electrical material, $115.

St. Petersburg.—13 cases electrical material, $1,399.

Venezuela.—46 packages electrical material, $345.

CANADIAN ELECTRICAL NEWS.

(Special Correspondence to the Electrical Age.)

Montreal, Sept. 22, 1899.

Hamilton, Ont.—In connection with the acquisition of the street railway systems by the Cataract Power Co. syndicate, it is stated that another transmission line will be constructed between the power house and Hamilton. Plans for introducing electricity as a motive power at the sewage disposal works are under consideration by the city engineer.

St. Catharines, Que.—The St. Catharines Hydraulic Co. has been incorporated, capital $40,000, to produce and distribute electricity. T. R. Merrit, W. H. Merrit and J. H. Ingersoll are provisional directors.

Teeswater, Ont.—The council is considering the purchase of the existing electric light plant and the erection of a stand pipe for waterworks purposes.

Kamloops, B. C.—The ratepayers voted on a by-law to raise $27,000 to improve the waterworks system, and $10,500 to extend the electric light plant.

Winchester, Ont.—The council is negotiating with Eager & Sanderson to light the streets of the town.

Arnprior, Ont.—At a meeting of the council on August 9th a franchise was given to R. Andersen, of Ottawa, for street lighting.

Weston, Ont.—The council has decided to submit to the ratepayers a by-law providing $6,000 for the purchase of an electric light plant. A waterworks by-law may be submitted at the same time.

Quebec, Que.—The Canadian Electric Light Co. will shortly let contracts for power house, hydraulic and electric machinery and transmission line. T. Pringle & Son, of Montreal, engineers in charge.

Liverpool, N. S.—The contract for an electric light plant has been awarded to the Royal Electric Co. at the price of $8,580. The Canadian General Electric Co. tendered at $8,697, and F. W. Clarke $8,508.

Coaticook, Que.—The Coaticook Electric Light & Power Co. have made application for exemption from taxation on proposed plant to be used as an auxiliary to the present lighting station.

Almonte, Ont.—Voting on the by-law to raise $30,000 for an electric light plant will take place on September 25th.

ELECTRIC RAILWAYS.

Montreal, Que.—Plans have been prepared by Ed. Maxwell, architect for a clubhouse, for the Montreal Street Railway Co., to be built at the corner of Harbor and St. Catharine Sts. The Demerara Electric Co. has been organized in this city for the purpose of doing business in Demerara. The company has purchased the franchises of the British Guiana Light & Power Co. and the Georgetown Tramway Co. and will convert the street railway system in Georgetown into electricity. W. B. Chapman, James Hutchison and B. V. Pearson are provisional directors.

Ottawa, Ont.—The Ottawa Electric Railway Co. at a meeting held last week decided to commence immediately the extension of its line to Britannia. The distance is about seven miles.

Smith's Falls, Ont.—Mr. Martin, architect of this town, has a scheme on foot for connecting the summer resorts along the Rideau River with an electric railway. He has secured a lease of the water power at Jones' Falls.

Erie, Ont.—Mr. E. Baxter, of Fort Erie, is said to be looking into the question of building an electric railway along the Canadian bank of the Niagara River from Fort Erie to Chippewa.

Toronto Junction, Ont.—The Toronto & Suburban Railway will probably be extended to Islington and Cooksville.

Berlin, Ont.—The Berlin Gas & Electric Light Co. are reported to be considering the building of an electric railway to Preston. Should this step be decided upon a new power house will likely be erected.

Tessalon, Ont.—It is said that the Rock Lake Mining Company purpose constructing an electric railway from Bruce Mines to their mine.

Nelson, B. C.—The power house of the Nelson Electric Tramway Co. will be built at the eastern boundary of the city limits. Mr. C. S. Drummond is president of the company.

Toronto, Ont.—The York township council at a recent meeting considered the proposed Avenue road and Mount Pleasant extension of Toronto Street Railway.

Winnipeg, Man.—It is reported that the Winnipeg Street Railway Co. will build new car barns next year.

J. Alcide Chausse.

The Electrical Age.

Vol. XXIV—No 15. NEW YORK, OCTOBER 7, 1899. Whole No. 647.

Conventions.

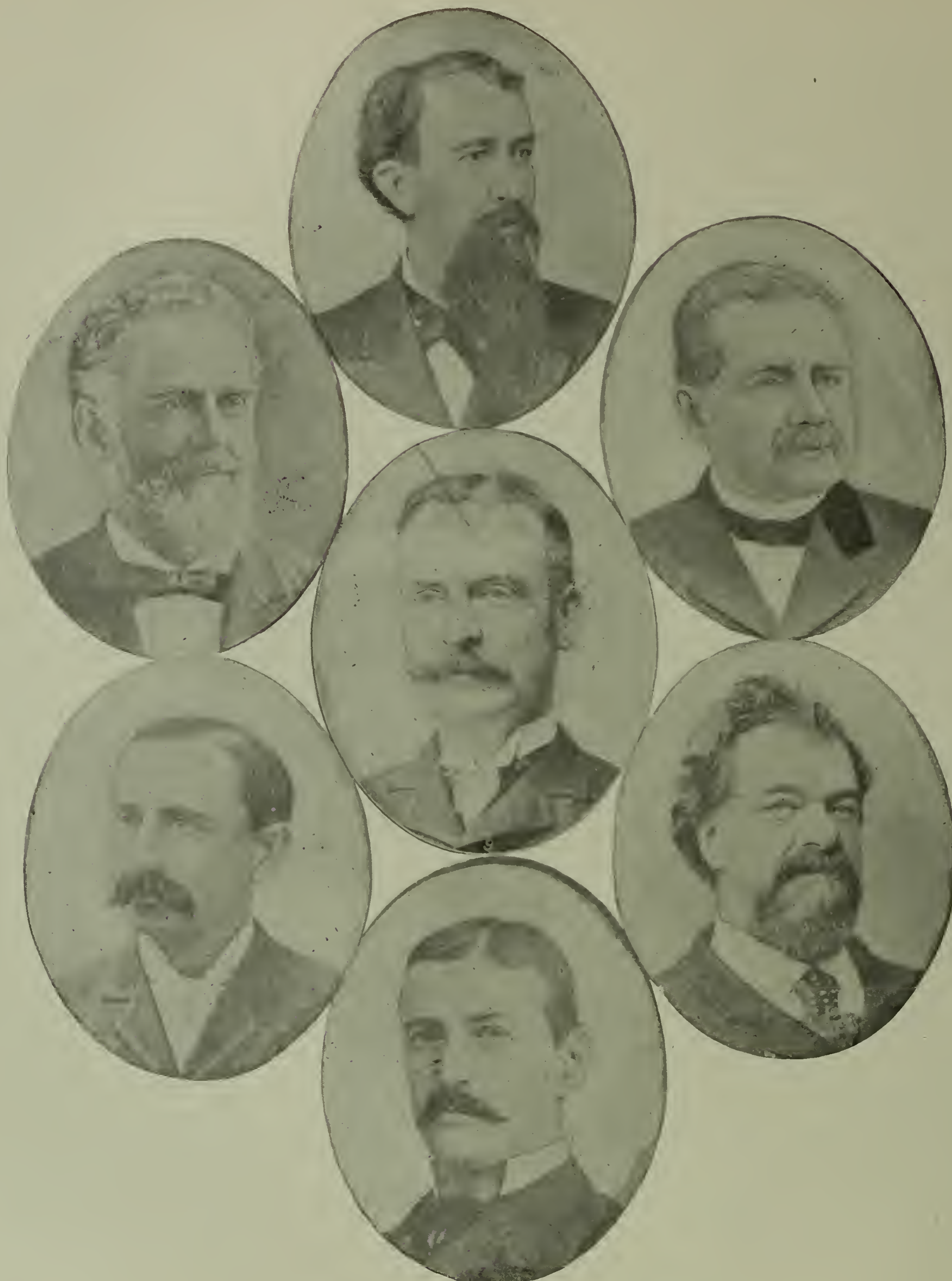
C. S Sergeant, President, American Street Railway Association.

THE EIGHTEENTH ANNUAL MEETING OF THE AMERICAN STREET RAILWAY ASSOCIATION.

The eighteenth annual convention of the American Street Railway Association will be held at Tattersalls, State and Sixteenth streets, Chicago, on October 17, 18, 19 and 20, 1899. The headquarters of the association will be at the Auditorium Annex, opposite the Auditorium Hotel. The following papers will be read: "Maintenance of Car Equipment." "Modern Street Railway Shops; Their Design, Machinery and Shop Practise." "Train Service and Its Practical Application." "Investments in Street Railways; How Can They Be Made Secure and Remunerative?" "Construction and Maintenance of Street Railway Tracks." The annual banquet will be held Friday evening, when the newly elected officers will be installed. In connection with the convention there will be an exhibition of street railway supplies, all space for the same having already been contracted for. The following resolution, regarding the exhibition, was adopted at a meeting of the executive committee, held at Chicago February 6, 1899:

Resolved, That the last day of the convention, Friday, October 20, be set apart for the systematic and careful inspection of exhibits by the delegates, and that all street railway managers be urged to send delegations from their mechanical, operating and accounting departments to inspect the same.

A complete list of the exhibitors is herewith appended: C. F. Orr & Company, Street Railway Review, Street Railway Journal, K. McLennan & Company, the R. W. Garton Company, Electric Railway Equipment Company, Electrical Review Publishing Company, The Railway World, Safety Insulated Wire & Cable Company, Novelty Tufting Machine Company, Mica Insulator Company, Manville Covering Company, R. D. Nuttall Company, Charles N. Wood, Protected Rail Bond Com-



W. H. Hazzard.
H. H. Littell.

Thomas Lowry.
John G. Holmes,
J. S. Walsh.

T. W. Ackley.
C. A. Richards.

pany, Creaghead Engineering Company, Ohio Brass Company, Consolidated Car Heating Company, Gold Car Heating Company, Heywood Bros. & Wakefield E. T. Burrows Company, The Curtain Supply Company, The Adams & Westlake Company, General Electric Company, Harold P. Brown, The Standard Paint Com-

H. M. Watson.

C. B. Holmes.

H. C. Payne.

D. F. Longstreet.

G. B. Kerper.

Company, American Rail Joint & Manufacturing Company, A. & M. Brake Shoe Company, Hale & Kilburn Manufacturing Company, The Pantasote Company, The pany, Central Electric Company, Garton-Daniels Electric Company, Westinghouse Electric & Manufacturing Company, The Falk Company, American Steel & Wire

Company, The Consolidated Car Fender Company, Dearborn Drug & Chemical Works, American Mason Safety Tread Company, Standard Underground Cable

Robert McCulloch.

Company, American Car & Foundry Company, Adam Cook's Sons, Leschen-Macomber-Whyte Company, Al-

H. M. Littell.

bert B. Herrick, Continuous Rail Joint Company of America, American Railway Supply Company, The International Register Company, Ohmer Car Register

Company, Graham Equipment Company, Meaker Manufacturing Company, The Barney & Smith Car Company, The R. Bliss Manufacturing Company, Paige Iron Works, Milwaukee Railjoint & Welding Company, Pear-

Joel Hurt

son Jack Company, G. P. Magann Air Brake Company, Christensen Engineering Company, McGuire Manufac-

Albion E. Lang.

turing Company, Pennsylvania Steel Company, The Q. & C. Company, Griffin Wheel Company, W. T. Van Dorn Company, Pennsylvania Car Wheel Company, The Lo-

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NEW YORK, OCTOBER 7, 1899.

CONTENTS:

ELECTRICITY AT HIGH PRESSURES.

In an article by Elihu Thomson, read before the New York Electrical Society, we find certain statements which contain sufficient material to supply considerable food for thought. In discussing electricity at high pressures, particularly when such discussions are backed up by a series of experiments, it is interesting to know how far practical science reaches and speculation extends. For instance, Thomson briefly describes the production of Roentgen rays from pressures of over a hundred and fifty thousand volts, a phenomenon with which we are all more or less familiar, and then adds: "It is indeed an interesting speculation as to what might be the character of rays produced by potentials of a million volts, for example, passing through tubes, the vacua in which are made proportionately high.

The conclusions of Thomson in continuation of this idea are that rays produced under these conditions will be able to pass through metals of unusual thickness, but would produce little or no effect upon fluorescent salts. The only means of indicating their existence would be through their power of causing ionization of gases or allied changes in them. This interesting field of research becomes of more practical importance in the eyes of the commercial world on account of the recent development of Marconi's system of wireless telegraphy, which is inherently a department of applied science dealing with mere ether waves. The reflective mind will quickly realize that a difference in degree, for instance, in dealing with high pressures, instead of low pressures, is generally accompanied with some new and startling phenomena. High pressures certainly produce results much more startling than low pressures; results which from a scientific standpoint are unique and exceedingly valuable. Of course, the field of speculative science is of such enormous scope that it embraces all that is or ever will be known in the world of molecules and atoms, and in consequence of this the humblest investigator cannot help filling in certain small gaps in his experimental results which naturally occur to those gifted with the smallest particle of imagination.

Elihu Thomson concludes his article on electricty at high pressures by saying: "I am tempted to think that possibly the flame gases of the sun actually reach the upper atmosphere of the earth and break down the insulation of the layers already under electric stress or themselves bring electricity which disturbs the condition of our air. * * * The earth may in fact be brushed by an invisible prolongation of a coronal streamer, the effect of which, acting like ionized gas or flame gases through which an electrical discharge has been passed, is to make the upper thin air conduct and relieve its accumulated electric stresses."

Prof. Pupin, of Columbia University, performed some experiments a few years ago for the purpose of crystallizing his opinion regarding the electrical origin of the sun's coronae. Photographs in his possession of artificial coronae seem to indicate that he was on the right track and that Elihu Thomson approximates the truth in expressing his belief that auroral displays, solar disturbances, coronal developments on the sun, and a possible coronal stream from the earth are reactions originally caused by tremendous agitations of a mechanical, chemical, and finally electrical nature.

THE AMERICAN STREET RAILWAY ASSOCIATION.

The representatives of a large and growing organization of the above title will meet at Tattersall's in Chicago about the middle of the month to participate in what is popularly called the eighteenth annual convention. It is hardly necessary to refer to the recent and unusual development in the United States of street railways. The investment they represent collectively is enormous. In fact, so many millions are involved that no adequate idea can be formed of the sum total. The sifting process through which all large enterprises pass before they settle down to a fixed routine has been experienced by those engaged in the business of street railways.

Experience has come with increasing years, and within the last century changes of a most radical nature have occurred, eventuating in the crystallization of the most modern of systems in regard to its complete electrical and mechanical features. The old-fashioned stage coach has become an antiquity; the horse car is rapidly becoming defunct, and in all large cities and progressive towns the cable car has been replaced by the overhead or underground trolley. Electric systems have been accepted by Americans in lieu of and in preference to any of the old-fashioned methods that once generally prevailed in every town of the least importance.

The object of the above convention is not exactly that of discussing new systems of street railways, but largely for the purpose of exchanging information on the management, maintenance and equipment of surface roads. As time moves on even the nature of these meetings will change, due to the detailed perfection of each system. But until that time comes there will be sufficient intellectual employment awaiting those whose desire to be well informed is as great as their capacity for new facts. We have tried to outline the history of the American Street Railway Association and show by illustration who its executives were and are at the moment of this writing.

rain Steel Company, The Dorner Truck & Manufacturing Company Hipwood-Barrett Car & Vehicle Fender Company, Cling Surface Manufacturing Company, Wm. Wharton, Jr., & Company, Chas. Scott Spring Company, H. M. Stiles, American Brake Shoe Company, The Ironsides Company, Siegrist Lubricator Company, Morris Electric Company, Crane Company, Multiplex Reflector Company, American Vitrified Conduit Company, New Haven Car Register Company, Chapman Valve Manufacturing Company, U. S. Rocking Grate Bar Company, J. R. McCardell & Company, The Baltimore Car Wheel Company, Miller-Knoblock Company, Major Cement Company, Weber Railway Joint Manufacturing Company, Joseph Dixon Crucible Company, Taunton Locomotive Manufacturing Company, and the Taylor Electric Truck Company.

The last convention of the above association was held at Boston, which, strange to relate, was the scene of the first regular meeting of the newly born organization on December 12th, 1882. Seventeen years have passed, during which time remarkable changes have taken place in methods of street railway traction, and of necessity the original organization has grown to very large proportions. The founders or originators of the American Street Railway Association were H. H. Littell, Walter A. Jones, Thomas Lowry, Henry M. Watson and J. E. Rugg. It seems that D. F. Longstreet suggested the formation of an institution of this description which he believed would be of immense benefit to those interested in street railways, although such as did exist in those times consisted largely of horse cars.

The street railway companies of the United States and Canada received a circular letter from the above named gentlemen, inviting their co-operation in "the promotion and advancement of knowledge, scientific and practical, in all matters relating to the construction, equipment and management of street railways; the establishment and maintenance of a spirit of fraternity among the members of the association, by social intercourse and friendly exchange of information and ideas, to the end that the best service may be obtained at the least possible cost." The first meeting was called to order by the Hon. Moody Merrill, and as the meeting progressed the following members were elected as officers: H. H. Littell, president; William H. Hazzard, first vice president; Calvin A. Richards, second vice president; George P. Kerper, third vice president, and William J. Richardson, secretary and treasurer.

Some of these gentlemen have long ceased taking an active part; others have passed the last milestone of their earthly journey, yet the list of past executives is fairly complete in these pages in correspondence with the dates and places of past conventions as follows:

Second meeting, Chicago, 1882-3, President H. H. Littell; third meeting, New York, 1883-4, President Hazzard; fourth meeting, St. Louis, 1884-5, President Richards; fifth meeting, Cincinnati, 1885-6, President Walsh; sixth meeting, Philadelphia, 1886-7, President Ackley; seventh meeting, Washington, 1887-7, President C. B. Holmes; eighth meeting, Minneapolis, 1888-9, President Kerper; ninth meeting, Buffalo, 1889-90, President Lowry; tenth meeting, Pittsburg, 1890-1, President Watson; eleventh meeting, Cleveland, 1891-2, President J. G. Holmes; twelfth meeting, Milwaukee, 1892-3, President Longstreet; thirteenth meeting, Atlanta, 1893-4, President Payne; fourteenth meeting, Montreal, 1894-5, President Hurt; fifteenth meeting, St. Louis, 1895-6, President H. M. Littell; sixteenth meeting, Niagara Falls, 1896-7, President McCulloch; seventeenth meeting, Boston, 1897-8, President Lang; eighteenth meeting, Chicago, 1898-9, President Sergeant.

T. C. Pennington, Secretary, A. S. R. A.

SPECIAL TRAIN FROM NEW YORK AND BOSTON.

The committee beg to advise that they have arranged for a special train via the Boston & Albany and New York Central & Hudson River Railroads for the accommodation of delegates and others attending the above convention, as follows: Leave Boston, B. & A., 10:30 A. M., Sunday, Oct. 15; Worcester, 11:45 A. M.; Springfield, 1:14 P. M.. Arrive Albany, 4:15 P. M.

Leave New York, N. Y. C., 1 P. M., Sunday, Oct. 15; arrive Albany 4:15 P. M.

Leave Albany, N. Y. C., 4:35 P. M., Sunday, Oct. 15; Utica, 6:52 P. M.; Syracuse, 8:15 P. M.; Rochester, 10:05 P. M.; arrive Buffalo, 11:55 P. M.

Leave Buffalo, L. S. Ry., 12 midnight, October 15, arrive Chicago, 2:30 P. M., Monday, Oct. 16.

The train will consist of Wagner vestibuled drawing room sleeping cars, and dining car serving meals through to Chicago.

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of " Answers to Inquiries."*]

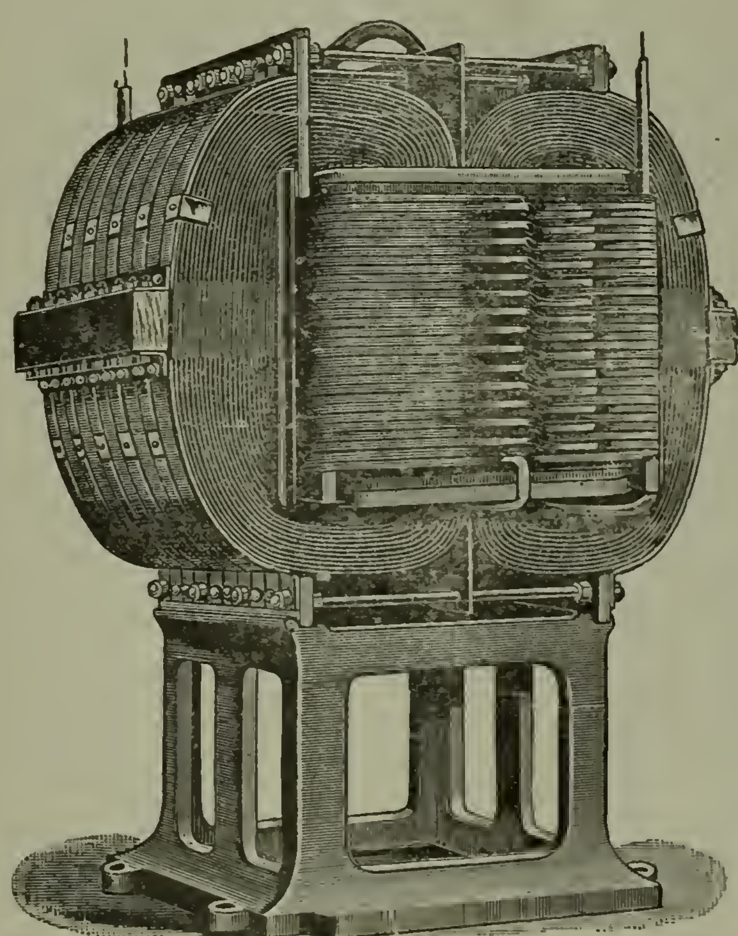
THE TINFOIL PHONOGRAPH.

In the illustration is shown one of the original tinfoil phonographs which excited so much wonder in the early history of the phonograph industry. A type of this phonograph is still on exhibition in the laboratory at New York College and the Girl's Normal School. As may be believed the sound is not very sonorous, approaching more in nature the wheezy whistle of an asthmatic patient. A sheet of tinfoil is carefully glued on the cylinder, the point of the diaphragm rests against it and the cylinder is rotated and fed forward by means of the screw shaft. It is difficult to recognize in this device the fine equipment composing the modern phonograph.

Tinfoil Phonograph.

DESIGNING TRANSFORMERS.

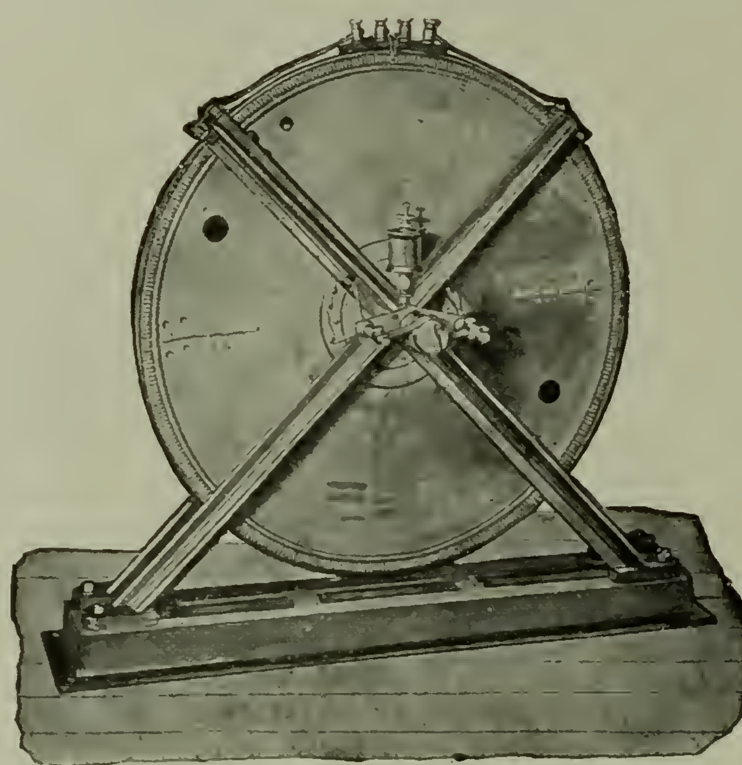
The first requisites for transformer design are highly permeable iron and a knowledge of the primary and secondary electro-motive force. A transformer to carry fifty lights and step down from two thousand volts to fifty must have the same ratio between the turns on the primary and secondary as that of the E. M. F. From two thousand to fifty volts means a ratio of forty to one. There will be forty turns in the primary to one turn in the secondary, and a resistance in the primary sufficiently great to allow no more than the needed current to pass. In the secondary sufficient current will be required to carry fifty lights, about fifty amperes in all, the size of the wire being more than fifty thousand circular mills. The cross section of the iron must be sufficient to carry the lines of force which will be low enough per square inch to prevent undue heating by hysteresis and eddy currents. In other words, transformer design calls for a careful planning of the cross section of iron and an equal care in the selection of the size of wire for each coil and its proper length.



Static Step Down Transformer, 500 Lights.

HIGH FREQUENCY ALTERNATORS.

In the illustration is shown a Tesla high frequency alternator, the average reversals of which per second exceed twenty thousand. The machine is built with a flat disk armature of mild steel and arranged around its periphery are very small coils on the pancake style, generating the alternating E. M. F. A band of wrought iron surrounding the armature has radiating inward four or five hundred short poles, composing the magnetic circuit. Coils are placed on these projections and separately excited. The rotation of the disk with its equal number of coils cuts the lines of force emanating from the poles and generates the high frequency used by Tesla in many of his experiments. With five hundred radial poles and a speed of five thousand revolutions per minute or eighty-three per second, a frequency of eighty-three times two hundred and fifty or 20,750 is produced per second. At this rate of speed and with these poles a total frequency of over one million per minute is produced.



Tesla Alternator; 2,000 Alternations per Second.

Miscellaneous.

THE FIELD OF EXPERIMENTAL RESEARCH.

BY PROF. ELIHU THOMSON.

(Concluded from Page 174.)

The interest in such experimental apparatus and the results obtained come largely from the apparent ability to secure a representation of the effects of lightning discharges upon a moderate scale, and the possibility of liquids and solids, at varying temperatures and pressures under high electric stresses. Broadly considered, however, the similarity of the effects to those produced in a thunder cloud is more apparent than real. The globules of water constituting the electrified cloud do not possess charges of millions of volts potential, the effects of which are seen in the stroke of lightning. The individual globules may possess only a moderate charge. When, however, they are massed together in a large extent of cloud the virtual potential of the cloud as a whole, with respect to the earth, may be enormous, though no part of the cloud possesses it. The cloud-mass not being a conductor, its charge cannot reside upon its outer surface or upon its lower surface nearest the earth, as with a large insulated conductor. The charge, in fact, exists throughout the mass, each globule of water suspended in the air having its small effect upon the total result.

When the cloud discharges, the main spark branches within and through the cloud-mass in many directions. The discharge can at best be only a very partial one, from the nature of the case. These are conditions which are certainly not represented in our experimental production of high-potential phenomenon, except perhaps upon a very small scale in the electrified steam from Armstrong's hydroelectric machine, a type of apparatus now almost obsolete. Yet if we wish to reproduce, as nearly as possible upon a small scale, the conditions of the thunder-cloud, we shall be compelled to again resort to it. In volcanic eruptions similar actions doubtless occur and give rise to the thunder clouds which often surround the gases sent out from the crater.

Considering, then, that the condition in the thunder-cloud are so different from those in our experiments with high potentials, we can easily understand that the study of lightning phenomena may present problems difficult to solve. Two forms at least of lightning discharge are quite unknown in the laboratory—namely, globular lightning and bead lightning, the latter the more rare of two. Personally I can not doubt the existence of both these rare forms of electric discharge, having received detailed accounts from eye-witnesses. On one occasion, while observing a thunder-storm, I narrowly missed seeing the phenomenon of globular lightning, though a friend who was present, looking in the opposite direction, saw it. The explosion, however, was heard, and it consisted of a single detonation like the firing of a cannon. According to the testimony of an intelligent eye-witness, who described the rare phenomenon of bead lightning within an hour after it had been seen, it is a very beautiful luminous appearence, like a string of beads hung in the cloud, the beads being somewhat elliptical and the ends of their axes in the line of their discharge being colored red and purple respectively. This peculiar appearance, not at any time dazzlingly bright, persisted for a few seconds while fading gradually.

Again, our knowledge of the aurora is not as yet much more definite or precise than it is in regard to the obscure forms of lightning alluded to above. Whether these phenomena will ever be brought within the field of research by experimental methods is an open question.

The endeavor in the foregoing rather disconnected statements has been to indicate directions in which the field of experiment may be extended, and to emphasize the fact that research must be carried on by extension of limits, necessitating more liberal endowment of research laboratories. I have tried to make it clear that the physicist must avail himself of the powers and energies set in play in the larger industrial enterprises, and finally that the field of possible exploration in physics by experimental methods has its natural boundaries, outside of which our advances in knowledge must be derived from a study of celestial bodies.

The riddle of gravitation is yet to be solved. This all permeating force must be connected with other forces and other properties of matter. It will be a delicate task, indeed, for the total attraction between very large masses closely adjacent, aside from the earth's attraction, is very small.

Scientific facts are of little value in themselves. Their significance is their bearing upon other facts, enabling us to generalize and so to discover principles, just as the accurate measurement of the position of a star may be without value in itself, but in relation to other similar measurements of other stars may become the means of discovering their proper motions. We refine our instruments; we render more trustworthy our means of observation; we extend our range of experimental inquiry, and thus lay the foundation for the future work, with the full knowledge that, although our researches cannot extend beyond certain limits, the field itself is, even within those limits, inexhaustible.

Stray Currents.

AN ENGLISH PRIZE COMES TO AMERICA.

The senior prize offered by the council of the British Society of Mining Students for the best paper on "Electricity as Applied to Mining Engineering," has been awarded to W. S. Gresley, mining engineer, of Erie, Pa., who is an honorary member of that institute. Mr. Gresley is also the contributor of the article on Coal Mining Methods in the coming volume of The Mineral Industry. The paper which gained the prize will be found in the Journal of the British Society of Mining Students, Volume XXI, page 123, June 1899, and is pubilshed by G. E. McMurtrie, Cinderford, Gloucestershire, England.—Ex.

VELOCITY OF ELECTRIC WAVES IN AIR.

Mr. G. V. MacLean describes in Phil. Mag., July, 1899, a very successful application of the coherer in the location of the modes and antinodes of a stationary electric wave train reflected from a metal sheet. Mr. MacLean's object was to determine the velocity of the waves from the observed wave-length and the periodic time of the oscillator.

The coherers used consisted essentially of two platinum globules which were adjusted to delicate contact, and the milliamperemeter in circuit with the coherer and a battery gave the indications. The coherer gave no response at all at the nodes, and the readings over more than a whole wave of the stationary train were remarkably regular considering the erratic space action of the ordinary form of the coherer.—Ex.

INTERRUPTER FOR BROKEN WIRES.

A novel form of automatic interrupter devised by Desornot is described in L'Eclairage Electrique. The object is to electrically disconnect a wire from the source of current, when a broken end falls to the ground; it is intended to be applied to circuits crossing streets and roads, and must be inserted at both ends, which are to be protected. In principle, it consists in breaking the continuity of the wire, and securing the two ends a slight distance apart in a closed insulated tube, which is partially filled with mercury; when the wire is horizontal the mercury touches both the ends of the wire and thus preserves the continuity of the circuit; but when the wire breaks, this interrupter will assume a more or less vertical position, in which case the mercury flows to one end of the tube, thus breaking the circuit.—Ex.

ELECTRICALLY TESTING THE COVERINGS OF STEAM PIPES.

A novel method of testing the efficiency of coverings for steam pipes electrically is in use. A section of the steam pipe is heated electrically by means of a coil of wire in oil within the pipe. The amount of energy necessary to keep the pipe at a definite temperature is measured. Since the energy supplied is just enough to maintain a constant temperature, it must, therefore, equal the heat lost from the pipe. Hence, from the electrical energy supplied, the heat lost from the outside of the pipe can be calculated. The new method, which was recently described by Prof. Charles L. Morton would seem to be worthy of attention.—Ex.

A USE FOR LIQUID HYDROGEN.

The use of liquid hydrogen has been proposed by Prof. Dewar for the production of very high vacua. If the end of a closed tube containing air is immersed in liquid hydrogen, the contens of the tube are quickly condensed to solid air, and if the portion of the tube from which the air has thus been removed is sealed with a blow-pipe, a vacuum is obtained so high that it will scarcely allow an electric discharge to pass. This condensation is accomplished almost instantly, the required time of immersion never being more than a minute. This gives a simple means of obtaining the high vacuum necessary in Crookes tubes, and might possibly be on a large scale sufficiently economical for use in incandescent lamp works.—Ex.

PEAT AS FUEL.

It is claimed for peat that it is superior to coal in its absolute freedom from sulphur and the absence of smoke, soot, dust and clinkers during consumption. In a great measure, this solves the problem of furnishing a cheap, clean, uniform ,and reliable fuel for all domestic purposes, and it is equally serviceable for grates, stoves, cooking ranges and furnaces, giving a long, bright flame and intense heat almost from the moment of ignition. It has been tested in locomotives with excellent results, showing that the thermal value of 100 pounds of peat is equal to 95.15 pounds of coal. It was also tried at the power house of the Metropolitan Street Railway, Toronto, Canada, and gave great satisfaction. The heat produced was much greater than that of coal, but it was 8 per cent. deficient in lasting power. It requires but little draft, and burns best in a shallow fire box.

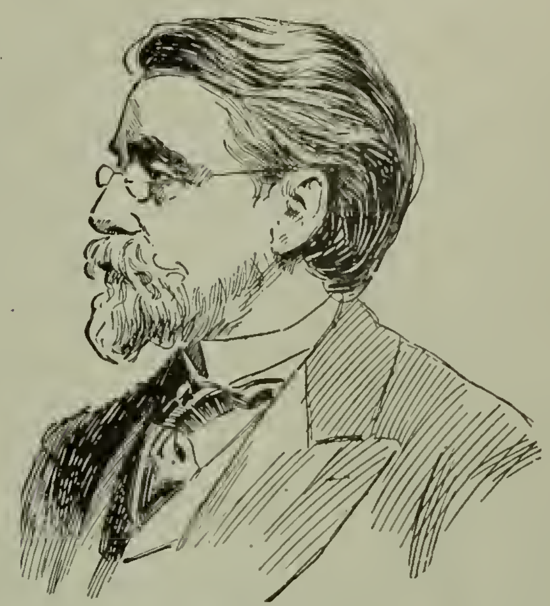
ALUMINUM FOR ELECTRIC TRANSMISSION.

The Hartford Electric Light Company, of Hartford, Conn., has ordered 33 miles of aluminum cable to transmit current from a dam in the Farmington river at Tariffville, Conn., 11 miles from Hartford, says the "Engineering and Mining Journal." The waterfall will realize 2,300 horse-power, which will operate two 1,000 horse-power generators, giving 10,000 volts. This current is to be transmitted over aluminum cables to the company's power station in the city of Hartford. There will be three cables for transmitting the current, strung in the form of a triangle on double cross-arms and double insulators. The wires will be left bare and will run to within a mile of the city limits, when the current will be reduced to 2,400 volts, at which voltage it will run to the company's city generating station, where the current will be trans-

Expositions.

OPENING OF THE NATIONAL EXPORT EXPOSITION AT PHILADELPHIA.

The opening of the National Export Exposition in Philadelphia on Thursday, Sept. 14th, under the auspices of the Philadelphia Museum and the Franklin Institute, proved to be a notable and inspiring occasion. It



Dr. W. P. Wilson,
Director-General National Export Exposition.

is the first National Exposition of the manufacturers of the United States for the advancement of American manufacture and the extension of export trade.

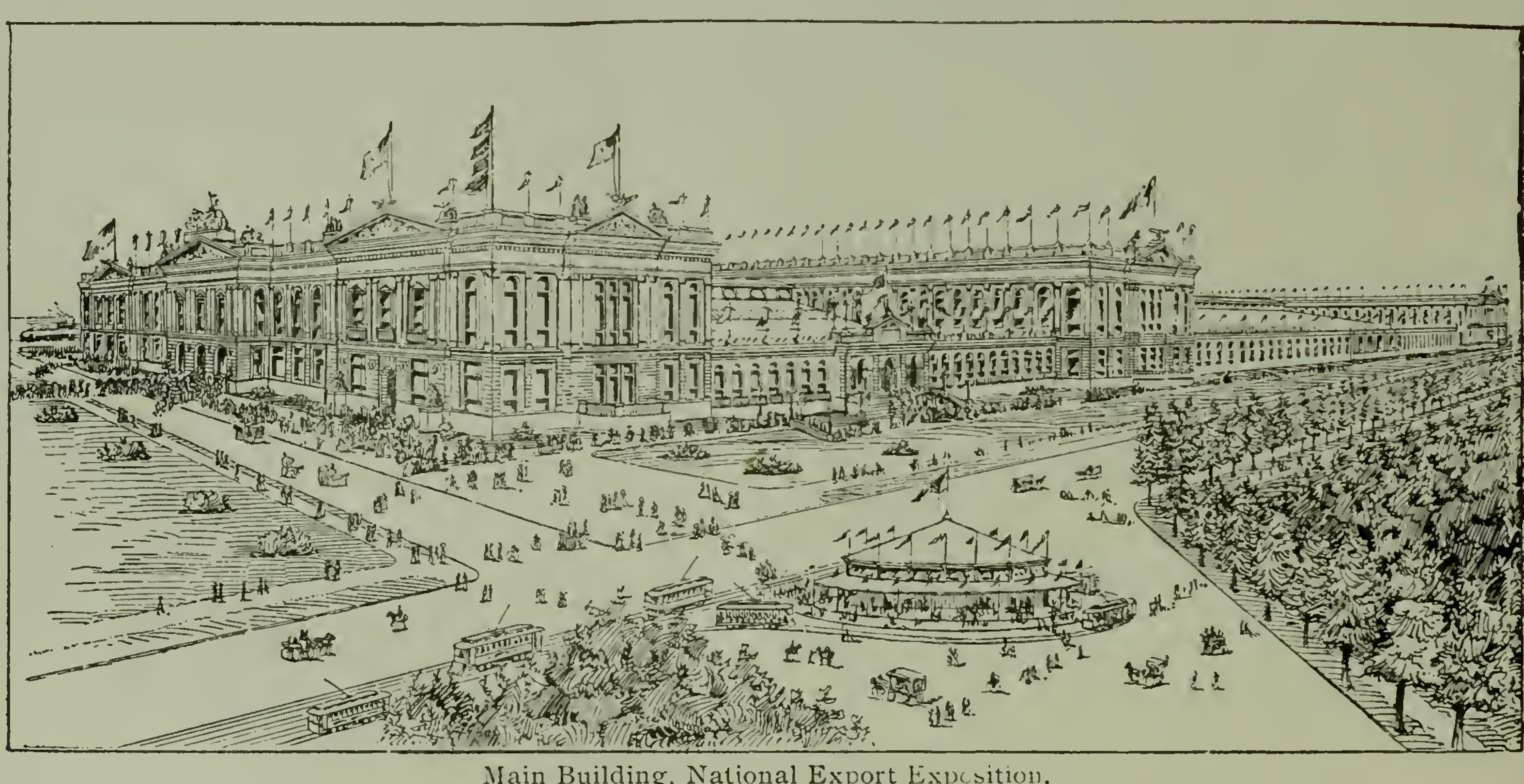
The opening exercises were held in the magnificent Auditorium which forms a part of the main building of the Exposition. This Auditorium has a seating capacity of nearly 6,000, but it was all too small for the accommodation of the enormous crowds which gathered to witness the opening ceremonies.

In the absence of President P. A. B. Widener, who is detained in the North, the first vice-president, Mr. W. W. Foulkrod, opened the Exposition in an address explaining its scope and referring to the expected importance of its results. He then formally on behalf of the Exposition management, turned the enterprise over to the Governor of the State of Pennsylvania.

Vice-President Foulkrod's address was followed by an address by Director-General W. P. Wilson, who gave an interesting account of the enterprise, its conception, its plans, its purposes and its possibilities, showing the immense advantages of such an exhibit to American trade and American exports, and explaining with much interesting detail what was expected to be accomplished and how it was to be done. Upon the conclusion of the Director-General's remarks, the Governor was introduced. He referred to the timeliness of such an exhibition, at a period when the American ideas of liberty and humanity, as well as of trade and commercial reciprocity were being carried into every clime and at a period when the American Government was holding sovereign sway, in lands scattered all over the world. Although he was here to represent the commonwealth and give its heartiest endorsement to the Exposition ,the fact was dwelt upon that this is not a sectional enterprise, not an exhibition of the city and for the city, or for the State merely, not of the North or of the South, nor of the East or the West of the country, but it represents in a peculiar way, the material trade and commercial interests of the whole country.

More music preceded the address by the Mayor of Philadelphia, Mr. Ashbridge, to whom the Governor transferred the custody of the exposition, on behalf of the State and the management of the enterprise. At the conclusion of the Mayor's speech the orator of the occasion, Hon. W. P. Hepburn, Chairman of the Committee of the Inter-State Commerce of the House of Representatives, was introduced. His address was a masterly presentation from the standpoint of a statesman who has had the opportunity and possesses the ability to intelligently study the subject of the influence of American commerce and American manufactory upon the current history of the world.

Archbishop Ryan, at the conclusion of a number by the United States Marine Band and the reception of a telegram from President McKinley, declaring the participation of the United States in the Exposition, dismissed the audience with a benediction. Simultaneously the machinery was set in motion by the President of the United States by touching an electric button in the White House. After this the buildings and exhibits were inspected by the guests and by the crowds that participated in the opening exercises.

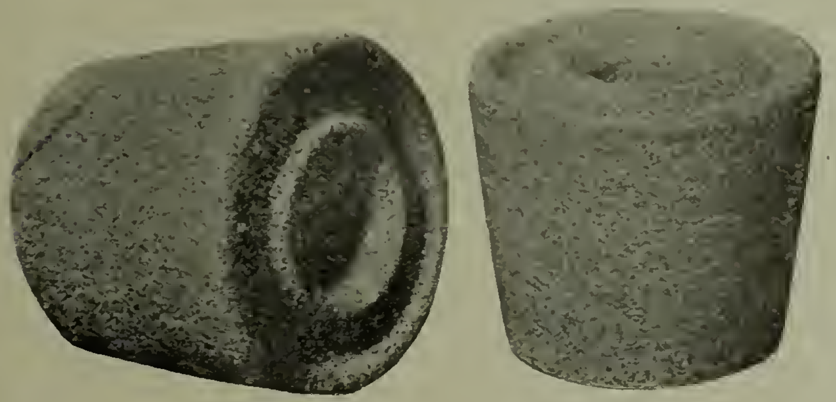


Main Building, National Export Exposition.

Insulation.

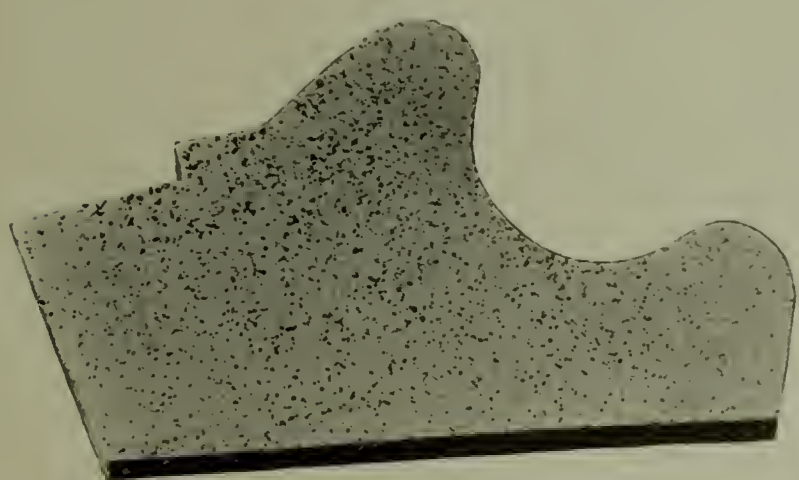
RECONSTRUCTED GRANITE.

One of the important features of the third-rail railway at Coney Island is the insulating blocks made of reconstructed granite, used between the rail sections. This material is so novel, and possesses so many remarkable properties, that it is thought that a description of it would prove of interest. "Reconstructed granite" is exactly what its name implies, and consists of choice Maine granite, pulverized, moulded into form and fused together at a temperature of 3,000 deg. F. It differs from the natural stone, of which it is composed, in several very important respects, viz.: (1.) In being absolutely fireproof, as it



Martin's Third Rail Insulators.

can be heated red-hot and thrown into cold water without being in the slightest degree injured or affected thereby. (2.) It resists the action of every known solvent, acids and alkalies of all kinds, except hydo-fluoric acid, and is only superficially affected by that. (3.) It is absolutely frost-proof, having been tested in liquefied air at an estimated temperature of 350 deg. below zero not only without injury, but was as strong while frozen as before, and not at all brittle, in this respect differing from all other materials tested in this way. As it is a well known fact that all natural rocks are disintegrated by extreme cold, and as 80 deg.

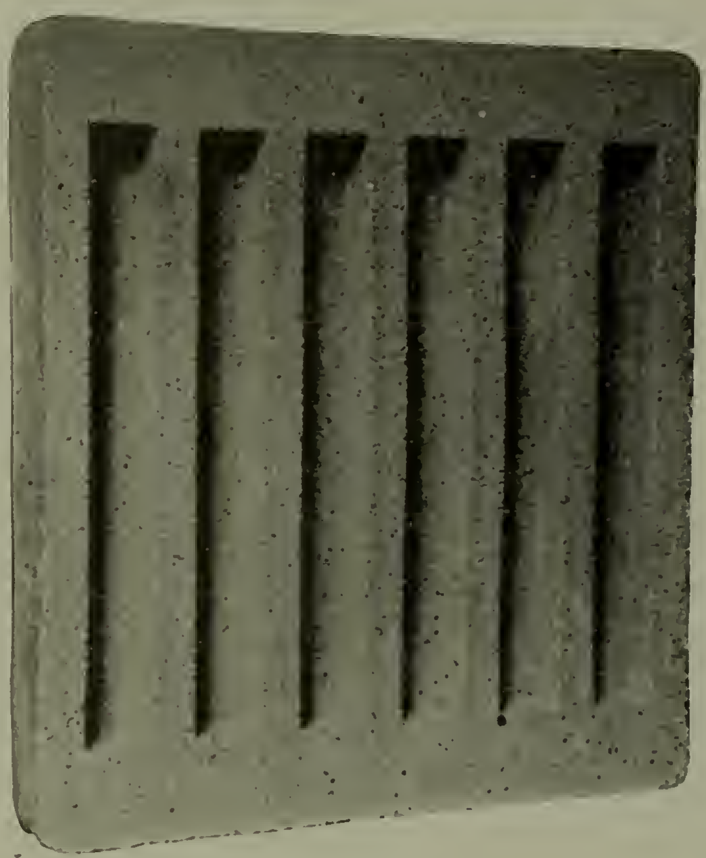


Arc Arrester for Street Car Controllers.

to 90 deg. below zero is the coldest temperature known upon earth, the test is a severe one. (4.) Natural granite not only contains a considerable percentage of moisture, but has a constant tendency to absorb more when exposed to dampness, whereas this material contains no moisture whatever, and being vitrified clear through (when prepared for electrical insulation), cannot absorb any. (5.) Its crushing strength, as shown by tests by the United States Government at the Watertown Arsenal, ranged as high as 14,560 lbs. per cubic inch, which is far above the average strength of the natural stone. Its tensile strength is from 680 to 700 lbs. per square inch.

Its great strength, its uniformity throughout, its non-absorbent properties, and its susceptibility to being rapidly and economically moulded into all ordinary shapes, at a comparatively low cost, would seem to make it a valuable insulating material, especially for railway work, when it would be constantly exposed to the weather, and frequently buried under ground; for these reasons it is rapidly growing in favor upon electric railways, especially for third-rail insulation. Herewith are shown two forms of these insulated blocks made of this material, the first being the section insulator of the "Murphy system" tested at Manhattan Beach, and the other the cup insulators of what is known as the "Martin system," now being introduced upon the Brooklyn and other elevated railroads. There are also many other forms.

A recent test at Niagara Falls showed that it required 56,600 volts to penetrate about half an inch of this material with a merely nominal absorption after soaking the fragments for many hours. Many other tests equally satisfactory have been made by eminent electricians.



Rheostat Block.

Reconstructed granite is manufactured at Norristown, Pa., by the Reconstructed Granite Company, of New York. These works are very extensive, covering nearly 7 acres of ground, and have direct connection to all parts of the country by both the Pennsylvania Railroad and the Philadelphia & Reading (B. & O.) Railroad, both of which have sidings into the works.

In addition to third-rail insulators, the company is now making a general line of insulators for electric railway purposes, more especially parts of controllers and rheostats, such as arc-arresters, fuse boxes, cut-outs, rheostat blocks, etc., of all the various standard patterns, and other special shapes as ordered; and as this material can be moulded into any desired form, there seems to be no limit to its usefulness as a high potential insulator. The principal advantages for its use in controller parts are high insulation, great durability, moderate cost, resistance to fire, frost and sudden changes of temperature and current, and last but not least, that there is no electrolytic deposit of copper possible upon this material, which is a frequent cause of short-circuiting in controllers. We illustrate to-day one of the standard forms of rheostat blocks and one style of arc-arresters made by the company, but there are numerous others, and electricians having special devices of their own can have them reproduced in reconstructed granite upon reasonable terms by addressing the Reconstructed Granite Co., No. 14 Dey St., New York, where a full line of their manufactures can be seen.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FOR WEEK ENDING SEPT. 29, 1899, $29,734.

New York, N. Y., Sept. 29, 1899.—The following exports of electrical material are from the port of New York for the week ending this date:

Argentine Republic.—9 packages electrical machines, $54; 36 packages electrical machines, $2,117.

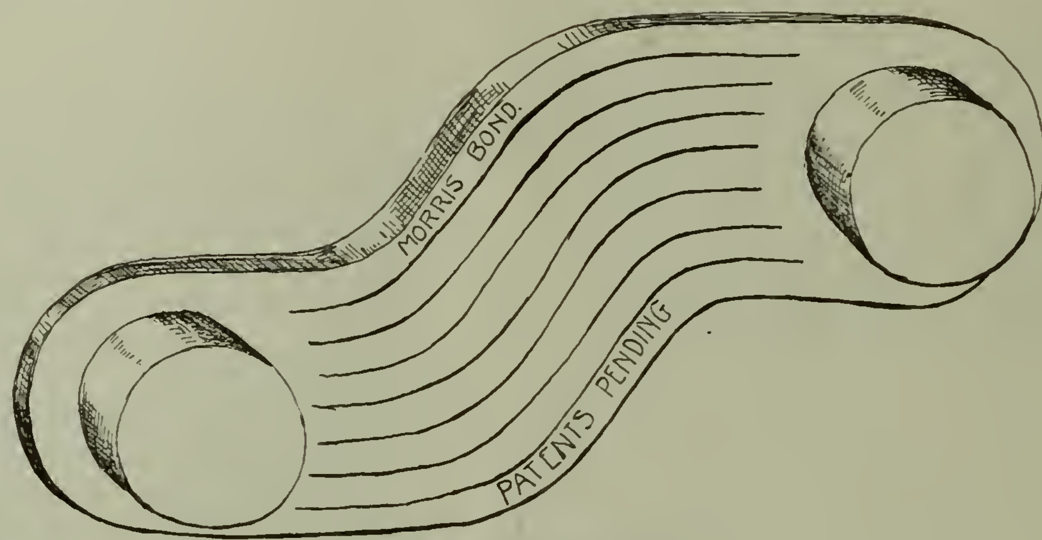
Antwerp.—31 packages electrical material, $3,388.

British West Indies.—6 packages electrical material, $116.

Brazil.—60 packages electrical material, $2,150.

Berlin.—27 packages electrical machinery, $5,100.

Central America.—2 cases electros, $26.



The Morris Rail Bond.

Cuba.—26 packages electrical material, $667.

Hamburg.—2 packages electrical material, $20.

London.—9 cases electrical carriages, $960. 3 packages electrical material, $125.

Leeds.—30 cases electrical material, $625.

Mexico.—21 cases electrical material, $798. Electrical material, $218.

Manchester.—1 case electrical material, $54.

Peru.—20 packages electrical material, $739.

Porto Rico.—2 cases electrical material, $101.

Rotterdam.—1 package electrical material, $50.

St. Petersburg.—206 packages electrical material, $5,425.

Southampton.—24 packages electrical material, $655. 18 packages electrical material, $2,036.

Sandwich Islands.—50 cases electrical material, $3,169.

U. S. Colombia.—14 packages electrical material, $756.

Uruguay.—1 package electrical material, $25.

STREET RAILWAY CONVENTION NOTES.

ELMER P. MORRIS, 15 Cortlandt St., New York, who makes a specialty of street railway supplies, will be at the Chicago convention of the American Street Railway Association in full force. He has secured 650 feet of space at Tattersall's which will be full of attractions for the street railway men. One of the drawing cards will be an X ray exhibit. Mr. Morris has always been one of the popular features of all conventions and his presence will add lustre to the Chicago meeting. His new Morris drop forged, one piece rail band will be on exhibition and in operation. Examine it in these columns and then call at Mr. Morris' New York office or at his exhibit at the Chicago convention.

FRANCIS GRANGER, the popular railway supply man of 26 Cortlandt St., New York City, will attend the Chicago convention of the street railway forces with his retinue of assistants and will make his exhibit shine with his Orient lamp. As usual, he is utilizing his natural talent in order to outdo all his previous efforts to make his exhibit at Tattersall's, during the meeting of the American Street Railway Association, so interesting that all the members will flock to it. Mr. Granger only makes a specialty of practical applications to street car service. His Corning brake shoe, which he has hand'ed for several years, has superior advantages over all other makes; by its use he guarantees a saving of twenty-five per cent. in the annual cost of brake shoes, a big decrease in the percentage of skidded wheels and unequalled braking efficiency. Its construction is varied in order to meet all special requirements of street railway service. His Ham sand boxes, styles 4 and 5, are made to meet the exacting demands of street car service, and all mechanism is made interchangeable. The Orient incandescent lamp, made specially for railway service, has a loop coil filament anchored positively by binding the lower extremity of the anchor wire around a chuck at the crown of the mount. Every lamp is of the exact efficiency desired by consumers and gives a full white light during its entire life at the guaranteed hours. Special miniature lamps of every style and grade desired are also made.

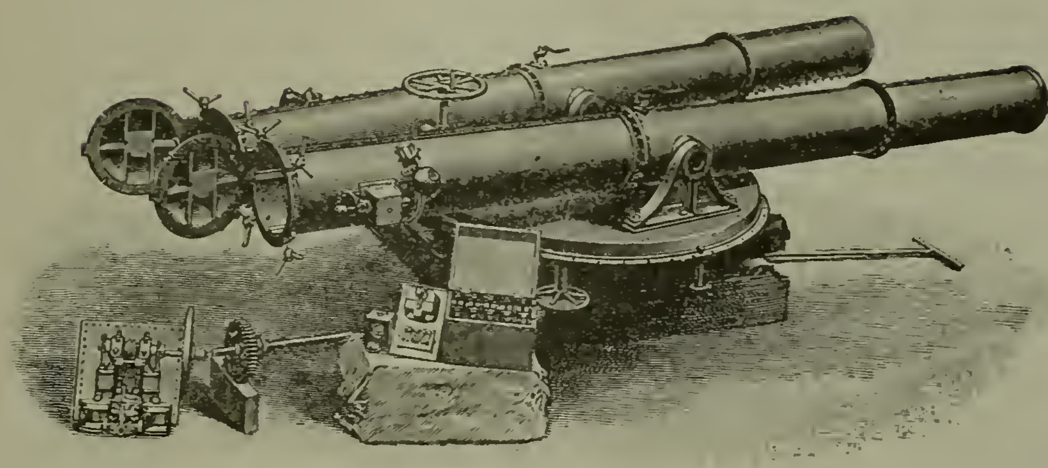
NEW YORK NOTES.

WE DESIRE TO EXPRESS our appreciation of the excellent manner in which the electrical and kindred supply houses showed their patriotism in welcoming Admiral Dewey. Special mention should be made of the decorations in the windows of J. H. Bunnell & Co. and the J. Jones Sons Company.

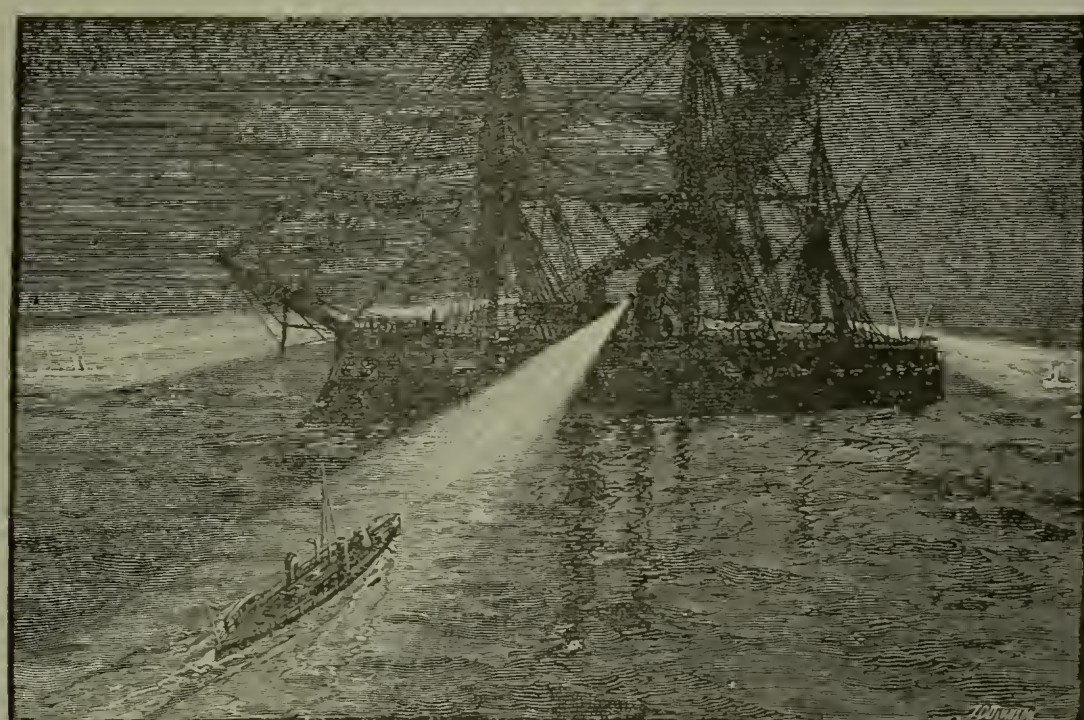
The Electrical Age.

Vol. XXIV—No 16. NEW YORK, OCTOBER 14, 1899. Whole No. 648.

Novel Applications of Electricity.



Revolving Deck for Yarrow Torpedo Boat Showing Electrical Discharge Apparatus.



War Ship Using Search Light.

ELECTRICITY IN NAVAL WARFARE.

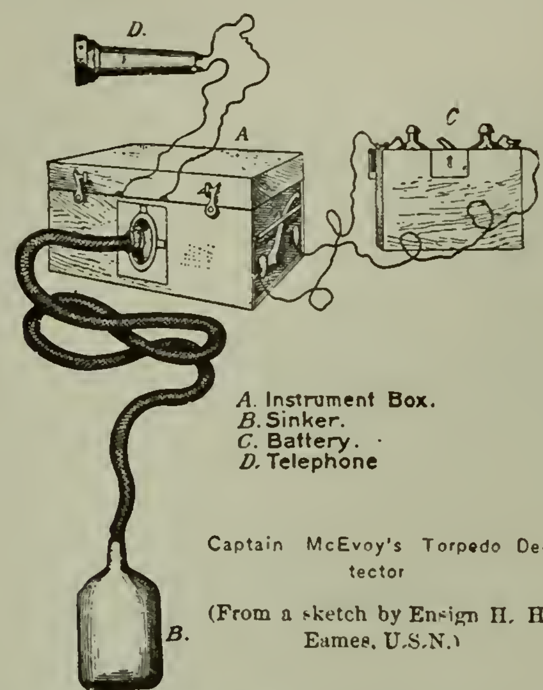
BY LIEUT. W. S. HUGHES, U. S. N.

The extension of the applications of electricity has been nowhere more rapid or remarkable than on board ships of war. Only a little more than fifteen years have elapsed since the first experiments in that direction in the frigate "Trenton." The experiment with the "Trenton" was watched with interest both at home and abroad. Foreign countries were not slow to follow the footsteps of the United States in the use of electricity for lighting and the operation of torpedo boats, searchlights, etc.

In the practical use of the searchlight it has been found that in order to afford sufficient time for a careful examination of the water's surface at points far removed from the ship, the beam of light must be revolved very slowly; and, in consequence, during a great proportion of the time any particular section of the water is in darkness. When it is remembered that it requires less than five minutes for modern torpedo boats to pass over a distance of two miles it may by easily conceived how in the interval between two successive Illuminations of the same spot a little craft like a torpedo boat might dart in and discharge its torpedoes. With the object of averting such danger ships of the French navy and on the Danish cruiser "Ivert" a number of stationary searchlights are grouped together, each illuminating its proper section, thus keeping the ship continuously surrounded by an unbroken circle of light.

But the searchlight is used not only to discover an enemy and to keep the latter visible in firing at night; it has been also successfully employed in signalling messages where the distances over which they are to be sent are very great. One of the methods of using it for this purpose is somewhat novel; the beam of light is simply flashed repeatedly against the clouds, lighting them up in each instance for a certain number of seconds, accord-are indicated by combinations of flashes of different durations of time.

Modern naval fleets must not only be prepared to rapidly move stationary torpedoes or fixed mines, with which every important port in time of war will be protected, but the ships themselves must be provided with a complete system of such weapons, ready to block up harbors in which an enemy's vessels may be discovered or in which



Captain McEvoy's Torpedo Detector

(From a sketch by Ensign H. H. Eames, U.S.N.)

they themselves may have taken refuge. In practical use the search for torpedoes is carried on in a boat with a box and battery and a metal sinker to which a small cable is attached, which is dragged overboard along the bottom of the channel or harbor where the presence of torpedoes is suspected. A telephone attached to this arangement is placed to the ear, but no sound is audible until the sinker reaches the vicinity of some metal body, such as a torpedo; then a buzzing noise is heard which becomes gradually louder as the torpedo is approached and loudest when it is touched.

Electricity has been the chief element in the development of those remarkable inventions known as automobile or fish torpedoes. They are with few exceptions steered, propelled or exploded by an electric current; and in some all three of these applications are made. No ship of war is now regarded as efficient whose armament does not include a number of torpedoes. The Whitehead is the torpedo in general use in the navies of Europe. Briefly, it is cigar-shaped, from nine to nineteen feet long, by eleven to sixteen inches diameter, made of thin steel, propelled by compressed air and carries an explosive charge of gun cotton, ranging from forty to one hundred and five pounds. In practical use the torpedo is discharged at the enemy's vessel through a tube which may be mounted on board ship, either above or below the surface, and upon reaching the water it is propelled by its own engines. The initial motion or discharge is effected by an electric fuse which ignites a very small charge of gun cotton placed in the tube behind the torpedo. The wires from the fuse are connected in the circuit of a battery and lead to the pilot tower, where the firing is accomplished by the usual means of a keyboard under the control of an officer.

The illustrations show the tubes in place on the deck of a torpedo boat and also represent them separately on a larger scale. It will be observed that they are mounted on a turntable so that they may be pointed in any direction. Finally an ingenious application of electricity is employed to explode the projectiles discharged by the pneumatic guns with which that remarkable craft, the United States dynamite cruiser "Vesuvius," has been armed. In this case six hundred pounds of explosive gelatine are set off by electricity.

THE PRACTICAL APPLICATION OF ELECTRIC MOTORS TO PRINTING PRESS MACHINERY.*

BY W. H. TAPLEY.

Chief Electrician, Government Printing Office, Washington, D. C.

The past five years have seen marked advancement in the transmission of power by electricity.

Aside from long-distance transmission and railroad work, no branch of the art can show such substantial results as have been accomplished in the field of individual

Deck Plan for Yarrow Torpedo Boat Showing Discharge Tubes Mounted on Turn Table.

motor application. In this latter the application of the electric motor to printing press machinery has produced results in power saved, improved product and increased output sufficient to cause every large printer to-day to look upon electrically-driven printing presses as a necessity and not a luxury.

Passing by the early arguments used for adopting the individual motor, the engineering problems of what is the best and how shall it be applied are now ready for consideration.

It will be necessary to subdivide the subject, considering each separately, afterwards drawing conclusions from

*Read before the Electrical Section of the Franklin Institute.

facts submitted.

The following is the definition of "geared" and "direct" motors:

Geared are single reduction motors.

Direct have the armature of motor keyed to the main driving shaft of press.

MAIN TOPICS.

Types of motors, attachment, control, protection, maintenance, cost of operation, advantages, a few facts of the power consumption of the government printing office.

These headings are themselves subdivided.

Types of Motors.—There are three kinds of motors used in printing press work, viz.: series, shunt and compound wound.

Series Motor, owing to its speed varying directly as work done, gives an unsteady and jerky motion to press, which interferes with securing the highest grade of presswork.

Shunt Motor, while giving much better results as to constant speed at all parts of the stroke of the bed of a press, is lacking in starting torque so essential in handling a press during "make-ready," as well as starting the press from all positions of the bed.

Then if lead of brushes is altered to overcome sparking; there is a corresponding change in speed of press shaft.

This fact the pressman sooner or later will discover and more than likely take advantage of on hurried work, excessive sparking from a distorted field causing him but little worry.

Compound Motor gives by far the best results for printing press work, having a stiff starting torque, constant speed and minimum sparking at moment of reversal, a constant factor in this class of work.

The commercial demands are for a tough motor, one built to withstand rough handling, overloads, long strains of work, not similar to pumps or blowers, which is constant, but the continuous starting and stopping, reversing, producing conditions which can only be met by a motor mechanically and electrically rigid in all its details; one free from repairs, always ready to be pushed to its maximum.

Sizes.—Motors should always be sufficiently large to handle the presses to which they are attached without straining, and wound for highest efficiency at 70 per cent. of rated output.

For example, suppose we have a 5 horse-power motor attached to a Huber press, bed 42 x 52 inches, running at 1,300 impressions per hour, printing 32 pages solid matter, using book ink and running under favorable conditions, the current consumption fluctuating from 12 to 30 amperes at 115 volts; allowing 8 amperes per horsepower, we have, for a 5 horse-power motor, 40 amperes, 70 per cent. of which is 28 amperes.

This press will take to start, varying according to position of bed, from 35 to 50 amperes at 115 volts.

From these figures it is seen that the press is handled promptly and properly, with ample margins, without using too large a motor.

These figures apply to presses that have been in operation some months, not to those newly installed, for often these will demand double the figures mentioned until they become "limbered up," during which time the motor will have a little extra work to perform, but a good motor will withstand this ordeal without harm.

In selecting the size of a motor, do not figure too close; get one sufficiently large to do your work without loss of time to the operator.

The price of motors is not direct as the horse-power, a 5 horse-power costing only about 15 per cent. more than a 3 horse-power motor, while you obtain 66 2-3 per cent.

(To be continued.)

Stray Currents.

A POWERFUL ELECTRO MAGNET.

A powerful electro magnet has recently been installed at the Manhattan Eye and Ear Hospital, New York City. It will hold up 250 pounds, and will attract and seize a bunch of keys thrown in front of it. The first test was made on a man into whose eye a sliver of steel had cut, passing through into the vitreous fluid in the posterior chamber, where no surgical instrument could reach it without destroying the eye. The patient strapped to an operating table was moved gradually toward the magnet, which finally drew out the steel through the opening it had made when entering the eye. As it left the eye the steel sliver flew like a flash to the magnet and clung there, while the eye sank back to its natural position.—Ex.

A NEW INSULATING MATERIAL.

The acetate of cellulose discovered two or three years ago by Cross and Bevan, in many respects resembles the nitro-celluloses which include gun-cotton, but differs from them in being non-explosive and in resisting high temperatures. It is not soluble in alcohol, acetone, or ether, but dissolves in chloroform, nitro-benzine, and some other substances. Dr. C. O. Weber has lately called attention to its valuable properties, predicting for it an important future. It is a better insulator than gutta-percha or indiarubber, and may take the place of mica for insulation and of celluloid for many other purposes.

ELECTRIC-BLASTING IN SLATE QUARRIES.

The system of simultaneous blasting by electricity has lately been adopted at Llarngwern quarry, Corris, with results which far exceeded the sanguine expectations of the directors and of the men, says "The Quarry and Builders' Merchant" of London. The first blasts were under the superintendence of Kellow & Co., Portmadoc, who supply the electric blasting appliances, and, when necessary, give instructions in their use. On August 8th, 15 holes, varying from 4 to 8 feet deep, were fired simultaneously, bringing down about 2,000 tons of waste rock in one operation, and on August 17th 3 blasts of 8 holes, 9 holes and 19 holes respectively were fired with equally good results.—Ex.

ELECTRICITY AND DISEASE.

The effects of high-frequency electric currents on disease, as shown by 24,371 applications to a total of 913 patients, have been summarized by Professor Apostoli in a report to the Paris Academy of Sciences. The current acts upon the cells, stimulating and regulating the nutrition. The general health is improved, and there is a return of energy, appetite and sleep, with invigorated digestion and greater fatigue endurance. The current is harmful in acute rheumatism, while it is directly injurious in bringing on eczema. It is beneficial in chronic rheumatism, especially so in gout, and gives good results in neuralgia, sciatica, calcareous formations, varicose veins, piles, dyspepsia and asthma.—Ex.

NOVEL ELECTRICAL EFFECTS.

A Chicago entertainer has made a great success with electrically lighted Indian clubs swung in a darkened room. The club is of special construction and the current is supplied by flexible wires enclosed in a rubber tube. Three series of eight, three, and one candle-power colored lamps are set in sockets in the club at right angles to the centre of the club, which is split lengthwise. At the tip of the club is a 32 candle-power lamp. When the clubs are swung at ordinary speeds the effect is very beautiful, an operator behind the scenes manipulating a switchboard, turning on and off the lights in the two clubs, which are swung to music. The patterns are almost infinite in their variety. Storage batteries furnish the current when the regular incandescent circuit cannot be tapped.—Ex.

AMONG THE SOCIETIES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The first regular meeting of the season was held at 12 West 31st Street Wednesday, Sept. 27th, President Kennelly in the chair. The paper of the evening, presented by Prof. W. Lispenard Robb, of Hartford, Conn., was on "Series Arc Lighting from Constant Current Transformers," and a working model of the apparatus was shown which was heartily appreciated by the audience. The discussion was participated in by Messrs. Fleming, Steinmetz, Hallberg and Mailloux. At the meeting of council in the afternoon the following associate members were elected: Henry Arthur Campbell, Kingston, Jamaica; Leslie Foster Davis, Kingston, Jamaica.

The following associate members were transferred to membership: William Enoch Moore, Augusta, Ga.; Henry M. Hobart, London, England, and G. Sacco Albanese, Nice, France. In order to satisfy the increasing demand for the final report of the Committee on Standardization, the secretary was authorized to publish a special edition, which will be sold at a nominal price. All members of the Institute have already been supplied with copies in the regular edition of the Transactions.

ELECTRIC SMELTING OF IRON.

The Stassano process for the production of iron and steel depends upon the application of the heat of the electric arc to the purpose of reducing oxides of iron and to melting the resulting metallic mass, says the "American Manufacturer and Iron World." The electric furnace employed is formed by the juxtaposition of two truncated cones by their bases, a third cone of similar formation being connected with the body of the furnace thus formed, and constituting the crucible in which the fused metal collects, and which is withdrawn by means of a tap hole. At a point somewhat above the opening of the crucible thus formed, and within the furnace itself are two cylindrical carbon electrodes 10 cubic metres diameter and 1 metre in length. The distance between their terminals—i. e., the length of the arc, is regulated from time to time by a contrivance worked by hand, in acordance with the indications furnished by the voltmeter and amperemeter, and is closed off by a hopper to exclude contact with the external air, but which has two outlets for the escape of the gases, notably carbonic oxide, resulting from the reduction of the ore used. The minerals charged are oxides, or carbonates, the latter undergoing a preliminary calcination. They are first pulverized, and the gangue, etc., is separated as far as possible from the metallic particles by magnetic means. An analysis is made in order to determine with exactness the proportion of carbon, lime and silica necesary to reduce the mixture and slag off the impurities during the subsequent operations, and obtain a metal of predetermined constitution. The necessary quantities of the above are then powdered, and intimately mixed with the concentrated ore, 5 to 10 per cent. of tar being added. The resulting paste is submitted to a pressure of from 200 to 300 kilogrammes per cubic metre in an hydraulic press, and the mass thus formed is broken in a special pug mill into pieces of about four cubic inches, these pieces forming the ultimate charge for the electric furnace. When it is desired to produce an alloy of iron with some other metal, ores of the latter in the necesary quantity are added to the mixture previous to the pressure in the hydraulic press. At the intense heat developed by the electric arc (3,500 degs.) the Fe_2O_3 is decomposed, forming with the carbon present CO_2, which is itself subsequently reduced. The CO formed escapes to the upper portions of the furnace, where it aids in the reduction of the metallic oxides, while the reduced metal, associated with more or less carbon, collects in the lower cone before mentioned. The impurities slag off and are tapped from a hole in the upper portion of the crucible. In one form of the furnace the operations can be carried out continuously, the withdrawal of the melted metal and the charging of fresh mineral taking place periodically, the latter being fed through an opening in the upper portion of the furnace. To produce one metric ton of iron or steel from 1,500 to 1,700 kilogrammes of fuel are required, according to the carbon contents of the description used. At 20 fr. per ton of coke the fuel cost of producing 1 ton of metal is 33 fr. In the Stassano process the energy required for 1 ton of metal is 3,000 horse-power hours. This amounts to an average of 18 fr., which is 15 fr. cheaper than in the ordinary way of smelting. The cost of the preliminary operations is certainly greater than in other processes, but this is unquestionably more than compensated for by the lessened cost of smelting. It is also claimed that the CO resulting from the operations in the furnace can be readily and economically applied to the subsequent heating of mill furnaces, etc., and will amount in value to 20 fr. per three-quarters of a ton of iron made. Taking these and various other considerations into account, it has been estimated that the cost of producing 1 ton of merchant bar by this method would (in Italy) amount to only 19.50 dols., against 31 dols. per ton by other methods.

WESTINGHOUSE WORKS IN GREAT BRITAIN.

Contrary to the natural expectation that we would do all the "worrying" over the intention of the Westinghouse Electric Company to build works at Manchester, the proposition has not been received with favor in all quarters here, as is shown by the following comment of a correspondent of the Manchester Evening Chronicle:

"The announcement has been made, and with the usual flourish of the Yankee trumpet, that electric works, such as were never yet seen, are to be erected in Trafford Park, Manchester. This statement may be true, but it is hardly fair that British electric-manufacturing concerns should have been so absurdly depreciated in this connection. As an instance, it is stated that the Westinghouse Company are now making four large electric generators for the Manchester corporations, which, it is inferred, no English maker could touch. As a matter of fact, Messrs. P. R. Jackson & Co., engineers, Salford, offered to make these very machines, and to comply with all the conditions set forth in the specification of the corporation. The order was given to the Yankee firm, notwithstanding the fact that the price of the Salford firm was only £800 higher in a £70,000 job. However, it may interest your readers to know that the Westinghouse Company have come rather late in the day, as events will, I think you will find, soon prove. I suppose the next boom will be new Yankee locomotive works, simply because all our "loco." shops are crowded out with work at much higher prices than obtain elsewhere."

It is stated that 100 acres of land have been secured, that the company's buildings will occupy 40 acres, that 5,000 men will be employed, that Lord Kelvin will be technical adviser, and that all the Westinghouse patents for England have been purchased. I am not certain but that the newspapers have said the purchase includes the patents for all Europe. At any rate, American customers of Westinghouse, who manufacture articles for European export, should find out, if they use as component a motor or an electrical fitting of Westinghouse manufacture, whether the sale of foreign patents is so absolute that it would interfere with the use in Europe of articles purchased from the American company.

MARSHAL HALSTEAD,

Birmingham, July 27, 1899. Consul.

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NEW YORK.

NEW YORK, OCTOBER 14, 1899.

CONTENTS:

ELECTRICITY ON OUR CANALS.

The subject of canals in New York State and those bordering upon it is rather a delicate one to certain well known political parties. But as the improvement of canals has been recognized as a means of hastening the chief delivery of goods from one part of the country to another the application of electricity for the purpose of facilitating this delivery becomes a matter of considerable practical importance. Various experiments have been tried by those interested in the canal question for the purpose of discovering whether speed could be made at a greatly reduced cost by propelling canal boats by electricity.

It is certainly obvious that two methods are open to inspection, the first that of dragging the canal boat by a rope, the motive power being an electric motor progressing along the bank of the canal; the second the installation of storage batteries and motor on board the boat itself. The first proposition is one that involves the use of track and a conductor or at least a means of supplying current to the motor, which must be built in such a form that it is able to exert quite sufficient tractive effort to move dragging the boat and itself at a greater rate of speed than that now indulged in by the historic mule. The care of a plant of this description, its cost of operation and electrical and financial efficiency over the old fashioned method does not belong to the field of delusion. Yet the determination can only be made by experiment as to whether storage batteries and motor on board the canal boat, thereby making itself contained, would be less expensive.

A recent notice in the daily papers that the executive committee of the Erie Canal Electric Traction Company had adopted the storage battery system for use as its motive power, subject to the approval of the Superintendent of Public Works, does not leave the situation entirely open.

THE DETERIORATION OF INSULATION.

A full recognition of the chemical or physical changes taking place in the various compositions applied to wires as insulation has led to new methods of applying the insulating material, of protecting it from atmospheric influences, and arming it against mechanical ill treatment. In spite of these precautions, which are, of course, well directed, the insulation of wires can hardly be depended upon after a lapse of ten years. This fact is of importance only in such cases where it may be difficult or impossible to replace the wires with new ones at stated intervals. It is also of importance in those cases where high tension currents are in use and deficient insulation might mean injury of a physiological character.

The use of gutta percha and ruber is certainly a most practical application of a material, suited in every respect to the conditions of electric construction in the installation of wires and the addition of sockets more or less protected in this manner. It might be advisable on account of these slow but inevitable changes in the composition of insulating material to express not only the insulating and dielectric qualities of a given brand of wire but to furthermore state the period of time during which no unusual deterioration can possibly occur. When moisture comes in contact with the insulation of any wire it is absolutely certain to affect it and to a degree dependent upon its salinity or otherwise alkaline nature.

Various experiments tried with wires exposed to such conditions over a period of three years have shown that to a certain extent it is not safe to depend upon their original high insulating properties or initial value as dielectrics. A complete study of insulation need not only be directed along the lines that lead to an improvement in the insulation of a wire but should tend to embrace that portion of the subject relating to the durability of the insulation as well.

THE SAFETY OF THE MODERN CONDUIT WIRED BUILDING.

Without desiring to put a feather in the cap of the manufacturers of conduit for the wiring of buildings it is without question a feather in their cap at least to know that the risks from fire in a building thoroughly wired and whose conductors are encased in conduit has been reduced to a degree hardly appreciated by the average layman. Since the date which marks the beginning of the evolution in conduit construction the confidence of those best able to judge, namely the architects, has grown to a point of absolute assurance.

In a building recently renovated on Fifth avenue, not five blocks from the Dewey Memorial Arch, the work of one early contractor was unearthed in the shape of two No. 6 wires of rather decayed insulation, carelessly thrown in between two supporting beams of a floor whose lights connected to these feeders. The old building had been troubled with carnivorae of a small and familiar species and traces of their teeth in various parts of the insulation of these feeders was distinctly noticeable. In fact, so much so that the present proprietor, who had not found it necessary to make a change in the distribution of his lights until the time specified, was at first astounded and finally highly indignant at the risks he had been running from fire.

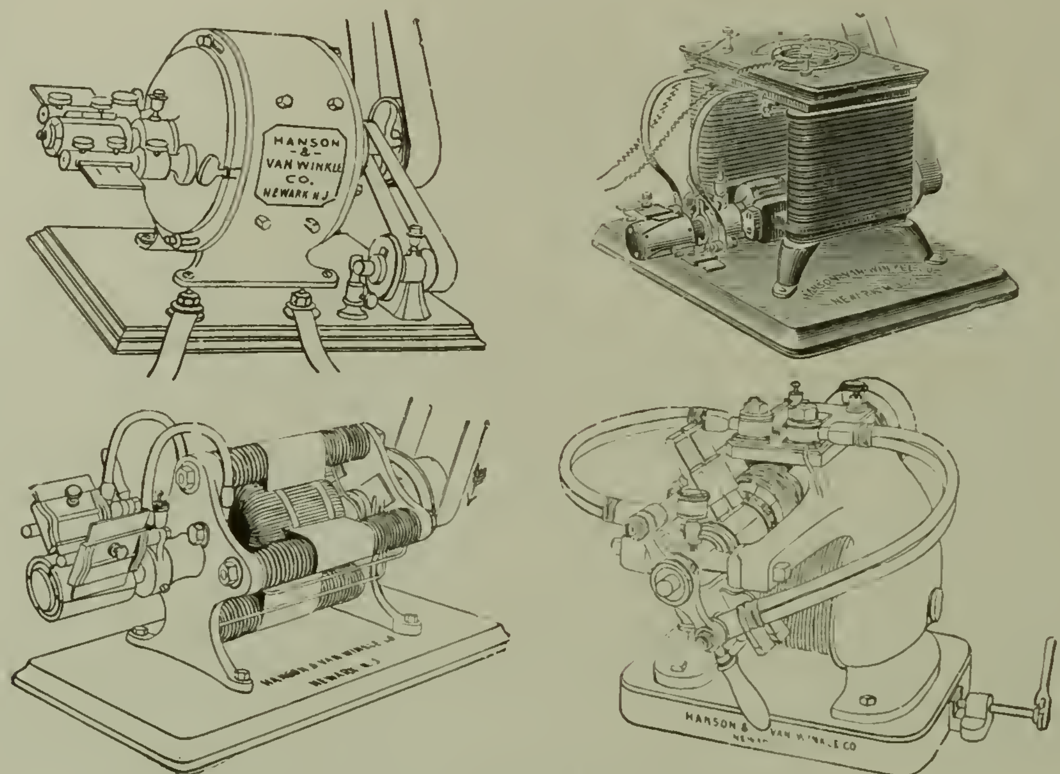
His first inquiry was naturally directed along those lines which called for samples of the conduit described to him as the future protection of all wires in the building. When shown a section of conduit which is familiar to all contractors and whose mechanical strength and high insulation are undoubted his approval was at once pronounced and emphatic. In other words, to the lay mind the sense of security after a survey of the materials to be used could not in this case as in any other have been less than perfect.

Electro=Plating.

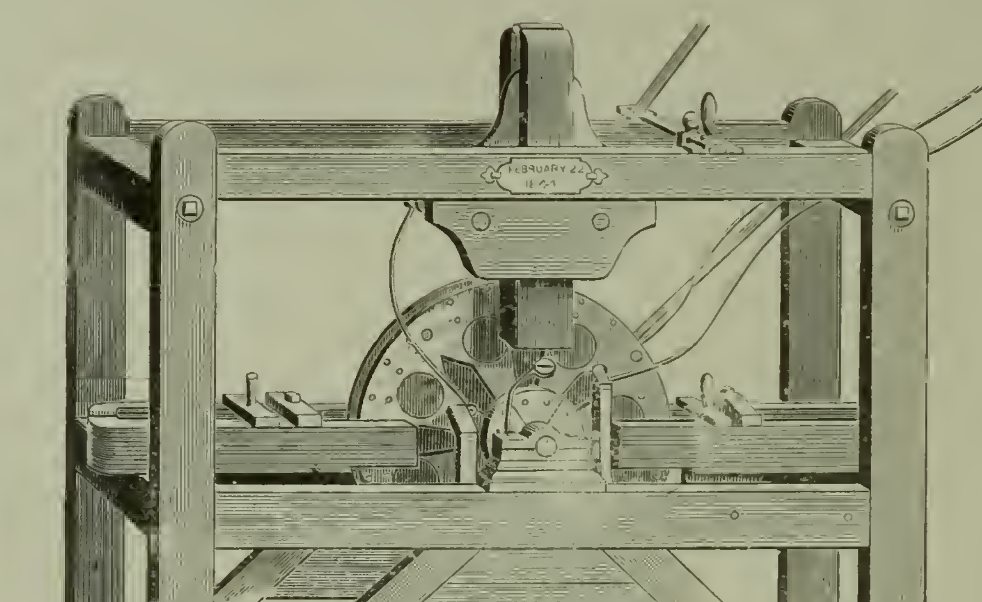
PLATING MACHINES OF THE PAST AND PRESENT.

The earliest experiments in the art of depositing metals by electricity, or, as it is commonly expressed, of electro-plating, were practically performed by Messrs. Prime & Son, of Birmingham, England. The machine they used is depicted in the sketch and enabled the above house to deposit silver successfully. It was built by Woolrich in 1844, and is historically important because of the great interest attached to it as the forerunner of all important types that subsequently followed. The art of designing electro-plating machines when guided by set scientific principles has so developed that platers are built of the highest effieciency and comparatively simple construction.

The house of Hanson & Van Winkle, of Newark, N. J., is practically responsible for the development of what afterwards became a vast industry; they constructed some of the first practical electro-platers and placed upon the market machines of greater detailed perfection and improved construction than other manufacturers. For instance, as far back as 1876 the Weston dynamo, the first in the field, was accepted by all platers as the solution of most of their difficulties. A considerable number of these machines are still in operation, not having deteriorated in any respect so as to affect their working operation since they were first manufactured. Among electro-platers the name "Little Wonder" is a most familiar one, the machine brought out in 1885 by the above concern bearing that title. In 1886 another type of electro-plater appeared simply called the "Wonder" dynamo. In this machine many of the small defects of preceding types were disposed of and in many respects further changes were neither required nor called for by practical platers.



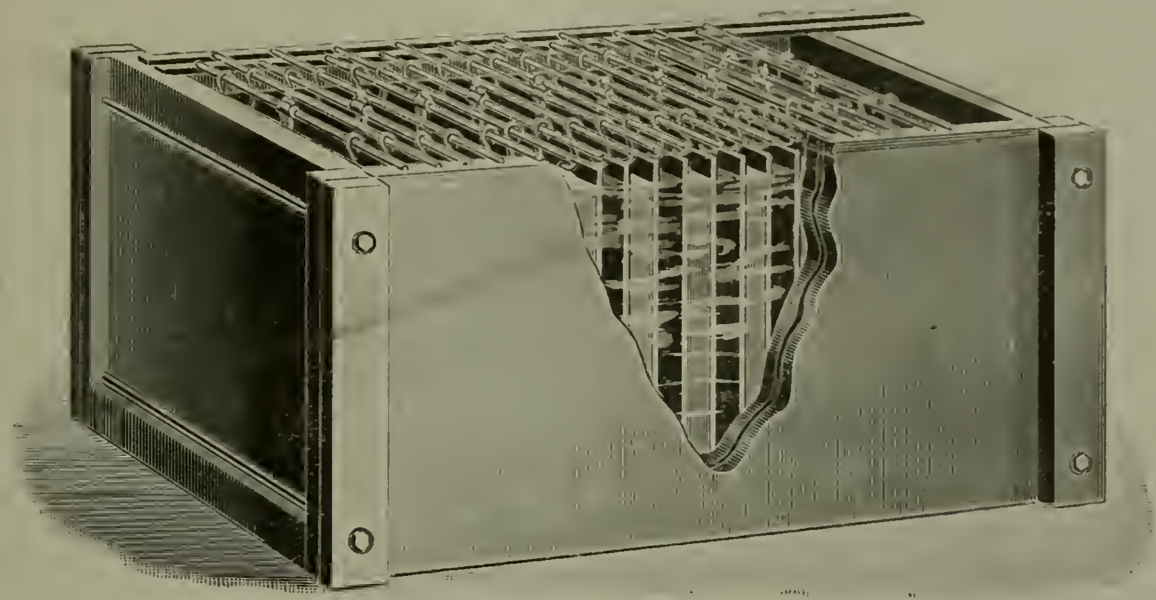
Various Types of H. & V. W. Dynamos.



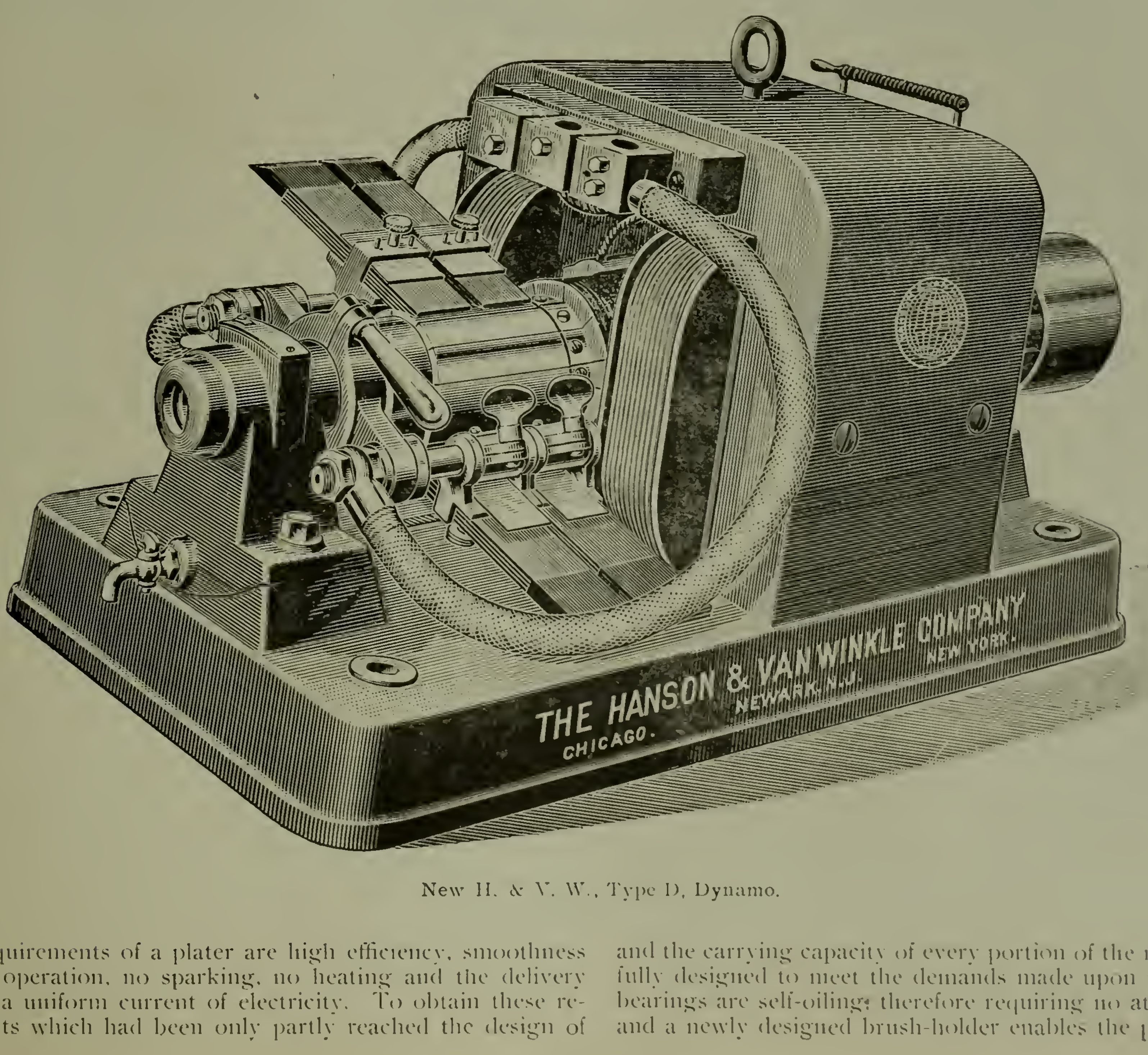
The First Electro-Plating Machine. Built by Woolrych in 1844.

It is difficult for the lay mind to realize how much scientific and practical knowledge must be brought to bear upon the construction of a modern efficient and smooth running plater. Various theories once afloat, regarding the construction of electrical machinery, having been proven faults made way for more firmly founded principles along which lines modern platers and in fact all up-to-date dynamos and motors are now built. The requirements of a plater are high efficiency, smoothness of operation, no sparking, no heating and the delivery of a uniform current of electricity. To obtain these results which had been only partly reached the design of the plater was so modified that it took the form represented in the illustration.

About 1891 the Hanson & Van Winkle Company brought out their "H. & V. W." dynamo which became a most popular article with the trade. The ironclad type of dynamo for electro-plating is shown in illustration. There is no heating either in the armature winding or field; sparking at the brushes has been wholly eliminated and the carrying capacity of every portion of the machine fully designed to meet the demands made upon it. The bearings are self-oiling, therefore requiring no attention, and a newly designed brush-holder enables the plater to



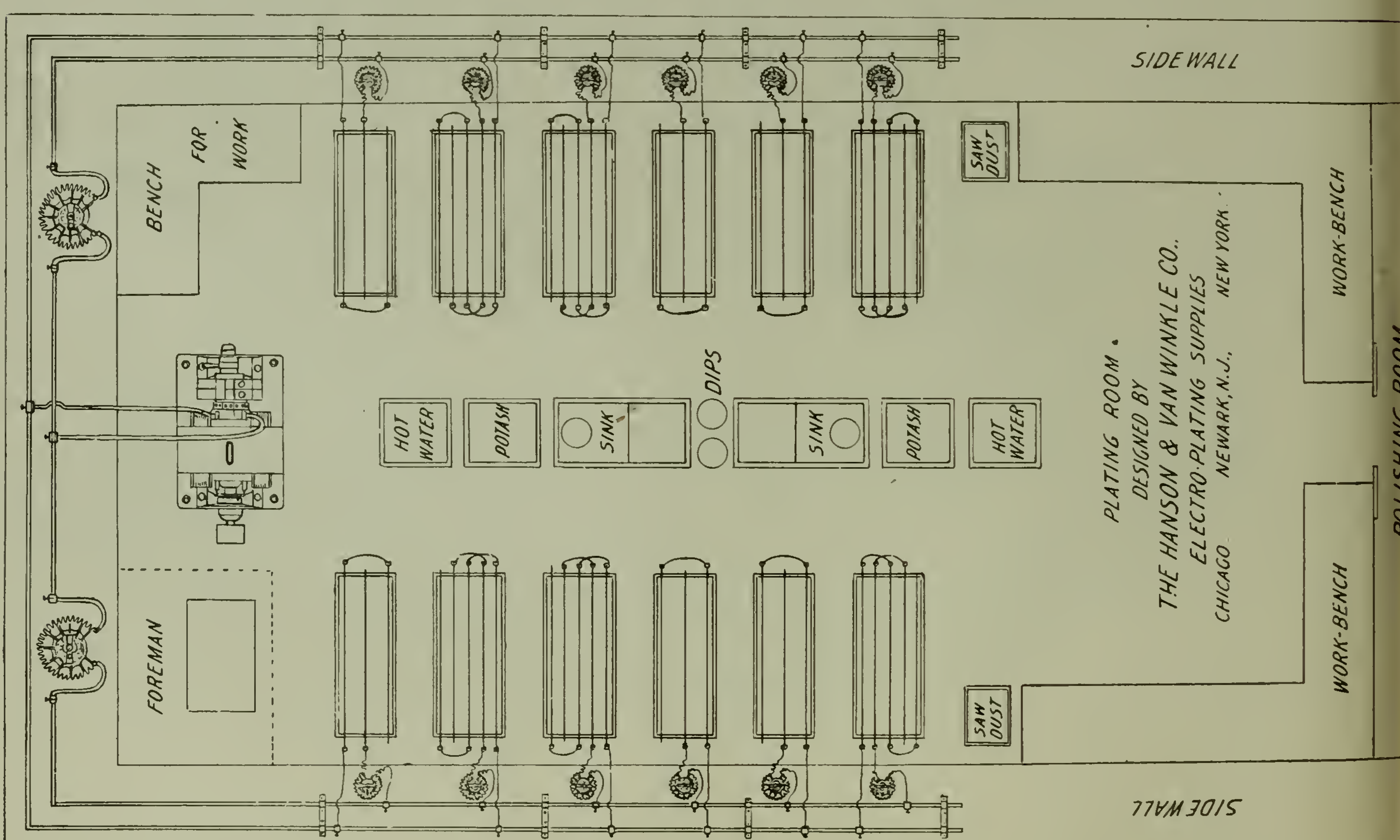
Lead Lined Wood Tank for Electrotyping.



New H. & V. W., Type D, Dynamo.

readily adjust the machine to any extent required. In another illustration a complete electro-plating plant is shown with current being fed from one of these latest types of platers to the various baths. A ground plan of this electro-plating plant is shown in another sketch. This concern make wooden tanks lead lined for electro-typing which for service cannot be excelled by any other construction. In the Newark Technical School the electro-plating department was thoroughly equipped by the Hanson & Van Winkle Company of the same city.

Interior View of Plating Room.



A special type of voltmeter, exceedingly serviceable for plating work, is shown in the illustration. The cheapness of this instrument is not a measure of its fine construction and usefulness. One of these connected to each tank and to the dynamo will indicate the volts with sufficient accuracy to prevent any errors being made in

Little H. & V. W. Voltmeter.

that respect. This instrument has been standardized with great accuracy and can be relied upon for practical work. The address of the Hanson & Van Winkle Company is Newark, N. J. There are branch houses in Chicago and New York.

ELECTRICITY IN A CAPSULE.

A company has been formed under the laws of New Jersey to do busines in electric capsules, says the "Sun." According to the promoters of the enterprise, a combination of chemicals has been invented to be dissolved in the cell of electric batteries. This new combination of chemicals is so powerful, according to the company, that a three-grain capsule of it, put into an ordinary battery cell, will yield enough electricity to run a 16-candle power incandescent light for one hour. It is said that the chemical can be sold as cheaply as calomel. It is also said that the new agent will consume zinc in the battery as rapidly as the solution now in use.

The value of the chemical is kept secret. The members of the company say that there is that in the combination which makes successful analysis impossible, and that they will not, therefore, patent it. The capsules that are to do all these things contain a fine white powder. The company says that its capsules can be easily transported in large or small quantities, and can be kept in warehouses, for an indefinite length of time. The particular advantage to be gained from its use, they say, will be its application to automobiles. The recharging of storage batteries will be no longer necessary when a battery can be started up at full strength by merely dropping a capsule into it.

Every farmer, camper, yachtsman and householder can have his own electric light plant. The capsules are not yet on the market. The stock of the company that owns the secret, however, is.

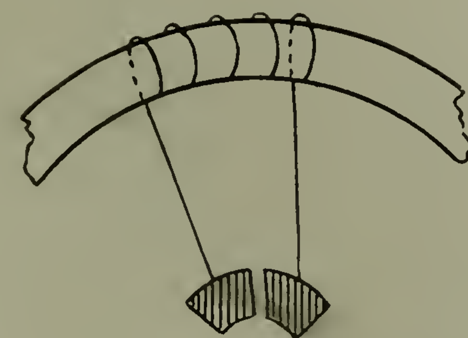
DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of " Answers to Inquiries."*]

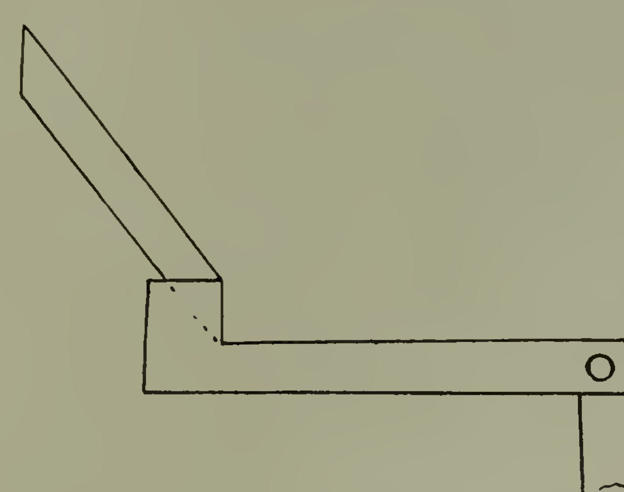
TECHNICAL NOTES.
SPARKLESS COMMUTATION.

A theory of sparkless commutation, as advanced by certain eminent authorities, is interesting from two standpoints. Silvanus P. Thompson, in an analysis of the subject, speaks of the coil producing within itself, at the moment of commutation and an instant after contact between the commutator segment and the brush is broken, the electro motive force of self-induction. The sparking



Coil and Segments in Position.

due to this, if not neutralized or obviated, is certainly severe but the remedy proposed by him and agreed upon by many writers as correct is the use of a magnetic spray, issuing from the pole piece and developing in the coil a counter electro motive force producing sparkless commutation. The electro motive force of self-induction and the electro motive force due to the magnetic spray by being opposed to each other annihilates any untoward effect ing good commutation is that of saturating the core surrounded by the coil. The variation in lines of force in that would otherwise occur. Another method of produc-

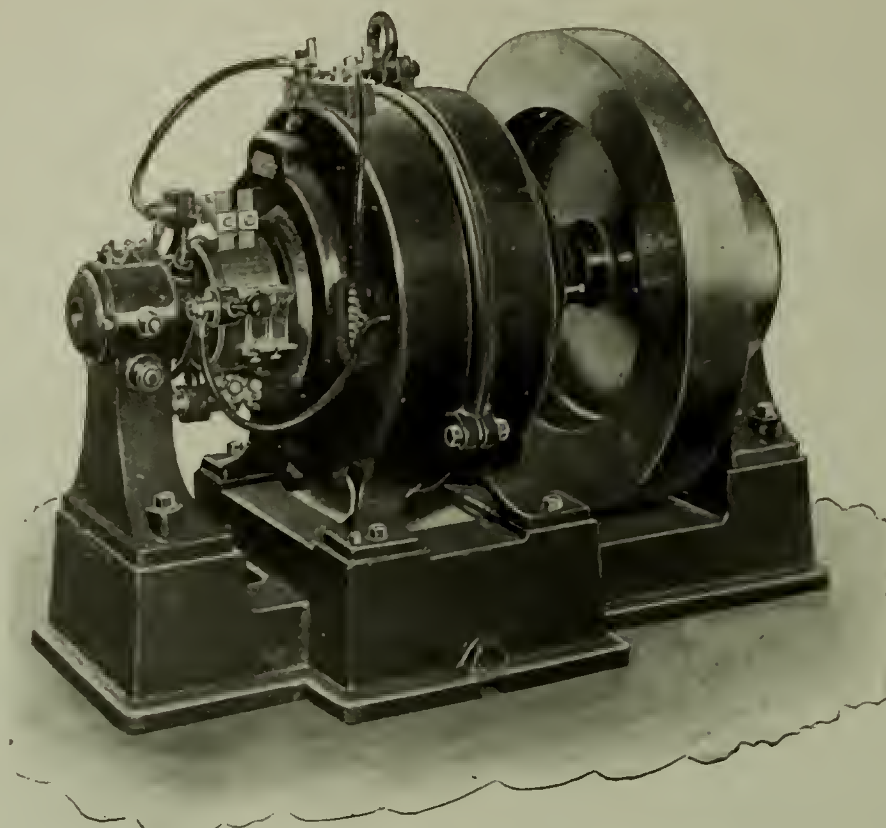


The End Connection of Bar Wound Armatures.
(See page 202 for article.)

consequence is so slight within the coil when the circuit is made or broken by the brush that sparking, due to the electro motive force of self-induction, is greatly reduced. Certain well known types of machines of American construction are built and, strange to say, work equally well as far as sparkless commutation is concerned, although as may be seen the principles followed out in either case are entirely different from each other.

END CONNECTIONS OF BAR WOUND ARMATURES.

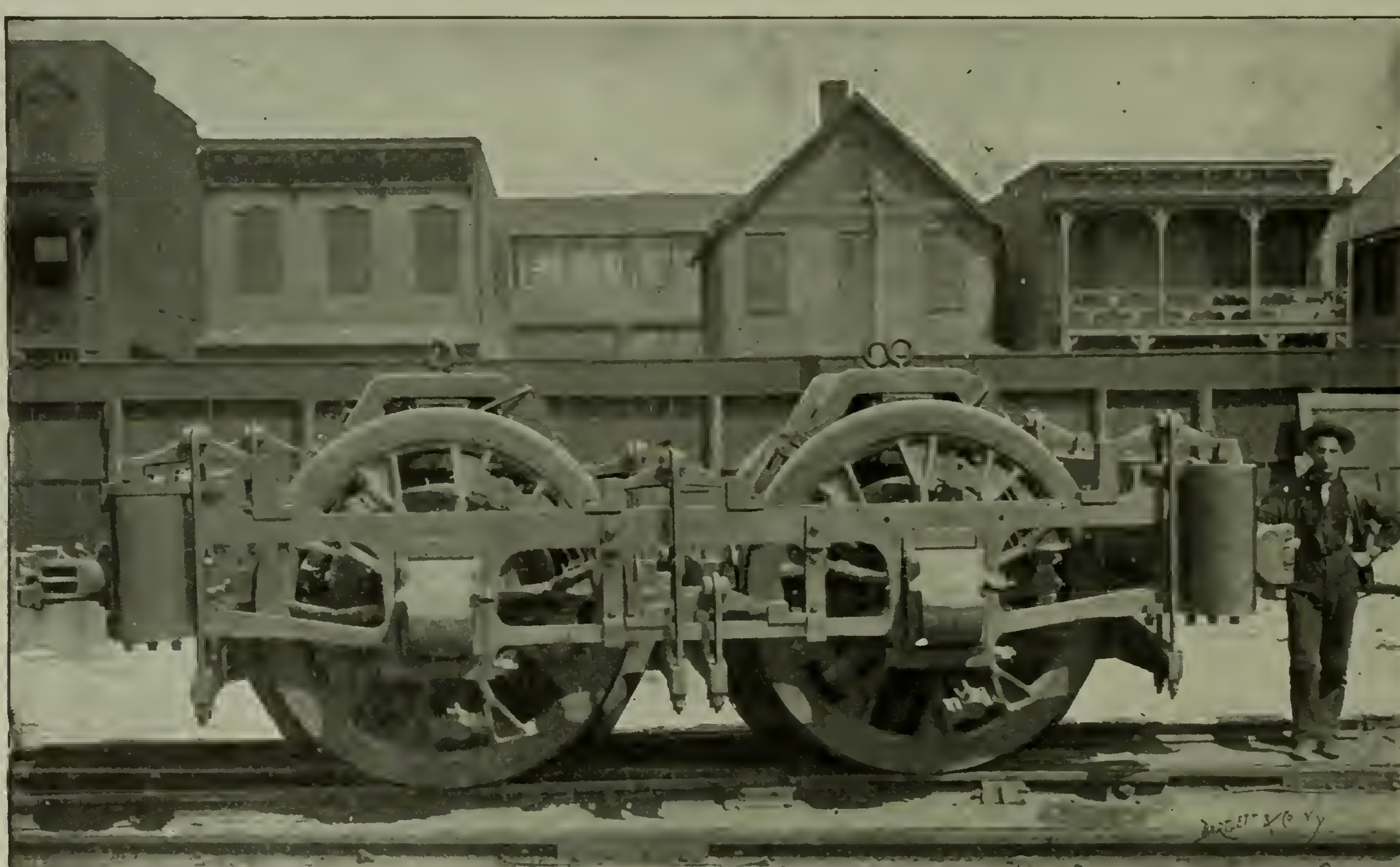
In the illustration is shown a method by means of which bar wound armatures are connected up without any undue projection occurring at the end. The bars are brought forward from the commutator and instead of being bent around they are constructed as shown in sketch, thereby enabling the manufacturer to place as many conductors on the armature as he pleases without having any undue extension at the end of a drum wound armature. The bend of each bar is parallel to that of the one preceding, as illustrated in the armature of a machine designed by Bradley, a well known American inventor. This principle is carried out in the construction of the movable armature coils of the Eickemeyer dynamo, the fame of which still remains in the mind of the designers and draughtsmen of electrical machinery of the last decade.



Generator with Momentum Pulley for Gas Engine Drive.

DYNAMOS DRIVEN BY GAS ENGINES.

The defects of gas engines were such and in many cases are such to-day that a uniform speed is not to be expected. In order to obviate this difficulty which is fatal to successful electric lighting the generators are supplied with pulleys, as shown in the illustration. These pulleys or fly wheels take up the variations in speed and keep the gen-



Electric Locomotive Designed for Freight Service on B & O. Road. (See page 203 for article)

erator running fairly uniform in that respect. Gas engine manufacturers guarantee speed limits which, if lived up to, remove the necessity of using a heavy pully, but in order to be on the safe side it is frequently deemed necessary to build machines with this hybrid fly wheel attached.

THE ELECTRIC LOCOMOTIVE.

The equipment of trunk lines with electric power, thereby dispensing with the use of steam locomotives, is still a mooted point in electrical and mechanical engineering. The difficulties are not due to any faults in the construction of the electric locomotive, either as regards its durability, speed, tractive effort or draw bar pull when starting from a condition of rest, but are largely due to the undesirability of erecting an overhead trolley line or a third rail system stretching over miles of distance and exposed to the inclement weather that would surely affect its working operation. In other words, electric traction on trunk lines can never become a practical success until a new system is invented through which feed wires and the main conductor will be absolutely protected from the wind or snow, the system being devoid of those automatic appliances which are never thoroughly reliable in an emergency. In the illustration is shown a locomotive used by the B. & O. road, well able to draw a train of loaded cars at a speed equal to that of a high class Long Tom. The driving wheels are about six feet in diameter, as may be seen by comparison with the engineer standing beside them.

SOME GOOD ADVICE AS TO USING THE TECHNICAL PAPERS.

Mr. Robert Quayle, superintendent of motive power of the Chicago and Northwestern railway, in his presidential address before the Master Mechanics' Association states:

"We should use the technical papers intelligently. It is a good plan for the head of the motive power department to mark articles and send them to their master mechanics and such other employes as they would deem wise, asking for comments and suggestions. Will not a little work in this direction pay well?"

Similar advice to young engineers is given in a recent contribution to "The Purdue Exponent," by Mr. Daniel Royse. He says:

"If a young engineer is so situated that he can contribute to the technical press as a writer in either of what are here called the first two classes, it will be of distinct advantage to him to do so. He acquires the ability to express himself well; he learns to think straight (or he is quickly found out); he will become known to his future clients. The discussion which may arise on this subject will be at comparatively short range; because publication is not delayed for weeks or months; an experienced writer is given a better chance to consider any reply to questions and criticism than is offered in oral debate at a society meeting; moreover, the men who take part in such discusions do so because they are interested in the subject. Lastly, the pecuniary reward is not to be despised.

"As a preparation for his future work a young engineer cannot do better than to become a close reader of the current periodicals which have for their field his chosen profession. Let him follow the discussions and if possible take part in them; in order to do this with credit to himself, he must become familiar with the subject, and having once mastered it will easily recognize it when after a period of eight or ten years that same subject appears again thinly disguised and heralded as something that is really new. Many questions have a way of reappearing at more or less regular intervals, so that the elders of the profession have met most of them more than once."

Business News.

SPECIAL EXPORT COLUMN. TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING OCT. 7, 1899, $87,033.00.

New York, N. Y., Oct. 7, 1899. The following exports of electrical materials are from the port of New York for the week ending this date:

British Guiana.—1 case electrical materials, $10.

Brazil.—6 packages electrical materials, $1,627.

British West Indies.—14 packages electrical materials, $20.

British East Indies.—45 packages electrical materials, $1,511; 8 cases electric machines, $2,075.

British Possessions in Africa.—51 blg. electrical materials, $3,287; 4 blg. electrical materials, $1,210.

Cuba.—2 packages electrical material, $72.

Central America.—363 packages electrical material, $1,035.

Genoa.—12 blg. electrical materials, $547.

Havre.—94 blg. electrical material, $16,503.

Hamburg.—78 cases electrical material, $3,812; 58 blg. electrical materials, $2,875.

London.—36 cases electrical carriages, $1,115.

Mexico.—2 cases electrical material, $25.

Milan.—4 packages electrical material, $69.

Marseilles.—418 packages electrical material, $50,620

Newcastle.—15 packages electrical material, $475.

Newfoundland.—3 cases electrical material, $60.

Venice.—2 packages electrical material, $85.

POSSIBLE INSTALLATIONS.

El Dorado, Ark.—The mayor may be addressed regarding the plans which have been prepared for the electric light plant and water works.

Augusta, Ga.—The Georgia Railroad intends to establish a plant for lighting depots, shops and yards by electricity. Address W. S. Brand, superintendent.

Lake Charles, La.—An election will be held to decide the issuance of $100,000 of bonds for the purchase of electric light plant and water works. Address the mayor.

North Wilkesboro, N. C.—An electric light plant will be erected. Address the town clerk, J. B. Horton.

Christiansburg, Va.—An appropriation of $10,000 for an electric light plant has been made by the city. Address G. W. Walters, clerk.

Albany, N. Y.—The executive committee of the Erie Canal Electric Traction Company has adopted the storage battery system for use as its motive power, subject to the approval of the Superintendent of Public Works.

NEW INCORPORATIONS.

Pensacola, Fla.—The Consolidated Electric Light & Power Co. has been incorporated with T. E. Welles, president; William Hays, vice-president and treasurer; A. F. Warren, secretary; capital stock, $20,000. The company will operate the plant of the Pensacola Electric Light & Power Co. recently purchased by William Hays.

St. Louis, Mo.—The Globe Electric Co., with a capital stock of $100,000, has been incorporated by Gustavus Heidel, George Anson Clark, Samuel D. Winter and others.

Maxton, N. C.—The Maxton Light & Power Co. has been incorporated by J. E. Duval, A. J. McKinnon, J. W. Carter, John Leach and others; capital stock, $3,000, with privilege of increasing to $50,000.

TELEPHONE CALLS.

Murray, Ky.—The Calloway Telephone Co. has been incorporated, with a capital stock of $5,000, by J. E. Wright, of Mayfield, and J. G. Hart, of Murray.

Shelbyville, Ky.—Major J. J. Downey, of Cincinnati, has ben granted franchise and will organize a company for the establishment of a telephone system in Shelbyville.

Sumter, S. C.—A telephone plant wil be erected by the Sumter Telephone Manufacturing Co. equipped with the latest machinery. For further particulars address F. C. Manning, secretary.

ELECTRIC RAILWAY NOTES.

Belair, Md.—A company is being formed to construct an electric railway from Belair to Van Bibber, a distance of seven and one-half miles.

Cumberland, Md.—A company proposes building an electric line to Uniontown, Pa., a distance of sixty-three miles.

Montgomery, Ala.—The proposed electric line from Pickett Springs, it is stated, will be built within the next year and the terminus at the Springs converted into a summer resort. The line will be about four miles in length.

STREET RAILWAY CONVENTION NOTES.

Messrs. M. R. Cockey and G. Swan, of the New York office, and Messrs. Welch and Tingley, of the Trenton office of John A. Roebling's Sons Company, will be at the Chicago meeting of the American Street Railway Association.

Lieut. E. J. Spencer, western agent for underground cables of the Safety Insulated Wire & Cable Co., New York City, will have a fine exhibit of railway cables at the American Street Railway Association convention at Chicago.

THE ROEBLINGS AT THE YACHT RACES.

Mr. H. L. Shippy, treasurer and general manager of John A. Roebling's Sons Company, 117-119 Liberty St., New York City, secured the beautiful steam yacht "Nooya," owned by Mr. Stanley Tweedy, of the New York Yacht Club, for the Columbia-Shamrock races. Mr. Shippy took a large circle of friends in the trade down to Sandy Hook during the last four attempts for the America's cup. "No Race" did not mar the enjoyment of Mr. Shippy's guests and, as the boys expressed it, they had a handsome time on the "Nooya," anglice "Darling Lady," and arrived home safely after a day's enjoyable outing. To ceelbrate the event Mr. Shippy sent out beautifully engraved souvenir invitations, showing the latest type of sloop yacht in full sail, a reproduction of which is shown herewith. John A. Roebling's Sons Compan are they famous builders of the Brooklyn Bridge, and are also well known for their skill in the manufacture of trolley wires, overhead, submarine and underground insulated wires and cables, as well as every known staple style of insulated wire and cable.

The Electrical Age.

VOL. XXIV—No. 17. NEW YORK, OCTOBER 21, 1899. WHOLE No. 649.

Novel Applications of Electricity.

Hon Judge Adam E. Schatz, Inventor of the Schatz Electric Canal Haulage System.

AN ELECTRIC HAULAGE SYSTEM FOR CANALS.

Considerable agitation has taken place of a political and popular nature regarding the great canal question. The question arising is one relating to the development of the canals and the consideration of a means of cheaply and readily transporting merchandise in canal boats from point to point. The Hon. Judge Adam E. Schatz, of Mount Vernon, has made a thorough and comparatively exhaustive study of the situation as regards the best method of transporting cargoes at a speed that far outvies that now possible with the mule. The railway is a great competitor of the canal but on the other hand, where its advantage lies in quickness of delivery, the disadvantage is ever present in dollars and cents.

The cost of transportation has been considered by Mr. Conder for the Select Committee on Canals and a table drawn up, showing the relative difference in cost of transporting freight by railway and canal. They are as follows:

Items of Cost.	Railway.	Canal.
Maintenance of Way	13	0
Maintenance of Works	7	2.3
Repairs of Rolling Stock	19	6
Traction	18	8
Traffic Expenses	30	6
General Charges	15	15
Interest on Capital	100	33.3
Total	200	70.6

It is therefore seen that the cost of transporting freight by railway is nearly three times that of the present cost by canal, the only difference being that of quicker delivery on the part of the railway systems. Accidents rarely, if ever, occur on canals; there are no rails to spread, there is little or no deterioration. In fact, as shown in the table, the maintenance and repairs which are 26 in a railway are 8.3 for a canal.

It is quite evident to the reader that canals perform an important function as an economic factor in the development of any given section of country. It would be difficult to estimate this in exact figures without taking into consideration the element of convenience and the manner in which they facilitate trade along their route. The Northern Venice, industrious Holland, is a fair example of what canals may do when they become, as one might say, a national feature. These canals are becoming thoroughly modernized for commercial purposes by the introduction of an increasing variety of steam, naptha, gasolene and electric launches, through which means goods are readily transported from place to place. For heavier work canal boats are in vogue and the system in that respect is no better advanced than here.

The State of New York has spent at least nine million dollars improving the Erie Canal. In a sense this is money misapplied for the reason that if one million had been utilized for the purpose of installing and testing a few of the canal haulage systems certain invaluable results would have been obtained, leading to a full appreciation of canals, in virtue of the rapid canal haulage system shown in practical operation.

Judge Schatz, in pursuing his investigations on this great problem, designed and constructed a system of canal haulage in which he makes use of an electric mule. It is an electric motor which moves upon a single rail and is supplied with a gear engaging with a rack, as shown in the illustration. It is the intention of Judge Schatz, in the installation of this system for practical purposes, to have the rails and rack raised about two feet above the ground on supports of short posts. Two copper conductors are attached and through them passes the energy supplied to the motor. The great advantages of this system are apparent to the engineer upon close examination. First of all no slip is possible, the engagement of the motor with the rack means a continuous and certain pull or, in other words, a tractive effort entirely independent of the size and consequently the weight of the motor. The question of tractive effort in all other systems is a very serious one as at times the resistance or retardation experienced by the canal boat is strongly emphasized. In stormy weather coatings of ice and snow would interfere with the operation of any other electric traction system and thereby put a stop to further traffic along the route. The Schatz system, however, is so constructed that tractive effort is always secured, progress is inevitable and a horse power and size of motor may be employed which would be wholly inadequate to produce the effect required with the ordinary rail system. The rate at which the boat moves can be made to reach eight, ten or even twelve miles an hour and at a cost which is far less than that demanded by railway companies for the transportation of an equal weight. A perfected canal system of this description would enable rapid changes to be made of goods, cereals, manufactured articles, etc., from the coast inland to the uttermost limits of the great lakes and from that more rural section of the country outward to the maritime centres. Further information in connection with this specimen may be obtained at the office of the inventor, Judge Adam E. Schatz, New York Life Insurance Building, 346 Broadway, New York City.

Miscellaneous.

ELECTRICITY AT HIGH PRESSURES.*

BY ELIHU THOMPSON.

My interest in the subject we shall consider this evening is the more pronounced from the fact that I began my experience with electrical phenomena by working with relatively high pressures or potentials. My first machine, constructed when I was eleven years of age, was a high potential apparatus, giving about 30,000 volts or thereabouts. It was a frictional electric machine, the main part being a wine-bottle revolved upon an axis, to which was added the usual rubber, silk flap, and prime conductor.

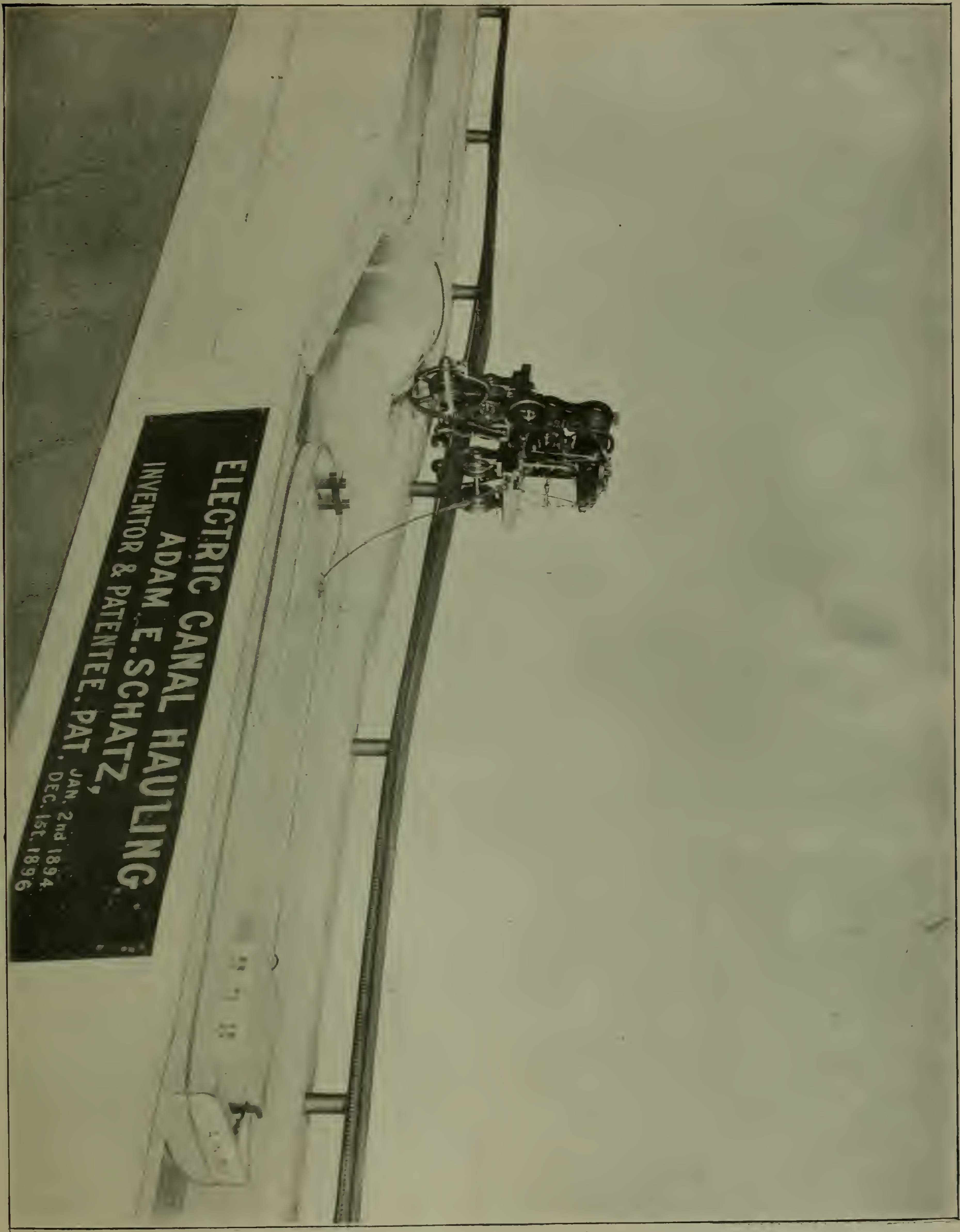
Electrical development on the large scale has in the past few years been going on in the direction of increase of electrical pressures, or increase of potential differences, and this fact gives a renewed interest. The prime cause of all electrical manifestations is, of course, difference of pressure or potential. That we have much more to learn in this fascinating field is evidenced by the condition of our knowledge in regard to the phenomena of lightning, the aurora, comets' tails, and possibly, also, of the solar corona. It is about one hundred years since Volta studied the voltaic battery and gave to the world a source of steady currents at low pressure. Long before that, however, the older experiments of the development of electric charges by friction, and the properties of charged bodies had been studied and wondered at.

Priestly, in his "History of Electricity," a work of nearly 800 pages, has even given expression to the opinion that, "In electricity there is the greatest room to make new discoveries. It is a field but just opened," etc. His book was published in the latter part of the last century. It dealt entirely with electricity at high pressures. Even the old experiment of rubbed amber would give 10,000 to 20,000 volts, and the old glass globe machines, such as Franklin used, a much higher pressure; nothing, however, in comparison with that of a lightning stroke. Still I must say that I have no sympathy for those who speak without hesitation of hundreds of millions of volts even in such cases, or who affect to describe apparatus as in existence to-day developing pressures of several millions of volts. A few years ago (in 1892) I constructed a high frequency coil which gave a torrent of 64-inch sparks, estimated by me at the time as representing about three-fourths of a million volts, and since thought by Professor Trowbridge, of Jefferson Physical Laboratory, Harvard University, to have required one million volts. Professor Trowbridge has since constructed apparatus from which he has obtained some sparks of seven feet in length, a discharge of perhaps something more than a million and a half volts.

This apparatus was calculated to give about three millions of volts, but probably before that pressure was obtained, the leakage, brush discharges to the walls, floor, and surrounding objects, limited the pressure to that which gave the discharge of seven feet.

To illustrate the development of electrical pressures by friction, I may describe an experiment of many years ago. I poured a layer of turpentine varnish upon a clean tin plate and allowed it to dry into a flexible sheet closely adhering to the tin. Upon stripping it off carefully so as not to cause friction, it came away with an electrical pressure, or charge, sufficient to cause small sparks, etc. The varnish in close association with the tin surface, had taken up an opposite electrical state to that of the tin. The pressure or potential difference was not, however, high while the surfaces remained in contact, but, upon separating them, the pressure rose gradually during separation. This

*A lecture delivered before the New York Electrical Society.



Model of Schatz Electric Canal Haulage System.

was owing to lessened capacity, there being no more electricity in the one case than in the other. The positive and negative electricities were neutralized or bound by being close together, and the pressure was very low. When the film was raised, the electrical pressure rose and energy was expended, just at it is expended in lifting a weight.

I may illustrate the conditions by laying a thin sheet of rubber upon a smooth zinc plate, and rubbing with a piece of fur the upper surface of the thin rubber film. A bound charge is accumulated upon the rubber, and the zinc and the rubber exhibit, as tested by the electroscope, only a slight electrification. The charge is so nearly neutralized by the opposite charge brought up by the zinc that the potential exhibited is very low. Upon stripping the thin rubber from the plate, work is done in overcoming the attraction due to the opposite charges, and the potential of the rubber at once rises so that it gives sparks of two or three inches to the knuckle held near it.

When, as in this case, the electricity is developed by friction, the rubbing only acts to secure area of contact, or to insure the condition that all parts of the rubbed surface shall have been in close contact with the rubbing body—in this case the fur. If a piece of ebonite be rubbed by the fur, wherever the two touch bound charges are developed and would remain bound and neutralized. They would exist at low voltage until they were separated. The high pressure charges only come into existence as the two bodies are gradually separated. How inefficient the friction process must be can be understood when it is pointed out that the actual work which produces electricity is not that of the rubbing, but only that of the contact and separation of the two bodies. The friction proper produces heat; the pulling apart of the bound charges gives electrical energy at high pressure.

(To be Continued.)

Stray Currents.

TUNNEL LIGHTING.

In carrying out the repairs of the Torcenay Tunnel on the Eastern Railway of France, a portable electric light plant is employed. A railway truck carries a petroleum engine driving a dynamo, which furnishes current, both for propelling the truck by means of a motor and for lighting the works in the tunnel with 4 to 6 arc lamps or 20 to 40 incandescent lamps.—Ex.

SIX OF ONE AND HALF A DOZEN OF THE OTHER.

Horse Owner—"Suppose the motor of your automobile gives out when you are half way between two towns. What then?"

Horseless Carriage Owner—"Well, I wouldn't be any worse off than if I were half way between two towns with a horse and buggy and the horse should die."—Ex.

A NEW ELECTRIC LIGHT.

A new electric light has been patented by a Parisian, for which is claimed increased light at a minimum cost. The wire, instead of being simply a loop, is made to coil around a vertical tube in the center of the bulb. This tube is made of a special reflecting composition and is said to give to the lamp a much greater illuminating power at one-half the cost.—Ex.

RAPID TELEGRAPHY.

A dispatch to the N. Y. World from Budapest, dated September 30, states that the system of quick telegraphy invented by the two Hungarian engineers, Pollak and Virag, and to which we referred in our issue of July 5, 1899, was tried on September 29 for the first time in Eastern Europe. The test was made upon the government wires between Berlin and Budapest. All the experiments were successful, 78,000 words an hour being transmitted. While the wires were working the trial was watched by representatives of the two great American telegraph companies, the French government experts, and the Hungarian telegraph authorities.—Ex.

A GREAT BRAZILIAN WATER POWER SCHEME.

A Brazilian scheme for a water-power electric plant proposes to obtain 16,000 horse-power from the Tiete river and transmit it electrically to the city of Sao Paulo, twenty-four miles distant. The electric energy to be developed is to be used by the Sao Paulo Tramway, Light and Power Company, which has offices at 621 Broadway, New York. Important contracts for the work have already been let to the Stilwell-Bierce & Smith-Vaile Company for turbines, Pennsylvania Steel Company for rails, the Lorain Steel, the J. G. Brill, the American Steel and Wire, the John A. Roebling's Sons, the Rand Drill, the General Electric and other companies for their special products and appliances, in all aggregating several hundred thousand dolalrs. But this, it is said, is only a beginning. Capital to the extent of $5,000,000 is required for the undertaking, and this amount is to be furnished by American and Canadian capitalists. Mr. F. S. Pearson, of No. 621 Broadway, New York City, is the consulting engineer to the company.—Ex.

AUTOMOBILE EXPOSITION IN PHILADELPHIA.

The National Export Exposition, now being held at Philadelphia, will afford the first general exhibition of automobiles in America. The invasion of horseless carriages is assuming an importance that compels recognition of their claims. The exposition is therefore giving every facility for a representative display of these modern vehicles. On the west side of the Main Building a beautiful smooth driveway has been constructed expressly for automobiles, on which trials of speed and comparative tests by horseless carriages will be made daily for the edificationof visitors who may turn from the inert exhibits in the buildings to this operative one on the grounds. Several manufacturers of vehicles in Philadelphia, New York, Boston and elsewhere will make exhibits of automobiles, locomobiles, and the various forms of horseless carriages and wagons, showing the application of gasoline, electricity and steam as the motive power.

TO INCREASE NIAGARA POWER; THE POWER COMPANY CALLS FOR BIDS FOR THE CONSTRUCTION OF A NEW WHEEL PIT.

The Niagara Falls Power Company has called for bids from a score of contractors in various parts of the country for the construction of a new wheel pit, says the "Sun." This pit will be over 400 feet long, about 20 feet wide and 180 feet deep. It will be cut out of solid limestone and will be located on the inlet canal, opposite the present power station. In this pit there will be room for at least ten big 5,000 horse-power turbines, which will bring the total amount of power produced by this company up to 100,000 horse-power. The bids are to be opened on Oct. 5, and the specification call for the construction of the necessary tunnels. The old wheel pit has been lined with brick and the new one will be treated similarly.

Just how many wheels will be installed in the new pit at the start is a matter of conjecture, but the fact that the entire pit, instead of a section, is to be built, is a strong indication that the company realizes that the demand for power will not fall off. The call for bids is an indication that many more milions of dollars are to be at once expended on the force of the Niagara.

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CONTENTS:

THE INCREASING DEMAND FOR ALUMINUM WIRE.

The cost of a transmission plant is governed by the length of the transmission line and the capacity of the generating station. The generating station, if driven by water power, runs at a minimum expense as long as the demand for power exceeds a certain minimum limit. The transmission line, however, is expensive to install in proportion to its size and length, or, in other words, in proportion to the power it transmits. Copper conductors weighing a certain number of pounds per foot amount to an aggregate weight of tons per mile and thus call for supports which are neither affected by the wind or the weather. The conducting power of a copper wire is estimated from ninety-five to ninety-seven per cent. of the carrying capacity of a silver wire of equal cross section.

The copper trust, however, has so boomed the price of this metal that at the present period the erection of a twenty mile transmission line involves an outlay of considerably greater magnitude than a few years ago. For this reason after the conducting power of aluminum, in conjunction with its extreme lightness, had been fully recognized it began to be regarded as a possible substitute for copper in certain special cases. This idea has gained ground and several large mining and power transmission companies have erected aluminum lines which, to all intents and purposes, are fully the equal of those made of copper.

In an article by Prof. F. A. C. Perrine on the tests and calculation for a forty mile aluminum wire transmission line, read before the third annual convention of the Pacific Coast Electric Transmission Association of San Francisco, several interesting points are brought forth in connection with the weight, size, length and tensile strength of an aluminum transmission line. The line the professor refers to operates between the Blue Lake power house and the Stockton sub station. "The wire is 294 mils in diameter or 86,433 circular mils in area; it weighs 419.9 pounds per mile and the ultimate tensile strength of each wire is 1,539 pounds or 22,700 pounds per square inch. The stress at one per cent. elongation is 800 pounds; conductivity by dimensions is 59.9 per cent. of Matthiesen's standard for soft copper. As compared to a copper wire this is the same as a No. 6 in weight, a No. 5 in breaking stress, a No. 3 in resistance and a No. 1 in capacity and inductivity. It is the same size as No. 1 and its resistance an equivalent to No. 3, but while it has only the weight of a No. 6 it has the breakage strength of a No. 5; so as regards the necessary strength in a span the wire is equal to a copper wire of about 70,000 pounds tensile strength or a steel wire of about 60,000 pounds tensile strength."

The rapid introduction of aluminum is not necessarily confined to power transmission plants. It could be used with great efficiency for the winding of magnets where bulk is not of much consequence and possibly in the construction of generators. The demand is certainly increasing among electrical manufacturers and engineers and we expect in the near future to hear of some progressive concern with enterprise enough to surround certain standard sizes of aluminum wire with insulation and place them on the market for regular consumption.

MAKING GRAPHITE BY ELECTRICITY.

The geological conditions prevailing at the time when graphite was formed were such that we are led to believe that in the intense heat of the electric arc such conditions may be reproduced with the necessary consequence resulting in the shape of high class graphite. The carbons of an arc lamp practically undergo this process through which coke is transformed into graphite. The carbons in use to-day are made of crushed gas house coke or retort coke mixed with a saccharine solution and heated in closed moulds in a fiery furnace. Were a block of this carbon subsequently placed in an electric furnace and protected from the air in the proper manner it would undergo a chemical change which would lead to its transformation into another species of carbon, commonly called graphite. At Niagara Falls a plant has been erected the purpose of which is to change coke, in the manner described, into graphite. What the quality is we are not prepared to state but the chances are strongly in its favor of being a form of graphite on a par with that imported to this country from the mines of India.

In the beginning of the next century three large industries will be on foot which are practically the direct outcome of experiments with the electric furnace. They are the manufacture of aluminum, calcium carbide and carborundum. It would not be surprising if a fourth were added to this list, namely the manufacture of graphite. According to the latest reports the graphite manufactured is of high quality and some of it has been exported for use abroad.

THE USE OF HIGH PRESSURES.

Not only has the use of aluminum wire marked an advance in the development of power transmission but, in addition, the gradually increasing use of higher and higher pressures. High pressures can be safely employed at the present writing entirely through the care exercised in the manufacture of insulators. In a few years twenty and thirty thousand volt transmission plans will be as common as ten thousand volt plants of to-day.

THE CENTENARY OF THE ELECTRIC CURRENT—1799-1899.*

BY DR. J. A. FLEMING, F. R. S.

In the market place of Como, overlooking one of the fairest of the Italian lakes, a statue stands, erected to commemorate an illustrious experimentalist and an invention epoch-making in the history of the world. The statue represents Alessandro Volta, and the invention was the instrument which gave us the first practical means of generating a continuous electric current. Volta was led up to the achievement that secured for him an imperishable fame by a long course of experimental research, which bore fruit of a splendid and enduring kind. Hence the centenary of his ever-memorable investigations, which opened a new chapter in the history of electrical discovery by giving to the world the voltaic pile, is being fitly celebrated by men from many lands meeting at this moment in his native town. It is a familiar fact that almost exactly one hundred years ago Volta communicated to Sir Joseph Banks, then president of the Royal Society of London, a letter dated March 20, 1800, in which he describes his invention of the electric current generating appliance, since known as the voltaic battery or pile. This paper, printed in the Transactions of the Royal Society as having been read on June 26th of the same year (Trans. Roy. Sec. Vol. XC., Part I, p. 405), stands as a landmark in the intellectual record of our race. No thoughtful person can regard the modern use of the electric current thus given to us by Volta, or review the astounding results which a century of its possession by the world has brought about, without feeling some desire to know what is known of the inner mechanism of this nimble servant of mankind.

Fig. 1.—Original Volta Pile. (Through the courtesy of "Electricity.")

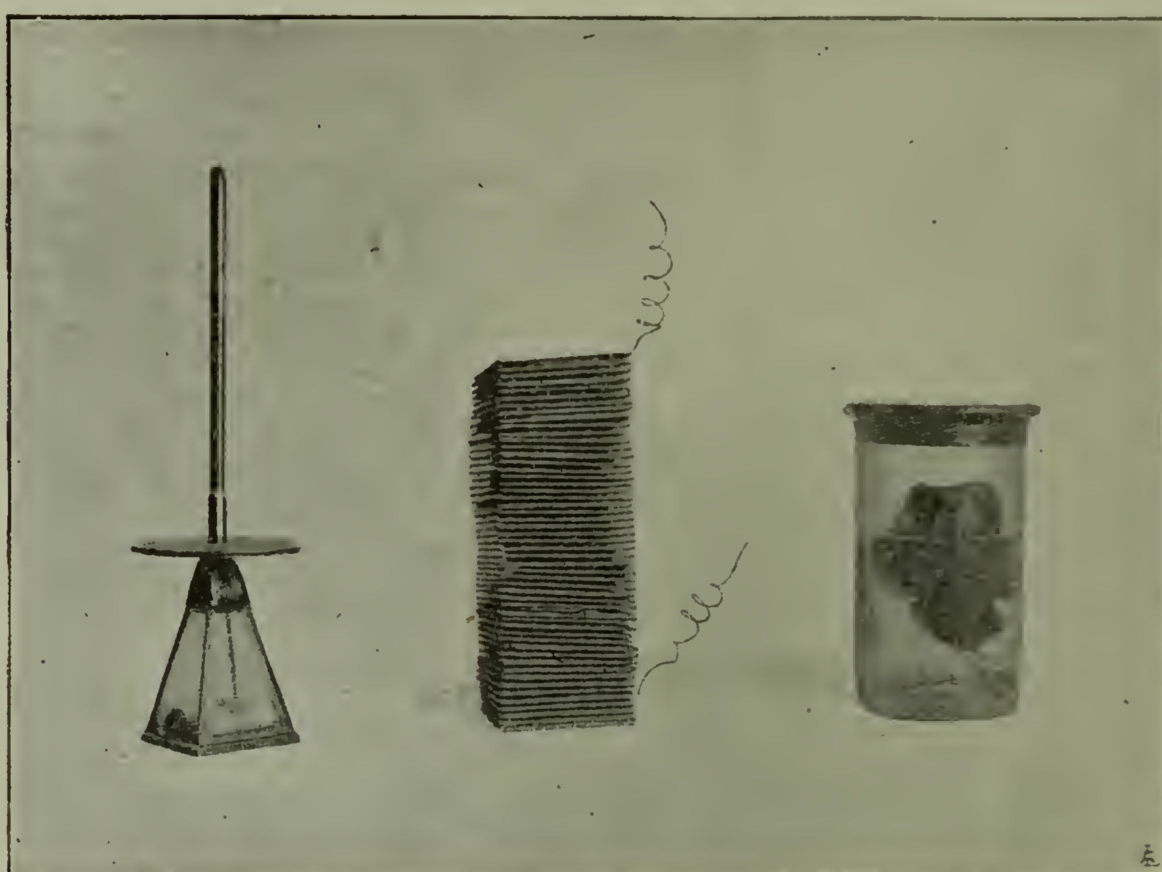


Fig. 2.—Condenser, Pile and Torpedo. (Through the courtesy of "Electricity.")

*Abstract of a lecture delivered in the Connaught Hall, Dover, Sept. 18, 1899, during the meeting of the British Association.—From the London Electrician.

My aim to-night will be, by a few experimental demonstrations, to direct your thoughts to consider the chief conclusions reached after a century of investigation on this matter, and to indicate the problems which yet remain to be solved before we can answer with any considerable degree of approximation the question so often asked, What is an electric current? Leaving out of account unnecessary historical statements, we may say that Volta made two important discoveries, or, rather, made a practical contrivance and elucidated its operation by a scientific discovery. The discovery was the fact that if pieces of different metals—say zinc and copper—are placed in contact and then separated they are found to be in different electrical states. The manner in which this effect can be shown is to employ two perfectly flat disks of zinc and copper, each provided with an insulating handle. The disks have their faces very slightly varnished with an insulating varnish. One of these disks, say the lower one, is connected to an electroscope having aluminum leaves, and the other is held in the hand. If the disks are superimposed and connected for a moment by a copper wire, on lifting off the upper disk the leaves of the electroscope diverge. The copper disk under these circumstances is very slightly negatively electrified and the zinc disk positively. Volta's researches on contact electrification started one of the historical controversies of science, and it is not too much to say that probably, even now, no two physicists would state their creed as to

Fig. 3.—Original Volta "Couronne de Tasses." (Through the courtesy of "Electricity.")

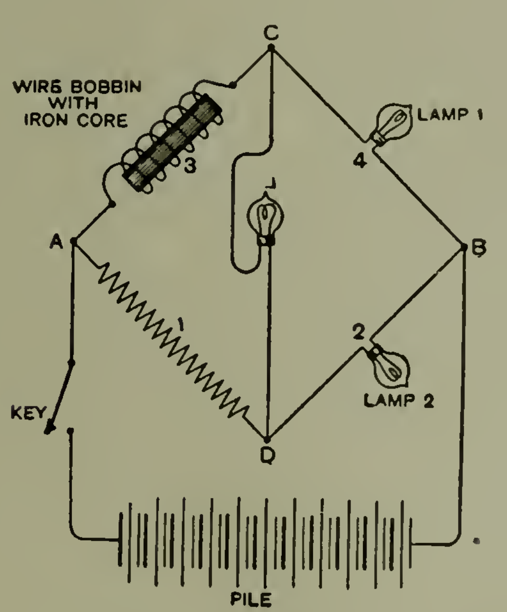
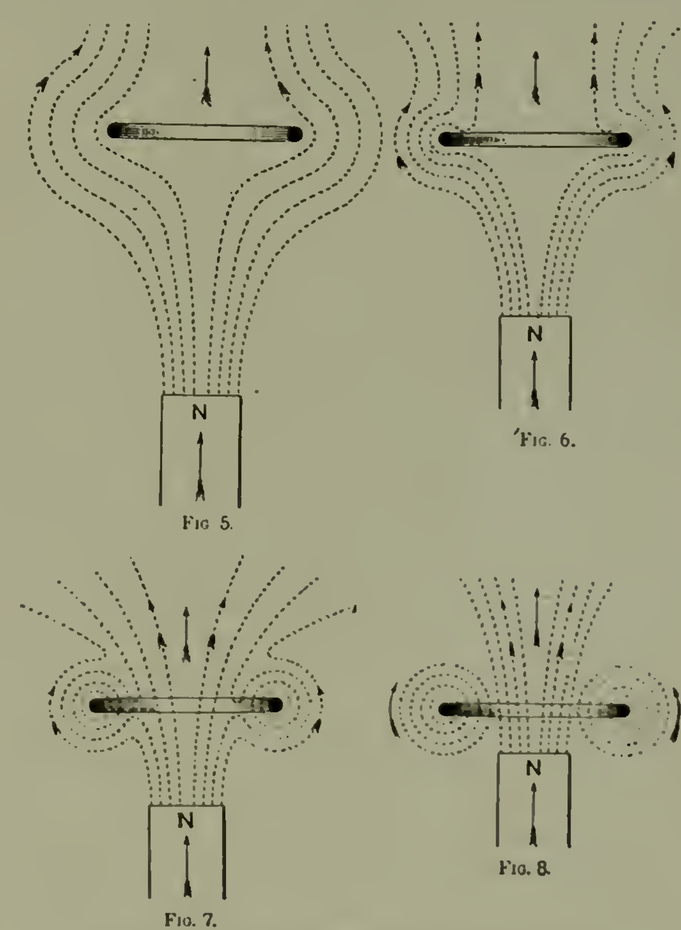


Fig. 4. (Through the courtesy of "Electricity.")



(Through the courtesy of "Electricity.")

the origin of the electromotive force in the voltaic cell in precisely the same terms. Let us, at this stage, now examine the results which take place when a simple voltaic cell or combination is formed. In a glass vessel we place some water slightly moistened with sulphuric acid, and in this we place a rod of zinc and one of silver. If the zinc and the silver do not touch no visible action takes place. Pure zinc is perfectly insoluble in dilute sulphuric acid. If, however, the zinc and silver are made to touch by joining across them a silver rod or wire, a violent effervescence is then seen to take place around the silver rod. This effervescence is due to escaping bubbles of hydrogen, and indicates a chemical action. You will notice that we have here three substances in contact—zinc, silver and acidulated water—forming a circuit. During the contact of the three substances we have an electromotive force acting in the circuit. We have also a chemical action taking place between the materials in the vessel by which the zinc is gradually dissolved away by the dilute acid, and in its place we have produced sulphate of zinc, a compound possessing less chemical energy than the zinc and the sulphuric acid taken together which formed it. Finally we have an exhibition of new and peculiar properties in the connecting wire and the circuit which are described by saying that an electric current is flowing round the circuit.

A series of these cells may be arranged, as was done by Volta and Cruickshank, into a battery (see Fig. 3) and the end plates may be joined by a circuit-closing wire, which then becomes the seat of an electric current. The peculiar property of this voltaic arrangement of conductors of the first and second class is that it can maintain in and around the circuit-closing wire this physical state called an electric current. Our business this evening is chiefly to investigate, as far as possible, the nature of this effect.

I wish, in the next place, to direct your attention carefully to the effects which the pile or battery produces in the surrounding medium or space, both when the circuit is open and when it is closed. Suppose the circuit in the first place open and the end plates of the pile connected to two plates of metal placed in proximity, one of which is fixed and the other movable, it is found that there is a stress or pull between them which draws them together. This attractive force between plates attached to the terminals of a Volta pile is of exactly the same character as that which exists between two light objects connected to the terminals of an electrical machine, one being charged with positive electrification and the other with negative. It follows from facts first discovered by the celebrated Henry Cavendish that, with a given battery, the attraction not only depends on the form and distance of the plates, but upon the material or dielectric, as it is called, in which they are immersed. If the plates connected to the pile are placed, say in turpentine or alcohol, the plates under the same conditions will attract each other more strongly than they would if they were simply in the air. Moreover this attraction is a proof that there is energy in some form stored up in connection with the system. It is an important matter to ascertain exactly where the energy resides. We can, following Cavendish and Faraday, prove that the energy is stored up in the dielectric, and not in the metal plates. The operation of the battery on the insulating plate is to produce a change equivalent to a strain which releases itself when the two metal plates bounding its surface are subsequently connected by a conductor. In electrical language this strain is called a displacement, and is said to be produced by electromotive force. The displacement takes place along certain strain lines, and it represents a storage of energy in connection with every cubic inch of the dielectric, just as much as there is a storage of chemical energy in connection with every pound of gun cotton. Hence, in association with Volta's pile, there is an association of energy, called electrostatic energy, distributed through, and contained in the surrounding medium or dielectric. The end plates of the pile, or any plates connected to them, tend to pull each other together in virtue of this stored electric energy.

In the next place, if the circuit of the pile is closed by a wire, we find in addition an effect taking place in the space round the wire of a different kind. We are able to show that the space is possessed of magnetic qualities and is said to be traversed by magnetic flux. When the flux is steadily in one direction we say that the current is continuous. When the flux is first in one direction and then in the reverse, we say that the current is alternating.

We can now proceed to an experiment in illustration of the fact that a magnetic flux system is a store of energy. We connect in series with a voltaic pile two parallel circuits (see Fig. 4), one part of one circuit consisting of a very long coil of wire of many turns. The other circuits consist of two lamps or carbon filaments having very few convolutions, and a short wire whose resistance is equal to that of the bobbin. Across the middle of these parallel circuits is bridged a small glow lamp. If we send a current through the parallel wires the proportions of the four sections of the two parallel circuits may be so adjusted that the bridge lamp does not light up, because no current goes through it. But if we switch off or break the connection with the battery the bridge lamp flashes up for one moment, whilst the others go out. This flashing up is due to the discharge through it of the energy which is associated with the magnetic flux surrounding the long coil of wire, the magnetic flux energy being transformed into heat and light energy by the resistance of the lamp filament in the bridge circuit. This experiment shows that when the currents are flowing through the two paths energy must be associated with the system, since on severing the connections with the battery we have an evolution of light and heat, as shown by the flashing up of the bridge lamp. This energy is derived from the system of magnetic flux around the circuit of the long wire bobbin.

Figs. 5, 6, 7, 8 are intended roughly to indicate the relation of the primary magnetic flux to that round the secondary circuit at different stages. As the secondary circuit advances towards the magnetic pole the divergent system of magnetic flux from the magnetic pole embraces it. The flux lines then wrap round the wire and are finally, so to speak, nipped off, leaving a separated system of flux lines embracing and associated with the secondary circuit. This secondary or detached flux is rapidly destroyed, its energy being dissipated by the resistance of the secondary circuit. The flux belonging to a magnet or primary circuit, by being moved across or caused to "cut" a second circuit, thus gives birth to another system of flux, called the secondary flux or current, which has a transitory existence. Instead of moving either of the circuits we may employ an alternating magnet or primary flux and we then obtain an alternating secondary current in the secondary circuit. This secondary current may be strong enough to illuminate a small glow lamp in the secondary circuit. You will be able then to notice that this alternating magnetic flux penetrates quite easily a piece of wood or sheet of zinc, but cannot pass through a good conductor or plate of small resistance, such as a thick sheet of copper. The reason is that its direction is being reversed so rapidly that it has no time to get through to the other side of the good conducting copper.

If we bear in mind an experiment, shown a few moments ago, proving that currents in opposite directions repel one another, it will be seen at once that there should always be a repulsive force between a primary circuit and a secondary circuit, at the moment when the secondary current or flux is generated in the latter.

If we place an aluminum ring over an alternating current electromagnet, and excite the latter with a powerful alternating current, we make a very vigorous alternating magnetic flux which penetrates the aperture of the ring. The ring then jumps up into the air (see Fig. 9). Falling down again it floats, as you see, upon an invisible cushion of magnetic flux. The ring, however,

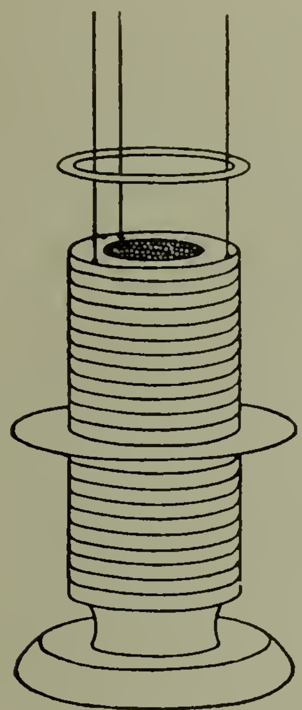


Fig. 9.
(Through the courtesy of "Electricity.")

soon becomes very hot in consequence of the powerful secondary current generated in it. That there is such a current is proved by trying the experiment with a broken ring, which, as you notice, will not jump. Rings of copper will also jump, but are less nimble than rings of aluminum, and rings of brass will hardly jump at all. The above experiments are all illustrative of the effect of a varying or changing magnetic flux in generating a secondary flux around another adjacent circuit. The

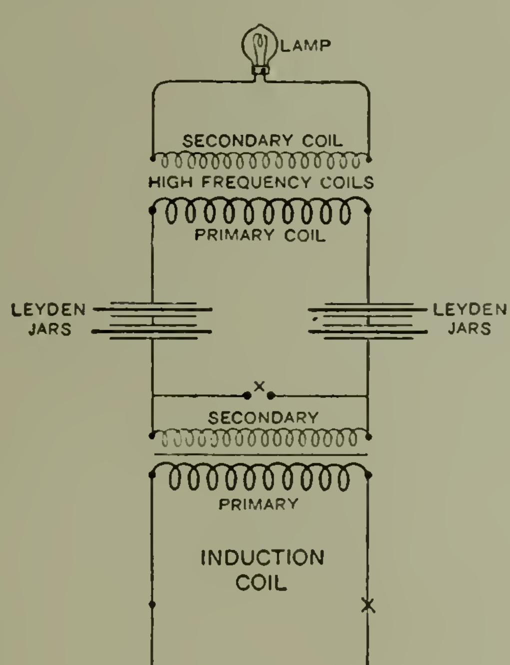


Fig. 10.
(Through the courtesy of "Electricity.")

very currents which we are using for our experiments, provided for us by the kindness of the Dover Electric Lighting Company, are generated in this manner. With alternate-current transformer apparatus I have it in my power to illustrate to you many of the facts concerning electric currents, and in particular to produce alternating currents of very great frequency, viz., about one million per second. It will, therefore, be desirable to explain a little in detail the arrangements. Through the primary circuit of an induction coil (see Fig. 10) is passed a current from a voltaic battery, which is interrupted about 1,000 times a second by a Wehnelt high-speed break. This interrupted primary gives rise to an interrupted high electromotive force in the secondary circuit of the coil. To the ends of the secondary circuit are attached the interior coatings of a set of Leyden jars, which are in effect sheets of glass coated with tinfoil on each side. This high electromotive force or stress produces an electrostatic strain in the glass, and that strain is a store of energy. Two discharging balls (+) are arranged across the terminals of the secondary circuit, and when this strain reaches a certain value the air insulation between the balls breaks down and an electric spark passes between them.

One point it is essential here to explain very clearly. The air and all other gases at ordinary atmospheric pressures can endure a certain maximum electric strain produced in them and remain up to that point very good non-conductors or dielectrics; if, however, the electromotive force exceeds a limiting value, the air or gas passes immediately into a highly conductive condition. This property of passing instantly from a non-conductive

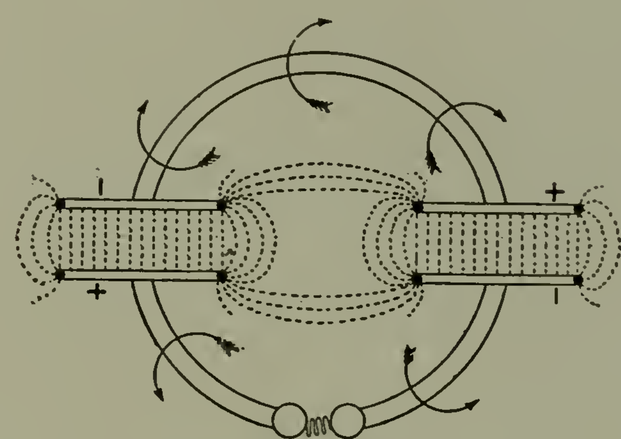


Fig. 11.
(Through the courtesy of "Electricity.")

to a conductive condition under a certain critical electric stress is a characteristic property of gases at ordinary pressures. In the arrangement before us the outside coatings of the Leyden jars are united by a wire wound on a wooden frame. Hence, when the air gap breaks down into the conductive condition, we have a circuit (see Fig. 11) composed of this wire on the one side, the conductive spark gap on the other, and these are separated by two plates or condensers in a state of electric strain in opposite directions. This electric strain is in effect an electromotive force. It was produced by an electromotive force, and it is in turn, when produced itself, a source of electromotive force; just as a spring can only be stretched by a mechanical force and when stretched is itself a source of mechanical force. Hence, the electrically strained glass releasing itself begins to produce round the circuit a magnetic flux embracing it —that is to say, it produces in the circuit an electric current. Owing, however, to the inertia-like quality of the magnetic flux, this flux or current cannot be produced at once, and when produced it cannot be annihilated instantly. The flux when generated persists and expends its energy in charging up the condensers in an opposite direction—in other words, its energy passes back into energy of electric strain, and the process of creating the flux or current is then again repeated, and so on until the energy of the original electric strain is all frittered away into heat. Accordingly we have in the wire connecting the outsides of the condensers an enormously rapid alternating current, and a current having a frequency of about a million a second is now being produced in the large circuit attached to a battery of 12 Leyden jars on the table before me. It can be proved at once that there is in the wire an alternating current, because if we place near this first wire carrying the high-frequency current another secondary circuit having included in it a small glow lamp, you see at once that the lamp lights up when the secondary circuit is placed near the primary circuit even when it is more than a yard away (see Fig. 12). The whole space for an immense distance round this high-frequency primary circuit is therefore filled with a tornado of alternating magnetic flux, which renders itself evident by creating secondary currents in all closed conductors near it. We can also show you that this flux passes quite easily through a wooden board, but is stopped by even a thin sheet of perforated zinc.

It has been known for a long time, certainly for 20 years, that tubes full of powdered metals were very curiously sensitive to electric sparks, and that a mass of metallic filings behaves like a gas in this respect, that under an electromotive force of a critical value it passes from a non-conductive to a conductive condition. It was discovered by Prof .D. E. Hughes in 1879—although unfortunately not published at that time—that a tube full of metallic powder, which we call a sensitive powder tube, could thus be transformed from a very bad conductor to a very good conductor by making electric sparks near to it. Facts in science have often to be discovered many times over before their full significance dawns upon the world, and it has been so in this case. This simple fact about metallic powders was re-discovered by Prof. Calzeechi Onesti, in Italy in 1885, but much more fully examined and investigated in 1891 by Prof. E. Branly, to whom we owe the greater part of our accurate knowledge on the subject. Prof. Lodge independently discovered the wielding power which an electric spark exerts on two metallic rods or balls in very close proximity, and christened the arrangement a "coherer." The behavior of a sensitive powder tube to electric sparks can quite easily be shown by connecting a sensitive powder tube in series with a galvanometer and a voltaic cell, and then making in the neighborhood of the arrangement an electric spark. We find that at every spark the non-conducting mass becomes a conductor, but can be brought back again to its original condition by a slight tap or shake. Moreover, it has been found by Signor Marconi that a long vertical wire attached to the sensitive powder tube has the property of increasing enormously the distance at which it can feel the effect of an electric spark. These principles have received their most logical extension and completion in the evolution of the electromagnetic wave telegraphy which Signor Marconi has developed on such a large scale the last few years. The chief principle which underlies this industrial application of research is that the sensitive powder tube, when passing into the conductive condition, can be made to complete another voltaic circuit, and so operate any ordinary form of telegraphic instrument. By sending long and short impulses to act upon the sensitive powder tube and keep it for a longer or shorter time in the conductive condition, any of the ordinary forms of telegraphic instrument can be operated at a distance by the action of a local battery.

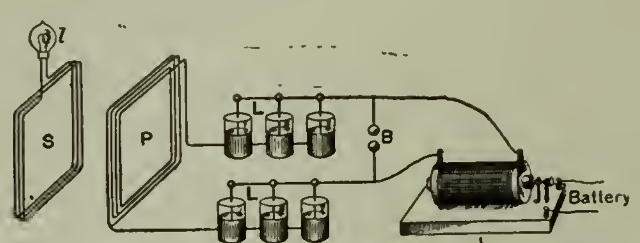


Fig 12. (Through the courtesy of "Electricity.")

It has been frequently asserted that the practical utilization of ether waves in wireless telegraphy would be limited by the difficulty of transmitting them through rock masses, buildings and other material obstacles. Experiment, however, proves that this is not the case, at least with the very long waves employed by Mr. Marconi. An exceedingly interesting experiment to illustrate this non-interference was tried on August 16, 1899, at Dover, between the Dover Town Hall and the South Foreland. The Town Hall at Dover stands in the center of the town and is surrounded by high cliffs. The Castle Rock rises on the east side to more than 400 feet above the level on which the Town Hall stands, and a continuous chalk cliff extends between the Castle and the South Foreland for a distance of four miles. At this latter place is one of the signaling stations of the Wireless Telegraph & Signal Company, and a mast and signaling wire 150 feet high was established there in April, 1899, for ex-experimetal purposes for communication between the South Foreland, the East Goodwin Lightship and a station at Wimereux on the French coast. At the suggestion of the author, the Wireless Telegraph Company kindly undertook to make an experiment as follows: The Town Hall tower is about 65 feet in height, and on this tower a flagstaff, some 45 feet high, is erected. A signaling wire was attached to this flagstaff, and the end brought down into the hall. Employing the Marconi apparatus it was found that not the slightest difficulty existed in communicating through or over the Castle Rock, with the station at South Foreland, and even with the Goodwin Lightship, 12 miles beyond. The immense mass of chalk cliff lying between the Town Hall, Dover, and the South Foreland appears to offer not the slightest obstacle to the passage of ether waves to or from the wire attached to the Town Hall flagstaff. The above described experiment only confirms many others made by Mr. Marconi, all of them showing that rock masses of very considerable size intervening between two stations do not in the least affect the freedom of communication by ether wave telegraphy. It must be obvious to you that the moment we have it in our power to close the circuit of a voltaic battery by merely making an electric spark at a distant place, innumerable applications at once suggest themselves. One of the latest and most ingenious of these is a method of steering self-moving torpedoes by means of an electric spark and sensitive powder tube which enables the movements of the deadly weapon to be controlled by an operator at a distance.

To us at present the interesting question, however, is to discuss briefly the mode by which the electric spark produces this effect at a distant place. The classical investigations of Hertz showed clearly we are concerned here with a wave motion. The oscillatory spark and current in the radiator produce an electric wave in space —that is to say, they produce a periodic electric displacement at any point .and this displacement is cyclical and passes through a cycle of values. Also it is accompanied by a periodic magnetic flux, the flux being at a maximum when the displacement is passing through its zero value, and conversely, the instant of zero magnetic flux coinciding with that of maximum displacement. Identical operations are being simultaneously performed at places distant by a wave length.

The trend of physical investigation during the last half century has been to lead us to regard energy as something distinct from matter and yet as always associated with it. We are always under the mental necessity of assuming some vehicle for energy when it is transferred from place through open space. We know that vast quantities of energy leave the sun, and that some of it arrives on the earth about eight minutes after its departure from the sun. Where is it during those eight minutes? In the same manner Hertz proved that electrical energy can leave a rod in which a very rapid oscillatory current is set up and travel with the speed of light outwards in all directions. We ask, Where is it after it has left the radiator, and before it has arrived at the receiver? The answer to both these questions is that it exists as free radiant or wave energy in the ether. Hence a second part of the answer to our question, What is an electric current? is that it is due to certain events or effects happening in the space-filling ether, the localization of these events being determined by what we call the conductor.

Finally, we are met by a more searching question, viz., What are those events, and what is the nature of the effects? In order that an answer to such a question may be intelligible it must be expressed in terms of some quantities with which we are already familiar, and it must not involve any more assumptions than are absolutely necessary. Very briefly, then, we may say that the tendency of modern research is to seek to reduce every phenomenon in physics to pure dynamics. Whether this is a legitimate or a full solution of the problem of interpreting physical nature, as presented to us by our senses, I will not venture to discuss. Suffice it to say that some of the most profound thinkers have concluded that it is the only solution which to our present mental faculties is satisfactory. Hence any detailed answer to our question can only be expressed in terms of some dynamical theory as to the constitution of the ether and its relations to sense-perceived matter. To touch even the outlines of the ether theories already constructed, examined or abandoned would be to tax your indulgence and my powers more seriously than I can venture now to do. When this century opened, Dr. Thomas Young made the first really competent attempt to apply the theory of a universal ether, assumed to be possesed of merely mechanical properties, to the explanation of the phenomena of light. Twenty years afterwards Ampere threw out a suggestion that the same hypothesis might supply the means of interpreting electrical facts. Joseph Henry upheld a similar view, Faraday strongly supported it. Clerk Maxwell, in his splendid dynamical theory of the electromagnetic field, published in 1864, first gave definite mathematical form and expression to a theory, including, not only electric and magnetic, but also optical phenomena in its grasp. Hertz in 1887, with magnificent insight, verified its fundamental assumptions.

Hence we see that, starting from Volta's discoveries a century ago, the conclusion has been reached that the actions we call an electric current, if alternated rapidly enough in direction, would end by producing a ray of light. We are, however, as yet in the region of conjecture when we attempt to formulate a specification of the exact nature of the motional and configurational changes which must be at the root of observed effects. To devise a theory of the ether such that from the simplest possible assumptions can be deduced the facts of electricty, magnetism and optics may be said to be the aim of physical inquiry at the present time. Whilst, under the guidance of its gifted leaders, the scientific army marches right on, it continues to dispense material benefits which are appreciated by all mankind. But it also reveals to our eyes the amazing complexity of structure which underlies the simplest of surrounding things, and points out regions yet more wonderful waiting to be explored. The unraveling of the tangled skein of cause and effect in the outward world of Nature affords to many intellects a fascinating pleasure; and it cannot be denied that, when pursued in a disinterested and reverent spirit, it is one of the highest occupations of the human mind.

ELECTRIC PLANTS IN GERMANY.

A most interesting feature of this Empire's development is found in the number of electric plants in course of construction and projected. French writers, notably Emile Gautier, Charles Bos, and J. Lafargue, are trying just now to arouse French emulation. It seems to me that American manufacturers might obtain contracts to furnish some of the materials needed in the plants. A large company has been organized here to build an electric railroad from this city (Chemnitz) to Burgstaedt, 12 or 15 miles away. As projected, the road is to run through many large and important villages. If continued to Mitweida, as some think it will be, should no rival concern open an opposition line, the distance covered will amount to 30 or more miles. There is also a project to build a central electric plant for supplying the road with power and the villages through which the road is to pass with electricity for light. Chemnitz has a population of nearly 200,000 souls; the towns included in the plans referred to contain about 75,000. The company expects to expend $357,00 on the road, and a similar amount on the buildings. Besides this, a cable road is being surveyed to Augustusberg, a well-known resort a few miles outside the city. While the disposition to patronize home industries is very strong here, I can not help thinking that we must have certain things which, once seen, would win their way to favor.

An interesting question is: How can an American house hope to obtain concessions or contracts? The best way, it seems to me, would be to send one or two experts, familiar with electric plants and their needs to study the situation. What is true of Chemnitz is true of almost every city in the Empire. In the month of June there were 330 railroads projected in the Empire. Of these, 73 were electric roads; 122 electric plants were projected during the same time. It would be easy for an expert to keep himself posted, by visiting or communicating with the United States consuls-general in Berlin, Frankfort, and Dresden. Patriotism has seldom been pushed so far as to force private companies to take inferior or dearer home products.

The market here just now is so large—consequently so important—that an effort should be made to sell in it, even at the risk of not making a great deal of money at the outset. The methods that have helped at home must help here. A report made by an expert who has gone carefully over the ground would supply specific details in a way not possible to consuls.

J. C. Monaghan, Consul.

Chemnitz, July 25, 1899.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING OCT. 4, 1899, $67,972.

New York, N. Y., Oct. 14, 1899.—The following exports of electrical material are from the port of New York for the week ending this date:

Argentine Republic.—101 cases electrical material, $4,023; 24 cases electrical machinery, $24.

Alexandria.—2 cases electrical material, $30; 1 case electrical machinery, $315; 99 cases electrical material, $5,002.

Antwerp.—17 cases electrical machinery, $376.

Brazil.—71 packages electrical material, $28,975.

British West Indies.—17 cases electrical material, $672.

Copenhagen.—2 cases electros, $15; 7 cases electric motors, $170.

Christiania.—7 cases electrical material, $567.

Central America.—122 packages electrical material, $1,261; 15 cases electrical machinery, $915.

Cuba.—27 packages electrical material, $702.

Genoa.—1 case electrical material, $16.

Hamburg.—77 packages electrical machinery, $1,550.

Hayti.—1 case electrical material, $56.

Lisbon.—3 cases electrical material, $150.

London.—117 cases electrical material, $6,392.

Liverpool.—7 cases electrical machinery, $340; 93 packages electrical material, $8,157.

Mexico.—176 cases electrical material, $4,011.

Newfoundland.—1 case electrical material, $135.

Nova Scotia.—4 cases electrical material, $63.

New Zealand.—1 case electros, $4.

Porto Rico.—4 cases electrical material, $75.

St. Petersburg.—34 cases electrical material, $3,232.

Southampton.—30 cases electrical machinery, $744.

NEW INCORPORATIONS.

Columbia, S. C.—The Cotton States Electric & Machine Co. has been incorporated. N. W. Girdwood, Ashville, N. C., president; capital stock, $5,000; to conduct a general electrical business, install electric, steam or water power plants, and will establish a shop for repairing electric and other machinery.

Chicago, Ill.—The Knox Automotoneer Company has been incorporated to deal in mechanical and electrical devices; capital stock, $25,000; incorporators, J. B. Woodruff, G. W. Knox, M. B. Starring, all of Chicago.

Buffalo, N. Y.—The New Motor Company has been organized, with a capital of $25,000, to manufacture steam, air, gas, gasoline and other motors, trolley wheels, bases and heads, emery wheels and boring machines. The directors for the first year are Samuel Wilkinson, E. L. Pixley and William M. Hoffman.

Minooka, Pa.—The Lackawanna Electric Light and Power Company has been incorporated, with a capital stock of $6,000.

Detroit, Mich.—The J. R. Pearson Company has been formed to deal in electric fixtures, mantels, etc. The capital stock is $10,000. The shareholders are Justice R. Pearson, Frank H. Crawford, Arthur J. Franklin.

Norwood, Mich.—The Norwood Electric Company has been incorporated; capital, $15,000; incorporators, J. E. Smith, G. F. Willett, G. S. Winslow.

POSSIBLE INSTALLATIONS.

Little Rock, Ark.—The city will expend about $50,000 in enlarging its electric light plant. Address A. H. Beeler, chairman.

Kissimmee, Fla.—The city contemplates the erection of an electric light plant. Address P. P. Hughey, city clerk.

Cuero, Tex.—The city is considering the establishment of a municipal plant, to have ten miles of line, 1,500 lights, etc. Address V. J. Grunder, of the committee.

Parkersburg, W. Va.—The Parkersburg Mill Company wishes to install an electric light plant.

STREET RAILWAY NEWS.

Atlanta, Ga.—The Atlanta & Roswell Electric Railway Company has been authorized to extend their lines in the suburbs.

St. Louis, Mo.—The Central Belt Electric Company has secured a franchise to build a line in the suburbs of the city and through a portion of the country.

Collinsville, Ill.—The Collinsville & Troy Railroad Company has been incorporated to construct electric railway; capital, $2,500; incorporators, D. M. Browning, H. S. Browning, W. S. Forman, of East St. Louis; E. C. Donk, O. W. Erickson, of St. Louis.

Kaukauna, Wis.—The East Shore Electric Railway and Light Company has been incorporated; the capital stock is $25,000; the incorporators are D. J. Brothers, William Breier and H. J. Mulholland of this city, and Charles Smith of Fond du Lac.

Fredonia, N. Y.—The Fredonia & Lilydale Electric Railroad, with a capital of $150,000, has been incorporated. It is to be operated through the village of Fredonia to and through the assembly grounds at Lilydale, a distance of about seven miles.

TELEPHONE CALLS.

Georgetown, S. C.—The Georgetown Telephone & Telegraph Company has been incorporated by F. Rehm, D. D. Rehm and L. S. Ingman, with a capital stock of $5,000.

Chattanooga, Tenn.—C. D. Mitchell, Frank Miller, A. S. Glover, E. E. Meredith and W. B. Swaney have organized a syndicate to establish a telephone exchange, the franchise for which will be applied for to the city council. Address W. B. Swaney.

Sioux City, Iowa.—The Iowa, Dakota & Minnesota Telephone Company has been incorporated, with a capital of $500,000. Incorporators, T. A. Potter, S. P. Helsey, B. C. Way, Britt, Iowa; Joe Kirby and J. E. McMahan, Sioux Falls.

Spring Valley, N. Y.—The New York Telephone Company are improving their line in Rockland County. A new copper line is being run from Haverstraw to Nyack. Connections will be made with Valley Cottage and Congers. A cable is being laid from Dobb's Ferry to Sneden's Landing, which will give Rockland and Westchester direct connections.

Columbus, Ohio.—The Miami Valley Telephone and Telegraph Company, with headquarters at Hamilton, has been incorporated by Will Christy, F. J. J. Sloat, M. J. Mandelbaum, Peter Schwab and W. C. Shepard, with $10,000 capital, to operate telephone and telegraph lines in Butler, Montgomery, Hamilton and Warren counties, with termini at Dayton and Hamilton.

Freeport, L. I.—The South Shore Telephone Company has decided to extend its system from Mineola to New Hyde Park, East Williston, Albertson and Roslyn. These lines will connect with the company's south side system.

Massillon, Ohio.—The Farmers' Telephone Company's plant at this place and the toll lines to various villages near by have been purchased by the United States Telephone Company, of which Henry A. Everett, of Cleveland, is president. The consideration was about $20,000.

The Electrical Age.

Vol. XXIV—No. 18. NEW YORK, OCTOBER 28, 1899. Whole No. 650.

Conventions.

John Millard Roach, President-Elect, American Street Railway Association.

PROCEEDINGS OF THE EIGHTEENTH ANNUAL CONVENTION OF THE AMERICAN STREET RAILWAY ASSOCIATION AT CHICAGO, ILL.

John Millard Roach, the newly-elected president of the American Street Railway Association, was born in Noble County, Jackson township, Ohio, on January 30, 1851. His ancestors came from Virginia and settled in the garrison on the Muskingon River, near Beverly. Mr. Roach left Ohio when eleven years of age and went to Rockford, Illinois, where he attended a high school for one year.

After this he went to Corinne, Utah, and from that place to Helena, Montana, covering the entire range of the Rocky Mountains and spending three years in that section of the country prospecting for gold. On a "bucking cayuse" he rode to Walla Walla, Washington Territory; Portland, Oregon; Oakland down into the lower part of California, around White Pigeon, Utah, and back into Helena, Montana.

After roving around the western part of the continent for seven years, making and losing large sums of money he returned to Rockford for a year, and settled in in the City of Chicago on Oct. 7, 1872, entering the employ of the North Chicago Street Railway Company as a conductor. He was an absolute stranger in the city, and had no friends or acquaintances there. After serving the company as a conductor for four months, he was taken into the office and made cashier. From that position he served in all the intermediate positions, until in 1889 he was made general manager of the North Chicago Street Railway Company, and in 1897 general manager of the West Chicago Street Railway Company; in both of which positions he remains in the companies which have succeeded to the control of these properties.

Mr. Roach married Kate E. Lyon in 1872 at Rockford, Ill., and has one son, F. Lyon Roach, born in 1875. Mr. Roach is a member of the Union League Club, Marquette Club and Union Club, of Chicago, and a Knight Templar, Lincoln Park Commandery.

First meeting Tuesday morning, Oct. 17th, 1899.

President Sergeant called the meeting to order soon after 11 o'clock. About him on the platform were the members of the executive committee and the past presidents of the association. Every seat in the meeting room was occupied. The president extended an invitation to any of the past presidents to take seats on the platform—"a happy thought." He announced that hereafter the meetings would be called to order promptly at 10 o'clock. He then introduced Mr. H. S. Taylor, public prosecutor of the city, representing his honor, Mayor Harrison, who delivered the address of welcome, which he concluded with these remarks:

The mayor fully appreciates the importance and value and dignity of this convention. He sends you his respectful salutation, and he wishes you may have a profitable and a pleasant time. Ever since the street railway companies have abandoned the jingling horses, and the epoch of cables has passed away and given place to lightning, we recognize the fact that the street railway man is fast—is becoming fast—and yet, notwithstanding that knowledge, common to us all, I assure you, as the public prosecutor, we have not taken any extraordinary police precautions on account of your presence here.

Once more, Mr. President and delegates, on behalf of the mayor, and speaking for the City of Chicago, we bid you a most hearty welcome. (Applause.)

PRESIDENT'S ADDRESS.

Gentlemen of the American Street Railway Association: We are to-day assembled for the eighteenth annual gathering of our association, and for the second time we meet in this great and prosperous city. I feel very deeply the honor which makes it my duty and pleasure to welcome you to Chicago in behalf of the street railway men of this city, whose generous exertions have provided us with all the essential elements for a profitable and enjoyable meeting. What remains to be done lies in your hands, and I may be permitted to urge upon you the desirability of a full attendance upon the business meetings, and a free and ample discussion of the papers which will be presented. In order that the time may be sufficient for this purpose, your Executive Committee has purposely restricted the papers to a smaller number than usual, and earnestly solicits your co-operation in giving them full audience and ample discussion.

As will be seen by the report which is to be submitted, the financial condition of your association is good and improving from year to year, for which happy condition we should not forget we are indebted to the efficient efforts of your officers in prior years when the bank balance was not so readily visible; nor should the generous support of our exhibitions by our friends, the supply men, escape our notice. The devotion of one day of your convention to the especial purpose of visiting the exhibits, which has been arranged by your Executive Committee, will be availed of, it is hoped, by every delegate, to the mutual profit of all.

Those gentlemen who met here in Chicago in 1883, many of whom are I trust present to-day, could have had little conception of the changes in their business which were to occur before the end of this century. At that time there were in Chicago, street railways operating about 153 miles of single track. At the present time the mileage of the surface street railways of this city is about 736 miles, of the Chicago interurban street railways about 261 miles, and of the elevated railroads about 100 miles, either operated or under construction, making an increase since your last meeting here of 944 miles of track. This remarkable extension of street railways, their equipment with mechanical motive power, the unique union loop system, and the successful application of electric power in the elevated railway service, are not only a wonderful testimonial to the courage, energy and capacity of their projectors, but they have made Chicago a street railway Mecca to which we all may come to observe and learn. We are, therefore, to be greatly congratulated upon the advantages afforded us by the selection of this city for our convention.

The year which has passed since we met has presented some unusual features, which are worthy of our attention. The tendency towards consolidation of small or competing roads into larger homogeneous systems has been manifested by many examples. With the introduction of electric motive power the old time horse railway company, operating a few miles of track on two or three city streets, has disappeared, and its larger successor has found necessary such changes in administration, such extensions of its system and service, that the advantages of combination with rivals have become more and more manifest. The street railway which formerly gave a short distance urban service has found itself extended far into the country; the same car which disputes the passage of a busy city street with a truculent teamster, may an hour later be flushing partridges and grouse along the rural highway, stopping to leave the tired artisan at his country home, and bringing a healthful excursion within reach of the humblest family; thus the trolley car is rapidly filling a long felt want, which was neither within the power nor the disposition of the great steam railroads to supply. All this means changed conditions with new responsibilities, and emphasizes the need of consolidation.

To successfully amalgamate such properties, and organize and operate them with due economy and a just regards for the needs of the communities to be served, requires of the operating officials a high degree of experience and skill. The new problems to be met offer better positions to which those who are ambitious may aspire, and the wonderful rapidity with which this situation has been developed, will be a lasting monument to the officials of our American street railways. The advantages of this larger growth are many, and perhaps not the least is a growing respect for the value and importance of the street railway industry, which we may all hope will ere long be recognized by just laws which shall deal fairly and equitably with the relations of the street railways to the municipalities, and give to capital invested in urban and suburban transportation, security and a fair return upon the investment.

Another of the notable events of the year has been the failure of a striking attempt at municipal ownership, with which we are all familiar.

It is greatly to be regretted that the year has been signalized by several very serious strikes and attempted boycotts. With the consolidation of systems, the question of labor assumes a greater importance. The paralysis of all the transportations of a large city is a grave public calamity, to be prevented by all reasonable means in the power of the officers and men of the transportation companies, and by the municipal authorities. The larger the system of any corporation is the more necessary it is that its management shall firmly and wisely conduct its affairs, and the more impossible that the responsibilities imposed upon the management should be delegated to others. Does it not, therefore, devolve upon us who are charged with such responsibilities to take the greatest care that our representatives before the public, the employes, shall always receive such liberal and just treatment at the hands of all our officials that they may feel their interests and ours to be identical, and may loyally work with us for the good service of the public and our corporations?

Care in the selection and instruction of employes may, therefore, well engage our constant attention. We are all merchants in that we have transportation to sell and must present it in an attractive manner if we wish to retain our customers.

The good will of the community which it serves seems to be an essential element of success with any public transportation company, and the best means to obtain that good will should receive our careful consideration. In this direction lies, I believe, a field of work for our association, and for each and every one of its members, which may be far more fruitful for good than our technical papers or our exhibits of apparatus. We are all aware of the wide difference of opinion which exists in the community as to the proper relation of street railways to the public, the service they should render and the burdens they should bear, and last, but not least, the returns they should expect upon capital. In the press and in educational and social reform institutions much prejudiced opinion and misinformation is promulgated calculated to injure public service corporations, and in so injuring them to deprive them of much of their ability to adequately serve the public. Is it not our duty, each and all, in our own communities and wherever else opportunity offers, to take steps to remedy this state of affairs? Let us seize every opportunity to refute these current fallacies, meet the self-styled economist on his own ground and show him that his "quasi-public octopus" is the greatest public benefactor and social reformer the world has ever seen!

Fair-minded men will generally listen to both sides of any question, and the ignorance of even those who should be well informed as to our industry, is so great that mission work to disseminate truth is imperatively demanded. I believe that work of this character has already been undertaken by one of our friends of the Chicago technical press, and that in so doing he has set a worthy example which we may beneficially follow.

One of the saddest events of the year was the sudden death in April last of our lamented friend, Mr. M. K. Bowen, president of the Chicago City Railway Co. Beloved by all who knew him, ever ready to spare his valuable time for the aid and information of others who sought to learn from his experience, he was an honor, not only to the corporation he served so well, but to the profession which will miss him so sadly. Ever faithfully interested in your association, his untimely death brings a feeling of deep loss to us all.

I venture to remind you of the work which our friends of the Accountants' Association have undertaken and are accomplishing. The importance of accurate and uniform accounts to the success of any railroad can hardly be over-estimated. A thorough knowledge of accounts and of finance are essential qualifications for the administration of large properties. The work so far accomplished by their association, and their further deliberations merit your earnest support, which will not only be beneficial to them, but to each and all of the members of our association.

I wish here to express my appreciation of the cordial support and valuable work of your efficient secretary and executive committee. That our association may always be so fortunate is my earnest wish. In conclusion may I once more express my sincere appreciation of the honor which you conferred upon me by electing me to preside over this meeting, and bespeak your patience with my shortcomings.

Then followed the reports of the executive committee and secretary and treasurer, which were adopted. In substance they were as follows:

The executive committee reported that it had received the report of the secretary and treasurer showing the statement of the finances of the association, the members in arrears and the Boston convention exhibit space remaining unpaid for. The secretary was instructed to write all eligible companies, inviting them to join the association. On motion of Mr. Woodruff it was voted that any American elevated railroad is eligible for membership. On motion of Mr. Lang it was voted that the publication by the association of legal decisions affecting street railways be dispensed with, as the street railway periodicals devote considerable space to this subject each month. The president read a letter from Mr. John T. Burnett, chairman of the special committee on the carrying of the United States Mail on Street Railways, in which he stated that the conditions during the year had not been opportune for effective work, and he believed that the committee should be continued for another year and be given further time for action; or, if preferred, a new committee should be appointed; on motion it was decided to recommend to the association that the committee be continued for another year. It was decided to enforce the usual rules concerning banquet tickets. On motion the following rules for the convention were adopted:

1. No member shall be recognized by the president unless he shall announce distinctly his name and address.
2. Speeches will be limited to 10 minutes unless the time shall be extended by the convention.
3. Members who desire to offer resolutions or other matters to be considered by the convention are requested to submit them in writing, over their signatures, to the secretary.

The following are the newly elected officers of the association:

President—John M. Roche, general manager Chicago Union Traction Co., Chicago, Ill.

First vice-president—John A. Riggs, president United Traction Co., Reading, Pa.

Second vice-president—H. H. Vreeland, president Metropolitan Street Railway Co., New York City.

Third vice-president—F. G. Jones, vice-president Memphis Street Railway Co., Memphis, Tenn.

Secretary and treasurer—T. C. Penington, treasurer Chicago City Railway Co., Chicago, Ill.

Executive committee—The president, the vice-presidents and C. S. Sergeant, second vice-president Boston Elevated Railway Co.; C. K. Durbin, general superintendent Denver Consolidated Tramway Co.; Nicholas S. Hill, Jr., general manager Charleston Consolidated Gas & Electric Co.; Charles W. Wasson, vice-president Akron, Bedford & Cleveland Railroad Co.; John R. Graham, president Quincy & Boston Street Railway Co.

Kansas City was selected as the next place of meeting.

A $750,000 POWER AND LIGHTING PLANT IN ATLANTA, GA.

A modern power and lighting plant will be erected by the Atlanta Railway & Power Company, at a cost of $750,000. All the power for the consolidated trolley lines, recently incorporated under the name of the Atlanta Railway & Power Company, will be supplied by this plant; also power for elevators, machinery, printing presses and other plants, and lights, both incandescent and arc.

Bolivar, Tenn.—The Progress Telephone Company has been incorporated, with a capital stock of $5,000, by P. F. Williamson, H. Williams, W. J. Cox, F. S. Luther and others; to generate electricity for telephone purposes.

New Iberia, La.—The city has decided by popular vote to issue bonds and levy a special tax amounting to $110,000 for erection of electric plant, industrial school, construction of water works and the canal reported during the week. Address "The Mayor."

Electro-Technics.

TRANSFORMERS. IRON LOSS—ITS INCREASE—THE REMEDY.*

BY G. WILBUR HUBLEY, LOUISVILLE, KY.

Attention to the subject of Transformers, Meters, etc., in the alternating field of electrical work has been very general, and much has been written and many have been the discussions on these subjects.

The necessity of inspection, testing, etc., of all meters in service, at regular periods has been conceded as an economic necessity by Central Stations, as well as being recommended by the manufacturers; yet such has not been true about transformers, and this important and essential apparatus has been most seriously neglected, owing to the impression and erroneously accepted fact that its characteristics are, in a measure, unchangeable. The transformer passes into its work and no further attention is given, except in cases of absolute failure by "burn out" or other extreme condition interfering with its service.

It is, however, a generally accepted fact that there comes a time in the history of transformers when their efficiency and profit earning can be greatly increased by means of substitution or change of characteristics.

It is the latter plan that the writer shall treat as the subject mater of this paper.

No other question has more commercial significance in the operation of a transformer system, from a central station standpoint of view, than the constant iron losses of transformers in service. Yet the question has had, probably, less careful and systematic investigation than any other detail of the alternating system, owing, doubtless, to the fact that the great and increasing losses in this direction have not been fully appreciated until within the past few years.

It must be admitted that great improvement has been made in this direction by the manufacturers, with a view of reducing this iron loss to its present low figure; but the question of "fatigue" is of greater importance than the initial conditions.

All data, tests, etc., as given in this paper, have been carefully and accurately compiled from actual facts and conditions, as they exist in the central station with which the writer is identified, and company whom he represents as delegate to your convention.

It has been found, in practice, that transformers having initially low iron losses (within limits of specification), after being placed in service, would show most decided increase. In most cases over one hundred per cent. increase, and in exceptional cases as high as three hundred to four hundred per cent. increase, within very short periods of service under normal conditions.

In fact, the "fatigue" feature or large increase of iron losses in many transformers made their further use commercially prohibitive.

To illustrate the conditions of the question, the writer gives the following records of a few tests on various sizes of transformers, showing the increase of iron losses during periods of service:

Capacity	Initial Test		Second Test		P. Ct Inc.	Third Test		P. Ct Inc.	Total P. Ct. Inc.
	Watts	P Ct	Watts	P. Ct		Watts	P. Ct		
500	36	7.2	6:	13	80.6	75	15	15.4	108.4
1000	58	5.8	75	7.5	29.3	100	10	33⅓	72.4
1500	60	4	97	6.5	61⅔	120	8	23.7	100
2000	75	3¾	125	6.1	66⅔	145	7¾	16	93.4
3000	80	2⅔	133	4.4	66¼	150	5	12.8	87½
4000	109	2.7	175	4¼	60.3	185	4.6	5.7	69.7
5000	120	2.4	140	2.8	16⅔	145	2.5	3.6	20.8
7500	145	1.9	167	2.2	15.1	190	2.6	13.8	31
10000	190	1.9	250	2.5	31.6				31.6
12500	218	1.7	238	1.9	9.1	315	2.5	32.4	44.5
25000	323	1.3	530	2.1	64.1				64.1

The above tests represent transformers of various types of manufacture during years of 1894, 1895 and 1896, and cover periods of service from 1894 to 1899. The actual service between tests vary from periods of six months to two years, but in most cases are tests made each consecutive year.

During the past several years the writer has carefully studied this question in all of its phases, as it relates to the practical conditions, as met with in every-day station work.

Only within the past year have manufacturers been willing to recognize or accept the adopted specifications on transformers of the central station. In fact, they would not guarantee initial limits or qualify limits of deterioration of their transformers in service. The writer adopted transformer specifications during the year of 1895 in which limits of iron loss were fully fifty per cent. greater than those of present day specifications.

The following specification limits were adopted January 1, 1899, and all transformers must pass under initial conditions within specified limits, or be rejected.

Insulation test to be made by a series of make and break contacts, and one prolonged contact, as follows:

1. Between primary and secondary coils.6,000 volts A. C.
2. Between primary coil and core......6,000 volts A. C.
3. Between secondary coil and core....1,000 volts A. C.

Temperature test measured by thermometers placed in mercury cups in core of transformers. Increase above surrounding atmosphere on full load test of eight hours' duration must not exceed sixty degrees centigrade.

Fatigue.—Iron loss must not exceed ten per cent. increase above limits, as specified, within period of two years' service.

Overload.—Transformers must be guaranteed to stand overload of twenty-five per cent. above rated capacity, for duration of two hours, with temperature increase not to exceed sixty degrees centigrade above surrounding atmosphere.

General Guarantee.—Transformers must be guaranteed for two years' service against burn out from any cause (including lightning), providing same are under normal conditions of service.

Remarks.—The above specifications do not contemplate the use of oil in transformers.

In case of failure of transformers furnished under specifications, all expenses of rejection shall be borne by the manufacturer.

It has been the practice of the writer to make initial tests on all transformers when received, and their acceptance or rejection has been strictly governed by limits, as set forth in specifications. And to repeat this test under similar conditions as often as opportunity permits, i. e., at all times when transformers were brought into station from service.

A careful and permanent record of all such tests are kept, as they apply to each individual transformer.

*Read before the twenty-second annual convention of the National Electric Light Association.

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CONTENTS:

ELECTRIC TOYS.

There was a time when the small printing press and the miniature steam engine and various other purely mechanical toys occupied the entire attention of jobbers in these lines of goods, but within the last few years a noticeable change has occurred, visible not only to those that have made and are making a careful study of the development of electrical engineering in its minor as well as its major branches, but visibly also to the ordinary layman. This change consists of a strong and increasing demand for electric toys which have, to a large extent, supplanted those of more ancient lineage.

Thousands of small motors, thousands upon thousands of dry cells to run them, a gigantic number of miniature lamps, electric bells, ad infinitum, in addition to cheap telegraphic outfits, medical coils and even electrostatic apparatus are being manufactured by quite a number of enterprising concerns. The retail price of these toys is not very high, generally lying within the limits of a dollar, and consequently a great deal of business ingenuity must be exercised by the manufacturers to make these toys serviceable yet cheap.

It seems that this new industry possesses educational features unlike any other legitimate branch of business. In most of the battery outfits sold directions are given for preparing the liquids, amalgamating the zincs, connecting up the motor, lamps, attaching wire to bells, etc All this constitutes experience for the younger element, making them wide awake to the great changes going on around them. In Connecticut, Massachusetts, Vermont, as well as New York State, vast quantities of these goods are turned out each year in a dozen and one different forms, making it sem as though the old-fashioned toys will soon be replaced by others strictly electrical in their nature and operation.

THE STEAM AND GASOLENE AUTOMOBILE.

The interest taken by the general public in the automobile has not diminished to any noticeable degree but it would be interesting to know whether the sales of the automobile manufacturers have been in strict proportion to the undoubted populartity of their products. The automobile, like the bicycle, made its advent suddenly. There was no gradual growth of the industry in this country and very few preliminary symptoms of the great demand for automobiles which is now supposed to exist Sifting the matter down to a common sense basis the question naturally arises whether the modern automobile performs the functions expected of it and whether its price is such that the general public will be able to appreciate it in a more practical manner.

Some of the requirements of automobiles have been laid down in a sensible way by manufacturers. One writer says that an automobile, to be perfectly satisfactory, must possess eight points: first, must be easily started; second, must be run quietly, smoothly and steadily; third, must be economical of fuel; fourth, must be practically noiseless; fifth, must be sufficiently powerful to do the required work running at moderate speed; sixth, must be as light as is consistent with strength; seventh, must be simple in construction, and eighth, must be capable of successful operation by anyone. Automobiles on the market at present are all covered by such claims, yet there are not very many in use, either in the city or outside of it. Those within the city seem to prefer the electric automobile and the man who wants to tour through the country purchases a gasolene or possibly a steam automobile. The hacking cough frequently heard by pedestrians when a gasolene automobile shoots by is suggestive of high pressure, heat, irregularities in the atmosphere, etc. For ordinary circuits around the city or suburbs, etc., a noiseless automobile, driven by motors supplied from storage batteries, is very satisfactory as well as cheap. The tourist will always find an automobile suited for his purpose, provided he is willing to put up with some of the possible inconveniences which are bound to occur in the long run.

As regards the cost of automobiles we notice in a paper devoted to that subject that the prices run from fifteen hundred dollars down to two hundred dollars. The hydro-carbon motor used by the American Automobile Company, the Stanley motor operated by steam and a variety of gasolene automobiles seem to average about the same price but a concern in Portland, Me., seem prepared to offer motor vehicles at a cost ranging from two hundred upwards ,according to, as they say, style, finish and intended purpose. In other words, the automobile business seems to be in about the same condition as the horse and carriage trade is at present. Very expensive vehicles are on the market with expensive driving gear and comparatively cheap outfits await the public's choice. The chances are, however, that the undue competition will eventually be the means of bringing automobiles down to a fixed figure and driving out those concerns whose automobiles are either impractical or too expensive, It is probably necessary to state what iron losses and their increase means to the average central station, except to call attention to the fact that existing iron losses in transformers approximate from fifty to seventy per cent. of output of the average alternating station.

Let us consider an average case, by way of illustration, to compare the probable useful current supplied with the iron loss or waste current per year, required at installation.

E. g. 1000 Watt transformers having initial iron loss of fifty-eight watts (5.8 per cent.), having been under service during a period of two years, records iron loss of one hundred watts (10 per cent.), or fatigue of 72.4 per cent. We will make the liberal assumption that this transformer averages full load for five hours per day

Capacity	Iron Loss Watts	Iron Loss P. Ct	Regula'n Per Cent.	Capacity	Iron Loss Watts	Iron Loss P. Ct	Regula'n Per Cent.	Capacity	Iron Loss Watts	Iron Loss P Ct	Regula'n Per Cent
500	35.	7.00	3.00	3750	90.	2.40	2.50	15000	210.	1.40	2.00
600	36.	6.00	3.00	4000	90.	2.25	2.50	18750	225.	1.20	2.00
1000	45.	4.50	3.00	5000	110.	2.20	2.25	20000	240.	1.20	2.00
1250	45.	3.60	3.00	6000	120.	2.00	2.25	25000	275.	1.10	2.00
1500	51.	3.40	3.00	6250	125.	2.00	2.00	30000	300.	1.00	2.00
2000	60.	3.00	3.00	7500	150.	2.00	2.00	37500	375.	1.00	2:00
2500	65.	2.60	2.50	10000	175.	1.75	2.00	50000	500.	1.00	2.00
3000	75.	2.50	2.50	12500	200.	1.60	2.00				

during three hundred days in the year; therefore initially the transformer will require during year "useful current" 1,500 K. W., and during year "iron loss" current 508 K. W. of total of 2,008 K. W. for service.

It will be noted that "useful" current is 74.7 per cent., and "iron loss" current 25.3 per cent., or "iron loss" current amounts to 33.0 per cent. of current used "usefully."

Consider similar service and conditions on this transformer after "iron loss" has increased 72.4 per cent., and we find it will require during year "useful current" 1,500 K. W., and during year "iron loss" current 876 K. W., or total of 2,376 K. W. for service. It will be noted now that "useful" current is 63.1 per cent. and "iron loss" current is 36.9 per cent., or "iron loss" current amounts to 58.4 per cent. of current used "usefully."

The question naturally arose, "What was to be done with transformers having such abnormal "iron loss"? It

Capacity Watts	Initial Test. Watts	Initial Test. P Ct.	Test before Treatment. Watts	Test before Treatment. P.Ct.	Increase Iron Loss Per Cent.	Test after Treatment Watts	Test after Treatment P.Ct.	Decrease Iron Loss Watts	Decrease Iron Loss Per Ct.	Kilo-Watts Saving Per Year
500	40	8	64	12.8	60.	42	8.46	22	34.37	192.7
1000.	60	6	88	8.8	$46\frac{2}{3}$	59	5.90	29	32.95	254.0
2000	84	4.1	150	7.5	78.6	117	5.85	33	22.00	289.1
3000	108	3.6	139	4.6	28.7	97	3.23	42	30.21	367.9
7500	140	1.9	167	2.2	19.3	135	1.80	32	19.10	280.3
10000	175	$1\frac{3}{4}$	240	2.4	27.1	160	1.60	80	33.33	700.8
25000	350	1.4	530	2.1	51.5	323	1.29	207	39.06	2,829.5

being out of the question to scrap these, or to obtain others by expensive method of exchange for new "present day" transformers, under plan suggested by manufacturers who willingly proposed to remedy this condition.

The writer began some experiments in line of treatment of iron of old transformers, and after some time obtained most successful and gratifying results in this direction. However, no claims can be made at present writing of the permanency or resultant action that may occur by the methods adopted ,as only time test will determine this point; but it is reasonable to expect the changes made in the character of the iron in transformers, so treated will prove itself more nearly constant and permanent than it was initially.

The method of treatment adopted is one of annealing the iron of transformers which show abnormal loss. The results have proven most gratifying, in all cases reducing the losses to their initial (or even better) records, and in no manner affecting other requisite qualifications of the transformer.

The work can be done readily and at an admissable low cost per unit, to make the work commercially within bounds, and a far better paying investment than any other plan that has been suggested or followed with the same object in view. In other words it restores the transformer system, whether transformers are new or o type, to their original, or even better, condition, as far as iron losses are concerned.

A table is herewith presented compiled from records of experimental work on transformers taken from service, without selection, in the regular course of business of station.

It therefore represents actual practical conditions. Some idiosyncracies are shown that are interesting. From this table practically correct deductions may be made as to possibilities of reduction of constant iron losses, and the advantages to be derived therefrom:

This table represents the average results of tests of transformers, of capacities, as noted.

Type, actual service or life of transformers, were not taken into consideration, as it is the object of the writer to present the actual practical working condition of the average central station. The station of which the writer is in charge has kept pace with the times in taking advantage of all improvements of modern apparatus, as well as modern methods of operation; and, moreover, gained decided advantage by complete change of all transformers to those of modern type, dating from the year 1894, when change was made from 1,000 to 2,000 volt system. And since such tim has made one extensive substitution of about fifty per cent. of these transformers to others of latest type and manufacture.

The cost of "annealing treatment," as practiced, can be accomplished at so low a cost per K. W. that it insures its success. The plan to reduce and regulate the increased iron losses in transformers is both simple and practical.

The following data of detail costs per K. W. capacity have been computed from records of actual costs during period of experimental work:

	Preparation.	Annealing.	Assembling.	Testing.	Total cost.
Av. cost per K. W.	.092	.106	.618	.084	.90

However, the above costs cannot be taken as criterion, as such only represents result of experimental work on transformers of various manufacture, type and capacity, and naturally these costs as given are considerably higher than will be found in practice. The average costs per unit will vary greatly under different local conditions, owing to the wide margin of variation of costs in transformers of small and large capacity, as the item of cost per unit does not vary proportionally with the capacity.

It can be liberally approximated that complete costs of "annealing treatment" will vary between twenty-two cents per K. W. on 25 K. W. size to $2.20 per K. W. on ½ K. W. size of transformer.

The advantages of the "annealing treatment" of iron of transformers will be more fully appreciated by facts deduced from foregoing data, as set forth in the following table:

per cent. on yearly cost of fuel, but increased capacity on boilers, engines, dynamos, etc. Hence the reduced fixed charges per unit, higher commercial efficiency of transformer system and consequent increased profits per unit of current sold; and last, but not least important, a periodical inspection, reinsulation and general renewal of all transformers in service, and an absolute control and regulation of their increase of iron losses.

In conclusion, the writer begs the indulgence on the part of readers of this paper for any errors in calculation or omissions of data, owing to limited time and attention that has been given in the hasty preparation of this subject.

Capacity Watts.	Loss Per Year Kilo-Watts Before Treatment	Loss Per Year Kilo-Watts After Treatment	Saving per year Kilo. Watts.	Saving per year at 2c. per kw	Estimate Complete Cost Treatment	Interest per year per cent.
500	560.64	367.92	192.7	3.85	1.10	350.
1,000	770.88	516.84	254.0	5.08	1.85	275.
2,000	1314.00	1024.92	281.1	5.78	2.60	222.
3,000	1217.64	849.72	367.9	7.34	3.60	204.
7,500	1462.90	1182.60	280.3	5.60	4.50	125.
10,000	2102.40	1401.60	700.8	14.00	5.00	280.
25,000	4642.80	1813.30	2829.5	56.59	5.50	1029.

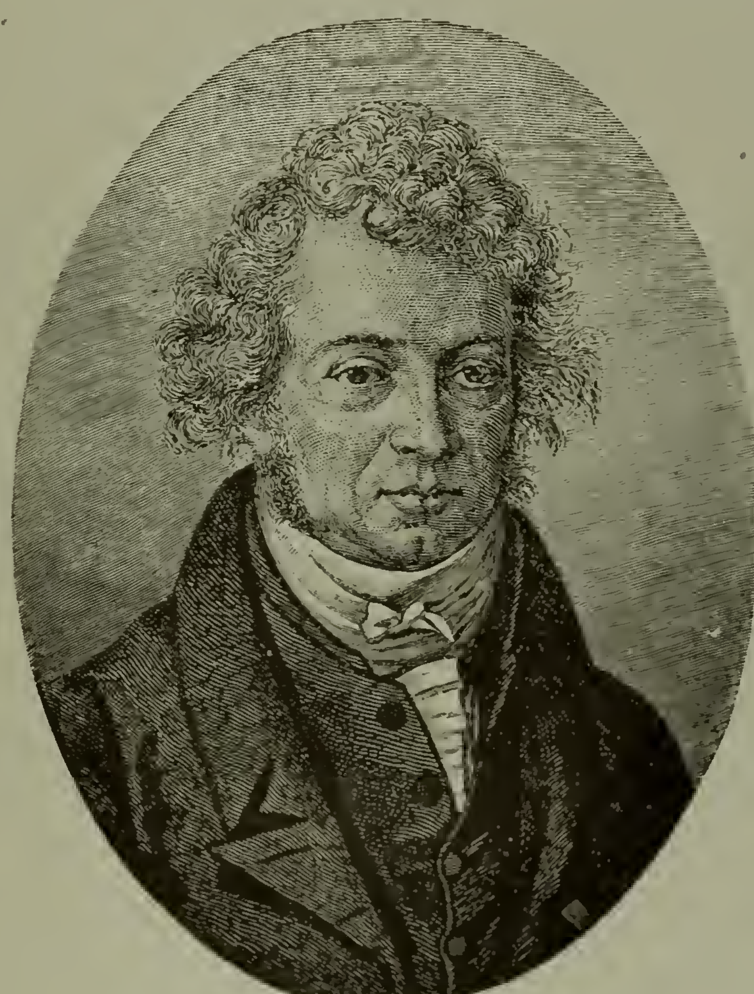
It will be noted that the gains by actual saving to be obtained through adopted methods of treatment of iron, at the extremely low cost per unit makes the system appeal for a place in the economic field of central station operation more strongly than any other measure in this direction.

By the most conservative estimate the average central station can reduce and regulate within reasonable limits this all important feature of loss wherever transformers are in service to fifty per cent. of their present records, and this means not only a saving of twenty-five to thirty

Magnetism.

AMPERE'S THEORY OF MAGNETISM.

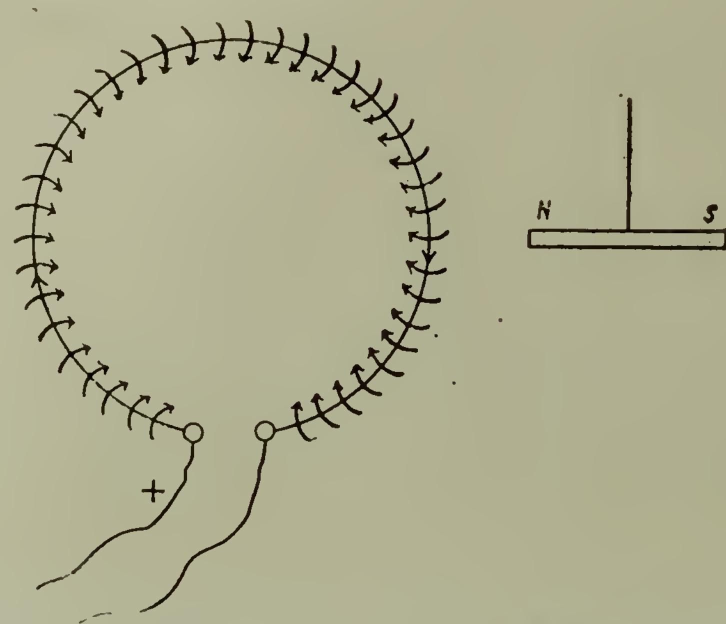
Ampere propounded a theory based on the analogy between solenoids and magnets by which all magnetic phenomena may be referred to electro-dynamical principles. Instead of attributing magnetic phenomena to the existence of two fluids Ampere assumed that each individual molecule of a magnetic substance is traversed by a closed electric current and further that these molecular currents are free to move about their centres. The coer-



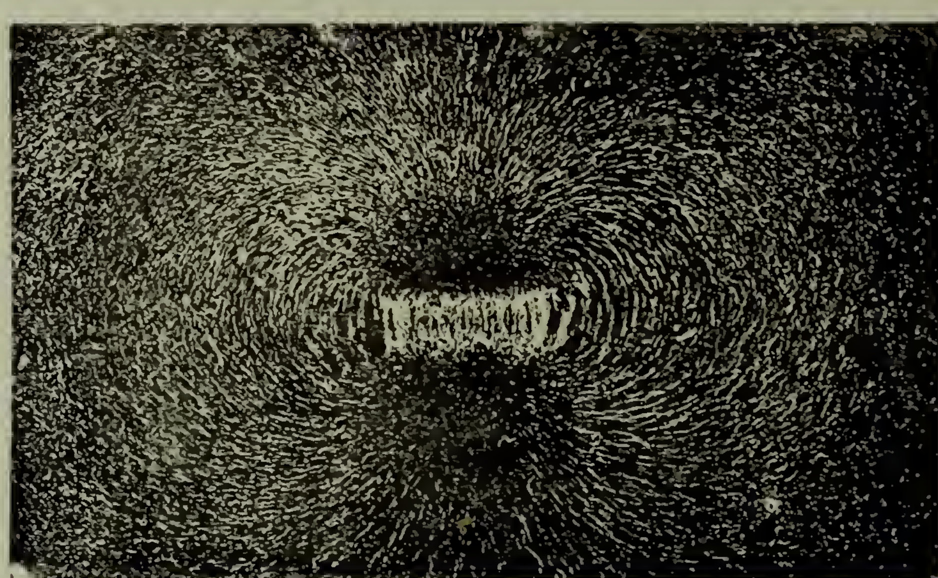
Andre Marie Ampere.

cive force, however, which is little or nothing in soft iron but considerable in steel opposes this motion and tends to keep them in any position in which they happen to be.

When the magnetic substance is not magnetized these molecular currents under the influence of their mutual attractions occupy such positions that their total action on any external substance is nil. Magnetization consists in giving to these molecular currents a parallel direction and the stronger the magnetizing force the more perfect the parallelism. The limit of magnetization is attained when the currents are completely parallel. The resultant of the actions of all the molecular currents is equivalent to that of a single current which traverses the outside of a magnet. In the illustration a single turn of wire is shown carrying a current surrounded by a magnetic whirl and representing theoretically what would be called a lamellar magnet, i. e., a thin slice of a permanently magnetized bar of equivalent dimensions. The polarity of a coil is anticipated according to known rules. If the current flows in the direction of the hands of a clock the end of a coil facing the observer is south ifif it flows against the hands of a clock the polarity as then observed will be north. Practice and theory coincide in many respects in supporting Ampere's theory of magnetism.

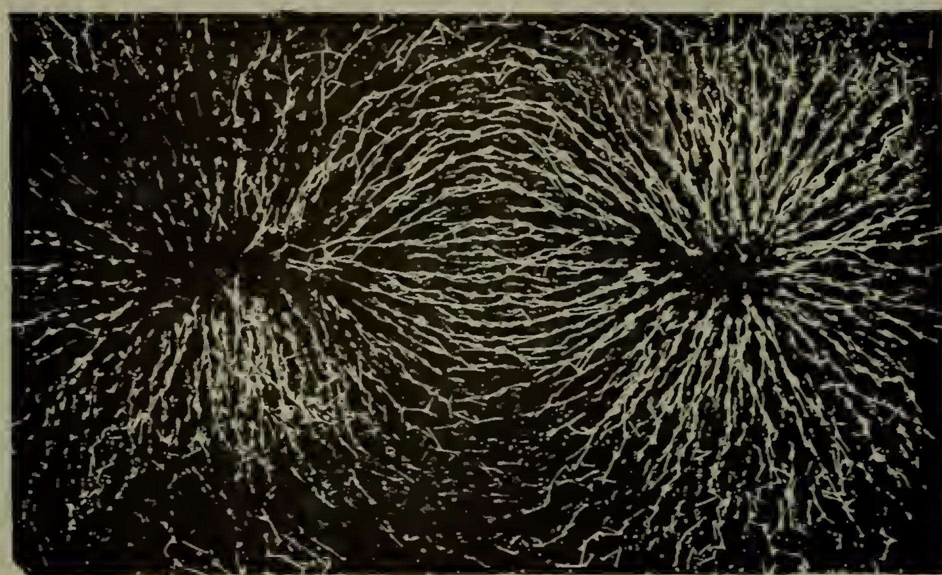


The Equivalent of a Lamellar Magnet.


Intense Attraction Shown, Due to Near Proximity of Poles; Lateral Repulsion Evident.

A MODERN VIEW OF MAGNETISM AS OUTLINED BY CLERK MAXWELL.

Maxwell supposes that any medium which can serve as the vehicle of magnetic force consists of a vast number of very small bodies called cells, capable of rotation, which we may consider to be spherical or nearly so when in their normal position. When magnetic force is transmited by the medium or acts through it, these cells are supposed to be set in rotation with a velocity proportional to the intensity of the magnetic force, and the direction of rotation is related to the direction of the force in the same manner as the twist and thrust of a right-handed screw. We have thus all the magnetic field filled with molecular vortices, as Maxwell calls them, all rotating around the lines of force as axes. These cells as they revolve tend to flatten out like revolving spheres of fluid and to become oblate spheroids; they thus contract along the lines of force and expand at right angles, creating a tension along the lines of force and a pressure at right angles to them. These cells are supposed to be elastic spheres, closely packed together and incapable of separating from each other. If any line of cells is set rotating the contraction of each along its axis of revolution must set up a tension or pull along that line; it behaves like a filament of muscular tissue and contracts in length and swells out or increases in thickness. Its several adjacent lines of cells are all set revolving in the same direction, the swelling out of each line causes them to press on each other; hence there is a lateral pressure and a longitudinal tension. In any space filled with these cells so revolving, the lines of tension or axes of revolution of the cells will take up certain positions, depending on the necessities for the stresses to adjust themselves to equilibrium and Maxwell has shown mathematically that such a system of lines of tension and correlated pressure is a force system which will distribute itself in a manner similar to that in which we find actual lines of magnetic force to do and that the behavior of magnetic poles to each other can be explained fully by the assumption of a tendency on the part of the lines of force between them to contract like elastic threads along their length and to push one another apart when laid parallel and proceeding in the same direction.—J. A. Fleming, M. A., D. Sc., in "The Alternate Current Transformer."

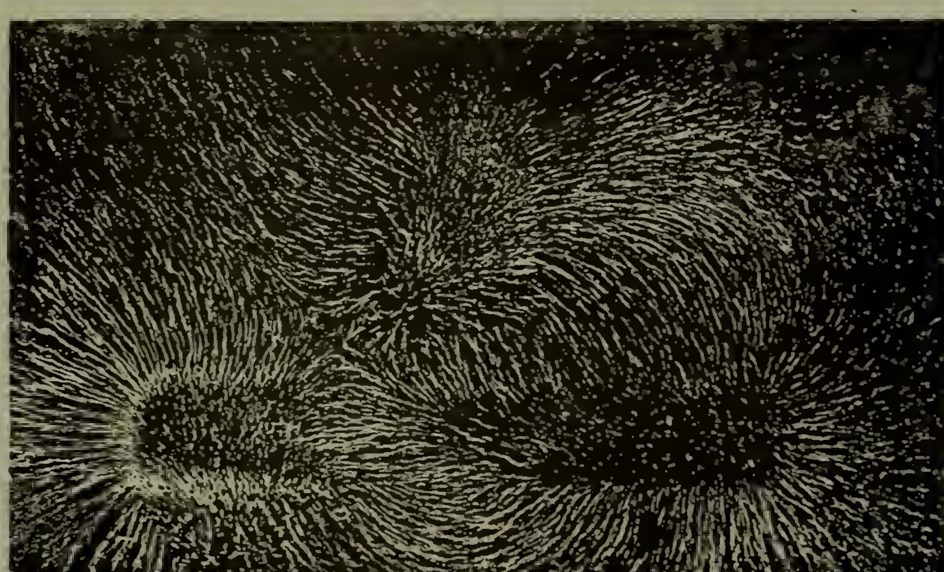


Lines of Force; Showing Attraction Longitudinally and Repulsion Laterally

UNPARALLELED EXTRAVAGANCE.

The ghost of Holman, the "watch dog of the Treasury," will, without a doubt, haunt the Department of Agriculture after hearing of that department's munificent offer of $660 per annum for an ornithological clerk who must have an excellent knowledge of ornithology and mammalogy besides, which his examination will include a practical test in the identification of specimens of birds and mammals. The advertiser who advertised in a daily paper for a first-class bookkeeper at $3 a week was determined not to be outdone by the government and the honors are about even between the two. His offer elicited the following reply, the only one attracted by the bounteous compensation:

"I am a young man, 37 years of age, having had a business experience of twenty-three years, being connected with the United States Embassy at Madagascar, and feel confident that if you give me a trial I can prove my worth to you. I am not only an expert bookkeeper, proficient stenographer and typewriter, excellent operator and erudite college graduate, but have several other accomplishments that might make me desirable. I am an experienced snow shoveler, a first-class peanut roaster, have some knowledge of removing superfluous hair and clipping puppy dogs' ears, have a medal for reciting 'Curfew Shall Not Ring To-Night,' am a skilled chiropodist and practical farmer; can also cook, take care of horses, crease trousers, open oysters and repair umbrellas. Being possessed of great physical beauty, I would not only be useful but ornamental as well, lending to the sacred precincts of your office that delightful artistic charm that a Satsuma vase or a billy goat would. As to salary I would feel that I was robbing the widow and swiping the sponge cake from the orphan if I were to take advantage of your munificence by accepting the too fabulous sum of $3 per week, and I would be entirely willing to give my services for less, and by accepting $1.37 per week would give you an opportunity of not only increasing your donation to the church, pay your butcher and keep up your life insurance, but also to found a home for indigent flypaper salesmen and endow a free bed in the cat home."



Attraction for One Pole, Repulsion for Another.

Uniontown, Ala.—The city has awarded contract for erection of its electric light plant; cost $14,000. Address "The Mayor."

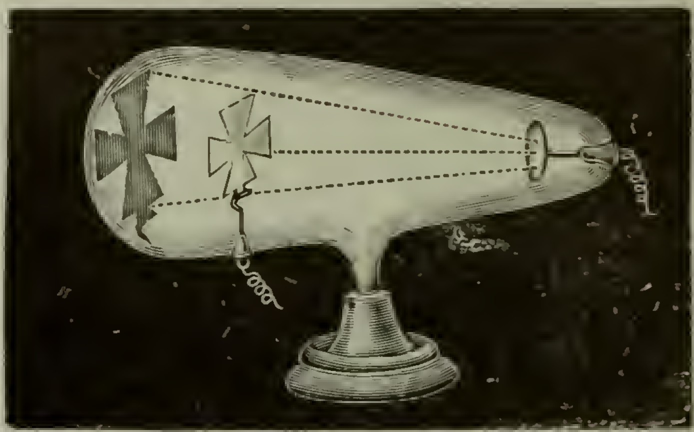
El Paso, Tex.—Contract will be awarded for construction of a telegraph fire alarm system. Address "The Mayor."

Light Phenomena.

CATHODE RAYS.

BY PROF. J. J. THOMSON, F. R. S.

The first observer to leave any record of what are now known as the cathode rays seems to have been Pluecker, who in 1859 observed the now well known green phosphorence on the glass in the neighorhood of a negative electrode. Plueckner was the first physicist to make experiments on the discharge through a tube in a state anything approaching what we should now call a high out normally from the disk yet enough light would be given out sideways from other parts of the disk to prevent the shadow being at all well marked. Goldstein seems to have been the first to have advanced the theory, which has attained a good deal of prevalence in Germany, that these cathode rays are transversal vibrations in the ether. The physicist, however, who did more than anyone else to direct attention to these rays was Mr. Crookes whose experiments, by their beauty and importance, attracted the attention of all physicists to this subject and who not only greatly increased our knowedge of the properties of the rays but by his application of them to radiant matter



Shadow Thrown by Cathode Rays.

vacuum. He owed the opportunity to do this to his fellow townsman, Geisler, who first made such vacua attainable. Pluecker, who had made a very minute study of the effect of a magnetic field on the ordinary discharge which stretches from one terminal to the other, distinguished the discharge which produced the green phosphorescence from the ordinary discharge by the difference in its behavior when in a magnetic field. Pluecker ascribed these phosphorescent patches to currents of electricity which went from the cathode to the walls of the tube and then for some reason or other retraced their steps.

spectroscopy has rendered them most important agents in chemical research. A great renewal of interest in these rays has taken place, owing to the remarkable properties posessed by an offspring of theirs for the cathode rays are the parents of the Roentgen rays. (Abstract.)

ELECTRO-PHOTOGRAPHY.

BY FREDERICK STRANGE KOLLE, M. D.

Early in 1896 I revived electro-photography and although the results have nothing to do with the Roentgen rays the experiments are carried on with much the same apparatus as used for radiography, except in the use of

Tube for Experimenting In Cathode Rays

The subject was next taken up by Pluecker's pupil Hittorf, who greatly extended our knowledge of the subject and to whom we owe the observation that a solid body placed between a pointed cathode and the walls of the tube casts a well defined shadow. This observation was extended by Goldstein, who found that a well marked though not very sharply defined shadow was cast by a small body placed near a cathode of considerable area. This was a very important observation for it showed that the rays casting the shadow came in a definite direction from the cathode. If the cathode were replaced by a luminous disk of the same size this disk would not cast a shadow of a small object placed near it, for though the object might intercept the rays which came

the vacuum tube. An ordinary photographic plate wrapped in black paper, is laid upon a small sheet of metal of about the same size as the dry plate. The latter is connected to the negative pole of the secondary circuit of a small spark coil. The glass side of the plate is turned downward and a metallic object, preferably a coin, is laid upon the film side of the plate or paper covering same. In the cuts a silver dollar was used. Over the coin another sheet of metal, i. e., aluminum, is laid which is connected to the positive terminal of a secondary coil. The rheotome is then screwed back as far as possible or until the primary current refuses to move it; the head of the hammer is then crowded forward as in flashing until several sparks have passed across the spark gap. Upon developing the plate a perfect image of the coin will be obtained. Around the periphery of the coin a ring or border of minute sparks may be seen, resembling or rather indicating the minute subdivisions of the spark or sparks allowed to have passed in the experiment. By carefully examining the coin during the experiment a pale blue or violet colored light will be found to encircle it as the sparks are allowed to pass.

Electro-Photography.

Business News.

ELECTRIC TRAMWAYS IN NICE.

The following, dated Nice, August 11, 1899, has been received from Vice-Consul Piatti:

In the course of an interivew which I had yesterday with the mayor of Nice, I learned that the new electric tramways which were to be operated about October 15 will, until the 15th of December, be run by horse-power. The reason given is that the existing telephonic wires

Electro-Photography by Static Discharges.

are not of sufficient strength to resist being affected by the power used for the tramways, so that they must be replaced by strong cables placed underground; but not a single concern, it is said, can be found in France to deliver the necessary cables before November 1.

This, in itself, may not be a fact of paramount importance; but, reverting to the continuous attempts made by this consulate to induce our manufacturers to cultivate the very considerable opportunities offered by the port of Nice for a direct trade with the United States, it may not be out of place to say that in this instance, an American firm might have competed with success in furnishing the necessary electric cables.

MAKING ADVERTISING PAY.

To make advertising pay it must receive more time, thought and attention than the busy manufacturer of today can usually give it, and there is a growing tendency to enlist special ability and help in the management of the advertising department.

The situation draws timely attention to the Manufacturers' Advertising Bureau of New York, and the aid it extends in this direction. This concern was established more than twenty years ago by Benj. R. Western, the original and present proprietor, and is unique in the niche it fills in the business world.

It stands alone in the work it undertakes, and its knowledge of trade paper advertising is most thorough and full of value to the manufacturer who seeks results. It makes a specialty of mediums of a technical and trade character and is a quoted authority on the subject.

The bureau assumes the entire management, when this is desired, of a firms' advertising department which includes all of its newspaper work, and receives compensation for its labors in a commission from the papers on their lowest known rates ,the same as an insurance broker in his dealings with the insurance companies.

That its methods are attractive is proved in the steady additions to its list of clients, among whom are to be noted recently the American Stoker Company, Adam Cook's Sons and Messrs. Manning, Maxwell & Moore, of New York, with its kindred interests, the Ashcroft Manufacturing Company, the Hayden & Derby Mfg. Co., the Pedrick & Ayer Co., the Consolidated Safety Valve Company and the Shaw Electric Crane Company.

The Manufacturers' Advertising Bureau offers beyond doubt a real help to the manufacturer who has not the time or inclination to attend to his own advertising in the careful, systematic and discriminating way it rightly demands.

That its motto, "We can help those who want to help themselves" states the case fairly is shown by the testimony of its clients which appears in a booklet issued by the bureau, bearing the title, "Advertising for Profit." Copies we understand may be had upon application, if you send your business card.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING OCTOBER 21, 1899, $53,052.00.

New York, Oct. 21, 1899.—The following exports of electrical materials are from the port of New York for the week ending this date:

Argentine Republic.—28 cases electrical machinery, $3,207.

British Possessions in Africa.—12 cases electrical material, $227.

Brazil.—21 packages electrical material, $1,915; 35 packages electrical material, $6,993.

British East Indies.—2 cases electrical material, $92.

British West Indies.—13 packages electrical material, $1,006.

Bremen.—3 cases electrical material, $70.

Chili.—2 packages electrical material, $49.

Dublin.—12 electric cable reels, $1,900; 2 packages electrical machinery, $200.

Ecuador.—34 packages electrical material, $277.

Glasgow.—23 cases electrical material, $315.

Genoa.—1 case electros, $10.

Hamburg.—1 electric vehicle, $630; 2 packages electrical material, $110; 70 packages electrical machinery, $1,048.

Hong Kong.—1 electro, $20.

Japan.—6 packages electrical material, $1,321.

Liverpool.—43 cases electrical material, $9,757.

London.—100 packages electrical material, $3,156.

Marseilles.—201 cases electrical material, $20,020.

New Zealand.—3 cases electrical material, $253.

New Castle.—3 cases electrical machinery, $400.

Southampton.—3 packages electrical material, $75.

Southampton—5 packages electrical material, $75.

NEW INCORPORATIONS.

Wharton, Tex.—Wharton Electric Light, Ice, Water Works and Cold Storage Co. has been incorporated by G. C. Gifford, Edwin Hawes, Tom Brooks, R. B. Hust n and others, with an authorized capital stock of $50,000.

New York, N. Y.—The J. H. Bunnell & Company has been incorporated to deal in telegraph and other electrical instruments; capital, $30,000; directors, Charles McLaughlin, Henry L. Shippy, William E. McLaughlin, John J. Greagan, William H. Bull, New York City.

New Haven, Conn.—The Vermont Construction Company has been incorporated to construct and build street railways; capital, $25,000; incorporators, C. W. Blakeslee, D. A. Blakeslee, D. W. Blakeslee, S. C. Morehouse, all of New Haven.

St. Louis, Mo.—The Globe Electric Company, of St. Louis, has been incorporated; capital stock, $100,000; incorporators, Gustavus Heibel, George Anson Clark, Gustave Miller and Samuel D. Winter.

TELEPHONE CALLS.

Lake Providence, La.—Preliminary surveys for the construction of a telephone line from Lake Providence to New Orleans are being made by W. G. Garrett, civil engineer for the Cumberland Telephone and Telegraph Co., Washington, D. C. Exchanges will be erected at Georgetown, Mt. Pleasant and East Washington by the Chesapeake and Potomac Telephone Co.

Columbia, S. C.—The South Carolina Telephone Co. has been incorporated by John H. Schofield, Henry O. Reid, Jerome Bradley, George W. Sutton and J. A. Helvom with a capital stock of $50,000; to carry on a general telephone and telegraph business.

Monticello, Ill.—The Platt County Telephone Company has been incorporated; capital stock, $5,000; incorporators, William F. Lodge, William E. Lodge, C. Snyder.

Boise, Ida.—Articles of incorporation of the Idaho Independent Telephone Company have been filed in the office of County Recorder Lamoreau. The principal place of business is Boise. The capital stock, $100,000. The incorporators are H. E. Neal, E. H. Beggs, J. S. D. Manville, George D. Ellis, A. J. Glorieux, C. F. Neal, A. D. Robb, Walter Schroff, H. W. Clement.

Kansas City, Mo.—The Chickasaw Telephone Company has increased its capital from $5,000 to $50,000.

POSSIBLE INSTALLATIONS.

Anniston, Ala.—A franchise has been granted to the Anniston Electric Co. for the erection of an electric light and power plant.

Braidentown, Fla.—H. W. Fuller will establish an electric light plant.

Alexandria, La.—An election will be held to decide upon the issuance of $8,000 of bonds for improvements to power house and electric light plant.

Hazlehurst, Miss.—A franchise for the erection of a 1,000 light electric light plant has been granted to R. N. Miller.

Fayetteville, N. C.—A power transmission plant may be erected at Locksville to transmit power to Fayette-power will be given. A syndicate with headquarters at ville, provided a guarantee is given that 2,000 horse-Richmond, Va., is backing the project. Walter L. Holt can be addressed.

Reidsville, N. C.—An electric light plant will be established in connection with the municipal water works. Address the mayor.

Charleston, S. C.—Bids will be shortly called for the erection of a new electric light plant. The contract is being prepared by R. G. Rhett.

Wartrace, Tenn.—An electric power house will be erected by the Wartrace & Lynchburg Railroad Company recently incorporated.

Plano, Tex.—J. Stark & Co. will rebuild their recently destroyed electric light plant.

Central City, W. Va.—An electric power plant will be erected by the Ohio Valley Electric Railway Co.

Kanawha, W. Va.—A franchise has been granted to the Kanawha Electrical Co. to erect a generating plant for the utilization of the power of the Kanawha River falls.

New Martinsville, W. Va.—Plans have been completed by Mr. Sands, of Wheeling, and James Chapman, of New Martinsville, for the proposed electric light plant, franchise for which was recently granted.

NEW YORK NOTES.

MR. JAMES GOLDMARK, of Goldmark & Wallace, 121 Worth street, New York City, has returned from an extended European tour. The firm of Goldmark & Wallace are well known as having introduced the popular "Hurricane" motors and dynamos. They are also the American agents for the noted Koch dynamo brushes.

THE SPRAGUE ELECTRIC COMPANY, 20 Broad street, New York City, have issued a neat little book of instruction for the proper installation of their flexible metallic conduit. The book, which is of convenient vest pocket size, is copiously illustrated, and contains also a table of electrical horse-powers and table giving decimal equivalents of fractions of an inch, thus making it an invaluable aid to the electrical engineer and contractor.

THE J. JONES & SON COMPANY, 64 Cortlandt St., New York City, manufacturers of and manufacturers' direct agents for electric light, telephone, telegraph, bell and battery supplies, panel boards, switches, etc., will have their latest catalogue, No. 8, ready for distribution on October 31st. This catalogue is devoted entirely to electric light supplies and contains numerous new goods and specialties. The catalogue is attractively illustrated the illustrations being always the most prominent feature. Their new bell and battery supply catalogue will be ready November 10th and will be the latest bell and battery catalogue given up entirely to this line.

J. E. LAVENS & COMPANY, 253 Broadway, New York City, are agents and contractors for the sale, introduction and installation of mechanical rubber goods of all kinds. The long years of experience of Messrs. Lavens & Company has made them acknowledged experts in rubber gaskets, flanges, unexcelled packings of all kinds, rubber sheeting and covers for dynamos, hard and soft rubber tubes of all sizes. Large orders are given special attention as to price, quality and quick shipments.

The Electrical Age.

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Automobiles.

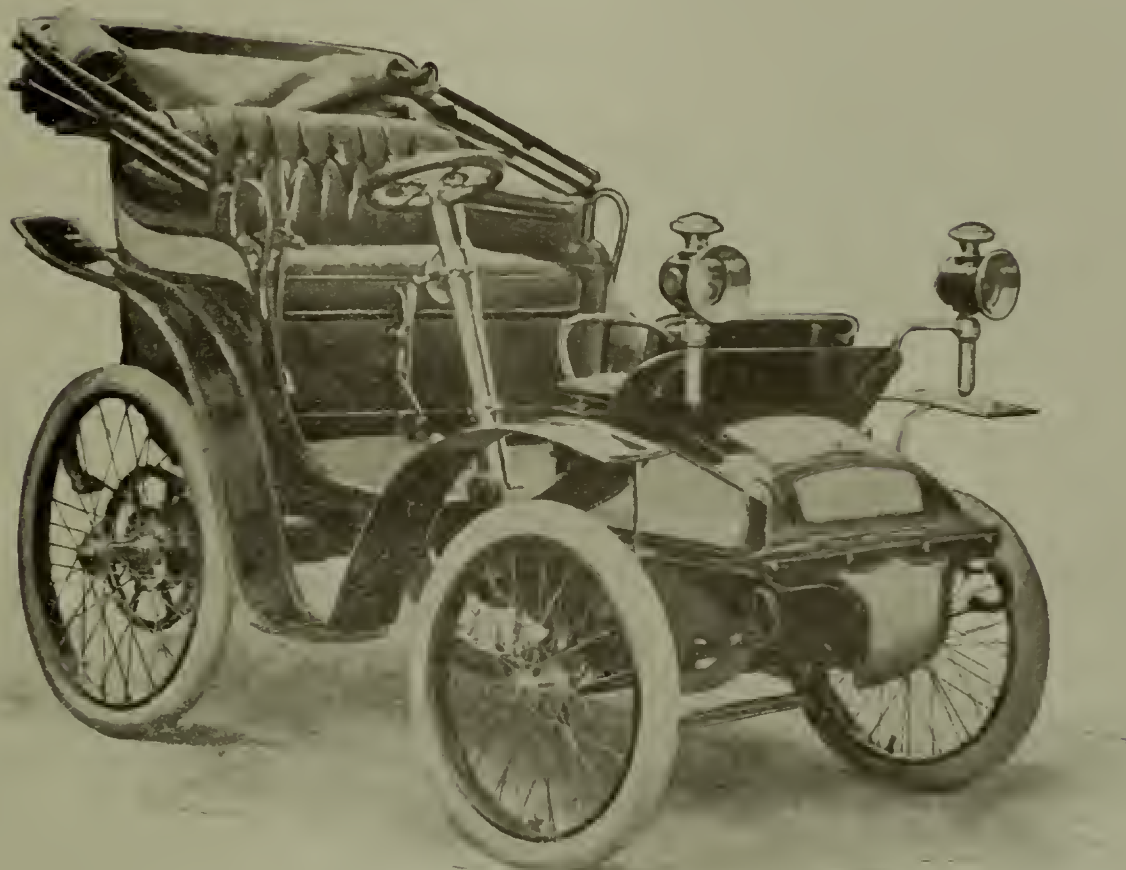

Fig. 1. Automobile Victoria.

Fig. 2. Automobile for Mining Purposes.

THE LATEST AUTOMOBILE.

It is about as well established as anything can be that the American inventors are determined to produce the right sort of automobile wagons, and at the present time many clear-headed inventors who are veteran wrestlers with nature's secrets are engaged striving to solve the problem necessary to give the general public an automobile that can be managed as easily as the ordinary conveniences of a household.

The Auto-Acetylene Company, of No. 13-21 Park Row, New York City, have been quitely developing an automobile and have had their expert in Europe for a long time investigating all of the automobile carriages in France, Germany and England and the motor contrivances used there. After two years' testing, modifying and perfecting the mechanism of their automobile, the company announces its intention to salute the public and say, "We are ready now for business, because we have an automobile that will meet the requirements and which is safe, reliable and capable of performing the work it is called upon to do."

In talking with one of the officers of the company he said: "We are not a large company; we have no stock for sale; we have never said a word about our automobile until now. Our purpose in the market is to make a regular line of automobile wagons, and especially heavy trucks, drays, stage coaches and miners' prospecting wagons. We do not intend to make a variety of ways and means for manipulating an automobile. We have a motor that works successfully. It has carried one of our wagons over the road for sixty-three hundred miles with but one accident, and the motor to-day is to all appearances as perfect as it was the first month it was in use. All we claim for our automobile is that it works successfully. We do not claim we have the only thing in existence, but we do say that we have one that is provided with a motor, carburetter, and steering apparatus that meets all of the requirements, and the machine as an automobile is capable of going every day up and down the ordinary grades at a speed suitable for such navigation, without fear of a breakdown at every cross road. The motor runs almost as noiselessly as an electric motor, there is no odor, no danger of explosions, and the operator is not compelled to take out a license as an expert engineer in order to be allowed to manipulate our automobile, nor must he be an expert electrician. Any child of ten years of age can be taught to operate our wagon in a few hours' time, and it is as easy to start or stop it as anything of the kind possibly can be.

A feature that has always been a drawback to the gasoline driven automobile is the odor that permeates the whole structure on account of the burning gas or the volatile element of the hydrocarbon escaping through the most closely fitted valves and connections of the engine. This is a feature the Auto-Acetylene Company's expert claims to have overcome, and there is no penetrating odor escaping through the mechanism of the wagon, and therefore it is quite suitable for use as a delivery wagon where it is desired to convey goods that would be injured by absorbing the odor arising from the ordinary gasoline engine.

The miners' prospecting wagon is in reality a mining camp complete, and at the rate of two and a half to four miles an hour it will go from two hundred and fifty to four hundred miles with the ordinary supply of hydrocarbon. It is fitted with a commissary compartment, in which can be carried enough provisions to last many days. There is mounted upon the truck an ore crusher that can be connected directly to the motor, and an assay furnace outfit to test the gold-bearing ore as it may be found. The seat can be turned down and will provide a bunk for two persons, and in practice while one man acts as navigator steering the wagon, his companion can be busy making assays of their findings about in the same way that an expert would in a well-equipped laboratory. As the prospecting vehicle carries a supply of fuel in the way of hydro-carbon, prospectors can start and go into the arid country one hundred and fifty miles away from their fuel supply. With a good supply of water and provisions and an extra barrel or two of gasoline aboard, they will be equipped to do prospecting that is impossible now. With a canopy stretching over the wagon, at night it is virtually a tent in which there is provided every convenience of an up-to-date laboratory, and also a cozy kitchen in which everything can be cooked and light provided from the hydrocarbon gas equal to the light we enjoy in New York.

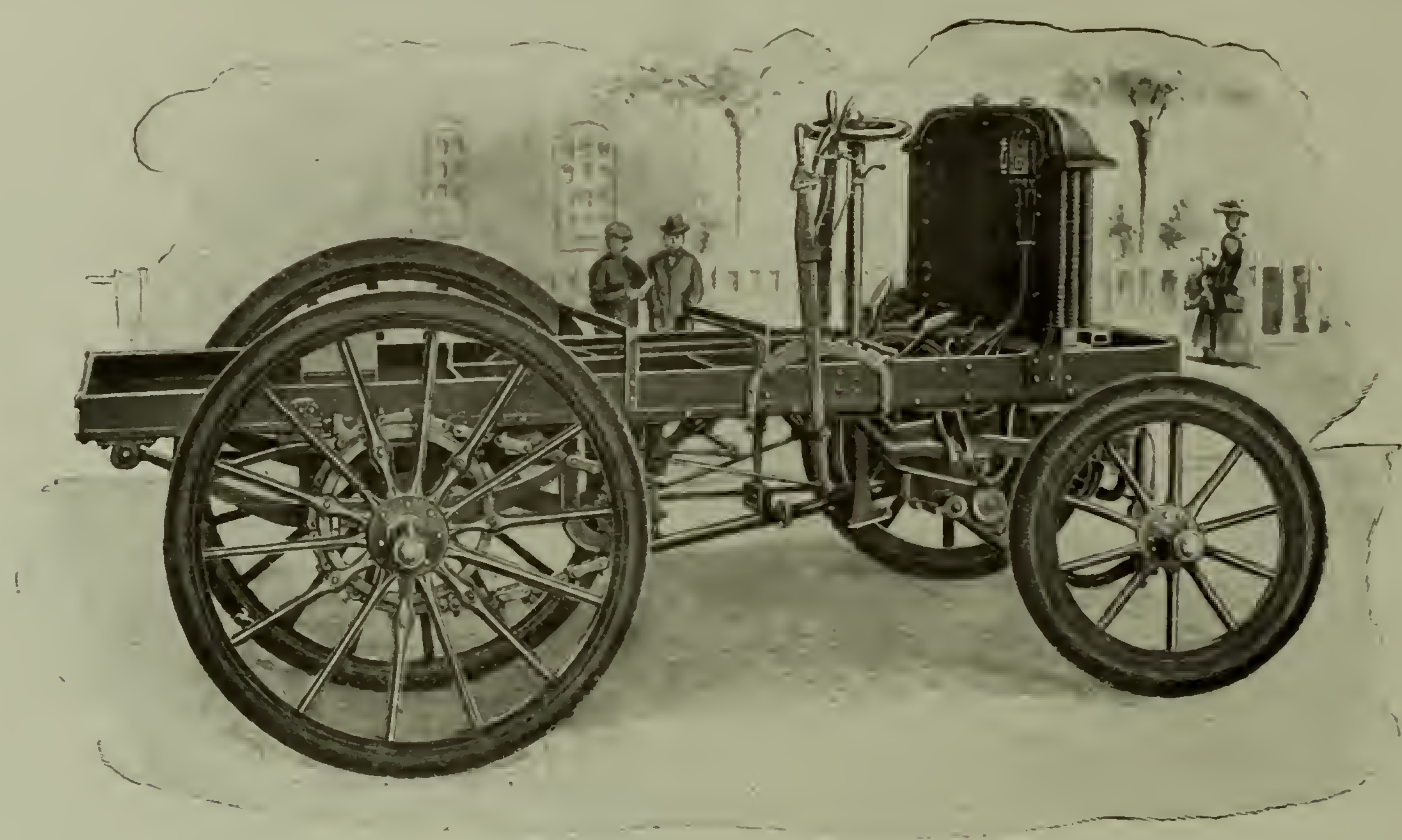

Fig 3.—Running Gear of Truck.

The privation endured by prospectors for gold is something not easy to comprehend. Often men start into a country like the Mojave Desert and the Great Basin of Arizona and never return. It is impossible for man or beast to live long enough to penetrate the country very far, and much of the country in which gold exists cannot be explored because there are no means of reaching the desirable localities; but with an automobile capable of traveling one hundred to two hundred miles, provisioned with food and an ample supply of water, which is one of the great essentials, men can go and stop along the way, examine the outcropping of rock or the placer fields, and yet they will be as comfortable as though they were in one of the modern hotels of the city, and when they have explored the country to their satisfaction and found what they believe paying ore, they have with them all the outfit necessary to make an examination and prove they are right."

Illustration, Fig. 1, shows an automobile suitable for two persons, and while the cut shows the ordinary bicycle wheel, the company say that practice has proven to them that a good, substantial wooden wheel is preferable, even though the body of the wagon be light. The running gear should be firm and rigid to effect durability. Fig. 2 illustrates one of the company's wagons to be put in service at Mojave, Cal. Fig. 3 illustrates the running gear of the company's standard truck, upon which any desired body can be placed.

The Auto-Acetylene Company has completed negotiations for a large factory at Hyde Park, Boston, Mass., and another at Greenpoint, New York, the intention being to use the Hyde Park factory for the construction of the regular line of automobiles, and the Greenpoint factory will be used for special vehicles and a department established for general repair work of all kinds of automobiles. The factory being located close to the business center of New York, will be convenient for automobilists when they want any repairs made to their automobiles. Both factories are equipped with modern machinery and every facility is provided for the manufacture of high-grade automobiles.

Electricity in the Mine.

ELECTRICITY AS APPLIED IN THE MINING DISTRICT AT CRIPPLE CREEK, COLO.

Considering its size, Cripple Creek, Colo., is probably the best electrically equipped mining camp in the world. Not only is electricity used in the mines in every way known to the up-to-date mining engineer, but also in the home of the miner, furnishing light, and on the street running trolley cars, do we find this invisible agent of mankind predominating. By its use, comparing it with steam, a saving of from fifteen to twenty per cent. is effected, to say nothing of the greater convenience and reliability under all conditions of service and weather experienced.

The twenty-seven mile transmission plant of the Colorado Electric Power Company transmits current to Cripple Creek at 20,000 volts. This company operates three Westinghouse alternating current, 470 K. W., 3 phase, 500 volt generators, capable of supplying 2,250 H. P. In many mines in the district Westinghouse type C induction motors have been introduced for hoisting, pump-

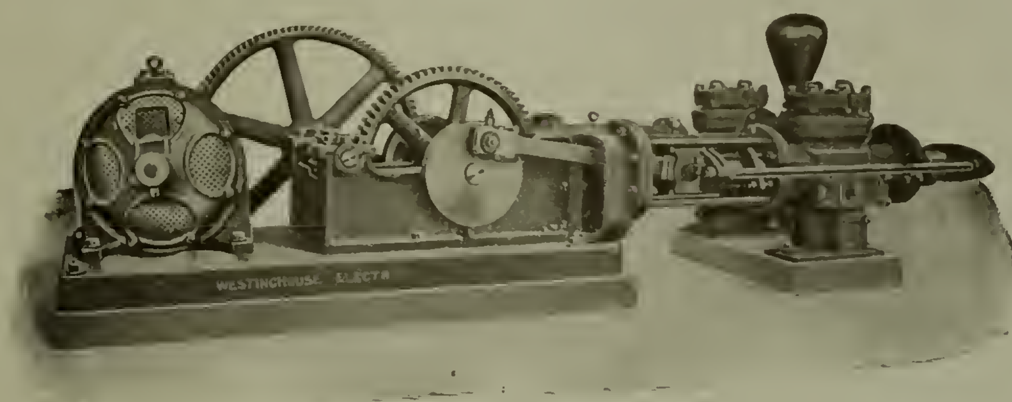

Fig. 3.—Electric Motor Operating Pump.

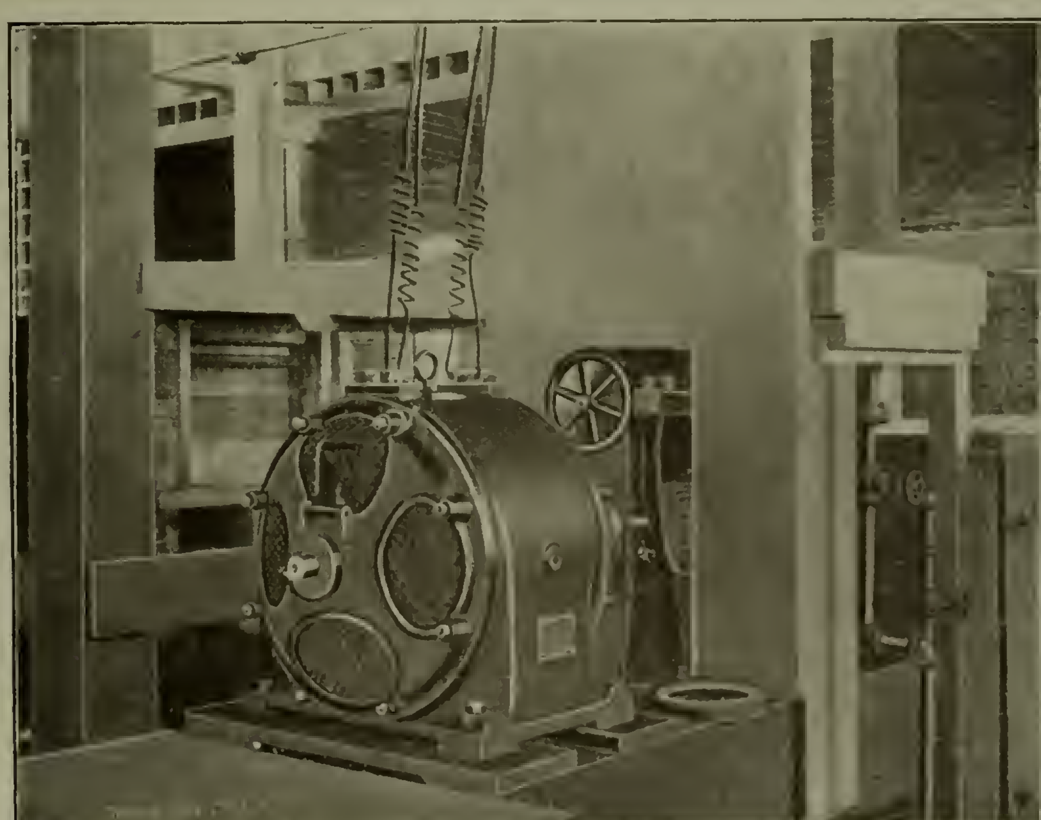

Fig. 1.—Westinghouse Electric Motors Operating Crushers

ing, operating air compressors for drills, lighting, and for operating crushers and other machinery. The Colorado Ore Reduction Company has a 150-H. P. Westinghouse motor for operating its crushing machinery. Fig. 1 shows two Westinghouse type C motors operating crushers, the motors being partitioned off from the crushers to preserve them from the dust, the belts passing through the partition to operate the machines. Fig. 2 shows a Westinghouse type C motor operating the mine hoist of the Wisconsin Mine, Cripple Creek. The Lily Gold

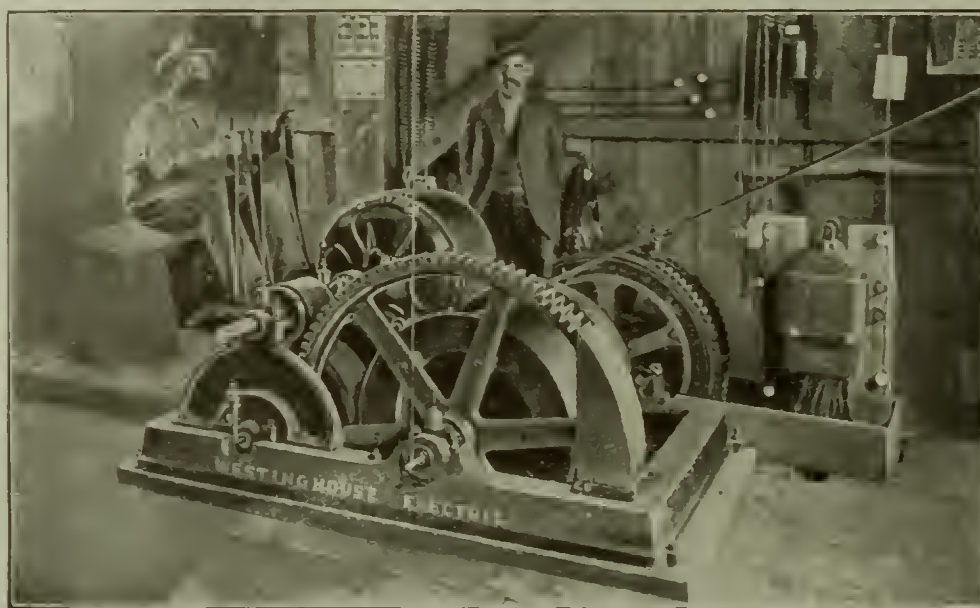

Fig. 2—Electric Hoist at Wisconsin Mine, Cripple Creek.

Mining Company uses 100 H. P. for operating hoists and air compressor; the Moon Anchor Gold Mining Company has a 100-H. P. Westinghouse type C motor for pumping from a depth of 600 feet. The needs of the majority of consumers range from 75 H. P. down to 5 H. P. A Westinghouse type C motor of 15 H. P. suffices for hoisting through a shaft 450 feet deep; when this depth is exceeded a motor of 30 H. P. is used, which will be sufficient for a depth of 800 feet; for still greater depths motors of from 75 to 100 H. P. are installed.

COST OF RUNNING AUTOMOBILES.

The following article from the London Daily Mail, gives costs of operation of automobiles:

Now, that at last the automobile movement may be said to have begun in earnest in this country, some amount of interest naturally centres in the question of heavy motor vehicles.

These are undoubtedly destined to replace horse-drawn wagons in the near future, and, if they had nothing else to recommend them, motor-driven wagons, etc., would appeal to firms who at present use horses solely on account of the difference in working expenses.

Mr. E. H. Bayley, of Bayley's Wagon Building Works, gave a Daily Mail representative some interesting particulars on this point yesterday. He is entitled to speak with some amount of authority, as he was chairman of the London Road Car Company, and now, in addition to employing 1,000 or so horses in his own business, is chairman of the Daimler Motor Company, and takes a keen interest in all that tends to lessen the cost of heavy traffic.

"Of course," he said, "no matter how excellent motor-driven vehicles may be, no one would look at them seriously if their use were more expensive than that of horses. That is exactly where the ultimate success of motor vehicles lies, for the tests by the Automobile Club at Richmond and, more recently, those held by the Liverpool Self-Propelled Traffic Association have shown that not only can motors do general carrying work more quickly and more efficiently than horses, but—most telling point of all—do it at less than one-seventh of the cost.

"For instance, we have a car which has been proved, under the tests already mentioned, to be capable of carrying a load of 3 tons 12 cwts. at a cost for fuel which works out a half-penny per ton mile. The total unkeep of such a vehicle, when all expenses for working, wages, fuel, repairs, insurance, etc., are taken into consideration, comes to a sum of £407 0s. 3d. ($1,980.73), and this, with a carrying capacity for two hundred and sixty working days, gives an average cost of a fraction under 3 half-pence (3 cents) per net ton mile.

"When that is compared with the cost of horses—my experience teaches me that it varies from 9d. to 1s. (18 cents to 24 cents) per ton mile—it can be seen what a future such vehicles have before them. In this branch of automobiles England has the lead, and presently she will not be so far behind with light carriages, for the Daimler Company is taking up the question of building racing cars to compete with those of French manufacture.

"Already, three orders for cars costing £1,000 ($4,866.50) each, have been placed, which shows that English enthusiasts are prepared to support home industries if given the opportunity."

The London Daily Mail is publishing an automobile column once a week. Mr. Alfred Harmsworth, the editor of the Daily Mail, will not object, I imagine, to my stating for publication that he is an automobile enthusiast and believes it patriotic for a man of means to purchase the best types of automobiles, foreign or British. This he does in order to create a greater interest in them in this country, so that the British manufacturers shall not, for lack of examples or cash encouragement, be behind the American or French manufacturers in this respect.

MARSHAL HALSTEAD, Consul.

Birmingham, September 20, 1899.

ELECTRIC GAS PRESSURE INDICATOR.

An electric telemeter for indicating gas pressure has recently been successfully tried in Detroit, where the pressure at the office in the city is communicated to the gas works, a voltmeter being used which is calibrated to read in terms of gas pressure, and a recording instrument is connected in parallel to it so that a permanent record of variations and pressures is kept.—Ex.

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CONTENTS:

A STRIKING DEFICIENCY OF THE MARCONI SYSTEM.

Signalling without wires is an interesting prelude to vast possibilities, but in the light of modern criticism it is not as practical a performance as one would wish for. The famous experiments of Hertz have not been without value if they have resulted in the establishment of a commercially successful signalling system with or without wires. Marvelous from one standpoint as communication may be through miles of ether yet, as a mode of communication, it has its shortcoming which will prevent it from becoming very successful until they are eradicated. The difficulties at present may be divided into two classes: first, that of getting signals through large cities without the use of receiving rods hundreds of feet in the air; secondly, the difficulty of preventing other people from receiving private communications.

Until the criminality of wire tapping was recognized and thoroughly understood, information amounting to thousands of dollars was stolen, but being recognized as a crime with severe punishment attached as a penalty, few if any, cases occur or come to public notice. On the other hand, to tap a wire requires a pretty good knowledge of telegraphy and a certain amount of risk and daring, only possessed by those who ultimately make a close acquaintance with the Bertillon system. It is not very easy to attach wires to lines within the city or even the suburbs without detection, consequently the present system of telegraphy is comparatively free from objections of this character. As long as the ether is free and signals traversing thereby become everyone's property when sent broadcast, those supplied with working apparatus can, if they so desire, get within the range of a transmitting device of the Marconi system and obtain a complete record of what the ether waves are carrying.

It is not likely that the objection to the erection of high poles for terminal wires will ever be as serious as the utter lack of privacy associated with the Marconi system. Were a large transmitting device erected in any central square a hundred thousand people supplied with suitable apparatus could take down the signal transmitted form there without the least difficulty. Therefore it seems probable, on account of this selective power or automatic discrimination, that the Marconi system will be confined in its application to a few special cases.

There is a thereotical foundation for the construction of a system which will possess the remarkable property of responding only to that transmitter to which it has originally been adjusted. This field of investigation is comparatively new and has earned the title of electric resonance, due to the similarity existing between a purely acoustic system of this kind and its equivalent with Hertzian waves. What the chances are of actually developing a system of so remarkable a character few can say, yet a line of careful experimenting would be the means of determining how little or how much reliance could be placed upon a system which would represent such possibilities.

There seems to have been some discussion of late regarding the original invention, the ownership being claimed by Prof. Dolbear, of Tufts College. If such be the case, Marconi's efforts in this country will be of little avail, and the government, by completing negotiations with Marconi, might find itself involved in a most disagreeable patent controversy. These facts have assumed shape in a statement received from Washington and reading as follows:

"General Greely said that there was no reason why the army should put itself under great obligations to Marconi, and that even if the funds of the department would allow the expenditures demanded, there was a doubt as to the advisability as to making any enormous concessions, because it was apparent that there will be trouble over the inventor's patent and the government does not wish to be involved in such controversies."

THE LAMP WITH A RARE OXIDE FILAMENT.

With the establishment of the lamp industry a variety of inventors interested themselves seriously in the construction of a lamp of either higher efficiency or longer life. The high efficiency lamp may in the near future become an actual possibility. The reason for this is to be found in a variety of patents granted to investigators in this line for a rare oxide filament, and perhaps the most interesting of these is one in which we may find a radical departure. The filament as made is composed fundamentally of a material capable of volatization, but a coating of one of the rare earths is laid upon this by some process sufficiently thick to form a hollow cylinder around the original filament. Upon passing a current through the lamp the inner core is burnt away and the external coating remaing intact eventually carries all the current. The high resistance of this outer coating and its almost complete immunity from destruction at high temperatures makes it practically indestructible. In consequence of this the temperature of the lamp may be raised to a point far exceeding that of incandescent carbon and as a necessary result an unusually high efficiency is obtained. A lamp of this description tested photometrically gave a candle power exceeding one hundred, with an actual consumption of less than one hundred and thirty watts. The life test was not completed, but the chances are that it would have been satisfactory as well. Thus it seems that the high efficiency, long-life lamp is neither a myth nor a miracle.

Applications of Electric Power.

THE PRACTICAL APPLICATION OF ELECTRIC MOTORS TO PRINTING PRESS MACHINERY.

BY W. H. TAPLEY.

(Continued from page 195.)

Belted, Geared and Direct-Connected Motors.—The main advantages to be gained from the individual application of electric motors to printing press machinery are steadiness of power as applied to main driving shaft, absence of overhead belting, economy of floor space, increased output and ability to place presses in a room irrespective of a main line of shafting.

The main difficulty with belted motors is the slippage of the belts, which frequently causes poor register and slurring; with overhead belting this is further increased from dust, dirt and scales, which are constantly given off from the surface of the belts, battering plates, and the obstruction to light in the room all tend to decrease the output.

In fact the belted individual motor has only two advantages over the main line driving, viz.: Location and independence of main line, in case anything happens to belting which might necessitate shut-down of all the presses.

As it retains all the disadvantages of the main line drive, it should be discarded where good work is wanted.

The geared and direct-connected motors only will hereafter be considered.

To reach a conclusion as to which is the better will, in most cases, necessitate an individual consideration, first, by the electrical engineer and the press builder, and, finally, by the proprietor, who pays the bills.

The principal features of each should be considered separately.

Geared Motor.—This must be of moderate speed, not of a high speed, for then the reductions, motor to press, are prohibitive.

Speeds should be from 1,000 revolutions per minute for 1 horse-power, to 500 or lower for 15 horse-power; this will permit of a suitable mechanical reduction and attachment to presses whose main driving shafts vary in speed from 90 175 revolutions per minute. When this is exceeded, it is almost impossible to make the press—one of the large types—run quietly, and if noise is an objection, the direct-connected type becomes advisable.

Hardly any two makes of presses have the same shaft speed, nor are the diameters of shafts the same; so for presses of same sized bed and production there is required for each make of press different ratios of reductions, which can be easily supplied by gearing, always using the standard motors.

While with the direct-connected motor, the armature, being keyed to press shaft, must be built especially for this individual type and make of press.

Its interchangeability with other presses of different manufacture is a great rarity.

If press is sold or replaced by another, the motor must be made over to suit, or else thrown away, while the standard geared motor is always ready for use with a change of gearing.

The ratios in presses vary from 4 to 1 to as high as 12 to 1.

Press ratio means for every 4 or 12 revolutions (as case may be) of press shaft there is made one impression.

In some cases the geared motor takes up more floor space than a direct-connected, but not always, notably in the stop-cylinder type, which has driving shaft at the rear of press, enabling motor to be placed under the delivery table, reducing the floor space even of belted presses.

Should trouble occur to the "direct" it is much more serious, for this means a shut-down of the press, until injured parts can be repaired or furnished by factory.

Waiting for special made motors to be repaired or rebuilt is very tiresome, as those of us know who have to place ourselves at the mercy of manufacturers.

Duplicate geared motor armatures can be kept on hand and change made easily during "make-ready," with no loss whatever of production.

Owing to the wide variation in speeds, bore of shafts, it is impracticable to keep on hand "direct" armatures; cost is prohibitive to keep a special armature for each size press.

Increased cost of direct over geared is from 25 to 33 1-3 per cent. for new presses as they come from the factory; cost of installation about the same.

Difference in cost of electrically equipping presses already supplied with belting depends largely upon circumstances, whether shaft has to be lengthened, turned off, etc.; but cost is nearly equal if gearing has to be bought and pulleys cannot be sold.

These figures refer to motors of about 5 horse-power and speed 175 revolutions per minute and up; smaller sizes, as well as lower speeds, make material advantages in favor of geared motors.

Voltage should be either 115 or 230. Five hundred volts is too high to have about so much metal which employees are constantly touching.

Attachment.—I wish to call particular attention to this part of the subject under consideration, for it is one that the electrical engineer is more likely to slight, it being wholly mechanical engineering.

First, in every case make the motor part of the press; it must not be placed on a separate foundation; it is absolutely essential that this be rigidly adhered to in all cases where satisfactory results are expected, for otherwise the gearing will get out of line. In the case of "direct" motors, there is liability of the armature hitting against the pole pieces or else bind the main press shaft sufficiently to get a hot box and cut the shaft.

Next in importance is to provide a proper foundation; in most cases up to 3 horse-power, an iron bracket of sufficient strength, securely bolted to frame of press, will meet all the requirements; in all sizes from 5 horse-power and upwards, an extension of masonry foundation on which press rests should be made; cast-iron motor must not only be bolted to press, but anchored to the masonry foundation by grouting in cement or with anchor bolts—in many cases both should be done, thereby obtaining a foundation amply massive to take care of all the jars and strains to which the motor will be subjected, without running the risk of loosening the bolts in foundation and getting motor out of line.

In a "Huber" press, running at a speed of 1,500 impressions per hour, the bed is traveling at the rate of 300 feet per minute; weight of bed, with form, over 1,000 pounds; a total of over 300,000 foot-pounds to take care while the press is running at full speed within a bed travel of 4 to 5 feet, with reversal following immediately. To cause a more sudden stoppage would be disastrous to the machinery of the press.

Editor's Note.—Through an oversight in making up the following lines were omitted from the end of the first instalment of Mr. Tapley's article:

more power.

The efficiency of a 3 horse-power and 5 horse-power motor, both running under load of 2 horse-power, will be within 2 or 3 per cent. of each other, thus placing each on substantially the same basis as to commercial efficiency.

This reserve power will prove a valuable source of revenue before the year is closed.

The rough usage to which the electric motor is subjected on presswork is such that if repair bills are to be kept down the initial cost must not be the sole guide.

In the case of direct motors, the outboard rigging makes it much easier, at the same time presenting a more graceful appearance when finished, to attach motor to press without either foundation or motor sub-base. In this case the supporting brackets must be rigid and bolted to press with a "driving fit," for, when play is left in bolt holes, trouble is sure to arise sooner or later from the motor shifting its position.

Even with direct-connected motors, it is best, wherever possible, to provide a sub-base, for reasons mentioned in connection with geared motors, as well as the assistance received during installation. The proper handling of motors weighing from 500 to 1,100 pounds, while working to a "driving fit," with the ordinary appliances at hand in a printing office, is not rapid or satisfactory work.

(To be continued.)

Electro-Statics.

ELECTRICITY AT HIGH PRESSURES.

By ELIHU THOMSON.

(Continued from page 208.)

The phenomena of development of high electrical pressures by belts, such as those of high speed machinery, are illustrations of the same principles. Instructions are sometimes given to discharge the belt by a row of points connected to earth, so as to avoid the belt electricity endangering the insulation of a dynamo or motor by charging its frame. Such a procedure is the very one to enhance or increase such danger, and the proper procedure is to connect the points to the frame itself and to the shaft which serves as the countershaft belted to the dynamo shaft. Some of the larger belts used in transmission give very striking exhibitions of electricity at high potentials. Sparks over three feet long were obtained under a large belt at the Narragansett Electric Lighting Company's station, in Providence, some years ago.

The old electrophorus was an instance of the utilization of similar principles of alternate binding and freeing of a charge produced by friction upon a resinous plate contained in a sheet metal tray. When the insulated disk of the electrophorus is lifted off the resin surface, the charge on the resin binds itself to an opposite charge induced in the tray, and when the disk is returned and connected to the tray or to the ground, the charge mostly binds itself with an opposite charge induced in the disk now resting upon the rubbed resin. Upon disconnecting the disk from earth and lifting it off the resin surface, it is found to be possessed of a charge of opposite name to that upon the resin surface, which latter again binds itself to its opposite in the tray. The work done is the lifting off of the disk against electrical attraction between the disk and resin surface, the energy used in lifting manifesting itself in a high presure charge in the disk.

The apparatus known as Armstrong's Hydro-Electric Machine is an instructive example of the operation of similar principles. It enables a high potential to be produced from the effects of a slight charge produced in minute drops of water which are driven along with steam, through a jet lined with box-wood. The globules from partly condensed steam, on leaving the jet form a small cloud into which collecting points from a prime conductor project, and a high potential charge is thus given to the conductor, from which long sparks may be taken. Since the actions occurring in this steam electrical machine serve to throw light on the accumulation of high pressures in a thunder cloud, I may be pardoned for dwelling upon the matter for a few minutes.

(To be continued.)

Stray Currents.

A COSTLY CONVERSATION.

Long distance telephone conversations, or rather a series of conversations, recently occurred between parties in New York and St. Louis. The total cost of them was said to be about $3,000; most of the talking was done at night, and the bill for one continuous conversation amounted to $716. This figure indicates that the talk must have lasted into the high-priced day hours., for any one can converse from eight o'clock in the evening to six o'clock in the morning for $600, the rate being $1 per minute. Special care was taken to avoid interruption by operators cutting into the line.—Ex.

ELECTRICITY IN THE SERVICE OF THE HIGHWAYMAN.

According to the New York Sun, a certain Philadelphian with the euphonious name of Goroditzski was walking along Grand street in this city the other day when he saw a man with an electric machine peddling shocks to children at a penny a shock. The little ones laughed so much that he fished out a penny and said he'd try the machine himself. "He bulls out der handtle a liddle vay," said Goroditzki, as reported in the Sun, und I veels somedings dickle mine handt. Den he bulls oudt der handtle avay oudt, und bode off mine handts go up in der air und I gand't get 'em down. Vile helbless am I a loafer runs ub und he dakes mine watch and schain. I stamb und rache und schwear, but the feller mit der machine keebs mine handts in der air until der dief iss gone, ven he bushes der handtle in und runs avay mit der machine."—Ex.

THE AMAZON CABLE TO BE ABANDONED.

The Amazon Telegraph Company, Limited, will very likely abandon the cable in the Amazon, from Para to Manaos. It seems that the frequent changes in the river bed puts strains on the cable which it is quite unable to bear, and thes changes also make the work of repair almost hopeless. The company are said to be building land lines round those pieces of cable which cannot be maintained. They were also recently making extensive enquiries as to the possibilities of the Marconi system of telegraphing, which, with improved speed, would be able to render considerable service in the Amazon distrist, where the exceedingly rapid growth of the trees makes a land line very costly to keep up.—Ex.

EASING THE WAY OF THE TELEPHONE GIRL.

The life of the telephone girl, says the London Chronicle, is not altogether a happy one, and if the public have sometimes reason to complain of the invisible operator who fails to put them in immediate connection with their correspondent, the girl has still oftener reason to complain of the public. In Paris the claims of these useful and much maligned public servants have been recognized, and a splendid building has been put up for them by M. Boussard in the Rue Desrenaudes. It includes every modern comfort and convenience, cloak rooms and lavatories, well furnished salons to which girls may retire for periods of rest, brilliant lighting, varnished walls, and most wonderful of all, all sorts of perfumes will be provided gratis for the refreshment of the weary operator

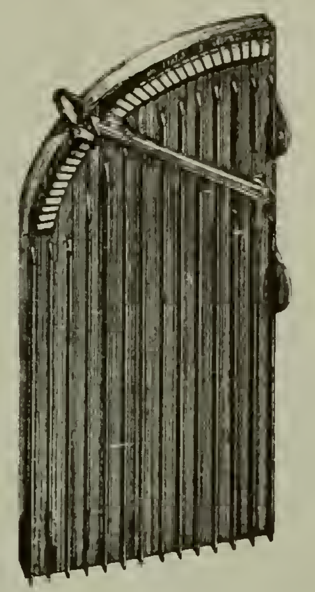
A NEW STORAGE BATTERY.

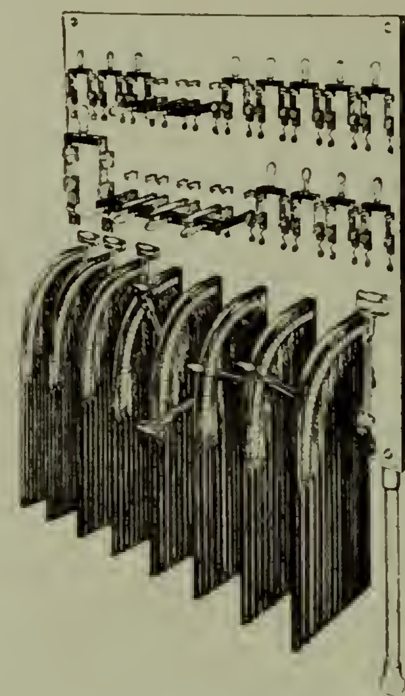
The newly patented storage battery of Mr. H. H. Knepper is designed to withstand shaking, as in electric vehicles. The plates may be of the usual kinds, but are completely enclosed in an envelope of wood pulp or similar material, and in the spaces between these envelopes perforated fillers or sheets of absorbent material are placed. Both the envelopes and the fillers absorb the electrolyte and expand, holding the active material from dropping to the bottom of the cell. The perforations of the fillers form enclosed receptacles, and permit the use of a greater quantity of the electrolyte than could be used if the fillers were solid.—Ex.

Station Appliances.

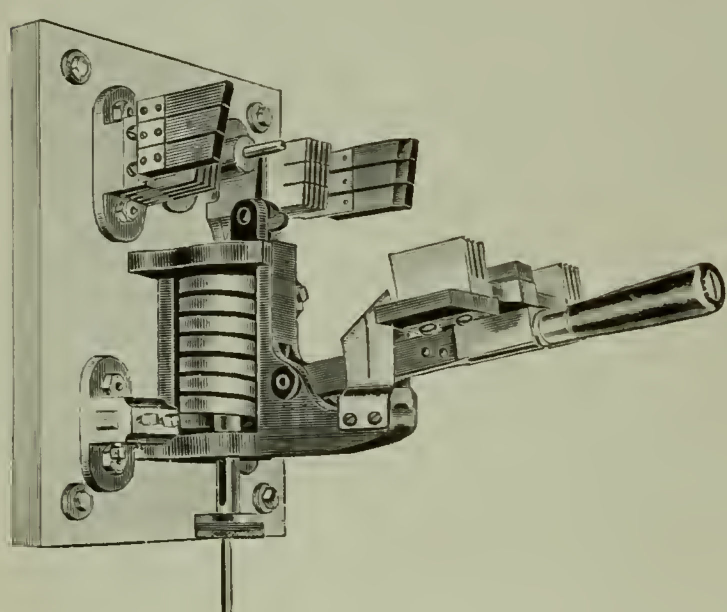
SWITCH AND RHEOSTAT CONSTRUCTION.

The secret of rheostat construction, particularly of that class in which the resistance wires are imbedded in an insulating material in close contact with iron, is the proportioning of the radiating surface of the rheostat to the heat developed inside. Many facts and figures might be produced bearing upon this subject, but a little experimenting, backed up by some calculations, will bring things down to a proper commercial basis. The question is largely this: how many square inches of iron is required under the circumstances mentioned to get rid of one hundred watts of heat energy.





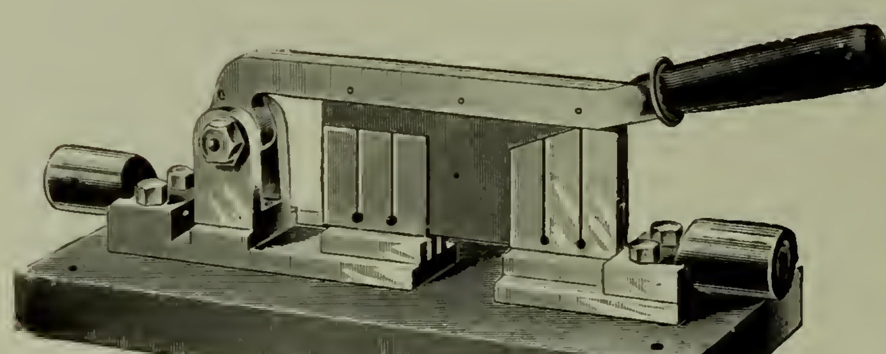
Enamelled Rheostats For Station Service.



Automatic Circuit Breaker.

A temporary experiment, with the resistance wire lying in comparatively close contact with ribbed iron castings, of which these rheostats are built, and a careful measurement of the current and electro-motive force will give the watts passing through the wire. With ten amperes and ten volts one hundred watts would have to be dissipated and a resistance of ten ohms, and the radiating surface of the rheostat would have to be sufficiently great to emit this heat without unduly raising the temperature of the rheostat. This ratio will probably be anywhere from one to ten square inches of radiating surface per watt transformed into heat in the rheostat. The construction and application of these rheostats, as employed in station practice, is shown in the two illustrations where they are mounted in position, occupying a minimum of space with controlling switches connecting with various circuits above.

Automatic and Non-Automatic Switches.—The rules governing the construction of switches are self-evident in their application. A switch must have sufficient carrying capacity, that is to say, sufficient cross section of metal. It should be quick acting, otherwise arcing will ensue and quickly ruin it, and finally it must be of solid construction or the frequent opening and closing will rack it to pieces in a very short time. Allowance must also be made for the pressure and extent to which the switch can be opened. This calls for some

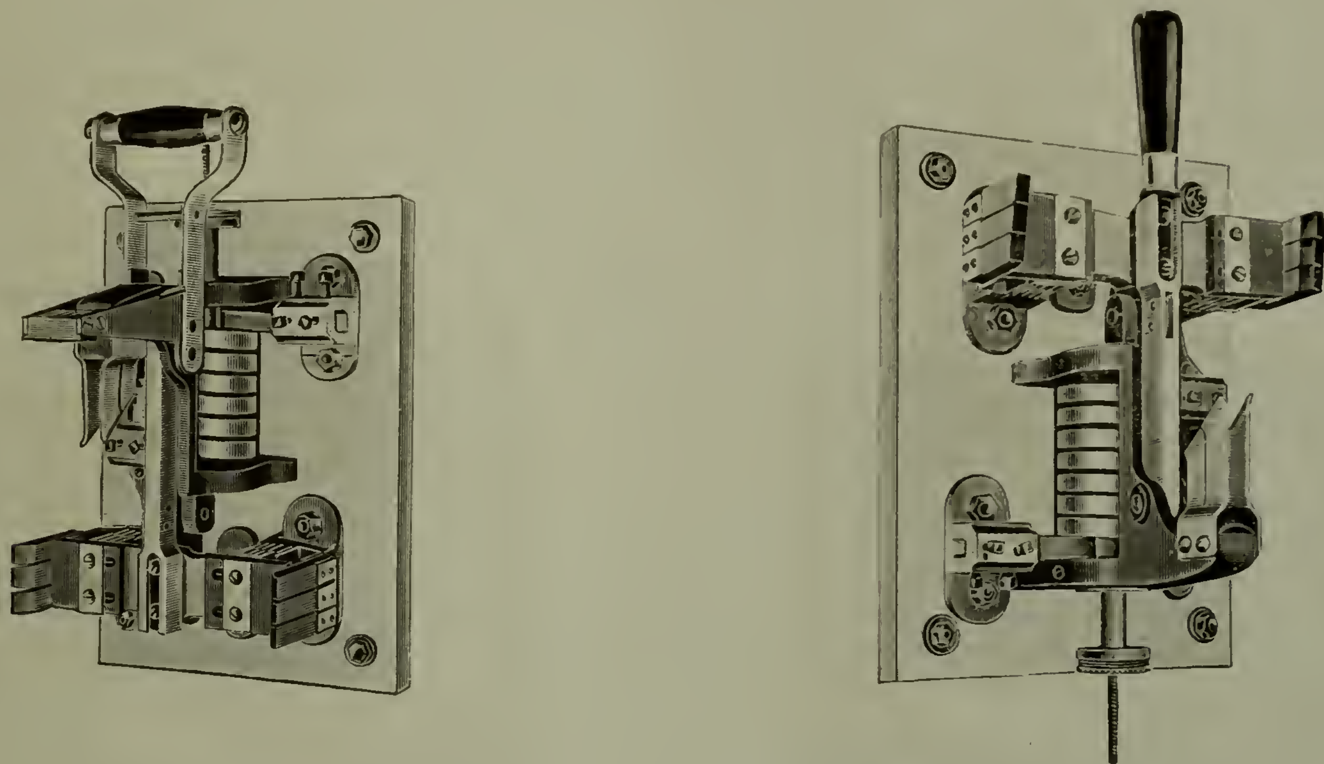


Station Switch.

figures on sparking. A table may be drawn up which will give the reader some idea of the relationship existing between the length of a spark and the pressure required to produce it.

Pressure.	Sparking Distances in Inches.
4,000 volts	1-6
5,000 volts	1-4
7,000 volts	1-2
8,000 volts	2-3
11,000 volts	8-10
14,000 volts	1

The sudden opening of a circuit is apt to develop a very high self-induction which manifests itself as a heavy arc, which in a slow acting switch would mean its rapid destruction. A type of quick-acting switches which practically serves the purpose at the same time of circuit-protecting devices is the automatic circuit breaker. In this type of switch, which is a switch and a solenoid in one, all the requirements are faithfully adhered to regarding carrying capacity, quickness of action, etc. An overflow of current means an energizing of the solenoid to an extent sufficient to operate a catch, thereby allowing the blades to instantly separate. As an emergency device this type of switch cannot be excelled representing, as it does, both as regards its function and performance, an ideal automatic switch.

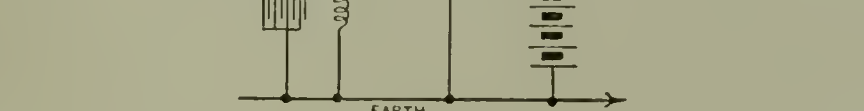


Other Types of Automatic Circuit Breakers.

THE DUPLEX SYSTEM OF TELEGRAPHY.

The principle utilized in the duplex system of telegraphy might, under other circumstances, be employed in the operation of bells, anunciators, etc., instead of the sounder. The idea of the duplex system is to prevent the sender from receiving his own signals and to allow both the sender and receiver to communicate at the same time without interference. In the sketch illustrating the system above mentioned current coming in over the line passes through the differential winding at the coil end. Half of this current goes to earth through C and X; the other half operates the sounder R. When the sender presses his key K the current passing through the coil M divides up, half going to the earth C and X, the other half going over the line. The condenser and resistance X being the artificial line having the same resistance and capacity as the line proper, therefore the division of the outgoing current between both line and ground is perfectly equal.

A wireless telegraphy system could be installed between two points and the signals conveyed further by a duplex or quadruplex system if the line is being used by other telegraphers. Without the resistance box and condenser duplex telegraphy would be very difficult and require the use of a synchronizing system, which at its best is apt to be unreliable. If in place of the sounder bells were installed, a single line could be used with ground connection for operating a bell system or an annunciator drop. Circumstances similar to this sometimes occur when the line is in situ; for instance, buried in the plaster, and further additions would be unsightly and unallowable. Duplexing electric bell circuits need not be very expensive if the condenser and resistance box are cheaply made.



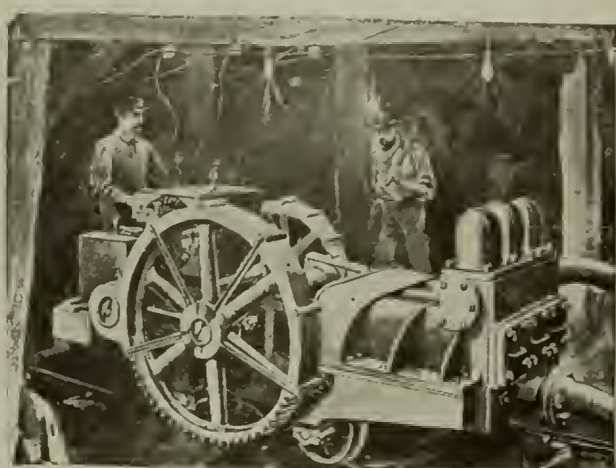
Single-Current Duplex.

ELECTRIC MINING PUMPS.

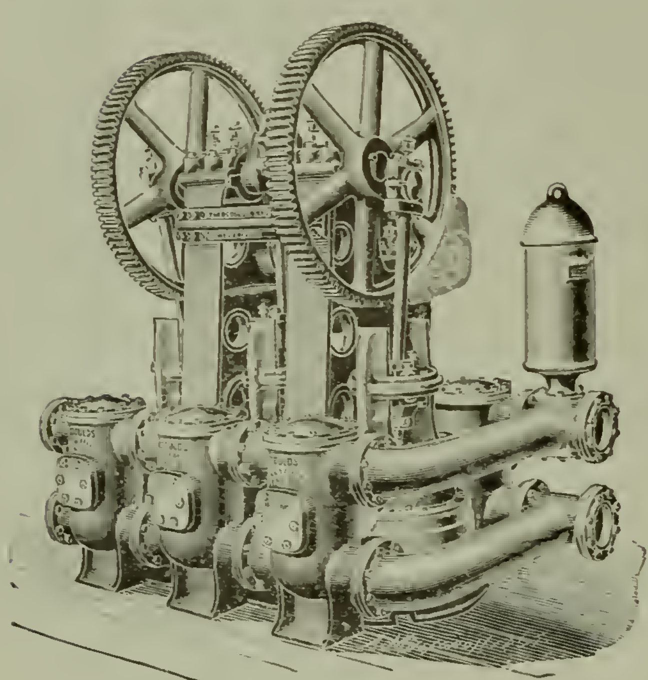
The demand for electric pumps has been constantly increasing ever since the mines, situated in various parts of the country, have been further developed through the introduction of electric light and power. The California El Dorado Company are peculiarly situated in this respect, the power station being fifteen hundred feet below the mine and two miles distant. In order to get water up to this point some very effective method must be employed and electricity must be the main element in this undertaking. In other words, electric pumps, as they are popularly called, are simply a combination of an electric motor and pump.

The circumstances governing the amount of power required likewise take into consideration the head of water, the distance of pump from the source of supply, the length of transmission line, etc. The commercial sizes of triplex pumps are 2.5x4, 3x4, 4x4, 4x6, etc., up to 10x12. A table may be employed giving the horse-power up to 40 as the ordinates and the sizes of pumps as the abscissae. The gallons of water per minute and the head of water in feet can be determined by this means. For instance according to a table of this kind, three horse-power will deliver twenty-five gallons per minute from a 4x4 pump or two hundred and eighty-eight foot head of water. Forty horse-power would deliver from a 10x12 pump three hundred and fifty gallons per minute at a head of two hundred and seventy-four feet. It is not therefore a difficult problem to install an electric pump, provided the power required for the pump is known. It is simply necessary to put in a motor of appropriate size generally sold in conjunction with the pump, allow for drop in the lines so as to land enough power at the motor, and take ordinary precautions as regards grounds, leakage and insulation.

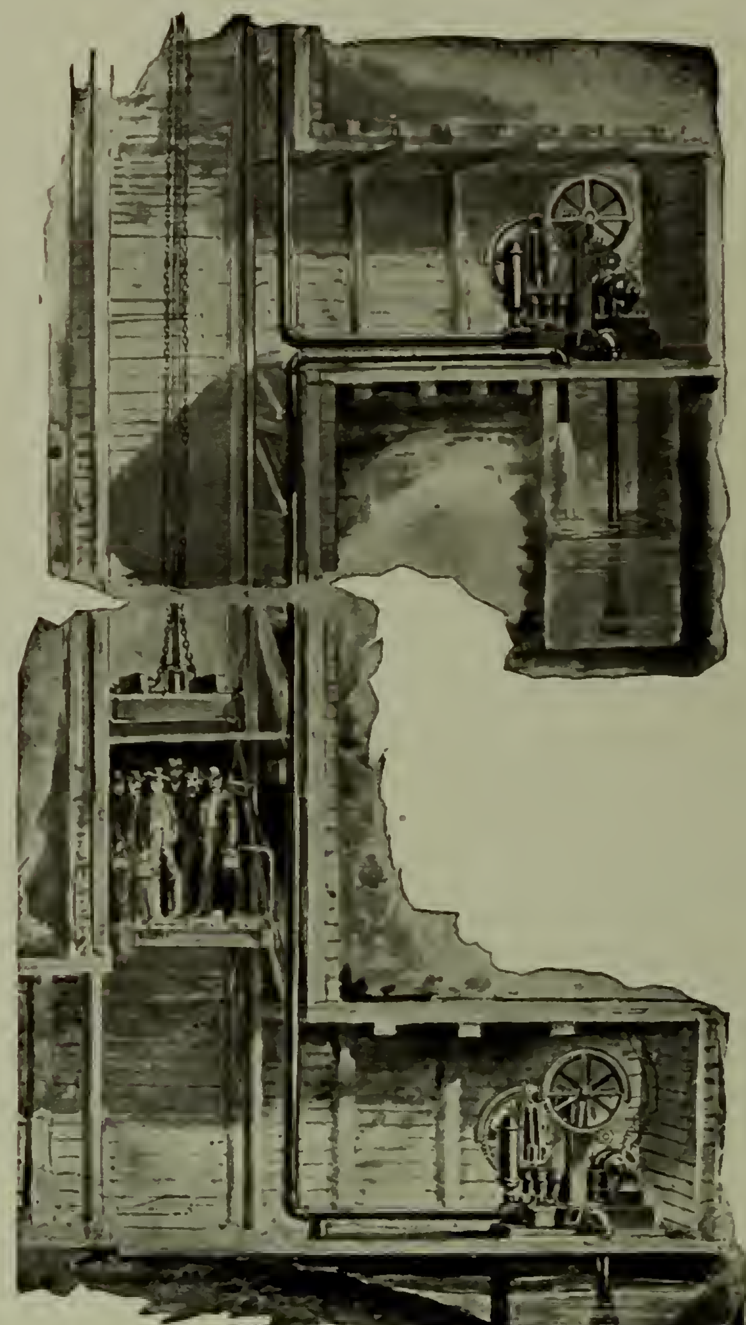
In the illustrations are shown mining shaft with pumps operating to keep it free from water, as well as an electrically equipped tunnel, both as regards light and power. The Goulds Manufacturing Company, of Seneca Falls, N. Y., make a specialty of this class of machinery.



Portable Mine Pumping Outfit.



Gould's Triplex Pump.



Electric Mine Pumping in Shaft.

THE OMNIPRESENCE AND ADAPTABILITY OF THE MODERN ELECTRICAL ENGINEER.

In commenting upon the selection of Sir William Preece, the eminent electrical engineer, as president of Congress of the Sanitary Institute, our contemporary, the London "Electrical Review," states that to the casual observer it must seem something of a mystery that this one Institute should choose its president from the ranks of electrical engineering. It is really wonderful to contemplate how much the world appreciates the intelligence of the modern electrician. Search the universe up and down, from Glasgow to Cape Town, from New York to Southampton, and you will find that where experts, diplomatists, presidents and company-promoters are wanted, the electrician is always there. It is not too much to say that if the General Staff of France became disrespected to-morrow, if Kruger ceased from Krugering, if the Czar abdicated and went to Paris, a telegram addressed to the Electrical Engineers would ensure that every gap in the political fence should be filled, and that the world should still go on, talking.

In the case of the Sanitary Institute, however, it must be admitted that they showed a good deal of wisdom in going far afield for fresh ideas. It is a question of healthy homes, healthy workshops, healthy churches, healthy prisons, healthy post-offices; and it is improbable that any one man should have experience of all of these at once. As an electrician, Sir William Preece was able to call attention to the advantages of electrical methods of ventilation and illumination, and he did well to emphasize the merits of dust-destructors.

Electric Railways.

STREET RAILWAY INSTALLATIONS.

A small station for street railway work should contain about two dynamos of forty K. W. capacity each, and an engine of eighty horse-power at one quarter stroke. The number of elements should be such that the disabling of one will not interfere with the working of the rest. Two boilers should be used because they deteriorate and must be inspected. Therefore two dynamos, two engines and two boilers of excessive capacity are required. The failure of a boiler is more likely to occur than that of any other machine or part. A boiler must have a large capacity because the same number of heat units are necessary for high as low pressure steam. For a given output of mechanical horse-power the lower the steam pressure the more of the steam is consumed by the engine. The boilers should be of between fifty to one hundred per cent. greater capacity than needed, for two reasons: first, to continue the operation of the plant in the event of a breakdown and, secondly, in case the fires run low to be able to supply enough steam. The engines need not be of greater capacity than required because large engines consume large quantities at no load or little load and have greater cylinder condensation. In fact, practice has shown that the steam used by a large engine at no load is equal to that used by a small engine of higher speed at one-fifth stroke or less. The cylinder condensations are in favor of the smaller engines; therefore the smaller is the most efficient for such variable loads. There is no need, in the face of these facts, of using engines of too great capacity but it must be very strong because of the tremendous variations in load. This applies to the crank and incidentaly calls for heavy lubricating surfaces of ample dimensions.

The Steam Plant of a Power Station.

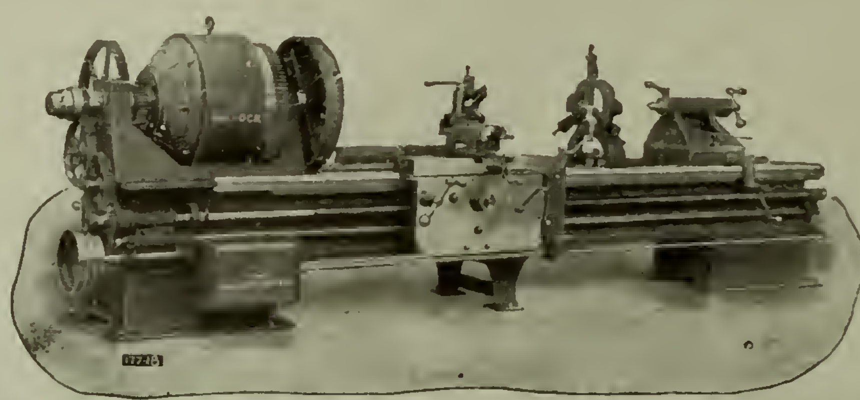
WIRELESS "TELEPHONY."

Sir William H. Preece has recently been carrying on some interesting experiments in wireless telephony, so called. Four of the poles have been erected near Carnarvon on a sand bank at the southern end of Menai Straits. Half a mile off four similar poles were erected, and half a mile further on is a high pole supporting a coil of wire, one end being anchored in deep water. Between these points he has succeeded in transmitting the sound of a succession of taps. These taps were made with the view of sending messages by the Morse code. They were heard at the receiving station by placing a special telephone to the ear. The system is more rapid than that of Marconi, but the sounds are not as distinct as they might be. As a matter of fact, it is not telephony at all, but a system of telegraphy in which a telephone is used as a receiver.—Ex.

A DIRECT CONNECTED ENGINE LATHE.

The illustration shows a 28-inch swing screw cutting engine lathe driven by "Bullock" Type "N" motor. As will be seen, the motor is placed directly on the spindle in the head stock, taking the place of the cone pulleys. The armature spider is built directly upon the hollow spindle of the lathe.

By means of a new system of variable speed control, the motor is given a greater range of speed, without loss of torque, than is ordinarily given by the cone pulley, having sixteen speeds in either direction including the back gear. The controller is placed upon the leg of the lathe directly under the head stock, and is operated by a splined shaft running along the bed of the lathe, and a handle which travels with the carriage. The slowest speed is 60 and the highest about 250 revolutions.



A Motor-Driven Lathe.

The motor is fully described in Bulletin No. 6935, which may be had by addressing the Bullock Electric Mfg. Co., Cincinnati, O.

Business News.

SPECIAL EXPORT COLUMN.
TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING OCT. 28TH, 1899, $73,266.

New York, N. Y., Oct. 28, 1899.—The following exports of electrical materials are from the Port of New York for the week ending this date:

Antwerp.—57 cases electrical material, $2,350.

Argentine Republic.—113 packages electrical machinery, $13,200; 260 cases electrical material, $16,109.

British Guiana.—20 packages electrical material, $450.

British West Indies.—34 cases electrical material, $1,067.

Brazil.—195 cases electrical material, $11,357; 6 cases electrical machinery, $523.

British East Indies.—7 cases electrical material, $218.

Brussels.—1 case electrical material, $20.

British Australia.—19 cases electrical material, $483.

Baden (Switzerland).—1 case electrical material, $50.

Central America.—72 cases electrical material, $1,400.

Cuba.—254 cases electrical material, $908.

China.—24 cases electrical machinery, $600.

Chili.—3 cases electrical material, $129.

Copenhagen.—6 cases electrical motors, $126.

Danish West Indies.—13 cases electrical material, $1,215.

Ecuador.—90 packages electrical material, $986; 3 cases electrical machinery, $108.

Glasgow.—4 cases electrical material, $320.

Hong Kong.—22 cases electrical material, $625.

Havre.—108 packages electrical material, $10,511; 121 packages electrical machinery, $3,150.

Hamburg.—1 case electros, $130.

Liverpool.—129 packages electrical material, $5,573.

Porto Rico.—8 cases electrical material, $143.

Stettin.—6 cases electrical material, $1,000.

Uruguay.—24 cases electrical material, $615.

TELEPHONE CALLS.

Baltimore, Md.—Plans are being prepared for the Maryland Telephone & Telegraph Company by J. Evens Sperry for three sub-stations to accommodate 1,000 telephones each and to cost $5,000 each.

Georgetown, S. C.—The new Georgetown Telephone & Telegraph Company will extend the present Georgetown telephone system and will also build a telegraph line to some outside communication.

POSSIBLE INSTALLATIONS.

Pine Bluff, Ark.—An electric light plant will probably be established by the city. Address the Mayor.

Tallahassee, Fla.—Sixteen thousand dollars of bonds will be issued for the erection of an electric light plant. Address O. C. Van Brunt, city clerk.

Montezuma, Ga.—The plant of the Montezuma Light & Power Company will be enlarged.

Tupela, Mo.—A $7,000 electric light plant will be established. Address J. W. Hoyle.

Gaffney, S. C.—Water power on Broad River, near Gaffney, has been purchased by H. L. Spears for a number of local capitalists. Power will be utilized to operate an electric light plant.

Nacogdoches, Tex.—The American Telephone & Telegraph Company has been granted a franchise for the erection of an electric light plant.

Norfolk, Va.—The Virginia Electric Company has applied to the City Council for permission to place its wires under ground.

Montgomery, W. Va.—The Kanawha Traction and Electric Company will erect an electric power plant. Address E. W. McCormick, manager.

NEW INCORPORATIONS.

Sumter, S. C.—The Sumter Electric Light & Ice Company has been incorporated by Robert M. Wallace, Chas. T. Mason and B. O. Purdy; capital stock, $25,000.

Charleston, W. Va.—The Chemical Electrical Ore Reduction Company has been incorporated by J. E. Chilton, J. E. Scaggs, T. Popp and others; capital stock, $2,000; to conduct a general mining and mining business.

The Electrical Age.

VOL. XXIV—No. 20. NEW YORK, NOVEMBER 11, 1899. WHOLE No. 652.

Water Power Installations.

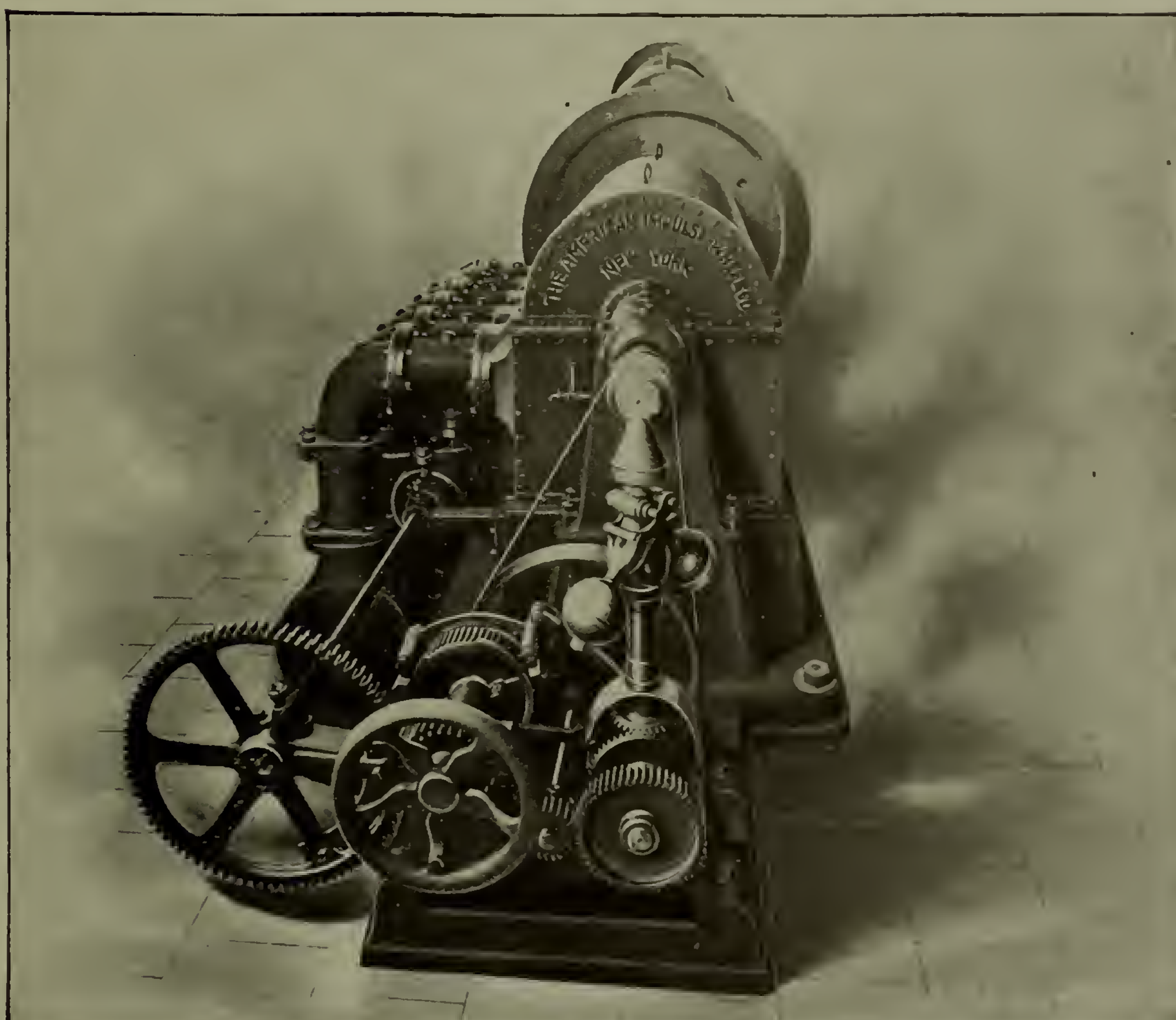


Fig. 1.—Mechanism for Operating Valves.

A UNIQUE WATER POWER PLANT.

There is at present in successful operation in the pumping station of the city of Columbus, Ohio, a plant installed by the American Impulse Water Wheel Company of New York, which is unique in character, and which presents a number of interesting engineering features.

The Director of Public Improvement, finding that the pumping capacity of the station was greater than the city's needs required, cast about him for some means of utilizing this surplus capacity, and hit upon the idea of using the surplus water that the pumps were capable of supplying to drive water wheels direct connected to dynamos, the current thus generated being used for supplying light to the surrounding district by means of arc lamps.

Specifications were accordingly prepared and submitted to the leading water wheel manufacturers, with the result that the plan proposed by the American Impulse Water Wheel Company was accepted as the one giving the best promise of fulfilling the requirements, and the contract was accordingly signed.

The specifications were very rigid in their requirements with regard to both efficiency at all loads and to speed governing under sudden and great changes of load. The difficulty of the problem was also much enhanced by reason of the very limited space available for the machines and piping, and the high speed required for direct connection to the Western Electric Company's 100 light arc dynamos, which was the dynamo selected by the engineer in charge. This speed, 650 R. P. M., necessitated the use of impulse wheels only 18 inches in diameter, and in order to obtain 110 H. P. from each unit 18 nozzles were required. These were arranged with 6 runners, 3 nozzles to each runner, since a larger number of nozzles per runner would have reduced the efficiency below the guarantee.

The use of contracting nozzles to keep up the efficiency at light loads was prohibited by the great cost and complication of so large a number of contracting nozzles. Ordinary butterfly valves were accordingly used and the cam mechanism for operating these valves shown in Figs.

1 and 2 arranged to actuate them one after the other instead of all together as had previously been common practice. As a result of this ingenious arrangement all the valves in operation, except one, would be wide open and working, therefore, at their maximum efficiency, and thus the low efficiency of a partly closed butterfly valve would have an almost inappreciable effect in lowering the total jet efficiency of the machine, and at six values of the load, when a valve had just completely closed, would have no such effect at all.

relay actuating 6 cams as shown in Figs. 1 and 2, the connection between the cam shaft and the governor being by gear and pinion.

The water chambers were cast in two pieces as shown in Fig. 2, the nozzles being bolted on so as to come in exactly the rigid position with reference to the runners. This large casting rested on the cast iron base and was bolted to it. The casting was made of riveted boiler iron in two parts, the upper half being provided with eye bolts for lifting. The details of the piping, receiver, etc., are

Fig. 2.—Water Chambers and Valve Operatin · Mechanism

The rigid requirements with regard to efficiency having been thus complied with the problem of speed governing was next attacked. The small diameter of the runners, rendered necessary by the high speed so far reduced their momentum that it was necessary to add a heavy fly wheel in order to keep the variations of speed within the guaranteed limits. The high speed also prohibited the use of the ordinary cast iron fly wheel. The wheel was accordingly made with a steel rim shrunk to a cast iron web. The governor is the ordinary mechanical

clearly enough shown in the accompanying illustrations.

The fact that this plant has now been running for over twelve months without trouble of any kind and to the entire satisfaction of the engineer in charge reflects great credit upon the management of the American Impulse Water Wheel Company, and especially upon their consulting engineer, Mr. Thorburn Reid, to whom was entrusted the task of meeting and overcoming the difficulties presented by this new departure in water wheel engineering.

The Storage Battery.

STORAGE BATTERY INVENTIONS.

The motor-car movement has greatly stimulated the efforts of inventors to produce a storage battery of great capacity per unit of weight, and, according to the Electrical Review, not a few batteries have been put on the market professing to be of much less weight for equal output than the older forms. An examination of these new batteries and of the specifications reveals the fact that the inventors have not succeeded in making any departure from the essentials of the Faure or Plante cells, lead and lead salts alone being successfully used. The plates consist of lead salts held in or upon a lead grid or electrode.

In stationary batteries there are no objections to constructing the girds substantially enough to perform the two functions of supporting the active materials and collecting the current therefrom, thus producing cells of considerable weight, 6 or 7 watt-hours per pound weight of battery being a fair result in capacity. Such batteries are well understood and are durable and reliable, but for successful traction work batteries of such weight are not suitable.

Fig. 3.—Western Electric Generator

Most inventors endeavour to reduce the weight by increasing the proportion of lead salts to the weight of the grid; in heavy batteries we may find the lead grid equal to twice the weight of lead salts used in making up the plates, while in some recent cells we find it claimed that the grid is only half the weight of the salts.

So long as lead is used in batteries, the only invention possible is in the direction of reducing the mass of lead in the cell, sufficient being left simply to collect the current. The supporting of the active materials being no longer trusted to the grid, the inventor then devises supports of ebonite, glass acid-proof paper, and other materials, much lighter than lead, which are applied in two different ways.

One uses a grid of vertical lead wires threaded through horizontal strips of ebonite, forming shelves, which carry the active materials and support them. Another takes glass rods as a weft interwoven with lead wires, the glass giving stiffness and resilience to the plates. A third employs very light perforated girds, and supports them by plates of light acid-proof paper, also perforated. Others prefer envelopes of celluloid or ebonite to hold the paste on extremely thin grids.

In all this there is not much invention. Still, if by some means a battery of great capacity and small weight can be produced it is worthy of a patent.

It is claimed for some of these cells that 15 to 16 watt-hours per pound of battery, at a discharge rate of 1 ampere per pound of battery, has been obtained. We have failed, however, to find any independent confirmation of a capacity in any batery exceeding 10 to 11 watt-hours per pound. We are convinced that all these high-capacity light-weight cells will require very frequent renewal of plates; the negatives rapidly decline in capacity in continuous work, and the positive grids soon corrode right through, the internal resistance increasing as these changes go on.

The renewal of cheap plates as soon as the capacity falls below a certain amount should be provided for in all battery traction projects renewals forming a large part of the cost of battery traction. Plates which were expensive to renew would be no improvement over cheap plates of the same capacity.

In judging traction batteries, it is not, therefore, sufficient to find the capacity per pound weight only. It is necessary to find how long that capacity is maintained in continuous working. Say a battery starts with a capacity of 12 watt-hours per pound, how many full charges and discharges will it stand before the capacity falls to 10 watt-hours per pound and what will be the cost of renewal? These questions are rarely answered in descriptions of new cells.

In connection with road traction by batteries, we find that most vehicles for that purpose carry 80-volt batteries. Why 80 volts? We have never been able to find out the reason for this singular voltage; why not use larger cells and fewer of them?

The battery is so near the motor that loss in the leads is negligible. As only 100 to 120-volt circuits can be used for charging 80-volt batteries, probably 80 volts was selected in the days when 110 volts was the usual pressure; but nowadays 200 to 250 is becoming so common that batteries to be used on supply from street mains must be raised to 160, 180 or 200 volts pressure, although small cells do not give quite as high a capacity per pound as larger ones.

On the whole, inventors have not much room for improvements in lead cells. When they have reduced the grid to a minimum, and supported the active materials by something lighter than lead, their efforts are exhausted, and a possible capacity of about 14 watt-hours per pound is obtained for a time.

Stray Currents.

A HANDY TELEPHONE ARRANGEMENT.

A simple and handy arrangement of the receiver and sender of a telephone has the former attached to the door of a small box, with the latter set in the box itself, so that on opening the door the receiver swings out and adjusts itself without touching it with the hands.—Ex.

TESTING THE BALANCING OF ARMATURES.

The best way of testing the balancing of armatures is to mount them in bearings which are free to move, then while the armature is running the heavy side can be found with a piece of chalk and counterweights adjusted on the opposite side until the cessation of movement of the bearings shows that the center of gravity coincides with the axis of the shaft.—Ex.

A NEW PRIMARY BATTERY.

In a new primary battery the negative electrode is peroxide of lead electrically formed from a lower oxide and supported by a gird or placed in a porous pot. The positive electrode is zinc, iron, or tin. Sulphuric acid, phoshoric acid, and acid sulphate are employed. Plates of this formation may be used in a dry battery.—Ex.

A PHONO-TYPEWRITER.

A dispatch from Racine, Wis., to a daily paper of this city states that a dentist of that place claims to have perfected a so-called phono-typewriter. By talking into an ordinary phonograph the keys of a typewriting machine are operated electrically and are said to record any dictation verbatim. Just how the vibrations of the voice are made to operate the keys of the machine electrically is not stated.—Ex.

AN ELECTRIC FOGHORN.

An electric foghorn has been invented by a Canadian electrical engineer. A naphtha engine supplies the motor power for a dynamo, which furnishes the electric current by means of which three pairs of electro-magnets operate half a dozen clappers, which strike against a large gong with the frequency of about 36,000 strokes to a minutes, producing a continuous sound. Its effectiveness is enhanced by a mechanism on the principle of a megaphone, by means of which the sound is not only intensified, but thrown in the required direction. A full-sized foghorn is to be sent to the British Columbia coast, where it will be put in operation at once.—Ex.

AUTOMOBILE FIRE ENGINES.

Electrically driven fire engines and hose carts are soon to be introduced in Paris. An electric hose wagon has been on trial for some weeks, and is sent out every day for drill practice. The wagon weighs 2,160 pounds, and with complete equipment 5,610 pounds. This tender can run 37 1-2 miles, at a speed of nearly ten miles an hour, on one charge of the batteries. Upon a good road it runs at the rate of about 15 miles, and ascends without difficulty 8 per cent. grades. With electricity as the motive power there is no delay in starting out. The battery of accumulators weighs 1,144 pounds, and has a capacity of 180 ampere hours of normal discharge.—Ex.

ANTISEPTIC FOR TELEPHONES.

Mr. Albert E. Woolf, well known to the electrical fraternity as the originator of electrozone, was last week granted a patent for an antiseptic device to be used in connection with telephones. In the patent the invention is described as follows: An attachment to a telephone consisting of a movable cover having applied to its inner side a receptacle for a germicide, and a germicide or antiseptic contained therein, whereby, when the telephone is in use, the receptacle and germicide may be removed from the opening of the mouthpiece and when not in use the cover may be closed upon the mouthpiece.—Ex.

INCANDESCENT LAMPS OF SMALL CANDLE-POWER.

The French Societe d'Encouragement des Industries Nationale some time ago offered a prize for the best lamp of 2 C. P., the voltage to be 100. One of the conditions of the test was that the lamp should have a life of at least 400 hours. Lamps were offered by three manufacturers in competition for the prize, but the committee appointed to undertake the tests did not make an award for the reason that only one lamp had a life outside the minimum period. Each of the competitors, however, was given a silver medal in view of the excellence of the lamp presented in other respects than life. New propositions have been made in which the life is fixed at a minimum of 500 hours as a mean of five lamps tested. The prize will be awarded in 1901.—Ex.

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CONTENTS:

THE INTERNATIONAL MOTOR CARRIAGE EXPOSITION AT BERLIN.

Apropos of the recent parade of the Automobile Club of America, participated in by the best known builders of automobiles as well as private members, is the account of the International Motor Carriage Exposition at Berlin. The importance of this industry is shown by the fact that the Emperor of Germany, with a most distinguished retinue, in addition to many famous engineers and manufacturers were present at the opening ceremony. It seems as though more serious consideration is given to the subject of automobiles abroad than in this country. In fact, the conclusions of the Park Board in New York that automobiles are not pleasure vehicles reminds us of the opinion of a rather illiterate car conductor, regarding the transportation of a parrot on a road which had forbidden the passage of dogs, cats and similar pets. The conductor in reply to a demurring passenger said: "Cats and dogs are hanimals but a parrot is a hinsect."

The free introduction of automobiles wherever they can find traveling room in European cities has not been the direct cause of their present and ever-increasing popularity. It might be due to two reasons: first, the presence of exceedingly fine roads all over Europe, including England, and second, the direct recognition by the German, French, Belgian and Italian Governments of their value in martial warfare. By some the second reason might be more important than the first yet the case as it stands betrays a deeper interest on the part of our neighbors abroad in reference to automobiles of all descriptions than in America, the very home of up-to-date inventions.

Automobiles at the exposition in Berlin are represented by exhibits of one hundred and twenty concerns, representing eighty-one German houses, four Belgian, twelve French and two Swiss. "It is remarkable to note," to use the Consul's own words, "not a single American or English maker is represented in his own name although there are tires, driving chains and other machine parts of English origin, exhibited under the names of their German agents; and three of the most noticeable and admired electric motor carriages on exhibition are from the works of the Pope Manufacturing Company, of Hartford, and exhibited by the Motor Fahrzug und Motoren-Fabrik, of Marienfelde, a suburb of Berlin, which firm has acquired certain patents of the American company." Among the long line of automobiles represented, a rather heterogeneous assemblage, it does seem as though Germany was very much ahead of the United States although a general admission is made that France at present is still the leader. Electric, hydrocarbon, oil, benzine and gasolene engines are well represented but there is every likelihood that until electricity can be had on tap a little more readily neither in Germany nor America will the electric automobile be properly appreciated.

One exceedingly novel feature of the exhibition at Berlin was an automobile run by primary battery or voltaic accumulators. The negative electrodes of these cells were zinc plates; the positive peroxide of lead. This vehicle fully charged will run forty miles; weighs about three hundred and seventy-eight pounds and can carry a relay of plates, enabling it to cover twice that distance. Although ingenious this automobile calls for a certain amount of personal care which will prevent it from becoming a practical success in this country at least. Another curious combination exhibited there, of a hybrid type, was the Pieper double motor carriage, supplied with an electric motor, storage battery and benzine motor. Both the benzine and electric motor operate the same driving shaft but can be worked separately or together. The idea of the inventor is to use the motor and storage batteries within the city limits; for suburban work, within the near neighborhood of the city, both might be used, particularly when hills are to be climbed. For long distance runs, however, the benzine motor will do all the work and will in addition be called upon to drive the motor as a generator for the purpose of recharging the batteries when their energy runs low. This last operation is performed automatically, if the benzine motor is driving the carriage on a level road.

Without going further into the details of construction or varieties of devices on exhibition it seems evident that the unsettled state of the art is best expressed by the very variety presented to the visitor. In the course of time competition will drive out all but a few practical systems in Germany as well as the United States, and these, in all probability, will be best adapted to the conditions of city, suburban and long distance travel.

THE INCREASING MANUFACTURE OF INCANDESCENT LAMPS.

Very few towns or villages of any consequence are without an electric light plant, depending upon their supply of power from a waterfall in many instances, the use of culm, if in the neighborhood of a canal, or coal as ordinarily delivered for station purposes. In consequence of this up-to-date attitude on the part of the American public the demand for incandescent lamps has so increased that at present the industry represents an output of millions a year. In fact, it is reported that one large concern has turned out 8,400,000 lamps for the year ending January 31st, 1899. Taking twenty large cities in the Union which average up 3,000,000 lamps apiece a business is carried on each year of over 60,000,000, and possibly 100,000,000 incandescent lamps. What will the figure be when the great masses use electricity for light in place of gas?

Applications of Electric Power.

THE PRACTICAL APPLICATION OF ELECTRIC MOTORS TO PRINTING PRESS MACHINERY.

BY W. H. TAPLEY.

(Continued from page 235.)

Gearing should consist of rawhide pinions with cast-iron gear wheels, being sure to have both pinions and gear wheels cut by the same factory. Having rawhide manufacturers cut the pinions, and press builders or some other machine shop cut the gear wheels, invariably results in noisy running gears. Engineer should give personal attention to this when installing work.

The gear wheels should be fitted with taper bore, keyway and cap on end of shaft. The use of set screws is not satisfactory.

The pinion should be of the best grade rayhide, having brass sides and sleeve, latter thicker than depth of keyway. Face wide enough to allow for armature vibration, without metal sides running on face of gear wheel.

Teeth should not be too fine pitch. My experience has been that, for ordinary work, a 4-pitch diameter tooth is thoroughly satisfactory, showing little wear after continuous use for several years.

On heavy presses it is advantageous to connect, by means of a stiff wrough-iron bar, the press and motor bearings.

Satisfactory ratios of reduction, motor to press, from 10 to 1, desired speed not exceeding 120 revolutions per minute; 5 or 3 to 1 on higher speeds. These will run well, and with little noise or wear, for several years.

Great care must be exercised in selecting tne workmen that are intrusted with the lining of the gears; this is one of the most important parts of the installation of the electrical equipment, and should be intrusted only to trained experts in this class of work.

Position of Controller.—In attaching the controller to the press, care and judgment should be exercised to place same so that the handle is convenient to the press feeder, the direction being away from the body while starting press and towards the body to stop, which at times must be done immediately to prevent sheets getting on the roller, etc.

This should be fastened to a cast-iron bracket, when possible; otherwise, wrought-iron supports well braced will answer.

Wiring demands high-grade insulated wire, so protected that it cannot meet with mechanical injury.

The hanging of wires from the ceiling should not be permitted, as it is not safe, at same time interfering with the proper handling of the press.

On most presses the feeder is on the opposite side of the press from the motor, therefore, wires must be run across press to same. About a press is much oil and ink, all detrimental to the insulation of the wire, which must be kept perfect to insure uninterrupted use of the press. This can be secured by using highest grade rubber wire, taped and braided, enclosed in a continuous length of flexible tubing, these finally encased in black iron pipe, said pipe to be firmly bolted to press, if running across, or cemented into foundation with painted joints if running underneath press. If this method is adhered to, the thought of ever having trouble from your wiring may be placed to one side.

Printing Room Showing Electrically Driven Presses and Absence of Belting and Shafting; 45 C. W. Motors Installed in This Room.

Personal experience has shown that, where this method has been followed, we have never had a leak on our wires.

The knowledge that wiring when once installed is perfect and will give no trouble is fully appreciated by the engineer in charge, and will be by the proprietor, after a few expert bills for testing wires have been paid.

Keep controllers and rheostats as far away from the floor as possible; they will be kept cleaner and are less liable to damage from scrubwomen and trucks than if placed on the ground.

Control is a subject to which more care and thought has been devoted by electrical engineers than all the rest of the equipment combined.

A casual glance at what is necessary to properly handle a printing press before starting to print will disclose the problems which had to be solved. Take a large flat-bed two-revolution press, bed 42x52 inches, or one large enough to print 32 pages 16mo at an impression, as an example. Starting from the "make-ready," when the pressman places the form on the press and begins to see what is necessary to produce good work. In placing "overlays" on the cylinder, the press is moved a few inches forward, then reversed, or the cylinder is turned ahead a half revolution, then reversed a quarter, etc. In placing plates on the press, many times the bed is needed to be moved not over an inch or so; all this must be done quickly and absolutely, for unless the press is under perfect control an accident may easily occur. The more perfect the control, the less time is the press idle and becomes a wage-earner instead of an interest-eater.

After the press has been started and working satisfactorily, absolute control must continue, as there will be occasion to stop same quickly within stroke of bed or even less; this must be while under full speed and in such a manner as not to jar or injure the press.

Speed Control.—There are several methods in vogue at the present time, viz.: Resistance in series with armature, commutated field, field control by insertion of resistance, combination of resistance in armature and resistance in series with field, having the former take care of about two-thirds range of speed, then depend on weakening the field for the balance.

The latter method gives the widest range of speeds and for direct motors is the most satisfactory to install, both to seller and purchaser.

Most every engineer, without exception, cries down the armature-resistance method as grossly extravagant. On the surface, or from a theoretical standpoint of the motor itself, this is correct, but what are the facts in actual practice?

In most large offices certain presses are used on work which requires nearly always the same rate of speed, although the character of the work may not be uniform. These presses can be fitted with gearing suitable to give proper speed when motor is "full on," using the resistance only as a starting medium, rather than a speed regulator.

(To be continued.)

Printing Room Showing Electrically Driven Presses and Absence of Belting and Shafting; 45 C. W. Motors Installed in this Room.

ELECTRIC MOTORS ON BOARD SHIP.

A paper on Electrical Machinery on Board Ship, by Mr. A. Siemens, was read at the British Association's recent meeting, in which the author stated that direct driving was now generally preferred, and expressed an opinion that the type of generating plant now in use on board ship had reached a stage of development which would be improved, but not materially altered. To prevent the magnetic field of the dynamos affecting ships' compasses, "ironclad" dynamos and double wires—one for the return current—were used. These conductors formed the most valuable part of the system of electrical installation for power purposes on a man-of-war.

The superiority of electric motor over small steam engines or hydraulic distribution of power was dwelt on by Mr. Siemens. The two latter systems necessitated a network of piping all over the ship, which was difficult to arrange neatly, and gave endless trouble through leakage. The reason that the use of electric motors had not been more extended on board ship was due to the variation of the load that acompanied the working of most auxiliary machinery.

In the case of the winch, for instance, it frequently happened that the strain on the cable increased sufficiently to stop the movement of the winch. This would cause the current through the electric motor to rise to an extent that might seriously injure the machine. It was impossible to overcome this by a fuse, as the interruption of the current would allow the strain to be taken off the winch, whereas in most nautical operations it was necessary to keep the strain on. To overcome this difficulty, shunt-wound motors might be used. These could be kept running continuously, the drums of the winches being operated through friction clutches, or special cutouts could be applied in connection with series-wound motors. Through these cutouts the current through the motors was not interrupted altogether, a by-pass taking a safe current.

Examples of working a steering gear and rudder indicator were given. The suggestion that the main engines of a ship should be electrical motors was rejected as impracticable, whether accumulators or steam driving, on the Heilmann principle, were adopted. A 6,000-ton ship propelled by 8,000 initial horse-power would take 150 hours to cross the Atlantic, and that would be equal to 1,200,000 horse-power hours. Fairly efficient accumulators gave 10 watt-hours per pound, so that a horse-power hour could be obtained for 75 lb. of accumulators. The ship would, therefore, need 40,000 tons of accumulators.

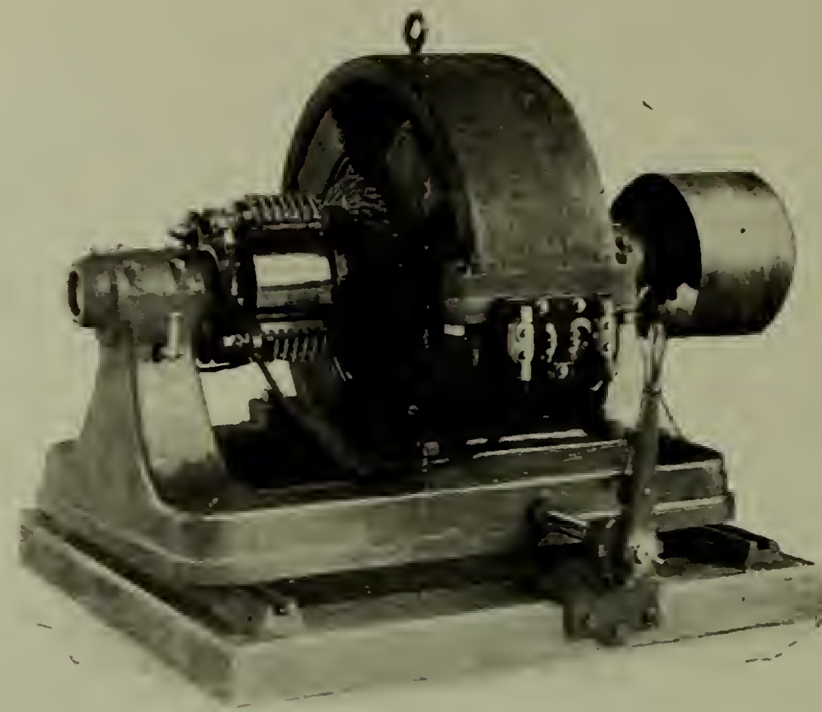
Electro=Technics.

FIELD DESIGN.

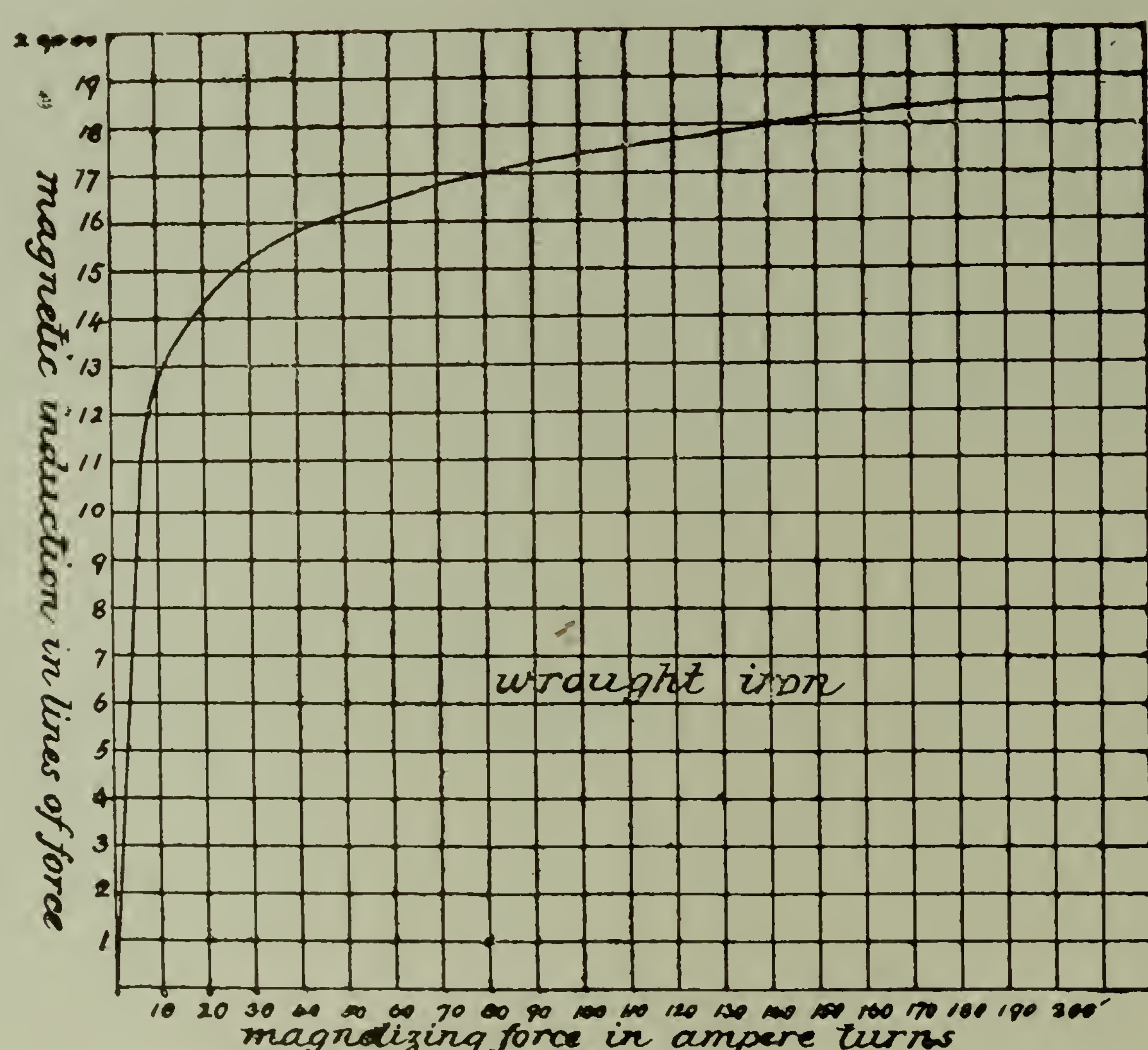
The point of saturation has as much bearing upon the economy of operation in the fields of generators and motors as the actual shape of the frame itself. The use of wrought iron and steel, particularly of mild steel, has at least had the effect of enabling manufacturers of dynamo electric machinery to arrive at a point where more dependence can be placed upon the qualities of the materials used for the magnetic circuit. In the illustration shown the magnetic curve is represented for wrought iron. Between this curve and a similar one plotted for mild steel no noticeable difference can be observed except possibly in the somewhat higher point of saturation attainable by the use of pure wrought iron.

In the construction of various types of machines used in electrical transmission plants, lighting and power distribution installations considerable dependence must be placed upon the point of saturation, as the regulation of all machines, whether dynamos or motors, lies between certain magnetic limits. If the metal is unstable and unreliable the magnetic condition of the same, if subject to fluctuations, will give rise to irregularities of action which entirely forbid more than an approximation to proper running.

A condition sometimes met with in motors or dynamos, created by those possessing a limited knowledge of design or still less experience in that particular art, is a phenomenon called by the name of "unbalanced field." An unbalanced field is one in which the ampere turns and permeability bear such a relation to each other that a slight change in the magneto-motive force will either cause a great increase in the number of lines of force produced or so sudden a diminution that further operation

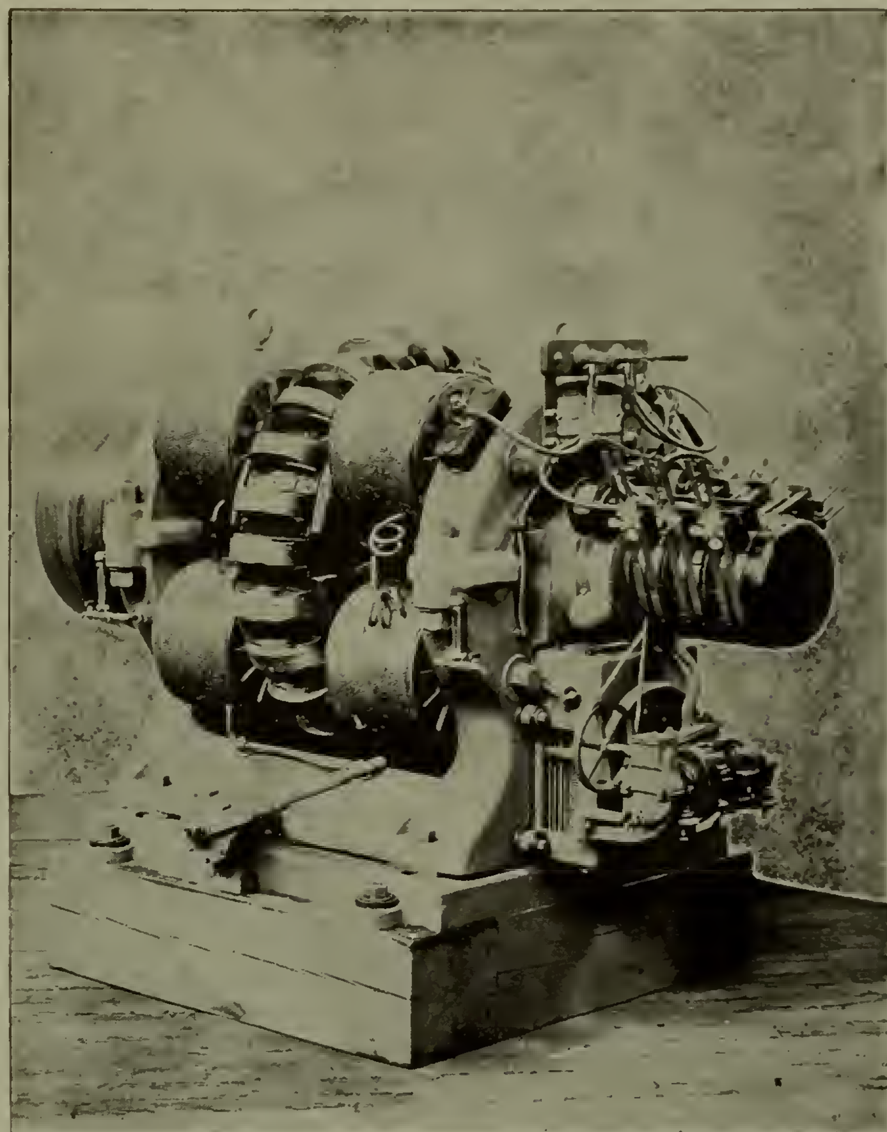


Frame With Saturation Fairly Uniform.



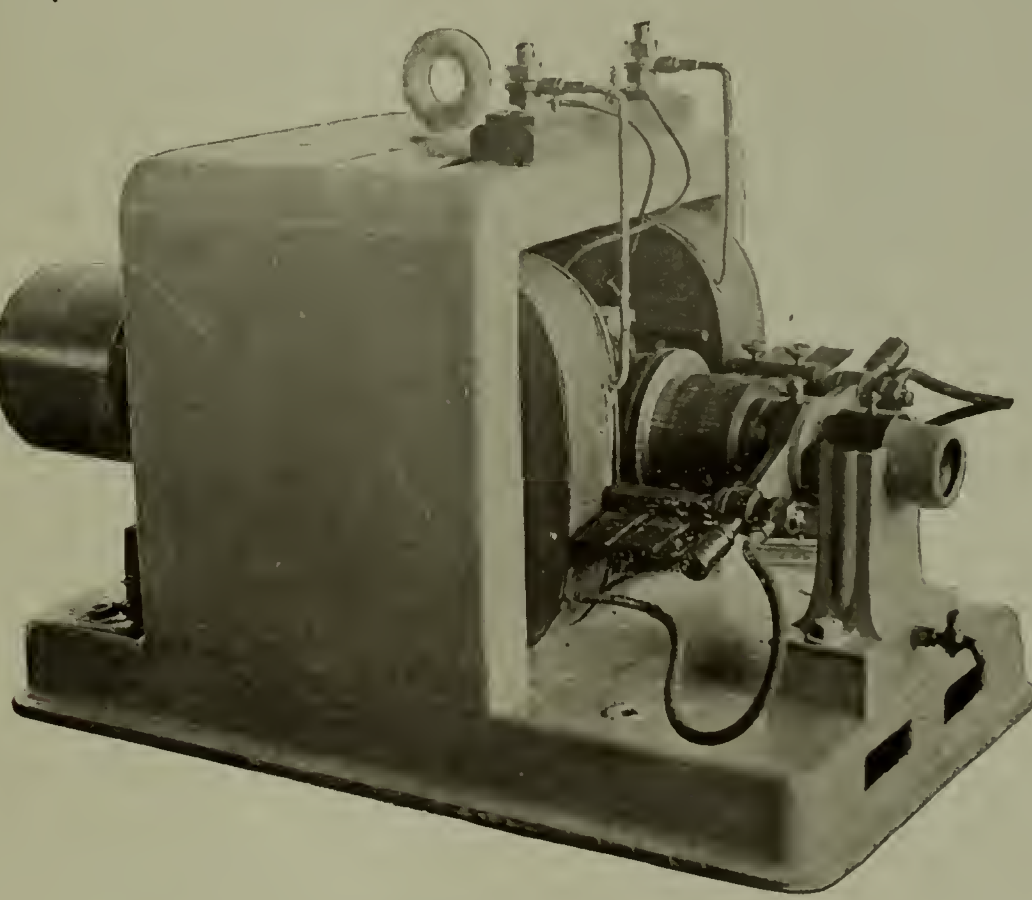
Curve of Magnetization.

within the limits prescribed is almost impossible. It is therefore necessary to design all practical types for a machines. The same is true of high speed and low speed machines.



Arc Light Machine. Magnetization Fluctuating.

fixed point of saturation, which saturation will depend upon the purpose of the machine, its speed, torque, the



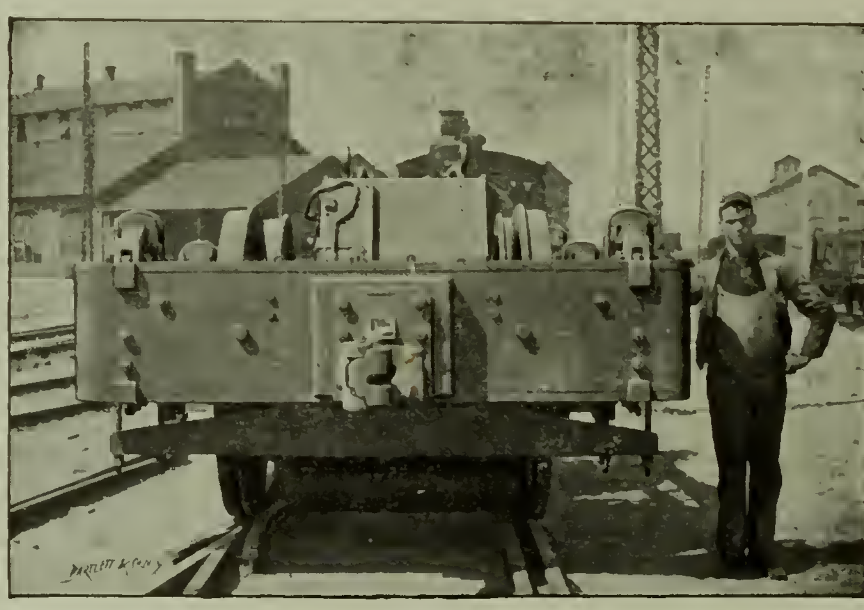
Motor with Specific Induction at Poles over 100,000.

nature of the magnetic metal and its capacity. In small machines the saturation is apt to be higher than in large

An immense amount of data has been put forward by various writers in connection with this matter, but a few plainly presented statements might be of some guidance to the technical student. Reference to the magnetic curve will show that with wrought iron cores the point of economical saturation is about one hundred thousand lines of force per square inch. With steel frames the same point of saturation may be observed but a slightly increased economy is attainable with the saturation not rising higher than ninety thousand lines per square inch.

From these general facts some rough conclusions can be drawn regarding special types illustrated in this a ticle. The street railway motor, according to certain practical authorities, may stand a degree of saturation, as far as the pole pieces and cores are concerned, reaching from one hundred thousand to one hundred and thirty thousand lines of force per square inch. In fact, in certain ironclad types of the same there is a minus leakage with a consequently higher degree of saturation. In ironclad types in general the saturation is apt to be much higher on account of the proximity of the field windings and armature, rarely, if ever, falling below one hundred thousand lines per square inch and this with either wrought iron or steel cores. In the arc light machine the range of saturation is controlled to a certain extent, either by a shifting of the brushes or a coil commutating device. On account of this the field is weak at light loads and may be saturated up to its highest possible limits when the load is heaviest.

In the old Clark, Schaeffer and some other types of arc light machines the saturation would vary from sixty thousand to one hundred and thirty thousand per square inch, being similar in this respect to the sudden changes in field flux experienced by street car motors. In street railway generators the same conditions are met with, the compound winding occasionally making up a difference of from twenty to fifty volts in the outside circuits. Naturally the steel frames used are ordinarily run at the normal point of saturation, between eighty and ninety thousand lines of force per square inch; due to the sudden drop outside the saturation may rise from this point to figures that are temporarily a near approach to absolute saturation. The electric light dynamo is in all probability the only machine for which we can assume a fairly constant point of saturation. In this type the variation, if any, does not exceed a few volts and the compound coil making up this difference will not force the iron up beyond the normal point of saturation, namely one hundred thousand per square inch.



Street Railway Motor. Saturation Approximating 120,000.

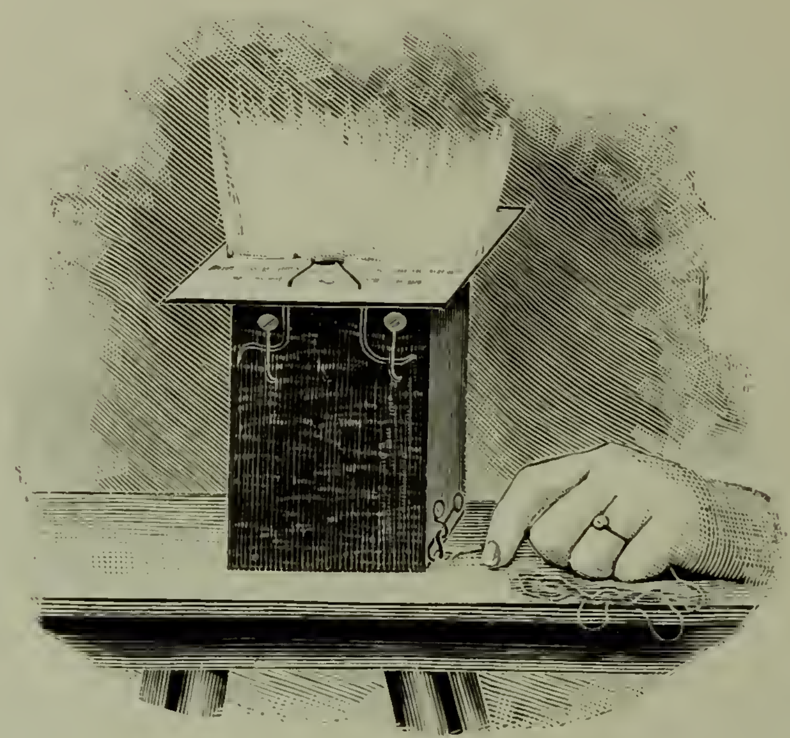
ELECTRICITY AT HIGH PRESSURES.

Due to pressure for space Mr. Elihu Thomson's article on "Electricity at High Pressures" will be continued in the next issue of the "Age."

Electrical Novelties.

ELECTRIC FLASH LAMP.

An electric novelty has come upon the market in the shape of an electric flash lamp, the invention of Vitalis Himmer, Jr., manufacturing electrician, 166-168 Greenwich St., New York City. The article as shown describes itself. The powder is ignited by an electric flash, and the operator can take his place among the group and be included in the picture. The electric spark never fails to ignite the powder, and responds at once to a gentle pull on the string as shown in illustration. The string is very long and may take a picture several hundred feet away from the flash, or, in fact, regulate these conditions to suit photographic rules. This flash lamp is so small and weighs so little that it can be carried in the pocket. The springs and electrical parts are all of German silver wire. In addition to this, half a dozen places can be illuminated at the same moment, thereby making it exceptionally fine for flash photos of large halls, convention



Photographers' Electric Flash Lamp.

meetings, etc. Vitalis Himmer, Jr., is a manufacturer of dry cells for all purposes, including medical batteries, galvanic, faradic and cautery outfits. He also manufactures electrical novelties of all kinds where the use of miniature lamps is required. The well known Himmer specialties and alarm clocks, gas lighters and kerosene oil lighters are being manufactured by him. He is said to be the only successful maker of one-half by two inch dry batteries for practical purposes.

ELECTRIC BLASTING APPARATUS.

Rock blasting by electricity is acknowledged to be the most effectual, and for economy, safety and certainty of action supersedes any other system. By electric firing a large number of holes can be exploded simultaneously, thereby utilizing the united strength of the explosive at the same instant, and obtaining at least ten per cent. more execution from the powder than if the holes were fired independently with the old-style safety fuse.

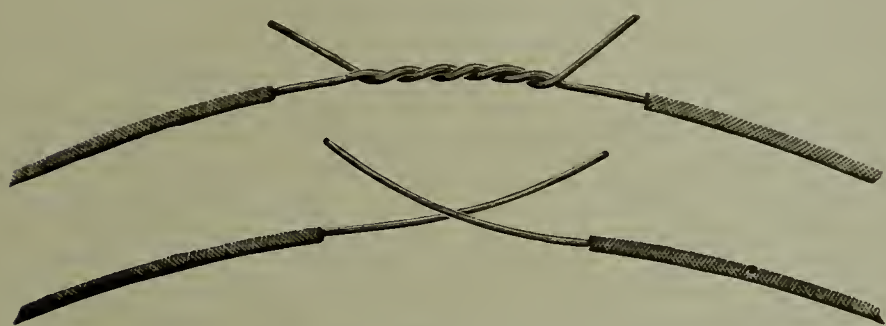
A twenty-five or thirty per cent. nitro-glycerine dynamite will lift more rock, when fired simultaneously by electricity, than would a forty or fifty per cent. dynamite if holes were fired independently with tape safety fuse. It has also been proven that the same amount of work can be done with a less number of holes where electricity is employed, than would be required if the charge was fired singlywith tape fuse.

In such places as shafts and tunnels, where ventilation is defective, it is usual for the workmen to wait perhaps half an hour or more after each blast to allow the smoke and fumes to clear away; and as several blasts are made daily, much valuable time is lost. By the Macbeth electric system and the selection of a properly made dynamite, the loss of time is reduced to a minimum. Not only are there less smoke and fumes, but fewer blasts are necesary to do the same amount of work.

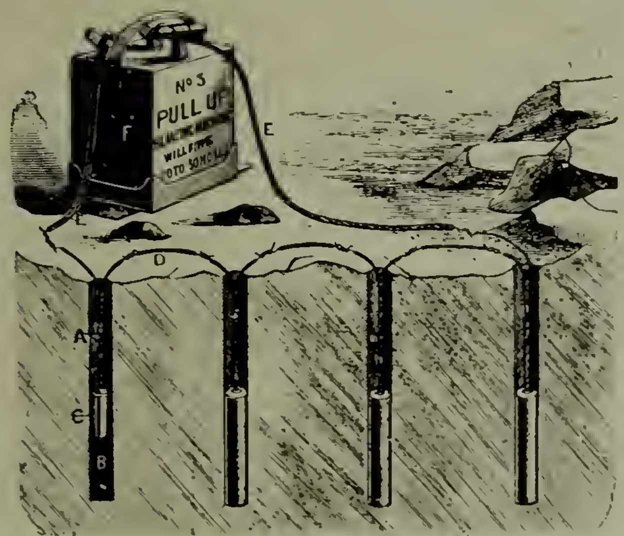
In the case of a misfire, the advantage of electric firing is still more evident, since, if the holes are not all simultaneously exploded, there can be no possibility of its exploding afterward; therefore there can be no danger in approaching the face at once to discover the cause. How different are the facts with the tape fuse under the same conditions. The life of the blaster is in danger, as a hole may explode at any time after he thinks there is no possibility of its doing so. The old-time, slow and dangerous system should be discarded for the safe, reliable and economical electric system.

In submarine work and in very wet shafts electric blasting is indispensable, as the charge can remain several hours, even days, in water before firing without deteriorating, thus giving time to complete the loading of holes, and to make the necessary preparations for exploding the charge.

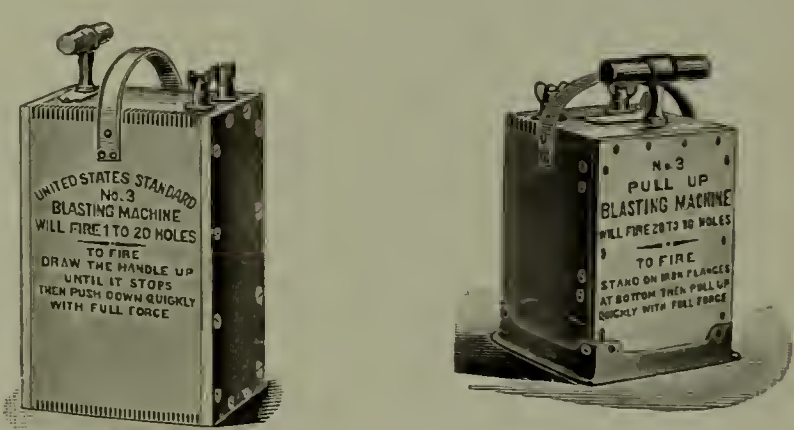
In mining gold, silver, lead, copper,iron ore, coal, salt, etc., engineers recommend the Macbeth electric appliances. Also for shafts, tunnels, quarry work, stump blasting, railroad work, well sinking, earth banks, and for all work requiring the use of blasting powder or dynamite. They recommend this electric system as superior in all respects to any other. For further information address James Macbeth & Company, 128 Maiden Lane, New York City.



Method of Making the Joint.



Charge Holes Connected in Series.



Various Styles of Blasting Machines.

Business News.

SPECIAL EXPORT COLUMN.
TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING NOV. 4th, 1899, $84,960.00.

New York, N. Y., Nov. 4, 1899.—The following exports of electrical materials are from the port of New York for the week ending this date:

Argentine Republic.—119 cases electrical material, $9,274.

Brazil.—106 cases electrical material, $4,093.

Bremen.—1 case electrical material, $40; 1 case electrical machinery, $70.

British Australia.—15 cases electrical material, $3,630.

Barcelona.—3 cases electrical material, $249.

Central America.—8 cases electrical machinery, $156.

Cuba.—89 cases electrical material, $2,478; 2 cases electrical machinery, $300.

Dutch East Indies.—14 cases electrical material, $259.

Ecuador.—208 cases electrical material, $1,140.

Havre.—211 cases electrical material, $32,919; 2 cases electros, $78; 1 case electrical machinery, $26.

Hamburg.—40 packages electrical machinery, $1,330.

Japan.—67 cases electrical material, $2,090.

Liverpool.—153 cases electrical material, $17,528; 5 cases electrical machinery, $100.

Mexico.—210 cases electrical material, $7,728.

Milan.—1 case electrical material, $106.

Peru.—21 cases electrical material, $232.

Santo Domingo.—31 packages electrical material, $497.

Southampton.—8 packages electrical material, $488.

Venezuela.—6 cases electrical material, $149.

NEW INCORPORATIONS.

New York, N. Y.—The Weber Electrical Manufacturing Company has been incorporated to manufacture and deal in electrical appliances; capital stock $1,000,000; incorporators, J. Pott, V. L. Sawyer, J. Weber, E. P. Schmidt, W. H. Klogh; all of New York city.

Syracuse, N. Y.—The Syracuse Automobile Company has been incorporated; capital, $10,000; directors, William D. Andrews, Henry T. Trebert and C. Arthur Benjamin, Syracuse.

New York, N. Y.—The Buffalo Battery Company has been incorporated; capital, $10,000; directors, William J. Knowles, Maria Knowles, and John J. Gibson, of Buffalo.

Niagara Falls, N. Y.—The Niagara Frontier Electrical and Machine Co. has been incorporated; capital stock, $15,000; directors, Robert D. McIntyre and Edward E. Tuthill, Niagara Falls.

Philadelphia, P. A.—The Cutler Relay Co., composed of New York capitalists, has been incorporated to manufacture and sell electric telegraph relays and sounders.

Passaic, N. J.—The Paterson and Passaic Auxiliary Fire Alarm Co. has been incorporated; principal office No. 245 Main avenue; to install and lease fire alarm systems; capital, $30,000; incorporators, James S. McKenzie, Carlton Hill, N. J., Benjamin J. Ward, Ridgewood, N. J., Charles R. Newman, Passaic, N. J.

Camdem, N. J.—The Loeber Incandescent Light and Heat Co., principal office New Jersey Registration and Trust Company Building, has been incorporated; capital, $5,000,000; incorporators, Frank M. Wirgman, Frank R. Hansell, W. F. Eidell.

TELEPHONE CALLS.

Richmond, Ind.—The new telephone company has completed its line to Connersville, and it is announced that the wires into Richmond, by way of Liberty, will be strung within the next week. The service will then be used in connection with the Home Telephone Company's system, which has outside connection with most of the towns in Wayne County.

Louisville, Ohio.—There is considerable talk here of organizing a local telephone company, composed entirely of Stark County men.

Fort Scott, Kan.—The Bell Telephone Company is putting up a line between this place and Kansas City.

Chicago, Ill.—The Swedish-American Telephone Co. has been incorporated; capital stock, $5,000; incorporators, Foree Bain, Tiodolf Lidberg and M. F. Allen.

Denver, Colo.—The Denver Independent Electric Telephone Co. has been incorporated; capital, $500,000; incorporators, Z. T. Esmond, George B. Fisher, N. C. Hughes, E. C. Miles, W. J. Smith, Douglas Washburn, George W. Wright.

Deckertown, N. J.—The Sussex Telephone Co. has commenced the extension of its lines from Lafayette to $10,000,000. The charter expressly states that the company can absorb other companies engaged in the operation of telephone lines.

Waterville, Minn.—The Canon Valley Telephone Company has been incorporated; capital, $15,000.

Springfield, Ill.—The Springfield Mutual Telephone and Telegraph Company has been incorporated; capital stock, $50,000; incorporators, Thomas W. Wilson, S. M.

STREET RAILWAY NEWS.

Omaha Neb.—Articles of incorporation have been filed by the Omaha, Council Bluffs & Suburban Railway Company; W. S. Reed, A. Delong, Geo. Townsend and C. B. Hannan, incorporators; capital stock, $1,000,000. The company will operate street railways on the streets and avenues of Council Bluffs and Omaha, the suburban districts of East Omaha and between Council Bluffs and Lake Manawa.

Galena, Kan.—The Fidelity Belt Railway Company has been incorporated; capital, $75,000. This line is to extend from Mineral, Cherokee County, to Pittsburgh and Galena. It will be an electric line.

Columbus, Ohio.—The Columbus, Buckeye Lake & Newark Traction Company has been incorporated; capital stock, $100,000.

Willimantic, Ct.—The Willimantic Street Railway Company has been organized with the following officers: President, J. M. Pettis, Boston; vice-president, George K. Nason, Willimantic; secretary, W. Ward Tuttle, Boston; treasurer, W. H. Abbott, Boston; directors, the above named and W. D. Grant and W. A. Arnold, of this city, and W. H. Clark, of Hartford.

Jefferson City, Mo.—The Secretary of State has chartered the St. Louis, Clayton & Western Railway Company, of St. Louis, with a capital stock of $2,000. The stockholders are L. G. McNair, F. R. Harris, L. W. Day, John G. McNair and T. J. Flanagan. The purpose of the company is to construct and operate a street railroad in St. Louis County, with its principal place of business in St. Louis city.

POSSIBLE INSTALLATIONS.

Fairport, N. J.—An electric light plant is to be established here.

Paris, Me.—A movement has begun for lighting Bethel Village with electricity.

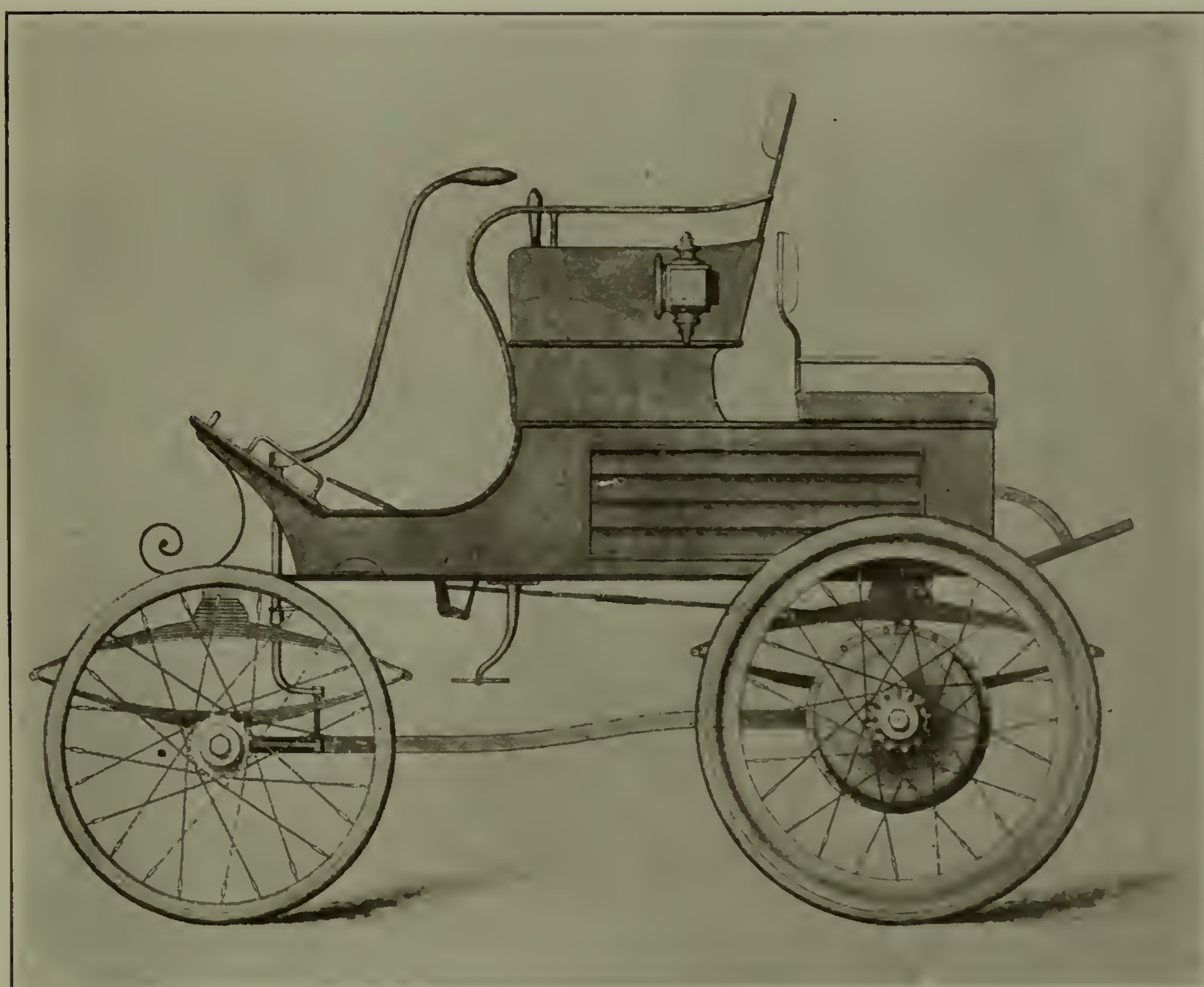
Perkasie, Pa.—The Borough Council has awarded the contract for the erection and construction of the borough electric light plant to J. F. Buchanan & Company, of Philadelphia, for $11,500. Work to commence at once.

Austin, Minn.—At a special meeting of the City Council it was decided unanimously to build an electric light plant to be owned and operated by the city. The plant is to cost $20,000 and to be of the latest improved machinery and dynamos.

The Electrical Age.

VOL. XXIV—No. 21. NEW YORK, NOVEMBER 18, 1899. WHOLE No. 653.

Automobiles.



Side View of Post Electric Automobiles.

THE POST ELECTRIC AUTOMOBILE.

The above illustration represents a new electric automobile, that will soon appear on our streets, that shows great mechanical and electrical ingenuity. The inventor has dispensed with all gearing. His motors being mounted directly upon the hubs of the wheels make a very neat and compact carriage. There being no gearing, the disagreeable noise heard from automobiles is entirely done away with.

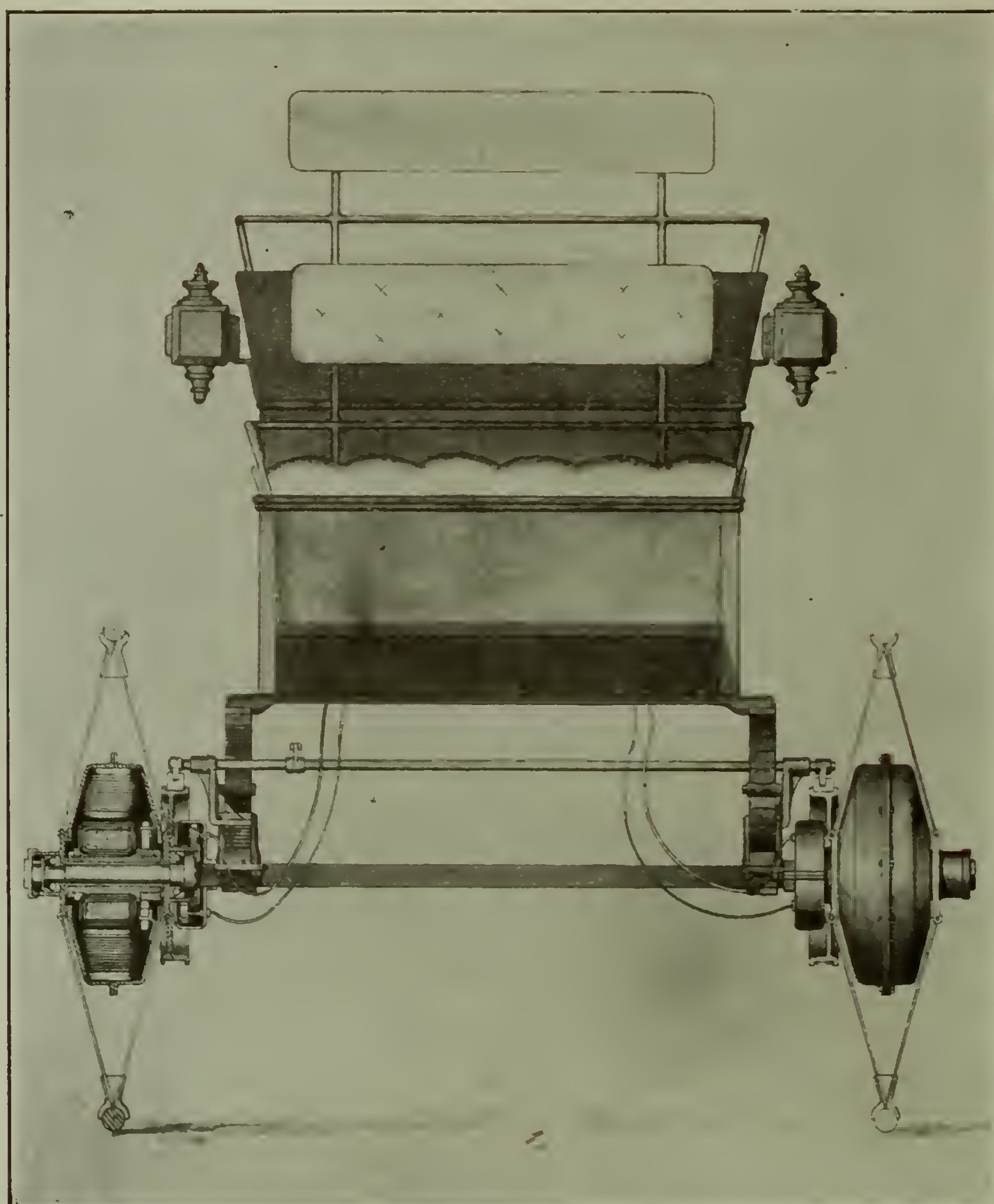
The electric motor being mounted in a very novel way between flanges and spokes of wheel, is encased in a water and dust-proof box, easily opened for any purpose that might be required. Placing a motor wheel directly upon each end of the rear axle does away with the present use of compensating gears, chains, or driving gears of any form, and thus dispenses with the great loss due to friction, caused by conveying power through gearing. This motor is readily adapted to any rotating mechanism, and constitutes especially an efficient and durable means for propelling vehicles of all kinds.

These automobiles are to be manufactured by the National Light & Power Company, of 10 Wall Street, New York City, who are the owners of the patents.

ELECTRIC TRAVELING CRANE MOTORS.

Owing to the fact that crane motors are "intermittent workers," motor manufacturers have been in the habit of supplying machines too small for the work for which they are intended, says Arthur Parrott in "Cassier's Magazine." They rely on the capacity of the machine for developing an additional 75 to 100 per cent. for short periods, and thus bringing the maximum horse power up to what has been specified. The results in some instances have been curious, not to say disastrous. For instance, a crane maker might order a 10 horse power for his hoisting motor, knowing that he has a right to expect that machine to develop 17 to 20 horse power for short periods, providing it is properly rated. But the motor maker supplies a 6 horse power machine, doubtlessly appeasing his conscience by his knowledge of the fact that it will develop 10 horse power intermittently. The consequences are what might be expected—injurious heating, excessive sparking at the commutator, frequently broken wires in the armature, and the total failure of the motor after a few months of dissatisfaction.

Latterly the best makers of electric cranes have the motors so arranged that worms, worm wheels and bevel gears and their concomitant evils are entirely dispensed with. In the earlier types, the power from the hoisting motor was transmitted by means of a worm to the hoisting gear, the idea being to make the crane self-sustaining without the use of a brake. Experience has proved that this arrangement, where heavy work is concerned, is not reliable, since in one instance a crane, constructed on this principle, allowed its load (a partly finished locomotive) to take charge of the motor and run down with a dangerously high velocity. Usually spur gearing is now used throughout in conjunction with an automatic magnetic brake. When current is switched on to the hoisting motor it puts into circuit an electro-magnet possessing sufficient power to raise the brake lever and render it inoperative at the moment that hoisting or lowering commences and also during its continuance. The act of "switching off" immediately, and without any attention whatever on the part of the operator, allows the brake to be automatically applied. It is necessary that the brake lever be fitted with a damping arrangement so as to prevent the excessive shock to the gearing that would othewise arise in the event of the brake being too suddenly applied. The advantage of the magnetic brake is obvious. If from any reason during working operations, the current should fail, the brake lever would be instantly released, and the brake would take charge of and sustain the load. Mechanical brakes of various designs and principles are sometimes used in conjunction with the magnetic brake just described.



End View of Post Electric Automobile

Electro=Statics.

ELECTRICITY AT HIGH PRESSURES.

BY ELIHU THOMSON.

(Continued from Page 235.)

Let S, Fig. 1, represent an insulated sphere, charged to, say, 10,000 volts potential with respect to earth. It will have a certain capacity depending upon the proximity of surrounding conducting objects.

FIG. 1.

Let this sphere be now surrounded by a number of hollow spheres, such as by bringing hollow hemispheres together over the center sphere, properly supported and insulated. Let the hollow spheres be well insulated from S, and from each other, by a sufficient layer of air or dielectric. If each hollow sphere be like S, charged to, say, 10,000 volts before being brought over S, the potential exhibited by the outer sphere will gradually rise as the spheres are added. This is owing to the diminished capacity of the concentric shells as compared with their capacity when separately charged.

If we now substitute for the hollow spheres and central sphere a large number of floating water globules in air as electrified and driven out from a jet J, Fig. 2, of a Hydro-Electric Machine, we have a similar condition, the result of which is that, although the globules so driven together in a mass but are slightly charged when leaving the jet, the combined effect of all results in greatly enchanced potential, owing to the fact that the water globules within the small cloud have virtually been deprived of capacity. Add to this the effect of diminished total surface of the globules due to their coalescing, and further the reduction of the surface of the globules themselves by gradual evaporation in the air, and we need not be surprised that the potential shown by the mass is high, though it was formed by driving forward into the cloud globules originally at comparatively low potentials.

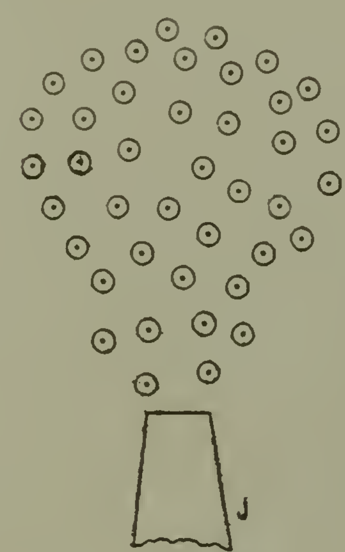


FIG. 2.

Applying the same considerations to the thundercloud itself, we seem to understand why it is that globules of water suspended in air may act inductively, when only slightly electrified at the start, and so give rise to the exhibition of enormous potentials. Assume a horizontal layer of air L, Fig. 3, saturated with moisture and possessing an electrical charge, however it may have been accumulated. If such a layer be uplifted by warm uprising currents from below, it will condense into a cumulus cloud containing electrified globules of water insulated from each other, but massed together in the cloud with diminishing capacity due to the various causes before mentioned: the inductive effect outward of the globules within the mass; the coalescence of numerous small globules into larger ones; and possibly also, in some portions of the cloud, the diminishing size due to evaporation. The cloud, as a whole, will show a high state of electrification, but no one part of it need at any time be very highly charged in the sense that an insulated body is charged. In the latter the charge is on the surface. In the cloud each globule is charged and also acts inductively with its neighbors, outwardly and toward the earth. In discharging, the spark forks and extends or ramifies through the cloud masses, often occupying an appreciable time in this process. The discharge of one

FIG. 3.

portion of cloud opens a good path of hot gas for other discharges to follow, and the disturbance thus spreads. Frequently discharges are multiple in character, several successive discharges following the same path to earth under the cloud, but, doubtless, within the cloud, ramifying in different directions and discharging different portions of the cloud mass.

If this idea of the actual conditions which exist in a thundercloud be true, it may easily be understood that attempts to represent the action of lightning by the discharge of small condensers, such as Leyden Jars, may utterly fail of their purpose. Neither can any arguments avail, based upon the discharges of lightning having a rapid oscillatory character. That the breakdown of the air under a thundercloud when a stroke to earth occurs is very sudden is doubtless true, but that the flow or flash is oscillatory or that it endures for an excessively short time may not be true; at least, not in all cases. The conditions must be very variable, and the discharges, occurring under wide variations of these conditions, are not likely to be alike. It is useless, therefore, to attempt to calculate the voltage or the current in a flash of lightning, and no estimate of the energy expended can be more than a guess.

Such devices as lightning arresters cannot be fully tested as to their action or effectiveness without actual practice with them during thunderstorms, and tests made with ordinary static discharges from Leyden Jars may not, and probably do not, represent the real conditions under which the devices themeselves will be required to work. Hertz showed that the higher pitch rays, such as those of the violet or ultra violet order in the spectrum, served to precipitate electric discharges between terminals set so far apart that the potential between them was insufficient to cause a spark. The thought occurs that possibly such phenomena as that of the return stroke, as well as that of multiple strokes or flashes of lightning, occurring practically simultaneously over different paths, may sometimes depend on the sudden illumination of the air by a first discharge provoking other discharges around it.

I am, moreover, led to suspect that very long discharges in cloud, such as those which occur horizontally, over distances of perhaps five to ten miles in a cloud layer, actually take an appreciable time to develop or progress. There seems indeed to be a progressive breakdown of the cloud, extending on and on during a time which can be noted.

I have in fact often watched the development of such discharges in the east or toward the eastern horizon, and have been able to turn the head and follow the discharge to its finish in the west or toward the western horizon. I have noticed also that these long discharges will start as a single streak, ramify, and extend their ramifications before the eyes. I am persuaded that this is no optical illusion; the effect seems to definite for that. It would be of deep interest to photograph such discharges on two plates, one fixed and the other revolving, and compare the images. This is quite a difficult matter, however, as lenses having a sufficiently wide angle to take in the whole path, or practically the whole sky at once, are not to be had, and one never knows just when, and at what portion of the cloud, the desired discharge may take place. Moreover, for such work the possibility of pointing a camera upward or nearly vertical may be prevented by rain occurring at the time.

(To be continued.)

Middletown, N. Y.—The Middletown-Goshen Electric Railway Company has been incorporated to construct and operate electric railway; capital, $100,000; incorporators, W. B. Royce, H. B. Royce, of Middletown; W. F. Biddle, E. H. Pyle, all of Philadelphia, Pa.

Stray Currents.

INFLUENCE OF THE MOON UPON ATMOSPHERIC CONDITIONS.

Just what influence the moon may have upon the electric condition of the atmosphere may be considered in doubt. It is a common belief, on Long Island sound, that no thunder storm can come up while the tide ebbs, also there seems good evidence to show that there are more thunder storms during new than full moon. We may be absolutely certain that the moon has no appreciable effect on any commonly recognized meteorologic element.—Ex.

AN AUTOMOBILE GOAT FOR LODGE INITIATIONS.

The latest electrical device to be invented is an automobile "goat" for lodge and other secret society initiation purposes. The goat is said to be so contrived that once set motion it goes in circles, the size of which are regulated by tiny wheels which can be set to keep the animal within circumscribed limits. In a recent trial of the machine, according to a daily paper, six ex-members of the First Illinois Cavalry, men who had conquered many stiff-necked and stiff-jumping cavalry horses, which were sold to the government as "regular rocking-horses," were thrown one after another by the goat and bucked all over the back yard.—Ex.

SCHOOL FOR MOTORMEN.

A school for trolley-car motormen is maintained by the Brooklyn Rapid Transit Company. Cars are run on the tracks about Fort Hamilton and Coney Island. Instead of having simply a room to practice in with controller and brake equipments, the men in Brooklyn actually operate the cars under competent instructors. School cars of various grades are used. In one car the use of the controller is taught, and in the next the use of the brake, and on the third the car as a whole is handled. The entire course takes from a day to a week. This is a rather better system than putting green motormen on cars which are actually run through the crowded streets of the city.—Ex.

ELECTRIC FLYING MACHINE.

Not a little attention seems to have been aroused among Vienna aeronauts, both military and otherwise, in regard to the merits of Stenzil's novel flying machine, recently invented at Hamburg. The apparatus resembles a stork in the form of its construction. The propelling power is supplied by an unusually powerful electric motor, the machine being steered by a bird-like tail, consisting of two adjustable spades; the motor, the propelling power of which is calculated to last three hours, weighs eight pounds, while the whole machine does not exceed seventeen pounds in weight. The wings will sustain a man weighing 150 pounds. The whole apparatus is stated to be easy to handle, and to secure not only a rapid ascent, but a safe descent.—Ex.

PRIMARY BATTERY CONSTANTS.

Theoretically one pound of zinc will develop just one horse power in a primary cell, if the E. M. F. is .2 volts (accurately 1.994). For any other voltage the consumption of zinc per horse power is, of course, inversely proportional to the voltage. This assumes that there is no local action. If the above is the difference of potential on closed circuit instead of the E. M. F. on open circuit, then this consumption of zinc refers to the useful output, and the energy lost in the internal resistance need not be considered, unless with respect to efficiency. In any battery, regardless of the voltage, one pound of zinc will develop 374 ampere hours theoretically, that is, not including the local action. One pound of bichromate of soda as a depolarizer corresponds theoretically to 277 ampere hours.—Ex.

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NEW YORK, NOVEMBER 18, 1899.

CONTENTS:

DOES ELECTRIC LIGHTING INCREASE FIRE RISKS.

The scapegoat served its function in olden times by bearing upon its head the sins of the multitude. It is not saying too much to state that the mysterious cause of unexplainable fires is generally attributed to the electric wires. Cases have even occurred where annunciator and bell wires have been blamed for this mischief, although sufficient current to create combustion from these conductors is hardly within the range of probability. In looking over the cause of the fires in the United States it is first shown that the average loss by fire has fallen in ten years to about one-third of its original proportions.

But in the Chronicle Fire Tables the opinion is expressed that the extended use of electricity has brought about a large increase in the way of fires, due to electric wires and light. Yet, in spite of this broad statement, more than 12,000 fires remain absolutely mysteries as far as their origin is concerned. To take a conservative view of the case and claim that electric wiring cannot cause fires would be obviously untrue. But a large body of proof can be brought forward to show that in many cases the hidden cause of fires, when other reasons have failed, is supposed to be due to electricity on the rampage, as it is popularly expressed. The chances of fire through ignition due to the blowing of a fuse, short circuits and grounds in a building thoroughly well wired are to-day reduced to a minimum, practically rendering buildings more immune from fire through the use of electricity than by the installation of gas pipes, acetylene service or any other known method of illumination.

It is of course admitted that defective wiring is just as apt to cause fires as defective gas fitting, if circumstances are propitious, but it is certainly a great question to decide in many cases what is the real cause of fire. Defective flues cause eleven per cent. of the conflagrations and more than three thousand fires are caused by lightning annually. The mere friction of machinery has been the cause of three hundred fires and five fires have actually been caused by the sun's rays passing through window glass. These apparently mysterious causes, limited to the figures given, would be swelled to larger proportions if a greater knowledge were possessed by the inspectors of the causes of fires.

It seems reasonable to suppose that a building is perfectly safe from fires that can in any way be attributed to the use of electricity if its wiring complies with the Board of Underwriters and Fire eDpartment rules. There is unquestionably great carelessness exhibited by electrical contractors installing plants or wiring buildings outside of the larger cities of the Union. Frequently lines are not protected by adequate fuses; they are exposed; grounds are allowed to remain and electric light lamps are so situated that combustible material in their neighborhood is very apt to be set on fire. In fact, it cannot be said that any but the smallest proportions of these fires attributed to the use of electricity occured within our larger cities.

The responsibility rests entirely with the insurance companies and municipal boards of any locality where such an idea has gained ground. Wiring done according to system based upon experience with the object in view constantly of avoiding any possibility of fires is the kind and the only kind that the law allows in New York city. The adoption of such rules and regulations by the governing board of any other city or town will certainly be the means of bringing about a general recognition of the greater safety obtained by the use of electricity.

NEW FIELDS FOR MOVING PICTURES.

The introduction of moving picture machines has opened up an industry which calls for the employment of many skilled hands. The building of the macnines themselves and of cameras for obtaining films of unique scenes calls for a large investment of capital within the factory and in addition means a considerable expense without for experts to obtain the views required. In many of the theatres, in fact, in nearly all of them, moving picture scenes have become a source of the greatest interest. And in this respect the use of the moving picture machine has been extended for the purpose of serving its function in a remarkable manner.

There are certain classes of apparatus which cannot be exhibited to purchasers without considerable expense and trouble; but by employing the moving picture machine the articles on exhibition can be thoroughly well illustrated in an interesting and profitable manner. The efficacy of a car fender, for instance, in removing obstructions and preventing injury to pedestrians cannot be better illustrated than by throwing upon a screen scenes from life, as it were, projected from a moving picture machine. In fact, for the advertisement of certain goods, as shown in various parts of the city, the moving picture machine is a great favorite and success.

In several large European hospitals and schools of medicine the moving picture machine has been used for showing the circulation of blood, the beating of the heart, many surgical operations actually being performed when taken from life and other scenes of scientific and medical interest. Were it possible to use the moving picture machine in schools for teaching history very few children would fail to be impressed to such a degree that the pursuance of such studies would be followed with enthusiasm.

Power Installations.

NIAGARA FALLS HYDRAULIC POWER PLANT.*

So much attention has been directed to the Niagara Falls Power Plant, with its present capacity of 40,000 horse power and actual output of from 20,000 to 30,000 horse power, that the public has not realized the size and rapidly growing importance of the Niagara Falls Hydraulic Power Plant, which has at present a capacity of 13,000 horse power, and has an enlargement under way which will increase its total capacity to 20,000 horse power. The method of developing the hydraulic power differs widely from that which has been employed with the Niagara Falls Power Plant, where, it will be remembered, the water is led in from the river above the falls by a short length of canal to the power house, and delivered through penstocks to a set of turbines which work under a head of 135 feet. The tailrace for the latter consists of a great tunnel with a fall of 50 feet in a length of 7,000 feet, and the water is finally discharged into the lower river at a point below the falls.

In the case of the Niagara Falls Hydraulic Power Plant, the water is taken from the river above the falls by an open canal and led to a point about a mile below the falls, where it passes through penstocks to turbines that are situated within a power house, which is built close to the water's edge at the bottom of the gorge, as shown in the two illustrations on the first page. The advantage of the latter system is that the effective head is considerably increased, and the loss of the head in the tunnel being 50 feet and in the canal only 2 feet. By suitably constructing the tailrace, an additional head of several feet is secured below the turbines, with the result that the total effective head of the hydraulic power plant

Interior of the 20,00

*Through the Courtesy of "Scientific American," is 210 feet. The total length of the surface canal is 4,400 feet, its present width at the entrance is 250 feet, and in 400 feet the width narrows down to 70 feet. At this width it continues into a basin which is located about 300 feet back from the edge of the gorge above the power house. The basin runs parallel with the edge of the cliff and is about 400 feet long by 70 feet wide. The company owns sufficient right of way to increase the width of the canal to 100 feet, if it desires to do so. For 40 feet of the present width of the canal the channel is 14 feet deep, six of which supply power to the lower works of the Pittsburgh Reduction Company, while the other two furnish power for the operation of the Niagara Falls and Lewiston Railway, better known as the "Great Gorge" route. The operation of the original installation was so satisfactory that a large addition was immediately commenced, and the building was increased to the size shown in our illustration. It now measures 100 feet by 120 feet. The addition to the plant consists of five wheels of the Jonval-Geyelin type, each of 2,500 horse power. Our

P. Power House.

and for the remaining 30 feet it is 8 feet deep. The work of widening the canal is now in progress.

The power house is a substantial building of stone with a steel truss roof. Water is led down to the power house by means of two penstocks, one of which is 8 feet and the other 11 feet in diameter. The original section of the building was completed in 1896, and an 8-foot penstock serves to convey water to four Leffel turbines, of 2,250 horse power each, which operate eight generators, illustrations show one of the new wheels in place. These wheels are fed by a new 11-foot penstock, which has a capacity of 12,000 horse power. It leaves the forebay with an elliptical bell mouth which measures about 20 feet by 11 feet, and is carried out horizontally from the cliff, supported on two heavy steel beams for a distance of 60 feet, and then drops vertically nearly 200 feet to the power house. For about fifty feet of its length beneath the power house floor it is 13 feet in diameter, and, after

NIAGARA FALLS HYDRAULIC POWER PLANT.

The Foot of the "Money Making Cliff."

passing beneath two of the wheels, its diameter is reduced to 7 feet, beyond which point it tapers off into a cone 18 inches in diameter, and finally ends in an air-chamber, which is feet in diameter by 15 feet in height. The object of the air-chamber is to cushion the vertical movement of such a great mass of water and prevent injurious shocks to the machinery. The steel used in the construction of the penstock varies from a thickness of 5-6 of an inch at the top to $1\frac{1}{8}$ inches at the bottom.

Above the horizontal portion of the penstock beneath the floor are carried a series of five 60-inch hydraulic valves which are placed horizontally and serve to conduct the water from the penstock up to the five turbines which are placed immediately above them. These valves, with their supporting girders, are shown in the lower illustration of our first page. The water flows through the valves to the turbines and is admitted by a gate to the guide-wheels, and through them to the runners. From the sides of the turbine the discharge pipes project laterally and then downwardly to connect with draught tubes 22 feet 8 inches in length, the use of which makes it possible to utilize in part the atmospheric pressure, and increase the effective head of the turbines accordingly. The turbine wheels are made of bronze, and they are located in the draught-tube casing, one on each side of the casing proper. The pair weighs 5,095 pounds. They are mounted upon a horizontal shaft and are directly connected to a general electric generator, which supplies

View of the Power House, Looking Up the Gorge Towards the Falls.

current to the new chlorate of potash plant of the National Electrolytic Company, located on the top of the cliff.

A walking-beam, working over the main casing, operates the gate which is connected to the beam by 2½-inch rods extending down through the glands into the casing. Above the walking-beam is an air cylinder 36 inches in height, with a diameter of 20½ inches. The turbine is controlled by a Reynolds governor. It should be mentioned that there are thirty-four buckets on the runners with a total area of 140.25 square inches. On the guide-wheel there are twenty buckets with a total area of 149.53 square inches. The General Electric Company's generator is shown in our illustration. It has fourteen poles and runs at 257 revolutions per minute, giving an output of 5,000 amperes at 175 volts. This represents a capacity of 875 kilowatts or about 1,200 horse power. The current is carried to the chloride of potash works on aluminium cables, the lower part of which is made in bar form and the upper part in the form of well insulated cables. The dynamo for the Buffalo and Niagara Falls Electric Light and Power Company is of 700 kilowatts capacity at 2,200 volts pressure.

The completion of the five Jonval-Geyelin turbines will raise the total horse power at this station to 20,000, but it is intended to build another 11-foot penstock and increase the total horse power of the plant to 30,000, which will be the maximum that can be developed from the present upper basin. Ultimately, however, it is intended to extend the basin along the cliff beyond the present factories of the small users of the company's water power, and carry down other penstocks to a new power house at the edge of the river. The company has sufficient room to install a total of 100,000 horse power, which is well within their grant of 125,000 horse power. The present capacity of the canal is about 40,000 horse power, but the company has a force of dredges which are continually at work enlarging and deepening it.

Visitors to Niagara will have noticed the cascades of water which fall from the side of the cliff in varying quantities in the immediate neighborhood of the company's power house. These streams are the tailraces of the various smaller factories which are built at the edge of the cliff, and take water from the company's basin behind them. The turbines operate under heads of from 60 to 100 feet. In some cases they are sunk in wheel-pits and discharge through tunnels, while in others a cutting is made through the face of the cliff. The total hydraulic power thus developed is about 7,500.

Applications of Electric Power.

RECENT DEVELOPMENT IN MARINE GENERATING SETS.

The requirements of marine work are most difficult to fill. Not only is space economized to the last degree but into this curtailed space must be built a machine which will have unusual capacity when speed and weight are considered, and be thoroughly reliable.

The combination illustrated in Fig. 1 consists of a Bullock Type "N-1" Generator direct connected to Forbes Marine Engine.

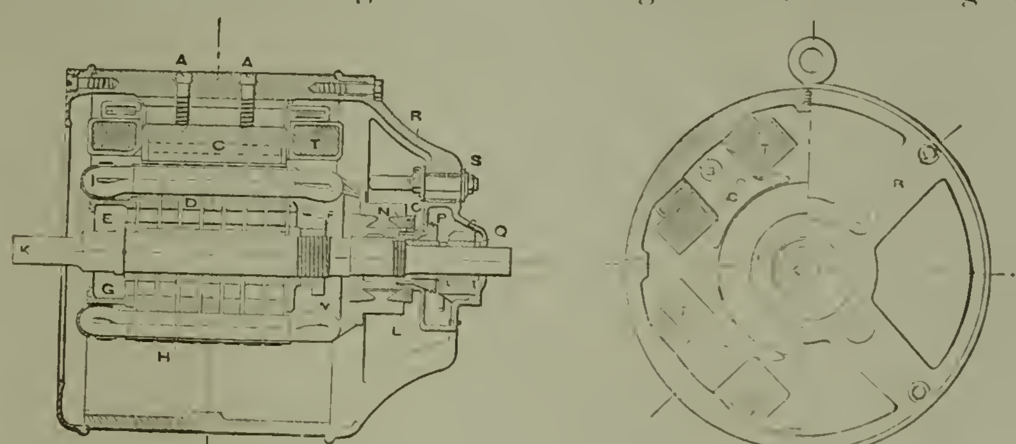
The engine cylinder is 5" x 5" and is made for the high pressures of modern marine practice. The cylinder is supported upon three hollow steel legs which are rigidly fastened to a subbase comon to both engine and generator. To two of these supports the cross-head guide is securely bolted. Means are provided to adjust for wear

Fig. 1.

of the cross-head shoe and guide and in the main bearings. A perfect system of sight feed lubricators is installed upon the side of the cylinder with copper tubes leading to all of the wearing surfaces of the engine.

A small balance wheel is provided and assists in the regulation of the engine speed. The governor, which is installed on the outer end of the shaft, is of the inertia-centrifugal type and maintains a speed between no load and all load limits of less than two per cent. variation. The valve is of the cylindrical balanced type and gives a perfect steam distribution.

The generator, like the engine, is very compact, pleasing in outline and presents some excellent features of mechanical and electrical design, as will be seen by consulting the sectional engraving.



SECTIONAL VIEW

BULLOCK TYPE "N-1" GENERATOR

The yoke is a steel casting of the conventional circular form, having inwardly projecting pole pieces of laminated soft steel. Each pole is bolted to the frame by two bolts "A-A," the centrally located rivet "B" of the laminated pole "C" being tapped and serving as a nut for the bolts.

The armature core "D" is built up of laminated soft steel mounted directly upon the shaft and held firmly together by iron end plates "E" and nuts "F," as shown, one end plate resting against shoulder "G." Ventilating slots "H" perpendicular to the shaft provide a perfect means of ventilation. The windings "I" are machine formed and hot pressed and are perfectly insulated before being placed in the slots of the core. The windings are held in place by steel wire bands wound in slots making a flush finish with the outside of the laminated core. The armature shaft rests in a phosphor bronze bearing of liberal dimensions at the outer end and is keyseated in the hub of the engine fly wheel, which is of extra width and provided for receiving the end "K." The commutator bars, shown at "L," are held together by sleeve "M," ring "N" and nut "O." Oil shield "P" prevents oil from finding its way from bearing "Q" into the armature.

The bearing "QQ" is of the self-oiling type, as shown. The end housing "R," securely bolted to the frame, carries the brush studs "S." The field coils "T" are machine wound and thoroughly insulated, and are slipped over the poles before the latter are bolted in position.

The engine operates at 600 R. P. M., and at this speed the capacity of the generator is 5 K. W. at 115 volts pressure.

This particular set is now installed upon the steamer "Aberdeen," a vessel recently built for the Pacific coast trade.

The manufacturers, the Bullock Electric Mfg. Co., Cincinnati, Ohio, will be pleased to send Bulletin No. 6934, showing other engine type generators, to those requesting it.

Fender Just Before Dropping.

THE HIPWOOD-BARRETT CAR AND VEHICLE FENDER.

With every new invention come certain requirements which, in the course of time, experience teaches must be met in order to give the invention the prestige and practical success that will lead to its adoption. Since street railways have been regarded by the American public as an inevitable and essential part of city life it has become necessary for the proprietors of electric roads to protect pedestrians from collisions with cars, in so far as it lies in their power. The street car fender is generally regarded as the most suitable means for attaining this end and

Fender Dropped to the Ground.

should be constructed in accordance with certain requirements, tending to insure those that fall or are caught on the roadway from serious injury.

The Hipwood-Barrett car and vehicle fender covers the ground by complying with the following requirements: the motorman has direct control of the fender by a simple motion of the knee through which it is made to drop. The forward sections will traverse the surface, whether rough or smooth, and conform to it in every respect. The body of a person coming in contact with the fender will not receive a violent shock because it is so constructed that it recedes sufficiently to remove danger from this source and the flexible dashboard protector prevents further injury after the fender has performed its functions.

Under such circumstances a pedestrian thrown by accident in front of an advancing car cannot suffer any injury more serious than that which may effect the nervous system at the near proximity of an apparent danger. In other respects the fender is designed to meet the conditions of street railway practice in being simple in construction and easily applied to various designs of cars. The weather cannot affect this device and the duplication of any part is immediately possible without calling for special skill or training on the part of employes. It takes about three seconds to attach the Hipwood-Barrett car fender for use, consequently it cannot be either complex in structure or difficult to handle

Fender Disposed of Under Back of Car.

Fender Bisposed of Under Front of Car.

The flexibility of this fender in conforming to the variations in the surface of the track and its elasticity have been well illustrated by the American Mutoscope

Company in one of their great moving picture scenes. It shows the operation of this fender making a burlesque of death by saving from destruction, with the car going at full speed, two dummies stuffed with sand and sawdust, weighing respectively thirty and fifty pounds. The realistic presentation of this subject holds the audience spellbound as the smaller figure is stretched out on the track with its head on the rail and the other figure stands right in the path of the advancing car. The car rides down upon the two pseudo victims with a speed of fifteen miles an hour and scoops them up without a particle of injury, rip or tear. This thrilling episode not only supplies a type of arena like amusement to American citizens but does more in illustrating the absolute freedom from danger to pedestrians under such circumstances by the employment of the Hipwood-Barrett car fender.

The Hipwood-Barrett Car and Vehicle Fender Company may be found at their offices No. 66 Broadway, New York City.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING NOV. 11TH, 1899, $36,169.

New York, N. Y., Nov. 11, 1899.—The following exports of electrical materials are from the port of New York for the week ending this date:

Argentine Republic.—97 packages electrical material, $1,374; 22 cases of electric motors, $1,377.

British Possessions in Africa.—2 cases electrical machinery, $50.

Berlin.—7 cases electrical material, $4,698.

British West Indies.—2 cases electrical machinery, $400.

British Honduras.—1 case electrical material, $26.

China.—16 cases electrical material, $422.

Hamburg.—39 cases electrical machinery, $102; 109 cases electrical material, $7,928.

Hong Kong.—5 cases of electrical material, $111.

Havre.—31 cases electrical material, $3,045; 1 case electros, $165; 5 cases electrical machinery, $181.

Japan.—15 cases electrical material, $2,921.

London.—47 packages electrical machinery, $1,865.

Liverpool.—135 packages electrical material, $5,776; 3 cases electros, $300.

Newfoundland.—13 cases electrical material, $149.

Odessa.—22 cases electrical material, $840.

St. Petersburg.—60 packages electrical material, $3,936.

Stockholm.—5 cases electros, $60.

U. S. Colombia.—2 cases of electrical material, $198.

Uruguay.—4 cases electrical material, $245.

NEW INCORPORATIONS.

Seattle, Wash.—The Pacific Coast Fixture and Electric Company has been incorporated; capital, $25,000.

Brooklyn, N. Y.—The Consolidated Electrical Supply Company has been incorporated; capital, $10,000. tors: F. F. Braillard, Jr., of 33 Bond street, and Grace B. Braillard, of Brooklyn.

New York, N. Y.—The E. Lindner Manufacturing Co. has been incorporated to manufacture electric goods, etc.; capital, $10,000; incorporators, E. Lindner, of Brooklyn; M. B. Ault, of Unionport; O. Pullich, of New York city.

Philadelphia, Pa.—The National United Manufacturing Company has been incorporated; capital, $1,000,000; incorporators, T. H. Springer, W. H. Rainsford, W. B. D. Smith, R. Thayer, J. S. Thorn, all of Philadelphia, Pa.

Passaic, N. J.—The Citizens' Gas and Electric Light Company has been organized to manufacture gas and electricity.

TELEPHONE CALLS.

Eaton, Ohio.—The Eaton Telephone Company has been incorporated; capital, $50,000; incorporators, W. W. Morrison, F. J. Bollmeyer, C. F. Brooke, Jr., J. Alexander, C. B. Cokefois.

Edmeston, N. Y.—The Morris Telephone Company will build a new line from this place to Morris, by way of Garrattsville, and down the Butternut Valley to Mt. Upton. The company already controls the Central New York Company's wire from Morris to Oneonta.

Humboldt, N. Y.—The Gibson County Telephone Company has been incorporated; capital, $20,000; incorporators, E. L. Mendenhall, E. B. Mendenhall, W. Mendenhall, V. T. Gizzard, J. T. McKibben, all of Humboldt.

Jewell City, Kan.—A telephone company has recently been formed in Jewell City, with Mayor J. W. Berry, president; Albert Whitney, secretary, and Geo. B. Crandall, treasurer. The system, when complete, is to include Jewell City, Mankato and Burr Oak, and will probably be extended to Ionia, Mayview and Randall.

Iowa City, Iowa.—The Johnson County Telephone Company has been incorporated; capital stock, $25,000. It will at once proceed to build an independent telephone line to Iowa City and Johnson County.

STREET RAILWAY NEWS.

Bedford, N. Y.—The Bedford & Eastern Railway, an electric street surface railroad three miles in length to operate in the town of Bedford, has filed articles of incorporation with the Secretary of State; capitalization, $30,000; directors, Charles, Charles Haines, William H. Lyon, of Bedford Station; William V. Malloy, of New Rochelle, and George Jeungot, Jr., and Horace B. Thacker, of Croton Falls.

Carlisle, Pa.—A trolley line will be constructed between this city and Churchtown.

POSSIBLE INSTALLATIONS.

Detroit, Mich.—Capitalists in Calumet are organizing a stock company to erect an electric lighting plant at Lakeview, near Calumet, and purpose to furnish lights for business houses and residences in the latter place. They intend to run an underground system of wiring from the plant to the city.

Bellingham, Mass.—The selectmen have granted a franchise to the Norfolk Electric Lighting Company for commercial lighting.

Paris, Tex.—The City Council of Cooper, Delta County, is considering the proposition of putting in an electric light plant.

The Electrical Age.

Vol. XXIV—No. 22. NEW YORK, NOVEMBER 25, 1899. Whole No. 654.

Illumination.

Class A.

LIGHT VS. ILLUMINATION.

The Holophane Patent Light Diffusing Globes, introduced recently by the Holophane Glass Co. of No. 1 Broadway, N. Y., have a special interest for electrical engineers, architects and decoration designers.

These globes are made of fine crystal glass in various artistic patterns and are very rich and ornamental in appearance. By the use of fine, accurately calculated, vertical ribbings on the interior surface of the globes, the light is perfectly diffused and the objectionable and injurious glare of a filament is destroyed, while by the use of fine horizontal prisms of equal accuracy on the exterior surface, the rays of light are refracted and reflected in the downward direction without any loss of power. The result is an evenly diffused and distributed illumination, far superior in effect and in efficiency to any obtained by the globes and methods now in use.

As is well known, the ordinary frosted lamp bulb partially destroys the glare but at the same time absorbs from 30 per cent to 50 per cent of the candle power; the use of reflectors limits the radius of illumination but at the came time intensifies the glare, while all forms of cut glass and otherwise ornamented globes and shades are open to similar objections. Many otherwise happy experiments in the new method of lighting directly from the ceiling have fallen just short of success for these very reasons. By the use of the Holophane, complete success is now possible.

A uniform, glareless illumination, closely resembling diffused daylight is produced. Every fraction of the candle power is utilized to the fullest extent; all the unsightly features of the installation are hidden; there are no sharp shadows. As the light is thrown downward, all the fixtures may be placed high above the level of the eye. Each of the Holophanes, irrespective of its size, is lighted up over its entire surface and produces the effect of a globe filled with a soft yet sparkling radiance. Another feature of the system is of greatest importance to decorative artists; through the action of the prisms upon the surface of the globe, most of the objectionable color rays emanating from the lamp are resolved and the light is purified and whitened; its transforming effect upon the tints of fabrics and decorations is thus greatly reduced.

While specially adapted for ceiling lighting, the Holophane system lends itself no less perfectly to all forms of electroliers, upright and pendant brackets, desk lights, etc., and is unequalled for the lighting of public halls, libraries, museums, reading rooms, picture galleries and private dwellings.

When used with arc lamps the Holophane overcomes many of the difficulties and objections that have hitherto been regarded as inherent in this form of high power light. They destroy the glare without loss of illuminating power; they prevent all sharp shadows, and so evenly distribute the light as to do away with shadow zones. The illumination directly under the lamp is as perfect as it is at other angles. Flickering and sparking are concealed, and in the case of enclosed arc systems the "travelling" of the light is done away with.

Class B.

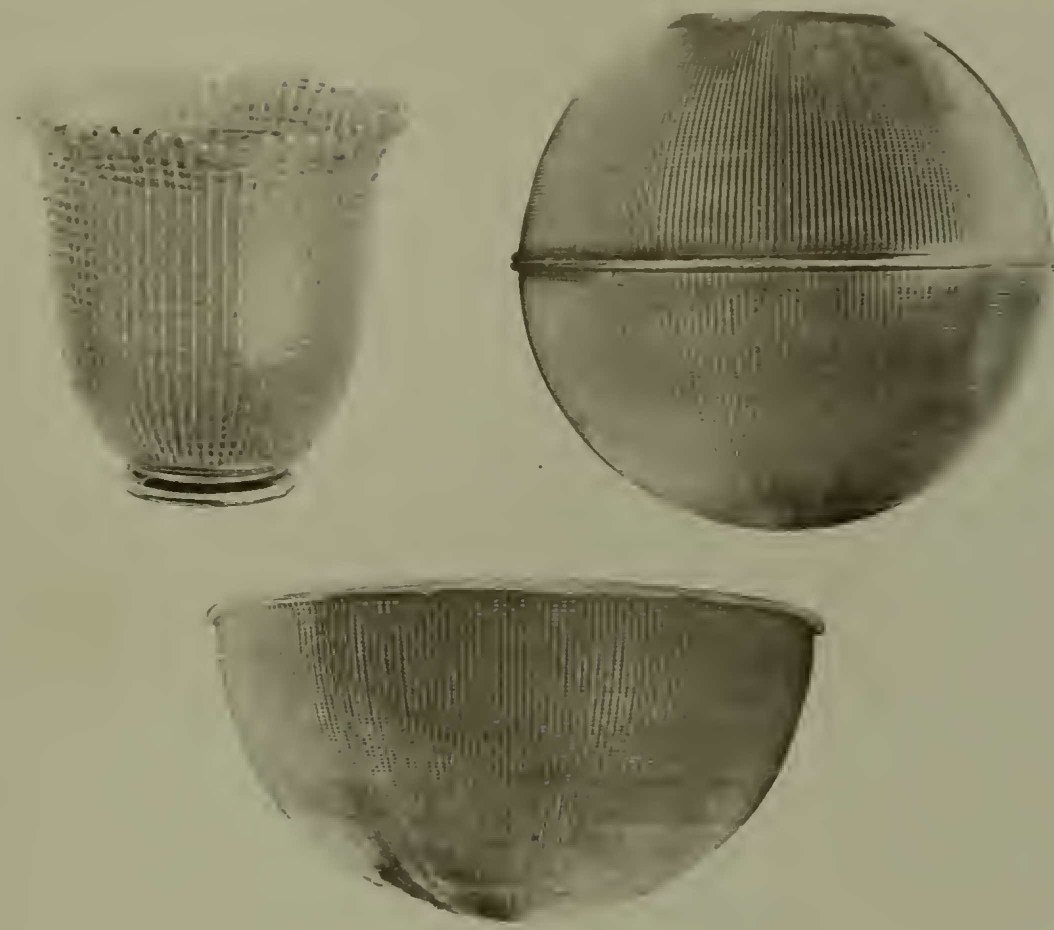
How perfectly the Holophanes control the light is shown by the accompanying diagrams. Globes of class A. concentrate the light downward. Those of class B. distribute it at a wider angle, while those of class C. throw the light over as wide an area as possible.

Class C.

To put it briefly, in the Holophane system scientific principles have for the first time been applied to the diffusion and control of light. The globes gained the gold medal at the Antwerp exhibition, and last year the Franklin Institute awarded the inventors the John Scott Legacy Medal and Premium, the highest honor that can be conferred upon an invention in this country.

An elaborate show room has been fitted up at the company's offices, where well informed attendants are ready to explain the system fully to all callers. The company has also prepared a pamphlet entitled "Light vs. Illumination," that is full of information of the highest value. This pamphlet will be sent free to all engineers, architects and others interested upon application.

Newel Post with Holophane Sphere.



Various Styles of Holophanes.
Electric Tulip. Two-part Sphere.
Hemisphere.

Applications of Electric Power.

THE PRACTICAL APPLICATION OF ELECTRIC MOTORS TO PRINTING PRESS MACHINERY.

BY W. H. TAPLEY.

(Continued from page 246.)

Controller should be of the barrel type, compact, having all contacts inclosed and protected. This should be provided with only one handle, and having five or six speed contacts with two points reverse. The necessity for limitation to one handle is that two will produce confusion when quick action is required; if operator is told to do this and then that, he generally does that, then this. With one handle the demand for instant reversal is quickly responded to as there is but one thing for the operator to do, i. e., push the handle in the opposite direction from existing conditions. This very soon becomes instinct with the press feeder and mistakes are unknown.

The controller should be so made that it can be easily repaired and inspected, provided with ample carrying capacity and liberal surface contacts, allowing not more than forty amperes to square inch; cylinder should be convexed and fingers concaved; where large quantities of current are to be carried by fingers, the latter should have copper braid connecting tip with base; larger size controllers should be provided with special contacts for breaking current, not depending upon them to carry current while in constant service—this will reduce heating to a minimum; it must be easily handled and free from breakdowns.

When a first-class controller has been produced the manufacturer has one-half the battle, for herein has been one of the greatest sources of trouble the printer has had with individual motors, viz., getting suitable control coupled with a substantial and reliable controller.

Reduce all automatic devices to a minimum, if not dispensing with them altogether on the controller; they are unnecessary, and as such are sources of trouble. A quick brake reduces sparking, thus lessening the chances of undue heating of contact fingers while in use—its adoption is an advantage.

Push buttons about a press, which is hand-feed, are superfluous and should only be used in connection with automatic feeders.

The great range of speed stipulated by some is seldom used in actual practice; ranges of running speeds from ten to thirty-five impressions per minute, as I see discussed, are so rare in large commercial houses as not to be worthy serious consideration. Cut work is not done at the high rate of speed of common job presses, nor are the same presses used for both classes of work and expected to produce the best results. Running the press at high rate of speed would soon make it unfit to do first-class half-tone work upon. And running common job printing on slow-speed cut presses would not pay. What is necessary in determining the range of speed is the knowledge of the class of work to be done most thereon and how it is to be fed. A general knowledge of presswork and common sense will, as a rule, settle these problems satisfactorily.

If extreme limits are insisted upon, the proprietor must suffer and take what he can get as to economy and first-class work.

Protection includes a larger field than the electric motor—the printing press and operator should be fully considered.

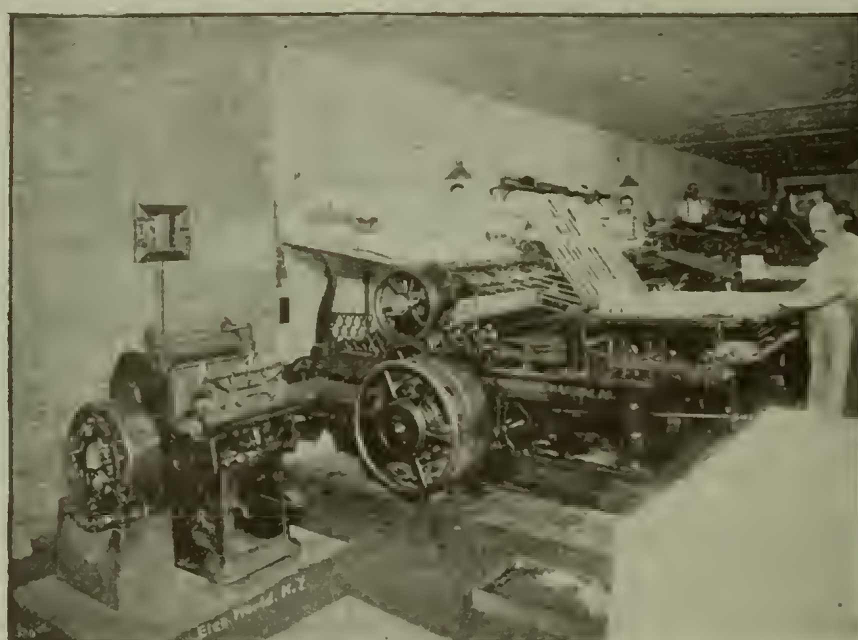
Experience has developed the fact that satisfactory protection is secured only by means of an automatic circuit breaker; this applies not alone to the motor, but the printing press and its operator as well.

In the individual application of the electric motor, in most cases, the price of the motor is small, compared to the machine to which it is attached. For instance, the cost of an ordinary two-revolution front or back delivery flat-bed press, book size, is about ten times that of a first-class electric equipment for same, installed complete in every respect.

The motor will stand more rough hadling than either the printing press or the operator, and still be in condition to do its work properly, conclusively showing that more very materially eradicated. The impact from a blow four or five times the capacity of a motor, which a fuse permits, must expend itself somewhere; if it does not break a part, it strains the entire press, and constant repetition means lost motion in running gear—this is fatal to good printing.

This was such a serious objection to the individual connecting of electric motors to printing presses, that one of the oldest and most prominent press builders in this country came out flat-footed against this method, and said we must have a belt as a driving gear, for this would slip or run off the pulley; gearing meant the wreck of the press if anything meant wrong. They were right when fuses were the only method of protecting the press, as they were not quick enough to prevent trouble. But with the use of a reliable circuit breaker all these objections are swept away, and we have better protection a hundredfold than slipping belts.

(To be Continued).



C. W. Motors Direct Connected to Presses.

than the protection of the motor is demanded. The results of the exclusive use of circuit breaker for printing press work are the reduction of repairs on presses 50 per cent., stoppages practically eliminated, with prolonged life of machinery. Presses can be handled promptly from any position, with circuit breaker set at 50 per cent. above capacity of the motor, providing the press is in free running condition; if it is not, the circuit breaker is the best tell-tale extant. The failure of the pressman to properly clean and oil his press is followed by a frequent opening of the circuit breaker, showing something is wrong and needs attention.

A personal experience in this line may help to explain more clearly the point in question.

Shortly after equipping some of the first presses in the office, constant complaints were received from one especial press, that the motor was not working satisfactorily, power unsteady, press would not start unless assisted by a laborer, circuit breaker was a nuisance, as it opened constantly. This continued until the press refused to work at all—motor was unable to turn it over. Investigation showed the main press shaft to be fast in its bearing, the pressman having failed utterly to oil or care for the press.

Henceforth we were not in receipt of complaints from that press; the ability of the circuit breaker to show up so clearly carelessness on the part of the workman established for itself a reputation which is still of the highest.

Injuries from rough handling and sudden starting are

A QUESTION OF PUNCTUATION.

Scorcher: How would you punctuate "Look at that pretty girl in her automobile come spinning down the avenue"?

Putter: That's easy; Comma after "pretty girl" and after "automobile."

Scorcher: I'd rather make a dash after that pretty girl.—Ex.

THE MARCONI SYSTEM IN THE ALPS.

The director of the Meteorological Observatory on Mt. Blanc has been considering the advisability of installing the Marconi wireless telegraphy system upon the mountain. The ordinary system of telegraphy is used normally, but the great snow-drifts have played havoc with the telegraph wires. It is believed that the wireless system of telegraphy would prove not only valuable from a scientific point of view, but would also increase the safety of travelers upon the mountain.

A VACUUM MICROPHONE.

A telephone transmitter has been recently invented in which the microphone is enclosed in a bulb, from which the air has been exhausted. Any form of microphone may be used; either granular carbon or pencils, and as in the case of the incandescent lamp, the exclusion of air permits the use of much stronger currents than would otherwise be allowable. The microphone is also protected from dust and moisture, and loud, distinct speech is secured.—Ex.

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THE ELECTRICAL AGE PUBLISHING COMPANY,
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NEW YORK, NOVEMBER 25, 1899.

CONTENTS:

BURNING REFUSE FOR ELECTRIC LIGHTING.

The combustion of a city's debris for the purpose of transforming its heat or latent energy into electricity has interested the governing board of many a large city in the United States and England. Garbage, as it is generally designated, consists of two classes of constituents, one easily combustible, the other requiring admixture of finely powdered coal or some element inducing conflagration. In the most notable case at hand, namely the Shoreditch installation, in England, the first class of materials in the line of garbage are consumed for the purpose of lighting the town. Considerable discussion has taken place as to whether it pays to use refuse for this purpose. It is certainly an excellent proposition from an hygienic standpoint to so dispose of these germ breeding products by the application of heat that the possibilities of disease emanating from them are reduced to a minimum, but it is a serious undertaking to install a large electric light plant whose main source of fuel will be a questionable supply of material, the calorific value of which per pound would require the combustion of enormous amounts of material to supply the required heat.

To be more definite a discussion of the annual acounts of the Shoreditch installation took place in that town last month.

"The members of the vestry at the meeting were occupied for over an hour in discussing the accounts of the electric light and refuse destructor undertaking for the year ending March 25th last. According to the accounts there appears on paper to have been a deficit on the destructor of $18,080 during the year and a paper profit of $18,160 on the lighting installation; but if the former sum is deducted from the latter the combined undertaking seems to show a surplus of $10,330 on paper."

Further remarks made in relation to this installation lead to the conclusion that the refuse was being disposed of in this manner at an actual net profit in cash and an absolute gain in hygiene. The success of this scheme indicates therefore its possible widespread application in many towns and cities in which the present expense of the removing and handling of this refuse is great enough to call for a consideration of this system. It must be understood, however, that the garbage and refuse of large cities varies in its character as a fuel, indicating that cases would undoubtedly arise where a disposal of the stuff in this manner would be attended by considerable expense. When the larger cities do their own electric lighting this method of disposing of refuse in place of coal would probably meet with serious consideration, but at present it is extremely unlikely that the Shoreditch installation will be regarded as any more than an experiment of doubtful issue by ourselves as long as coal is cheap and in abundance and our friends at Long Branch, Rockaway, Arverne and adjacent beaches do not raise too loud a cry when Father Neptune throws back on shore certain unpleasant mementos of a heavily laden scow that once went out to sea.

THE WIRELESS CRAZE.

It frequently happens that a new and marvelous scientific discovery becomes the subject of cartoon, ridicule, vaudeville humor and political lampoons. The consequence of this is to produce in the minds of the public an idea of an intimate familiarity with the subject, even to an extent that might be considered technical. As an instance of this the wireless telegraphy craze is predominating, and reports reach us from all over the world of the invention of systems of wireless telegraphy, wireless telephony, the wireless transmission of power and even the wireless transmission of pictures. This idea of transmitting energy without wires is as old as it is now supposed to be new. No one ever thinks it wonderful to witness the invisible manifestation of gravity upon a stone let fall from the hand. Although awe inspiring a flash of lightning from above is not considered a phenomenon with much mystery attached to it. The cohesion existing between the atoms and molecules of matter is not less wonderful than a fifty mile exhibition of wireless telegraphy, yet on account of the novelty of the last a ripple of excitement passes round the world and institutes the craze.

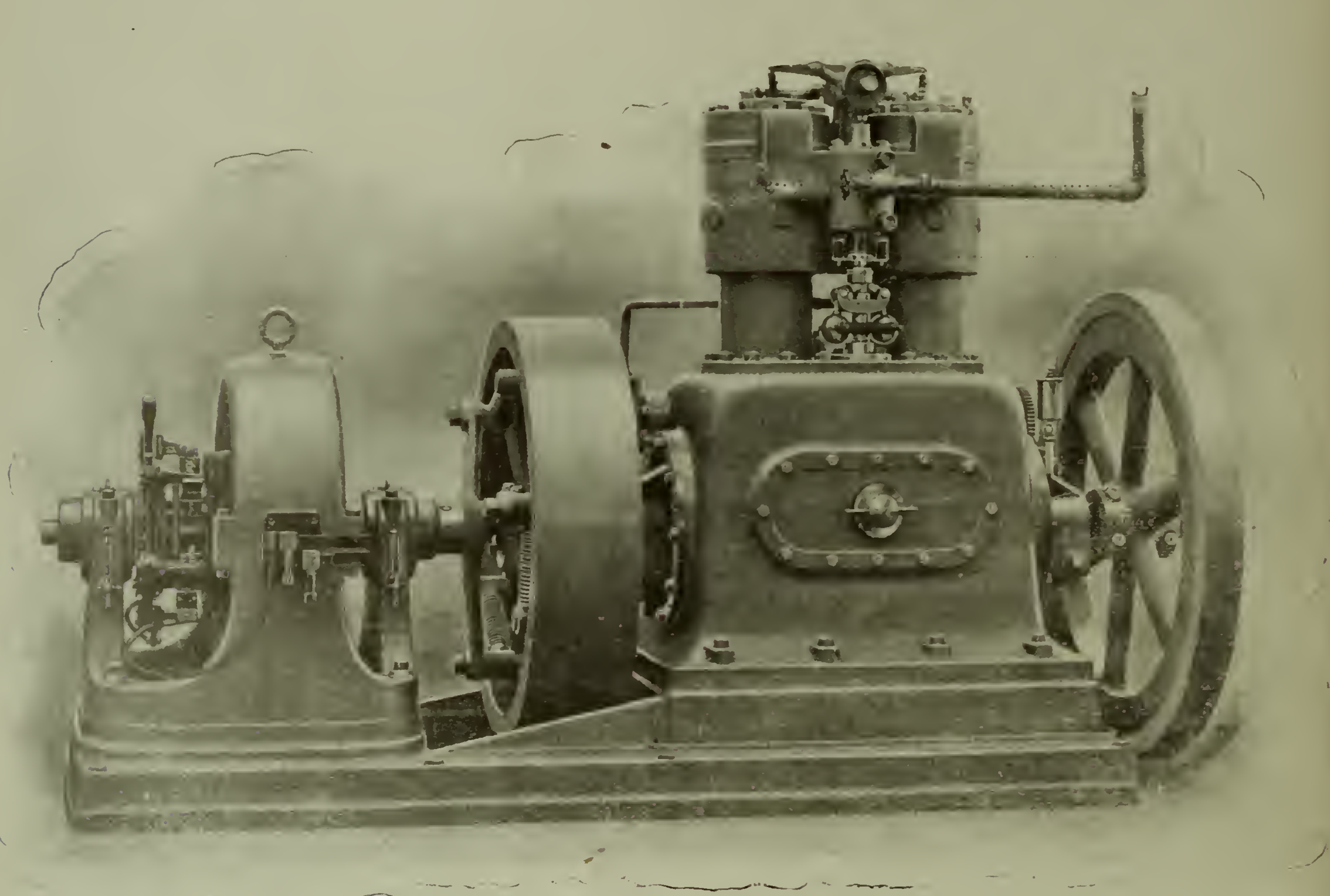
It is most likely that the future will disclose more remarkable manifestations of the transmission of intelligence without wires than any of the systems known today. The properties of the ether, its capacity for transmitting power in various forms of waves and its examination by scientists as a source of many new and interesting properties certainly leads us to believe that it is fated to play an important part in the economy of civilized nations. Wireless telegraphy is not so much a novelty as an indication that the ether may be used for purposes which are but now being barely suggested. Of these wireless telegraphy is the first, and it is not incompatible with modern thought to expect more before the next decade has passed. Standing as we do at the very threshold of modern science it is not wise to enthuse in an unreasonable manner or predict possibilities which may never crystallize and are merely the vivid imaginings of certain pseudo scientific writers pandering to the public taste.

Power Installations.

DIRECT CONNECTED GAS ENGINE PLANTS.

Improvements in gasolene engines has been very rapid during the last three years due to the growing use of the automobile and the increasing demand for some motive power for driving generators, requiring a minimum of care and causing a minimum of expense. The requirements of electric lighting are such that unless the most uniform speed is secured a variation in light will occur which is most disagreeable to the purchaser. Uniformity of speed and economy of operation are therefore important points in the construction of gas engines and a failure in either direction will mean a failure in supplying electricity at a constant voltage. The Westinghouse Machine Company, after years of experiments and trials, have finally crystallized their efforts in the form of a gas engine which in certain features is a duplicate of the familiar type of steam engine now on the market and well-known to stationary engineers. Gas and gasolene motors differ from each other more in name than in construction and must represent in their construction a type of mechanism which is simple, interchangeable and easily handled. From an economical standpoint the gas consumption should be limited and the different processes through which the gas is admitted, mixed with air and finally ignited, admit of no possible interruption, due to sudden changes of load lying within the rated horse-power of the engine.

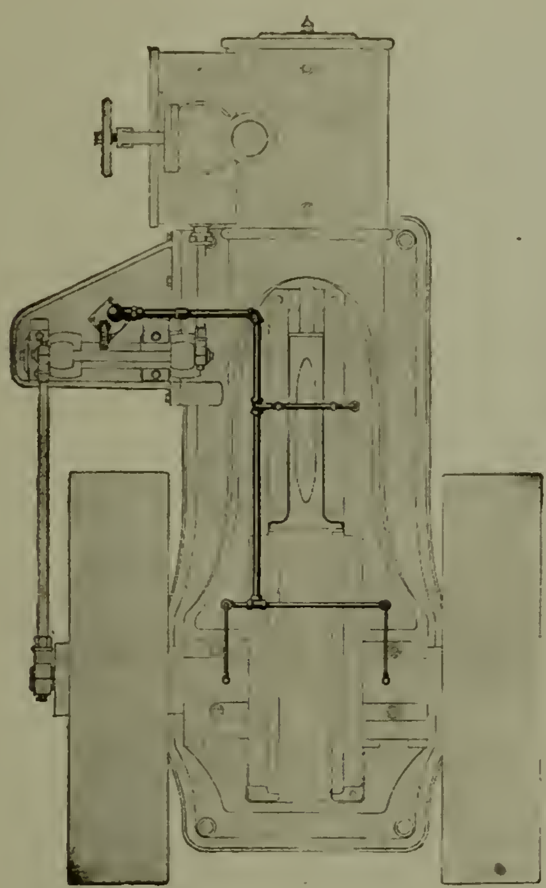
Gas engines should comply with the following requirements to as great an extent as possible. They must be easily started; must run quietly, smoothly and steadily; must be economical in fuel consumption; practically noiseless and sufficiently powerful to do the required work at a uniform speed. They must be simple in construction and capable of successful operation by the average janitor or engineer. In large types of gas engines the gas consumption does not exceed seventeen cubic feet per horse-power, but in the smaller sizes these figures may rise as high as thirty-five or forty cubic feet per horse-power hour. The igniting device of the gas engine above described is positive in its action, thereby insuring an explosion at the expected moment and preventing sudden outbursts of speed and heavy strains which are apt to cause serious accidents. In the illustration is shown a view of the Westinghouse gas engine direct connected to a multipolar generator. With gas at the present low rates in New York City electric lighting alone on a large scale is much cheaper than with steam engine and the care of boiler or contract with illuminating company. In fact, the recent cut in the price of gas from $1.25 a thousand cubic feet to sixty cents overrides all possible competition in running expenses and rate of deterioration of plant. At the figures given a twenty-five horse-power gas engine fully loaded consumes three hundred cubic feet of gas an hour, costing approximately twenty cents. The generator delivers enough electricity to supply two hundred and fifty sixteen candle-power lamps. The cost per horse-power hour is therefore less than one cent or about a tenth of a cent per lamp hour, as far as the actual cost of fuel is concerned. If the deterioration, wages, tene sufficient to make electric lighting by this method other than highly profitable.



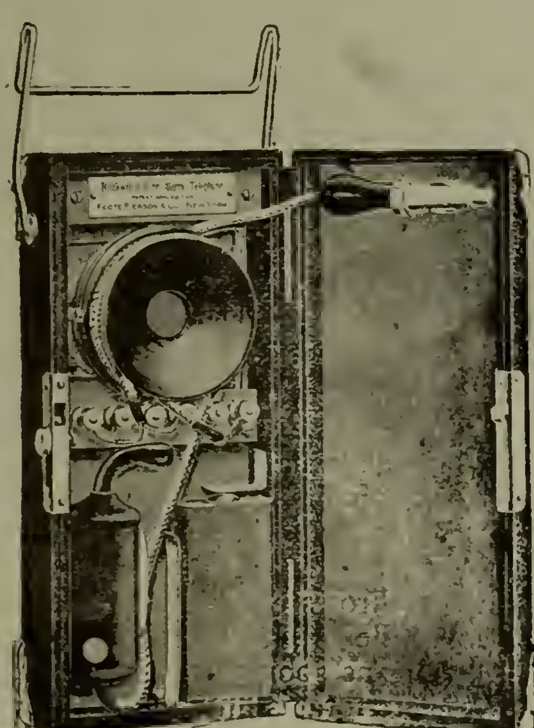
Westinghouse Gas Engine Direct Connected to Generator.

FIRE ALARM COMBINATION TELEPHONE.

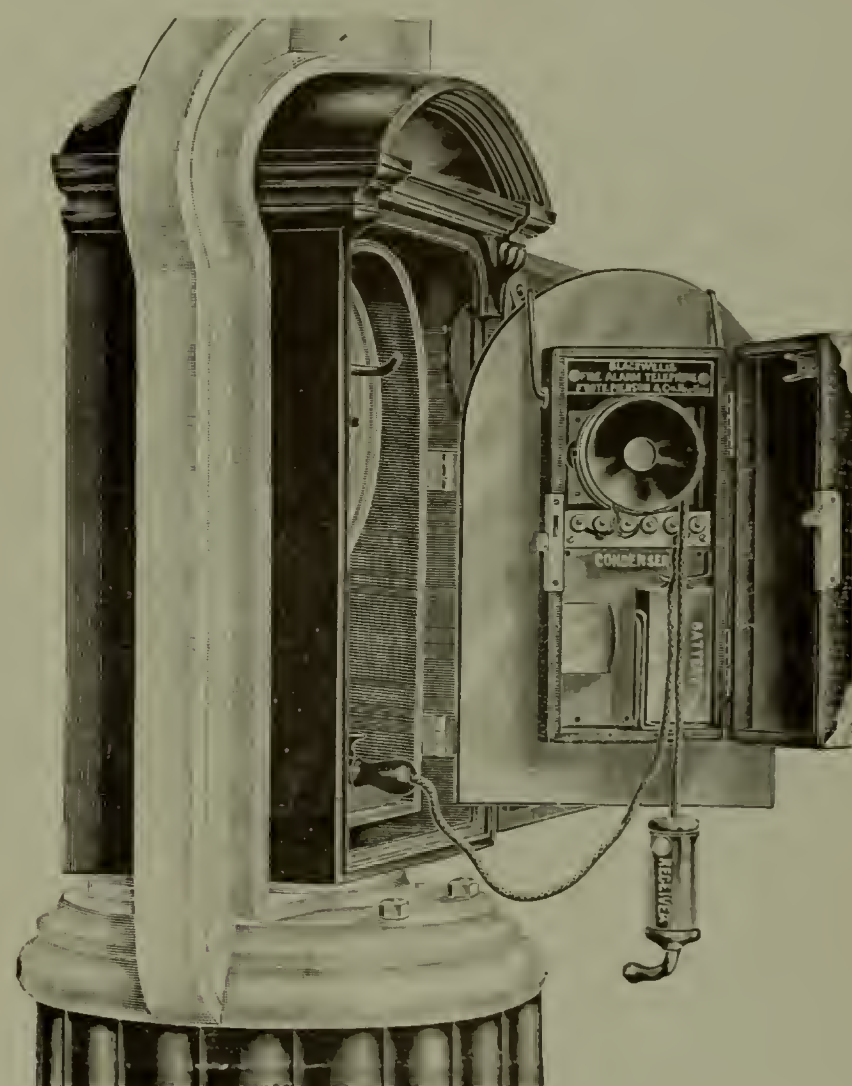
An interesting outfit has been placed upon the market by Foote, Pierson & Company, manufacturers of electrical goods and successors to The E. S. Greeley & Co. The instrument is designed to provide a simple and ready means of communication in a compact and portable form for the use of fire departments, railroad employes, ranchmen, etc. It is practically a complete telephone outfit minus the apparatus used for signalling. The instrument is connected to the ground through a condenser and an induction coil and communication may be carried on telephonically without interfering with the signal or signal wire. For trolley roads and all forms of street railways as well as railroads the receptacles provided with some open circuit signalling device are situated at the proper intervals on a parallel wire and equipped with a ground detector at the receiving end. The receiving end consists of a transmitter and receiver in which the induction coil and condenser are designed to be of the same dimensions, that is to say, of the same resistance and capacity as in the portable set. The fire alarm combination telephone is consequently of immense value in an emergency as it combines the features outlined above for sending alarms and establishing ready communication by telephone. This connection is effected by means of a small receptacle which is placed in the fire alarm box and is consequently ready for use at any moment. In addition to this interesting device Foote, Pierson & Co., are manufacturers and dealers in a variety of electrical apparatus and supplies, and are the sole manufacturers of the F. P. & Company's ink writing registers, Lewis automatic cutouts, Blackwell combination telephone, Willyoung high grade measuring apparatus, Argus lightning arrester and the W. B. G. accurate fuse protectors; their offices and factory are at 82-84 Fulton St., New York City.



Side Elevation of Westinghouse Gas Engine.
(see page 270.)



Combination Fire Alarm Telephone.



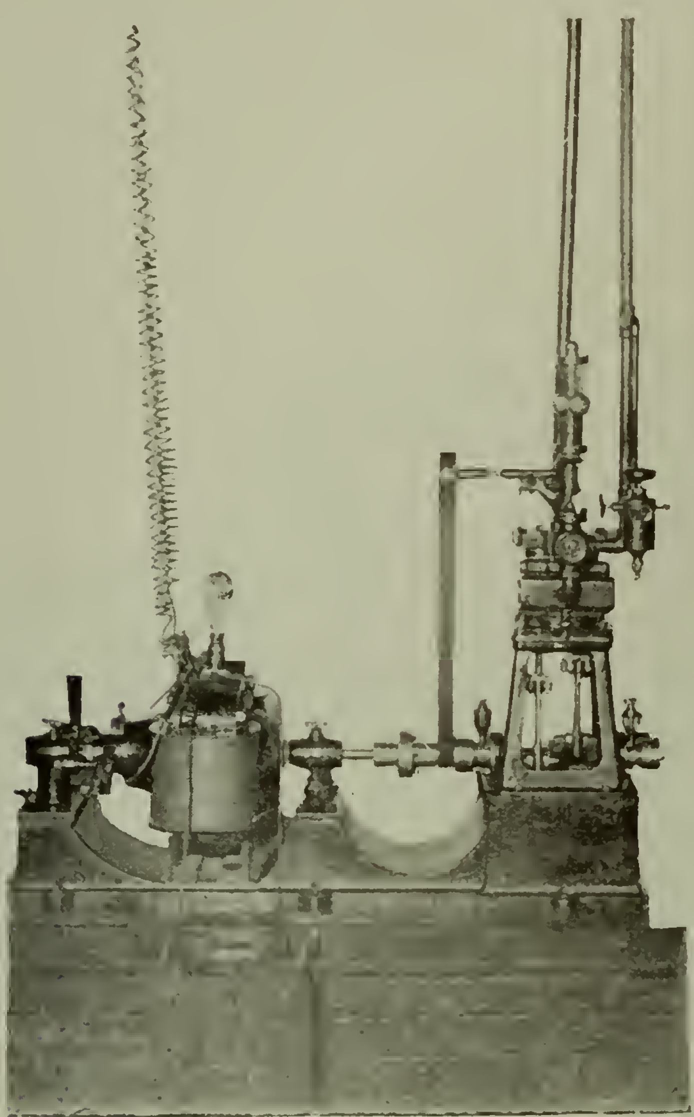
Combination Fire Alarm Telephone.

THE THERMO-CHEMICAL THEORY OF THE CARBON.

More than ten years ago Donato Tommasi described bon, one being coated with lead peroxide and imm r in a solution of sodium chloride, and he regarded the action as due to the oxidation of the uncoated carbon and the reduction of the peroxide. Reed considered the current to be due to the action of the sodium chloride on the lead peroxide, but this view is untenable, as in that case the coated carbon should be the negative electrode whereas the reverse obtains. Further, the E. M. F. calculated, according to the author's view of the action, is equal to that actually found for the element.—Ex.

A SMALL ELECTRIC LIGHT EQUIPMENT.

The application of a small electric light equipment, one that can be made portable, if necessary, is thoroughly appreciated by small power users who desire either power and light or light alone for a few lamps, charging storage batteries, etc. At the present writing the march of the British in the Transvaal by day and night to the relief of Kimberly is made possible by the use of portable electric light plants, operating search lights, which illuminate the



Small Steam Driven Electric Light Plant.

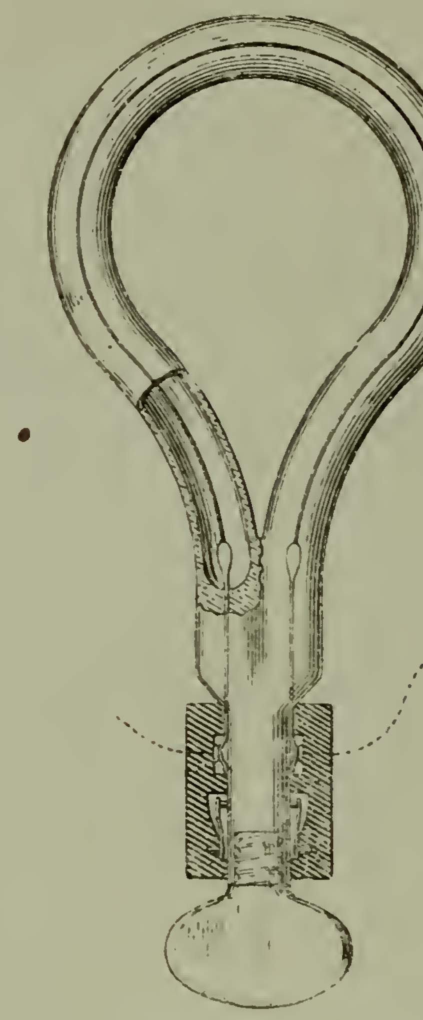
roads and render the advance of the British forces comparatively safe. This application of these small plants does not end in the army but is also found in cases of fire and accident where a search light performs an important function at the proper time. With a gasolene heated boiler and an engine and dynamo mounted on an elastic spring truck we have electricity on tap for any sudden call or pressing circumstances.

A NOVEL FORM OF TUBULAR INCANDESCENT LAMP.

A novel form of tubular incandescent lamp has been patented, as shown in illustration. The construction differs from that of the ordinary lamp in the respect that the carbon resides within a tube instead of a roomy bulb. The pumping of a tube, however, necessitates about the same amount of labor and time as that of a bulb and the near proximity of the glowing filament to the wall of the tube will cause an unusual degree of heat. On the other hand, the electric lamp occupies much les space and does not call for glass blowing other than that which can be accomplished by comparatively inexperienced operators. Changes in external construction will have little or no effect in improving the lamp but may, in some cases, tend to affect its qualities, either as regards durability or illuminating power.

DESK LIGHTING AS A SCIENCE.

In the early history of electric lighting the use of portable lights for desks and tables were of questionable value on account of the frail character of the flexible cords then manufactured; but as the art progressed the demand for lights capable of being placed in various locations about the desk or table were much sought after. The same styles that were used in the eighties for table lights are still much in vogue; but the great increase in the use of roll top desks has brought out several different forms, many of which are exceedingly objectionable, owing to the fact that every time the desk is closed they have to be lifted out and a proper place found for them on the top of the desk. To a man whose desk is "never closed" this would be no objection, but to one whose desk is frequently closed the trouble soon becomes so annoying as to make "portables" out of the question. This has led in some cases to reflectors mounted on flexible arms or upon clamps which are forced into the pigeonholes of the desk with wires leading through let-



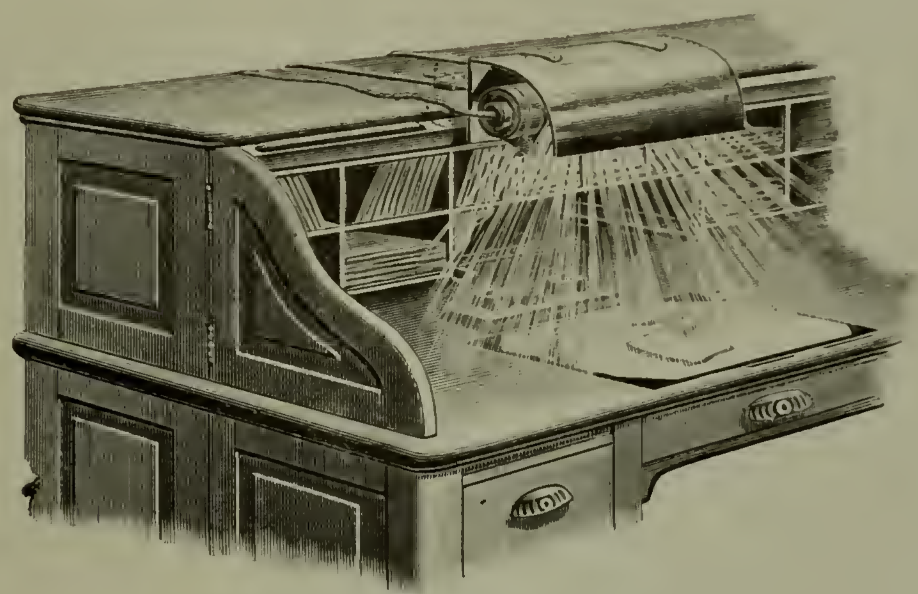
Novel Type of Incandescent Lamp.

ter slots or holes drilled through the desk; but this class of light is not without real objection inasmuch as the wires are liable to become broken in the desk, which is usually filled with inflammable material.

The least objectionable of the unscientific attempts which have been made in this line is the one which is mounted on the top of the desk with a movable slide. This form of lamp throws the light down upon the table of the desk, and while the lamp is fresh gives a full sixteen C. P. light, but as soon as the lamp becomes at all "aged" the light deteriorates until it is no longer usable.

In the "IMPROVED DAYLIGHT DESK" lamp, the principles involved in parabola reflectors are made use of with the result that the light of a sixteen C. P. incandescent lamp is greatly multiplied and diffused over the whole of the desk and sufficiently in front of the desk to enable one to read comfortably without any readjustment of the position of the lamp or reflector. The form of the lamp is such that a peculiarly soft light, most nearly approaching daylight, is obtained with any style of incandescent lamp, supported by any of the standard sockets.

The position of the reflector is such that no cords are taken within the desk, nor is it necessary to disturb the lamp in any way in opening or closing the desk.



Kinsman Improved Daylight Desk Lamp.

The design of the lamp makes adjustable reflectors or screens unnecessary, while the price is within the reach of any clerk or bookkeeper.

Electrical Novelties.

THE "MATCHLESS" ELECTRIC CIGAR LIGHTER.

With the increasing complexity in our surroundings and the conditions of daily life there seems to be an ever-increasing risk of fire. This risk is manifested in various ways, some of which may be traced to careless acts or thoughtless deeds, others to a too great dependence upon appliances or apparatus which is deficient in not affording the protection anticipated. One of the great dangers from which fires continually arise is the careless use

"Matchless" Portable Stand Lighter.

of matches, particularly by smokers. Not only is a match a disagreeable article to use on certain occasions but exceedingly dangerous in the neighborhood of curtains or when the floor is littered with combustible materials. Realizing the shortcomings of the match the "Matchless" electric cigar lighter has been introduced, which dispenses entirely with matches and simply calls for a minimum of knowledge in obtaining a light. If the torch is merely removed from its resting place the end of it lights up ready for use. If the torch of this electric cigar lighter falls to the floor the flame even then can do no damage, as it is always an inch above the surface upon which the torch may rest and in less than sixty seconds will die out. The "Matchless" electric cigar lighter is therefore an article of the utmost convenience to smokers and a device of the utmost safety to the owners of cigar stores, cafes, restaurants, etc. In the private home it is the means of avoiding unnecessary risks and consequently has met with great appreciation on all sides. The "Matchless' electric cigar lighter is built for electric light circuits and can be used on any voltage current, alternating or direct, up to 240 volts or on battery circuits. This article has met with the endorsement of the Board of Underwriters and Fire Department and is manufactured by Stanley & Patterson, 32-34 Franfort street, New York.

'Matchless' Wall Light.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING NOV. 18, 1899, $3,439.00.

New York, N. Y., Nov. 18, 1889.—The following export of electrical materials are from the port of New York for the week ending this date:

Antwerp.—44 cases electrical material, $1,362.

Amsterdam.—2 cases electrical material, $37.

Athens.—2 cases electrical material, $108.

Central America.—10 cases electrical machinery, $603; 3 cases electrical material, $122.

Genoa.—5 cases electrical material, $354.

Japan.—3 cases electrical machinery, $1,819.

Liverpool.—4 cases electrical material, $225.

Mexico.—3 cases electrical material, $53.

Manchester.—3 cases electrical machinery, $743.

Marseilles.—38 cases electrical material, $10,548.

New Zealand.—1 case electrical machinery, $75.

Odessa.—5 cases electrical material, $311.

Peru.—1 case electric material, $70.

St. Petersburg.—65 cases electrical machinery, $14,710.

U. S. Col.—8 packages electrical material, $190.

Uruguay.—3 cases electrical material, $9.

Venezuela.—10 cases electrical material, $100.

NEW INCORPORATIONS.

New York, N. Y.—The Brokers' District Telegraph Company has been incorporated; capital, $10,000; directors, Samuel M. Richardson, Henry D. Huck and George H. Vandewalker, of New York city.

Point Marion, Pa.—The Springhill Electric Light and Power Company, to supply light, heat and power, has been incorporated; capital, $1,200; incorporators, A. S. Maple, O. A. Miller, both of Point Marion; F. S. Ruff, J. J. Quertimort, J. J. Mayer, all of Jeannette.

tenance Company of America—principal office, No. 421 Market street, Camden, N. J.—has been incorporated to manufacture electrical contrivances; capital, $100,000; incorporators, Charles S. Reber, William H. Stirling, Daniel S. Mishoe, all of Camden, N. J.

New York, N. Y.—The Perfect Arc Lamp and Manufacturing Company has been incorporated to manufacture electrical devices; capital, $100,000; incorporators, L. Sylvester, of New York city; C. Hagedorn, R. Ward, both of Brooklyn.

St. Louis, Mo.—The W. A. Fuller Electric Company has been incorporated; capital, $5,000; incorporators, W. A. Fuller, J. B. Carroll, G. W. Grant.

Auburn, Ill.—The Auburn Electric Light Company has been incorporated, with a capital of $8,000; J. A. Wheeler, W. H. Ramsay and Geo. W. Hutton, incorporators.

Paterson, N. J.—The Union Water, Light and Power Company has been incorporated. The capital stock is $1,000,000.

Port Marion, Pa.—The Sprinfield Electric Light Company has been incorporated, with a capital stock of $12,000.

TELEPHONE CALLS.

Trenton, N. J.—The United Telephone and Telegraph Company has been incorporated; Alexander Brown, Henry A. Parr, T. J. Hayward, S. D. Warfield, James Bond, all of Baltimore, and John Haddon, of Jersey City, are the incorporators; the capital is $5,000,000.

Grove City, Minn.—The Grove City and Rosendale Telephone Exchange Company has been incorporated, to conduct and operate telephone exchange; capital, $2,000; incorporators, B. Bresden, N. N. Waylander, A. Liedholm, of Grove City; M. P. Madison, L. P. Sorenson, H. P. Anderson, all of Rosendale.

Lamont, Ill.—The Valley Telephone Company has been incorporated; capital, $10,000; incorporators, F. W. Welch, E. L. Husten, J. A. Freed, all of Chicago.

Flora, Ind.—David E. Miller, manager of the Flora & Bringhurst Telephone Company, has been granted a franchise to construct and operate an exchange at this place. It is understood that the Miller lines will soon be connected with the lines of the new company, of Indianapolis.

Parma, Mich.—The North Parma Telephone Company will soon have a line running into Concord township, as well as a line from Devereaux to this place, and will connect with the state line in this village.

West Milton, Ohio.—The Progress Telephone and Telegraph Company is extending its lines north from Pleasant Hill, north and south from Potsdam, and expects soon to build east from Troy and southeast from West Milton.

STREET RAILWAY NEWS.

Cleveland, Ohio.—The Cleveland, Barberton & Western Railroad Company, of Barberton, capitalized at $250,000, has been incorporated by C. C. Benner, Forest Firestone, Edwin E. Voris, Wm. A. Johnston and Philo Buel.

West Liberty, Pa.—The West Liberty Street Railway Company has been incorporated; capital, $12,000; incorporators, H. Moore, J. C. Fisher, J. S. McKelvey, all of Pittsburgh; A. C. Wettengel, of Elliott; G. Hook, Jr., of Bellevue.

Wilkesbarre, Pa.—The Wilkesbarre Street Railway Company has been incorporated; capital, $60,000; incorporators, M. B. Williams, W. Conyngham, J. N. Conyngham, A. A. Sterling, all of Wilkesbarre; A. G. Nesbitt, of Kingston.

Wooster, Ohio.—The Barberton Doylestown & Massillon Electric Railway Company has been incorporated with a capital of $50,000.

POSSIBLE INSTALLATIONS.

St. Louis, Mo.—Plans are being prepared by J. H. Lynch, Imperial Building, for the Bethesda Hospital, to be erected on Vista street near Grand. The hospital will have an isolated electric plant.

Calumet, Mich.—Capitalists of this place are organizing a stock company to erect an electric lighting plant at the little town site of Lake View, a mile from the city, and purpose to furnish lights for business houses and residents in Calumet, Red Jacket and Laurium.

LaFayette, Ind.—The LaFayette Cracker Company will expend $30,000 in improving their plant. An electric plant will be installed.

Cooper, Tex.—The City Council of Cooper, Delta County, is considering the proposition of putting in an electric light plant.

Shippensburg, Pa.—Members of Town Council are talking of a new electric light plant for this borough.

Dysart, Iowa.—The City Council of Dysart is now agitating the feasibility of putting in a gas plant for the purpose of lighting their city.

DeGaff, Ohio.—The Council has called an election to vote on the question of issuing bonds to enlarge the electric light plant.

CANADIAN ELECTRICAL NEWS.

(Special Correspondence to The Electrical Age.)

Montreal, Nov. 14th, 1899.

Bear River, N. S.—An agitation is on foot to construct an electric railway from this place to Digby.

St. Catherines, Ont.—The Niagara Central Railway will this week commence the conversion of the road between this city and Niagara into an electric line. The extension to Port Dalhousie will be undertaken at an early date.

Janetville, Ont.—The promoters of the Lindsay, Bobcaygeon and Birkton Railway held a meeting last week to further the scheme.

Hamilton, Ont.—It is stated that the Cataract Power Co., syndicate, will at an early date commence work on the proposed roads to Galt, Guelph and other cities. A double track will be built to Rock Chapel and a single track to Guelph, Galt, Berlin and Waterloo. Grading will likely commence this fall.

Ottawa, Ont.—The Ottawa Car Co. has purchased property on Albert street for the purpose of building an extension to their car shops. The Metropolitan Electric Co. expect to commence the construction of their power house this week. Tenders are invited for delivering 1,000 yards of blue clay at their works at Britannia Bay.

Woodstock, Ont.—Messrs. Iekes & Armstrong have accepted the franchise for electric street railway as offered by the town, and the work of the building will be commenced at an early date.

Rossland, B. C.—The Rossland & Sophie Mountain Electric Railway Co. is seeking incorporation. T. J. Ducan and W. A. McDonald are interested.

Hespeler, Ont.—The Galt, Preston & Hespeler Street Railway Co. will build a new station at this place.

Bracerbridge, Ont.—There is talk of an electric railway being built to connect Bracerbridge with adjacent points.

New Westminister, B. C.—It is understood that work will be commenced at an early date on the proposed tramway station and shed for the British Columbia Electric Railway Co.

Niagara Falls, Ont.—The town council is considering the offer of the Niagara Central Railway for the extension of the road and its conversion into an electric line.

Goderich, Ont.—The Water and Light Committee of council recently asked for power to purchase two 100 light transformers and belts for engine and dynamo.

New Westminister, B. C.—A local company has been organized to manufacture electric light carbons, they having secured water power right on Stave river.

Valleyfield, Que.—The Montreal Cotton Co. are excavating for a large extension for their electric power house.

Woodstock, Ont.—The question of municipal ownership of the electric light plant is engaging the attention of the council.

Ashcroft, B. C.—The Ashcroft Water, Electric Light and Improvement Co. purpose installing additional electrical apparatus.

Port Arthur, Ont.—The Ontario and Rainy River Railway Co. is preparing to construct a telegraph line from this place to Duluth.

Almonte, Ont.—The by-law to authorize the town council to borrow $30,000 to establish an electric light plant was defeated by the rate payers last week.

Grand Forks, B. C.—It is said that $30,000 will be expended within the next three months in improving the electric light system.

Bracerbridge, Ont.—C. H. Mitchell, C. E., of Niagara Falls, has made a report to council concerning the proposal to increase the power for electric lighting purposes. The proposed improvements will give an increase of about 600 horse-power, and will cost about $20,000. The power-house will be built at the foot of the falls.

Lewis, Que.—The council is about to construct an electric light system and invites competitive plans for same. These plans are to be received by January 1st, 1900. The first prize to be $1,000, and the second $500. Particulars may be obtained from Flavien Roy, secretary-treasurer of the municipality.

Quebec, Que.—Plans will be prepared at once for a large building for the Jacques Cartier Electric Light and Power Co. to be built on Lyons property, corner of St. John's and Auteuil streets. Mr. Ed. Slade has ben appointed manager of the company.

Weston, Ont.—R. H. Leighton, village clerk, invites offers for purchase of $7,000 of electric light debentures.

Winnipeg, Man.—The Bell Telephone Co. have decided to construct a long distance line between Winnipeg, Portage la Prairie and Neepawa. Mr. T. G. Shaughnessy is president of the company.

Wroxeter, Ont.—A company has made a proposition to establish an electric light plant here.

Newcastle, N. B.—Mr. Duncan, engineer, is preparing plans for the proposed electric light system.

Shelburne, Ont.—The council is still considering the taking over of the existing electric light plant or the installation of a new one.

Severn Bridge, Ont.—It is said the Mickle, Dyment & Son will probably supply electric lighting to the village.

Strathroy, Ont.—The Strathroy Electric Co. have refused to supply electric lighting at the price offered by the council.

Murray Bay, Que.—The American visitors at this place are forming a company to establish an electric light plant.

J. ALCIDE CHAUSSE.

NEW YORK NOTES.

P. C. ACKERMAN is meeting with his usual success which prevailed during his connection with Eugene F. Phillips. The Rhode Island Electric Works, whom he is now representing, have superior facilities for making every line of insulated and bare wires and cables for overhead, underground, submarine, office use, etc., as well as trolley wires and cables for electric railways. Their works are equipped with all the latest tools and machinery needed in the improvements constantly made in this line. Through Mr. Ackerman's experience his company has been placed in the front rank of the industries in his line. He is always to be found at his post, courteous and genial as ever. Mr. Ackerman occupies a suite of offices in the Havemeyer Building, 26 Cortlandt St., New York City.

JOHN CARROLL, late secretary and treasurer of the Eugene F. Phillips Electrical Works, of Montreal, Canada, is in town. It came as a great surprise to us to learn that Mr. Carroll was out of the management of the above works. He organized this industry nearly ten years ago, at a time when there was a growing demand for insulated wire and cables in Canada. Mr. Carroll has made himself very popular with the electrical trade of Canada, and through his energy and push developed an immense industry from a small business, adding many new features year by year as the business of that section increased. Mr. Carroll was one of the active spirits in the reception tendered the National Electric Light Association by the people of Montreal in 1891. Never before or since in its history has such homage been shown to the association, and Mr. Carroll worked day and night to make the meeting the success it was. His foresight into the future of the business that has since developed reflects the greatest credit upon him. The great insulated wire and cable industry which Mr. Carroll has built up in Canada will always remain a monument to his thrift and energy. Mr. Carroll has lost none of his genial uprightness and activity and will become an active spirit in the success of any industry fortunate enough to secure his services.

THE PERFECT ARC LAMP MANUFACTURING COMPANY, 137 Raymond St., Brooklyn, N. Y., have purchased the plant and assets of the Hagedorn & Ward Manufacturing Company, of the above address, and are now manufacturing all of the specialties formerly made by the latter firm, such as enclosed arc lamps in eight different styles, from 12 to 16 inches and from 1.75 to 7 amperes; also constant current, 6.8 amperes, and alternating current arc lamps, all alternations. They also manufacture the Perfect high voltage switches of all carrying capacities. Mr. Louis Sylvester, a prominent tobacco manufacturer of 165 Front St., N. Y., is the president of the company; Robert Ward, a well-known real estate man of Brooklyn, vice-president; Charles Hagedorn, secretary and treasurer; Bennerd H. Pomeroy, E. E., superintendent and electrician.

The Electrical Age.

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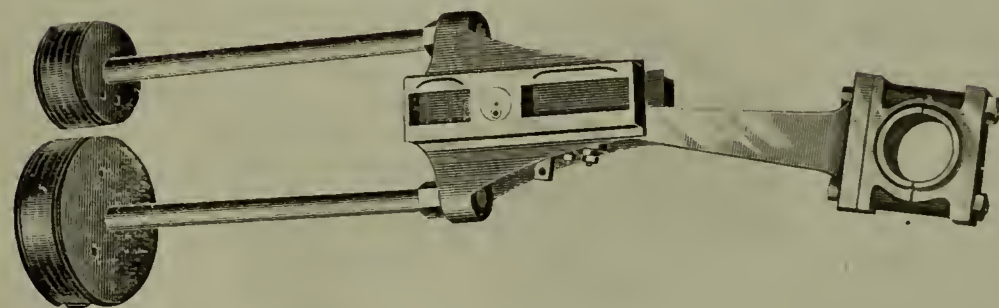
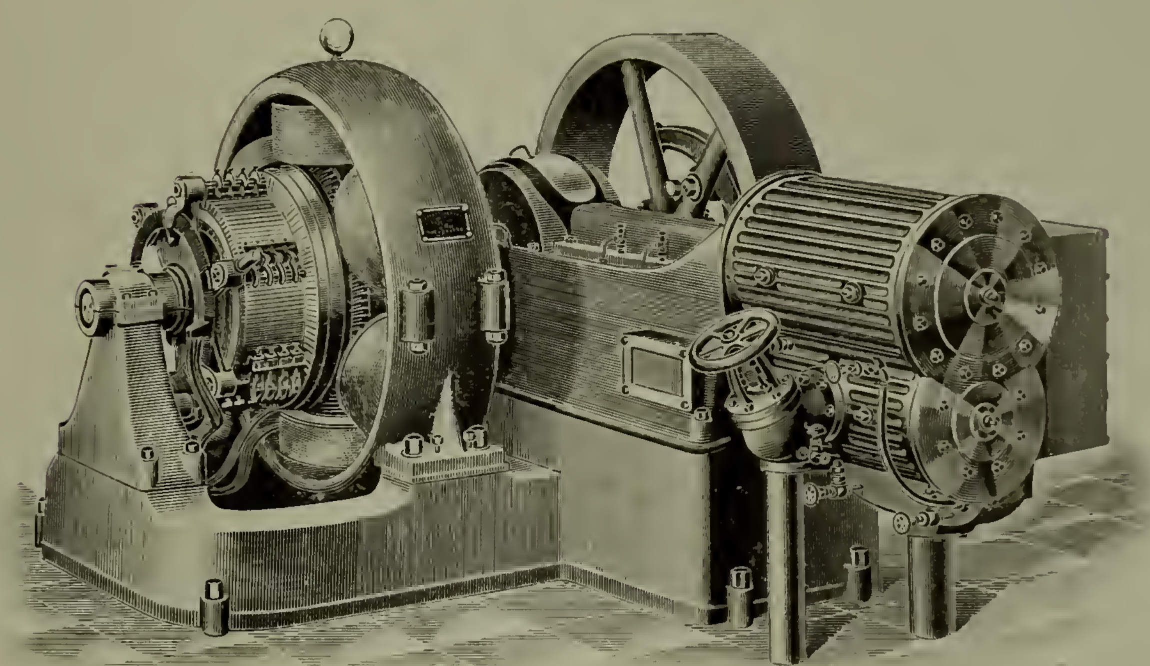
Electric Light and Power Installations.



View of Crankhead and Piston of American Ball Duplex Compound Engine.



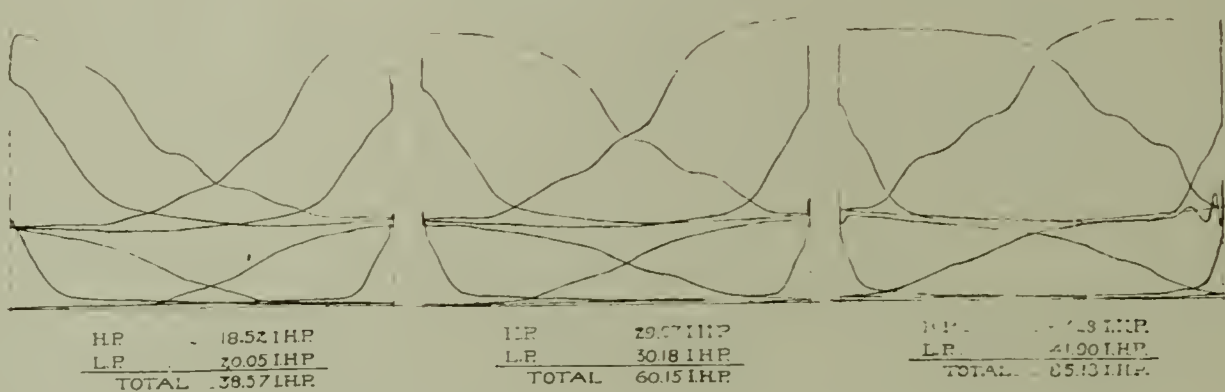
American Ball Duplex Compound Engine Direct Connected to Generator.

THE AMERICAN BALL DUPLEX COMPOUND ENGINE.

The manufacturers of steam engines and generators have long realized that it is only by co-operation that either can expect to attain that true perfection which is collectively represented by elegance of design, efficiency of operation and smoothness in running. The American Ball duplex compound engine and generator is an instance in which this co-operation of parts has been so eminently successful that large and well-known houses have made their choice of a direct connected plant of this description. The engine is the design of Mr. Frank H. Ball, an engineer of national repute and his son, F. O. Ball, whose various undertakings in the mechanical profession have been eminently successful. In the construction of the high speed engines with which Mr. Ball has been identified from almost the earliest days of its history and the parallel development of the electric light generator we find a case in which all the resources of modern science are brought into play to fulfill those conditions most desirable for their successful introduction. A simple machine which is light, efficient, smooth-running and not too expensive will meet with the appreciation of every fair-minded purchaser. In the American Ball duplex compound engine, illustrated in these pages, the feature of compactness is self-evident. Both cylinders and pistons are approachable from all sides and a single valve and valve gear reduces its care and handling to the lowest terms. Being as simple as a single cylinder engine and as highly economical as a compound engine no room for criticism is left, of either a commercial or technical nature.

In the design of the crossheads and pistons ease of operation is secured in connection with great mechanical strength. At the same time these two features are accompanied by a third in the nature of extreme lightness in weight. The cut-off in both cylinders occurs simultaneously, thereby giving to each its full and proper quota of work, from the lightest to the heaviest load, without the possibility of an unequal division. In the indicator diagrams is shown that at the three stages of load the division of work is equal; the steam distribution perfect and the operating conditions unaffected by the demand made upon the engine. The variations in the load of the generator, which can only be successfully met by a well designed and rapidly regulating engine, are not noticeable in the operation of the plant as a whole.

The generator designed and built by the American Engine Company, of 48 Raritan Ave., Bound Brook, N. J., is light in weight, efficient in operation and noiseless when running. There is no undue heating in any part; the commutator, brushes and general regulation inviting no criticism. The two combined represent the finest product of American skill and enterprise in the construction of electric light and power machinery. The following well-known concerns have purchased plants of the above description: The National Transit Company, Continental Iron Works, Weston Electrical Instrument Company, Standard Paint Works, James McCreery, Marlin Firearms Co., Western Electric Co., United Gas & Improvement Co., F. H. Richardson, World's Dispensary Medical Association, etc.



Indicator Diagram of American Ball Duplex Compound Engine.

Applications of Electric Power.

THE PRACTICAL APPLICATION OF ELECTRIC MOTORS TO PRINTING PRESS MACHINERY.

BY W. H. TAPLEY.

(Continued from page 268.)

One word about the protection of the employes before leaving this subject. Carelessness bred by familiarity is the great source of danger to the majority of employes, and lessening of results from this demands thoughtful consideration. By way of illustration I will narrate two such instances, which have come under my personal observation.

(1) A laborer was cleaning a press, while in motion, with cotton waste; this caught in the gear wheels, drawing in his hand. The circuit breaker opened promptly, owing to the increased power necessary to overcome the resistance of his fingers between the gears. The press stopped before the entire hand was drawn ito the moving macvhinery—three fingers only being hurt, one sufficiently to need amputation. Had fuses been the protection instead of a circuit breaker, nothing could have saved this man's entire right hand.

(2) A young lady passed too close to some moving machinery—three fingers only being hurt, one suffi-
on account of the closeness of rapid-moving presses—her dress skirts in some manner became entangled in the moving gear wheels, drawing her over against the machine; the quick opening of the circuit breaker stopped the press, with a result to her of a torn dress and a nervous shock.

The results which would have occurred in both instances, had circuit breaker not been in use, are sufficient to justify the employes in expecting that the highest type of protective devices will be used wherever possible.

The flexibility of the circuit breaker, in that it protects more than the motor, saving during the year in repairs more than its cost, clearly shows that it is a wise investment.

When installing an individually equipped printing press, the printer should insist on its use.

Maintenance.—Under this heading offices of reasonable size only will be considered, also assuming that presses are in constant use. Here the most satisfactory course to pursue is to have the care, inspection and responsibility of maintenance located at one source. One man should be intrusted with this work; a little study in systematization will accomplish all this while presses are "making ready," or at least so as not to interfere with work of production.

Inspection once in two weeks or once a month will do, in offices not too busy; this will keep down repairs, and, most important of all, keep the plant in A1 running condition, ready for anything.

Leaving care of motors to pressmen and laborers is a bad practice for everyone but the repair man. Not alone will the repairs increase, but, most serious of all, the press stops earning money when out of order, and at $10 or $15 a day this becomes expensive.

A good man who is able to turn off commutators, keep controllers in order and has a general idea of the electrical and press equipment, will pay for himself many fold during the year.

Small offices, like our branch offices, we look at once in two months.

Cost depends on what you are able to secure the services of such a man for—$2.50 to $3 per day.

Records should be kept of all repairs made and material used, if exact cost of maintenance is desired. This provides means of tracing where delays occur, whether in press proper or its driving motor.

Cost of Operation.—Herein figures can be used to obtain nearly any result desired, unless we demand full particulars, necessitating elaborate statement of all existing conditions. Having made most careful tests, the manufacturer cannot be guaranteed that his plant will operate within test figures, unless all conditions in commercial work are similar; these are impossible, so we are forced to make a test covering months of work, striking a balance from the results obtained; these will give average commercial figures, which in most cases will show an increase over a short test under favorable conditions.

To realize how much depends on the pressman, I desire to call attention to some facts with regard to two new presses recently installed in our office. These were "Century" two-revolution front delivery, bed 43x56 inches; connected to each press was a C-W, 2-100 compound motor, speed 130 to 230 revolutions per minute.

All went well for a month or so, then complaint was made that one of the presses ran slower the longer it was in operation. An examination disclosed the fact that the motor was apparently not large enough for the press, as the fields and frame became so warm that the hand could not be held on it for any length of time. Speed dropped from 180 to 140 revolutions per minute, after which circuit breaker was constantly opening, and it became necessary to shut down press every two hours or so that motor might cool off. A test showed that the press took 46 amperes at 120 volts; speed, 144 revolutions per minute; this was on fifth speed; moving handle to sixth and last point with circuit breaker set at 58, latter would open every time; this was reset at 70, and ammeter indicated 60 when change was made to last speed; current used, 48 amperes at 160 revolutions per minute. Press labored and did not run smoothly.

On examination we found that the track gibbs had been set up too close; after properly adjusting these and having press thoroughly oiled, we increased speed to 180 revolutions per minute, current consumed dropped to 30 amperes; even then the press was stiff, for its companion was running at 182 revolutions per minute on 22 amperes, both doing same class of work.

This showed the press was taking 60 per cent. more current than it should had only ordinary care been used, while it was consuming 100 per cent. more than its duplicate, working under similar conditions.

A commercial figure ought to show an increase of 15 to 20 per cent. over efficiency test.

A hurried glance at the comparative cost of operating belted, geared and direct connected motors is desirable, although a complete analysis is impossible to include in this paper owing to its length.

Belted motors, unless grouped, will not be considered, as they have no commercial standing for economy.

First, considering grouped presses of medium size, running from main line shaft, driven by a single motor. A line of drum cylinder presses of various makes, operated by belting afterwards driven by individual motors, gives actual commercial condition worthy of comparison. Taking, for example, thirteen drum cylinder presses in a row, with belting reduced to a minimum, a large motor belted to center of shaft, thus distributing load equally on hangers; using a 15 horse-power motor, so with all presses at work motor is running at about 75 per cent. load—very favorable conditions.

During two months these presses made 2,892,175 impressions, consuming 1,601,200 watt hours, or an average of .553 watt hour per impression.

As soon as possible after equipping these presses with 2 horse-power geared motors wattmeter records were taken. For four of the heaviest runing presses, a six months' continuous test showed the following:

Impressions, 3,813,542. Watt hours, 1,851,100, an average of .485 watt hour per impression, a saving of 14 per cent.

While disconnecting presses one by one, to equip same individually, the average consumption per impression for the remaining presses increased very rapidly. With five presses working we used between 50 and 60 per cent. more current per impression.

(To be concluded.)

Electro-Therapeutics.

ANIMAL ELECTRICITY.

W. S. Hedley, in the London Electrical Review.

Animal and metal currents were first clearly differentiated by du Bois-Reymond. He considered, and it is difficult to prove the contrary, that a natural electric current exists in normal resting muscle, "current of rest." During the action of the muscle he proved the existence of a current in the opposite direction to the "rest current." This was called "the negative variation," now known as the "current of action." Hermann combats the opinion that a resting uninjured muscle shows any current, and holds that the so-called "current of rest" is the result of chemical or other inequalities due to the injury. The views of English physiologists are as follows:

1. Normal muscle or nerve gives no current.

2. Local injury produces a current through the muscle from the injured to the living part.

3. Local action produces a current through the muscle from the active to the resting part.

Thus an injured or an active muscle produces electromotive force, and as in the Daniell cell the current goes from the active plate (the zinc) to the copper, so does the current travel in the injured muscle from the injured part to the sound part. When the circuit is completed through a galvanometer, of course the direction is reversed, and it is usual to describe the direction of a current in its relation to the galvanometer. The manifestation of the sudden difference of potential which is the result of stimulation is sometimes spoken of as the "excitatory variation" when the muscle is referred to, and as the "action current" when the galvanometer is referred to.

If a muscle giving the muscle current ("injury current") be tetanized, an action current will proceed from the uninjured to the injured part, i. e., from the part more capable of action to the part less capable of action. This current being in a direction opposite to the muscle current (injury current) constitutes a counter electro-motive force which tends to cut down or diminish the muscle current, and this diminution is the "negative variation" of du Bois-Reymond—"action current" of Hermann.

A contraction wave propagated along the fibre of an uninjured muscle is accompanied by an electrical disturbance traveling from the active to the resting part, and this variation (as revealed by a galvanometer uniting two electrodes placed at an interval on the surface of a muscle) is double or diphasic for the obvious reason that the action is not simultaneous throughout the muscle, but requires time for its transmission.

By far the most striking manifestations of animal electricity are, of course, to be found in electric fishes; here the nerve surfaces represent the active element of the battery, viz., the zinc in the Daniell cell. The electromotive action accompanying voluntary muscular contraction in the human subject has been demonstrated by du Bois-Reymond, and that accompanying tetanic contraction from electrical stimulation by Hermann. Physiologists consider that the variation of electrical potential from the beat of the human heart has been demonstrated. It is by some regarded as proved that the white columns of the spinal cord give electrical signs of nerve action, and even that action currents are manifested by the gray matter of nerve centers. The skin of all animals is traversed by an electrical current from without inwards. This is considered to be caused chiefly by cutaneous glands, but partly by the skin itself, as is proved in the case of the eel, whose skin has no glands. The action of light upon the retina causes an electrical change, i. e., a current accompanies retinal activity, as it does muscle activity. Indeed, it is probable that electrical phenomena always accompany vital action.

Stray Currents.

AN ACOUSTIC CONTACT BREAKER.

An improved contact breaker consists essentially of a tuning fork, of which the natural period of vibration can be synchronized with the alterations of the supply current.—Ex.

"RUBBING IT IN" ON THE HORSE.

An automobile is to be used by a Texas stockman in making inspections around his ranch. As far as the horse is concerned, this is "the most unkindest cut of all."—Ex.

TELEPHONY WITHOUT WIRES.

Dr. Peter Stein, the Russian electrician, will give a semi-public demonstration of a system of telephoning without wires, which he has invented. He anticipates that with his system wireless telephone exchanges will be possible, and persons provided with his portable electric instrument will be able to communicate with each other.—Ex.

VULCANITE.

This material which is sometimes called ebonite, is made from india rubber or caoutchouc and bitumen mixed in the proportion of about 2 to 1 by weight, and is then subjected to heating and considerable pressure. After undergoing these processes it is very hard, and is readily polished; it is very largely used in the manufacture of buttons, combs, knife handles, etc., etc.—Ex.

ELECTRICITY IN POWDER MILLS.

Considering the fact that electricity is so largely used for exploding mines, and that the slightest spark in a powder mill is likely to wreck the same, it is interesting to note that the induction type of electric motor is being largely used in the new powder factory of the United States Naval Department. The absence of a commutator and of all electrical connections to moving parts makes the induction type of motor of great use in such a position.—Ex.

A NEW SWISS ELECTRIC RAILWAY.

An electric funicular railway has just been completed up to the Schatzalp at Davos Platz. The electrical energy used on this line, which is about 2,200 feet long, is obtained from dynamos driven by gas-engines. Owing to the cost of the line having come out at much more than was estimated, an endeavor is being made to get permission from the Federal Government to increase the fares, and in consequence of this the opening of the line is being delayed.—Ex.

AN ELECTRIC TICKET SELLER.

There is at present under construction an electric machine which will be used on the elevated railroad stations in this city for selling tickets. The machine referred to is to be constructed in such a way that when you drop your nickel in the slot you will receive a ticket in exchange. There will be four of these on each of the larger stations. The reason this system has been adopted by the railroad trustees is to do away with the expense of having an agent on each station. It is believed that the machines now under construction will be put into use within a few weeks.—Ex.

THE ZEEMAN EFFECT.

In an extract from correspondence between Sir Norman Lockyer and Prof. Preston, printed in Nature in the issue of November 2d, the later defends his priority to Prof. Cornu in the discovery of the quadrupling of the spectral lines in a strong magnetic field. Prof. Preston published descriptions and photographs of triplets and quartets in a paper read before the Royal Dublin Society, December 22d, 1897. Prof. Cornu announced his discovery of them in the Comptes Rendus in the course of 1898. Prof. Preston has since shown that in a stronger field the quartet is resolved into a sextet by the splitting of the outer lines.—Ex.

ELECTROLYTIC LAMPS.

A patent recently issued to W. E. Irish describes a modification of the ordinary arc lamp, by means of which a rod or tube of some material which, when heated, conducts the current and emits light at a high efficiency, is substituted for the arc between two carbons, the arc serving as a means of heating this material and thereby starting the lamp. In one arrangement, the arc is surrounded by a sleeve of normally non-conducting oxide, of a rare earth, which is heated by the arc until it becomes a conductor; the arc then may be extinguished, leaving the sleeve incandescent. The idea is not without importance; if it is found that electrolytic bodies cost less for maintenance and electricity supply than arc lamps, we have here a ready means of converting the latter.—Ex.

WIRELESS TELEGRAPHY BETWEEN BALLOONS.

Experiments are being made at Vienna on the possibility of communication between balloons by wireless telegraphy, and they have met with some success. A captive balloon takes the place of the tall mast as used in the Marconi system. A copper wire is stretched between it and the earth, where the transmitting apparatus is placed. The second balloon, which ascends freely, carries the receiving instrument and is furnished with a wire 60 feet long hanging downward from the basket. The balloons received an transmitted messages up to a distance of six miles and at an elevation of about a mile. Of course, the great difficulty will be to establish a transmitting station in a free balloon, both on account of the weight of the necessary apparatus and also because there is danger of discharges from the powerful condenser so near the inflammable gas of the balloon. Future experiments will be looked for with interest by all who are engaged in making a study of wireless telegraphy.—Ex.

DISSIPATION OF ELECTROSTATIC CHARGES BY LIGHT.

The following is an abstract of a paper contributed by Oscar Knoblauch to the Zeitschrift fuer Physikal. Chemie, and appears in the Journal of the Chemical Society: "Many negatively-charged substances when illuminated gradually lose their charge, as may be shown by connecting them with an electrometer. The author has examined numerous substances in this way, and finds that those which are sensitive to light have a special tendency to lose an electrostatic charge. The discharged electricity must be conveyed by ions either of the substance itself or of the superficially-absorbed oxygen. Only negative charges are lost by dissipation, hence the discharged ions must be negative whether the substance is metal, sulphur, or glass. The author accordingly regards the dissipation as depending on an oxidation process, the loss of charge being effected by negative oxygen ions. In accordance with this view, oxidisable substances, such as sulphides and photographic developers, are found to lose their charges under the influence of light, whilst highly-oxidised substances like sulphates and permanganates are not affected. The fact that certain substances such as zinc take a positive charge when illuminated may be similarly explained. The oxidation of phosphorus is an analogous phenomenon."—Ex.

Hamilton, Ohio.—The Eaton Telephone Company has been incorporated, with a capital stock of $50,000. The directors are W. W. Morrison, of Bryan, Ohio; Fred J. Bollmeyer, of Wauseon, Ohio; C. F. Brooke, Jr., C. B. Cokefair and John Alexander, of Eaton.

Pass Christian, Miss.—The American Telephone and Telegraph Companw, to construct and operate telephone and telegraph lines, has been incorporated: capital, $25,000; incorporators, E. J. Hall, E. P. Meany, M. Eklestom, C. R. Bangs, A. W. Crandall, T. M. Miller.

The Electrical Age.

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CONTENTS:

TELEGRAPHING ONE HUNDRED AND TWENTY THOUSAND WORDS AN HOUR.

Receiving and sending signals by means of the Marconi system of wireless telegraphy is a feat well worthy of note at the close of this eventful century. The final acceptation of this system and its complete recognition by various governments of the world is indubitable proof that it possesses qualities of such importance that it may enter into and become established as a part of America's or Great Britain's naval equipment. When signals are received at sea from out of an apparent void of silence and darkness a certain sense of the mysterious will pervade one's being in spite of the strictly scientific nature of the test. Two difficulties present themselves, however, in relation to wireless telegraphy which have been fully appreciated by its promoters. They are first, the present impossibility of signalling only to a given individual, thus allowing any one supplied with a receiving device to obtain information not intended for him; and secondly, the obstacles in the way of rapid signalling. As it is a non-selective system and a slow system its use is limited to special cases, such as navy work, general marine signalling, coast survey tests, land warfare, etc. In fact, it is immediately applicable to cases which are not related in a commercial sense to the business world, as above outlined. Within these limitations wireless telegraphy meets with no competition, and provides a method of communication which certainly gives it a prominent place in the list of great modern inventions.

Sending dispatches at an enormously rapid rate has been successfully accomplished by means of Squiers and Crehore and quite recently by Messrs. Pollak and Virag, the inventors of the Pollak-Virag telegraph system. At a test made in the World Building on Sunday morning, November 26th, connection was made between New York end and the receiver at the Chicago end. It is difficult to estimate the exact practical limits of this system as signals have already been transmitted with almost inconceivable rapidity. One hundred and twenty thousand words an hour or two thousand words a minute were sent between Chicago and Milwaukee, and one hundred and forty thousand per hour would have been reached had the line between New York and Chicago been in good working order. The idea is simple enough, but its practical development must have called for wonderful patience and perseverance. The transmitting device consists of a metal wheel, over the rim of which a perforated tape passes, allowing a spring pessing against the tape to make and break contact through the perforations. This interrupted current is sent over the line and received in an electro-magnet, similar to a telephone receiver, the diaphragm in front of which vibrates back and forth in response to the impulses coming over the wire. A small mirror attached to the diaphragm reflects a beam of light upon a sensitized tape which photographs the signals with absolute accuracy. The irregular marks on the tape occur in such a manner that those above a line drawn through the middle of the tape mean dots and those below dashes. The Morse code is, therefore, faithfully carried out; the tape may be cut up into lengths of any number of feet, distributed as copy among a corps of telegraphers and set up in type with wonderful rapidity.

To illustrate the application of this system more popularly the following test could be made: sixty reporters working hard one hour would produce two thousand words a piece. At the end of the hour one hundred and twenty thousand words would be ready for transmission. This amount of copy the transmitting end would deliver in one hour to any distant point within a thousand miles. The process of translating the symbols on the tape, transforming them into English, ready for the compositors, is an every day occurrence to large newspapers. It is therefore evident that a single wire which can accommodate so many newspaper men is of the utmost value in connection with the Pollak-Virag system whenever an emergency would arise. A severe storm which has blown down wires, the reports from various war correspondents at the scene of a battle, and other special circumstances which might be called to mind, would provide instances where a high speed telegraphic system would be of immense value. When we look back over the half century that has passed and realize that Morse could transmit but one message over the wire at a time and that very slowly and know that to-day one hundred and twenty thousand words an hour have been sent and received over a single wire we can see the perfection of an ideal telegraphic system near at hand. It would take a keen mind to decide whether it will be a wireless system or one similar to that above described.

LIQUID AIR AND TORPEDO BOATS.

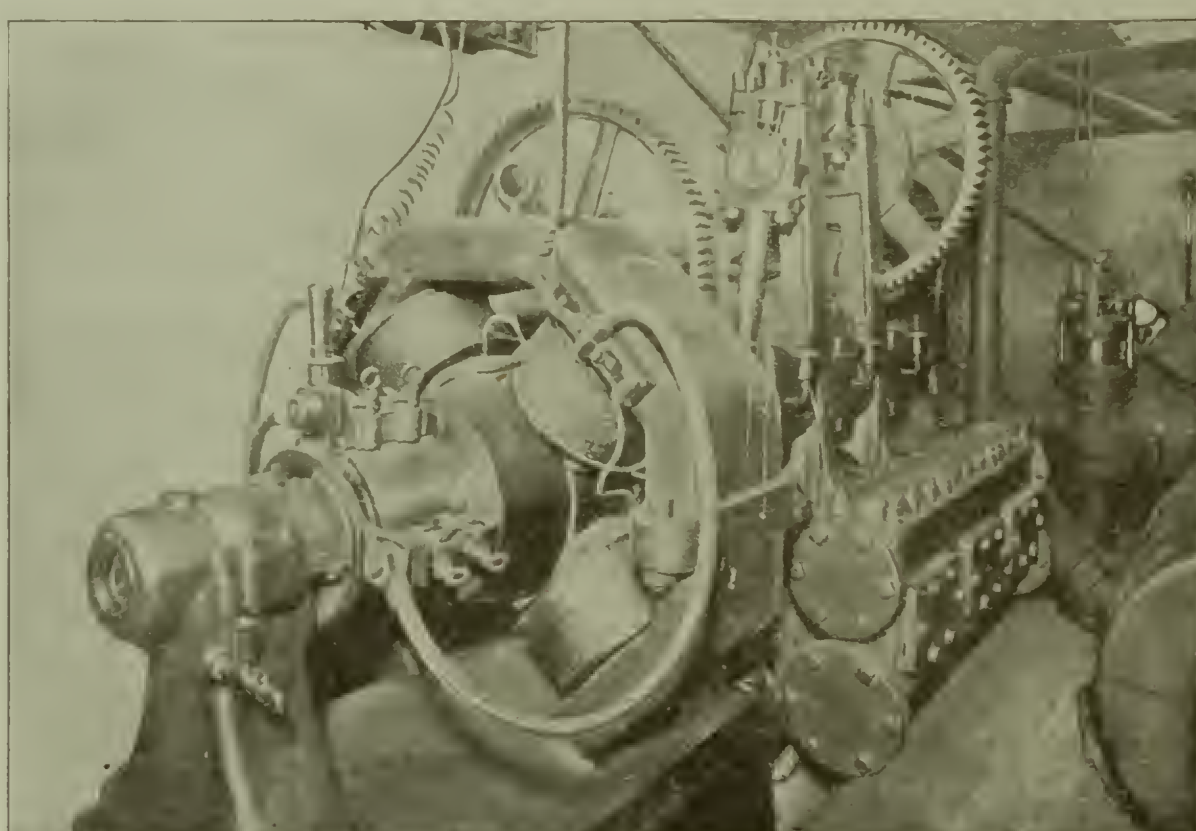
The imminent danger that sometimes attends tests made with submarine vessels to those entombed within might be prevented by the use of liquid air, stored away in tanks provided with proper safety appliances and brought into use when necessity arose. The recent trials of the Holland boat show that a twenty-four hours' submersion with a cerw of seven men is possible, but it would seem as though the immense volume of air represented by a few gallons of the liquified article would absolutely prevent a lack of the life-giving atmosphere on any occasion.

Technical Notes.

ELECTRIC PUMPS.

The application of motors to pumps has been of considerable industrial importance for elevator work, mining purposes and the storing up of water in reservoirs or tanks for future municipal or household use. One cubic foot of fresh water weighs 1,000 ounces, $62\frac{1}{2}$ pounds; one cubic foot contains $7\frac{1}{2}$ gallons; therefore the weight of one gallon is 8.33 pounds. If the number of gallons per minute to be pumped are known and the height to which they must be lifted the horse power required is equal to the product of the number of gallons per minute to be pumped, by the height in feet, by 8.33, the total divided by 33,000. This formula can be simplified so as to give us the horse power equal to the gallons of water times the height divided by 2,600. In other words, if 100 gallons are to be pumped every minute 100 feet the horse power of an electric motor, considering all losses must be equal to 100x100÷2,600 or four horse power. The conditions governing the electro-motive force or pressure in the line, its length, size, etc., the speed of the motor and all that relates to it enter into the province of elec-

Water Falls with Small Head.
(see page 283.)



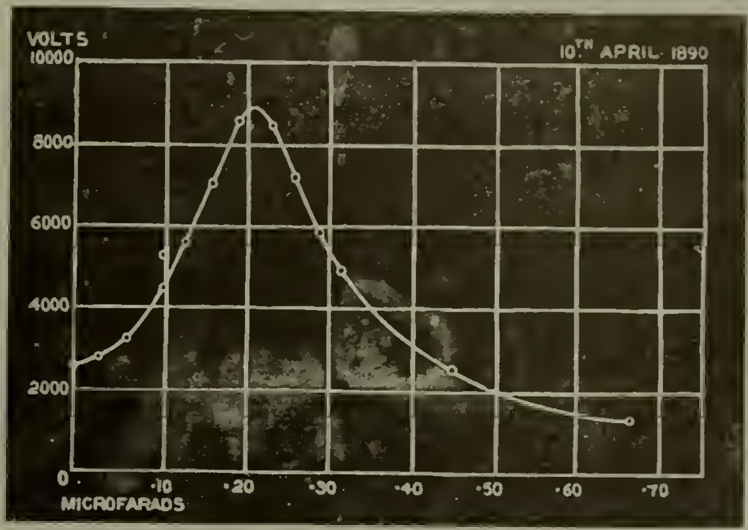
Direct Connected Electric Pump.

trical engineering. With the pump operating at a certain speed per minute the motor can be readily adjusted or at least designed to meet all requirements.

DATA RELATING TO WATER POWER.

BY F. G. BADT.

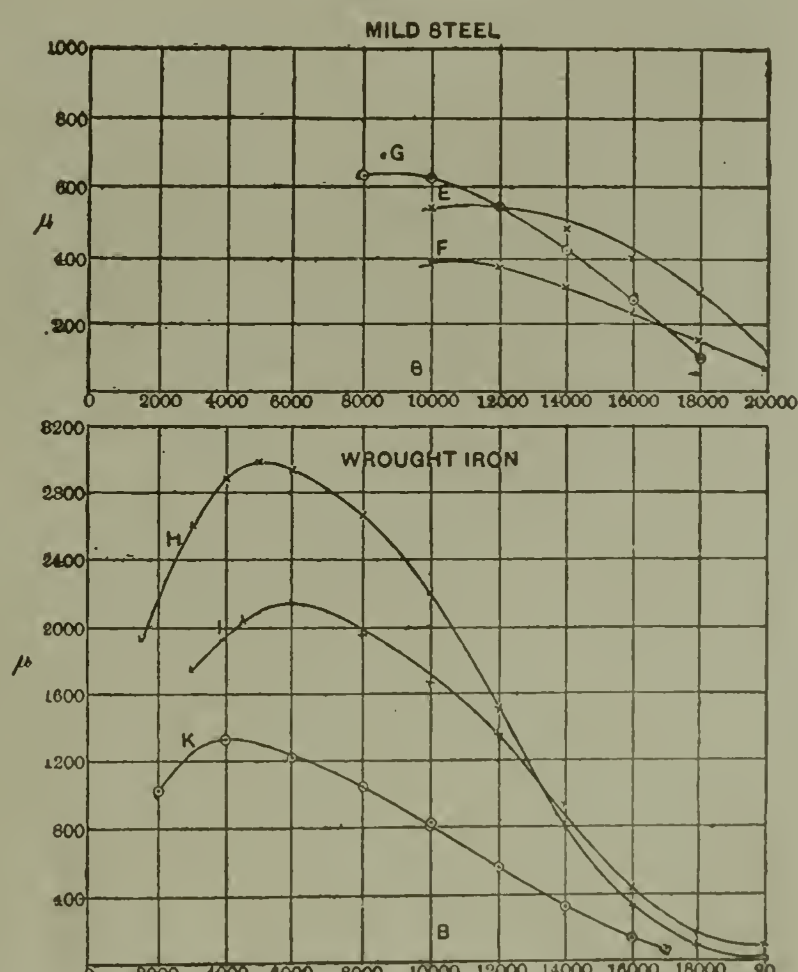
There are numerous natural water powers in the United States running to waste. These water powers may be improved, utilized for electric power transmission and be made to pay handsomely on the capital invested. As the improvement of a water power is attended with considerable expense the amount of power at various seasons should be exactly determined to prevent later disappointment. The determination of the amount of power is best left to a reliable hydraulic engineer. Any manufacturer of water wheels, however, will send on application complete catalogues giving practical rules and tables for determining the horse power of water powers. As one cubic foot of water weighs 62.5 pounds this figure multiplied by the number of cubic feet per minute, multiplied by the head in feet gives the foot pounds; this divided by 33,000 gives the horse power. Very often the quantity of water flowing per minute is not expressed in cubic feet but in miner's inches. A miner's inch of water is approximately equal to a supply of 1.5 cubic feet per minute. The commercial efficiency of the best water wheel is hardly over eighty per cent. Besides there is a loss by friction, water in pipes, shafts in bearings, etc., so that at best not more than seventy-five per cent. of the energy of the water fall can be utilized for driving electric generators. As the quantity of water flowing per minute depends upon the velocity of the stream, the number of miner's inches can only be ascertained by measuring the average velocity. This known the calculation of horse power is made in a fairly accurate manner.



Curve of Condenser Discharge.

CONDENSER DISCHARGES.

The charge and discharge of a condenser when supplied with a charge of high pressure is shown in the illustration. The capacity of a condenser is governed by the area of the plates, distance between them and nature of



Curves of Magnetization of Mild Steel and Wrought Iron.

(see page 284.)

the dielectric. With a limited capacity the charge of electricity will cause a potential difference depending upon the quantity held in statu quo. Various changes are manifested during charge and discharge and the relations existing between the capacity and voltage is shown in the illustration.

A COMPARISON OF THE PERMEABILITIES OF MILD STEEL AND WROUGHT IRON.

Mild steel and wrought iron differ from each other in permeability to an extent denoted below in the various plottings or magnetization curves. These curves express the relations existing between the lines of force per square centimetre and the permeabilities of the metals. Comparing the two we see that the permeability curve G of mild steel, at 8,000 lines of force per square centimetre, gives a permeability of a little more than 600. The curve K of wrought iron, at 8,000 lines of force per square centimetre, shows a permeability of about 1,100. Fine wrought iron and certain grades of mild steel differ considerably from each other, but good samples of mild steel and fair samples of wrought iron are practically alike, as far as their permeabilities are concerned, and their capacities for lines of force per square inch. The permeability of wrought iron, as shown by its various curves, rapidly diminishes, beginning at a point of induction running up to 20,000 and diminishing at about 2,000 in a characteristic manner. At present mild steel is almost exclusively employed for electrical machinery.

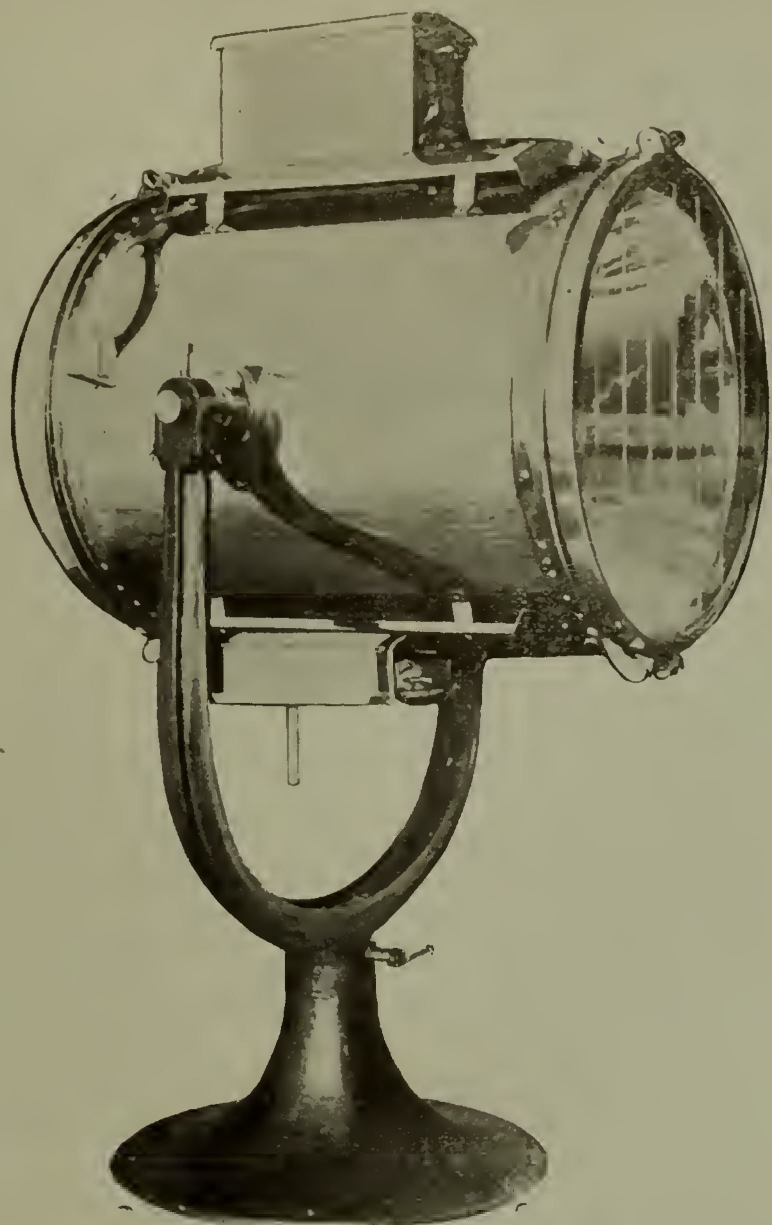
CAREER OF MARCONI.

Mr. Marconi is a very young man—not yet thirty years of age, as his portrait shows. Born at Bologna, but of English parentage on his mother's side, he speaks fluent and perfect English, with a slightly foreign gravity which belies his youth. He is, as he professes, an amateur electrician, and exceedingly modest as regards his accomplishments in comparison with some of the no doubt well-meaning chroniclers who have even unduly belauded them. He has been about four years at work on the particular subject of "wireless" telegraphy, carrying out many experiments on his family estate near Bologna before he discovered the important fact that electric waves generated by a sparking apparatus of the kind used by the lamented German physicist, Heinrich Hertz, would not only carry to long distances, but were unaffected by intervening hills and natural obstacles. At this date two miles was the maximum distance reached, while English observers had accomplished one-and-three-quarters miles. With his original apparatus for transmitting and receiving Hertz waves much improved, Mr. Marconi came over from England in 1896, and succeeded in getting the patronage of the British postal officials, under whose auspices he carried out signaling experiments on Salisbury Plain and at Penarth. Since then he has gradually improved both of his methods and his records, the distance traversed by his etheric signals being increased successively from fourteen and a half miles, between Alum bay and Bournemouth, to eighteen miles (Alum bay and Poole), and thirty-two miles, the present maximum obtained between two stations erected at the instance of the French Government on Dover cliff, close to the South Foreland light-house, and at Wimereux, near Bologne. In addition to this, Mr. Marconi has made successful experiments in carrying on signals between ships and the shore, a permanent installation having been at work for some time between the South Foreland station and one of the Goodwin lightships.

Collector Rods of Marconi's System.

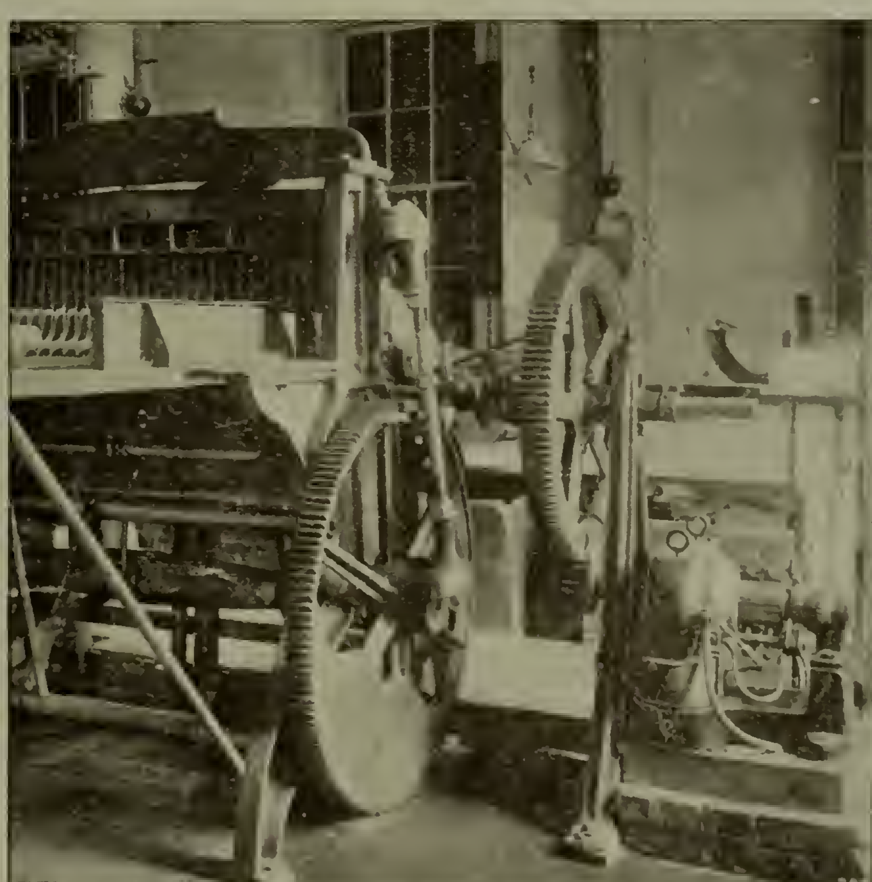
SEARCH LIGHT CONSTRUCTION.

A search light and a focussing lamp differ in the respect point, at the common foci of all the parabolas represented by various cross sections through the reflector.



Search Light for Naval Warfare.

that a parabolic reflector is used for one and a hemispherical white-coated reflector used for the other. The The glass in front is not one sheet but strips which expand and contract freely without fracture. The mechan-

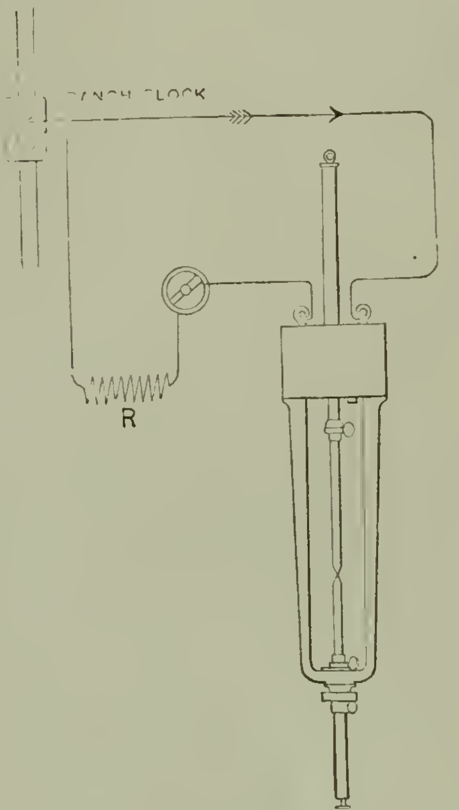


Example of Motor and Gearing.

carbons in a search light must remain focussed at a given ism of a focussing lamp and search light are practically identical, the feed in each case being such that the arc remains located in a fixed position. Focussing lamps average about five thousand candle power, as built by some concerns. The penetrating power of a search light depends upon its candle power and parabolic reflector. About one horse-power per twenty-five hundred candle power is generally consumed.

THE GEARING OF MOTORS.

Not only in the field of industrial activity do we find various examples of the single or double reduction gear motor but the custom has spread among all classes of machinery where a motor is called into use. In street railway practice the geared motor is a permanent feature of any railway installation and it has been accepted by experts here and abroad as the best means of transmitting power positively and, in the best sense of the word, efficiently. It is impossible to conceive of an electrical device propelled through the streets, either for municipal



Resistance and Lamp as Operated.

purposes, or as an automobile, in which the motor is not geared as the driving mechanism to the shaft, propelling the vehicle. Various examples, other than those found on the roads and streets of cities and towns, are on hand in the factories and shops of every large city in the United States.

Contrary to the European custom belting has various disadvantages of such a nature that Americans are more content to use an expensive method of transmitting power which the use of gears implies than the simple attachment of a pulley, driving a leather belt or rope. The saving of power is, of course, an important item, and the friction of a geared system is much greater than that of a belted plant as well as being more expensive but in spite of these facts the positiveness of a geared system and the thorough reliance that can be placed upon it in practice has led to its final adoption, in preference to any other mode of transmitting power, including even the sprocket wheel and chain, a system once greatly in vogue. A slipping belt in a moment of emergency presents a critical case to the engineering eye and has led to its condemnation where motors as small units are directly employed for driving machines.

ARC LAMPS ON INCANDESCENT CIRCUITS.

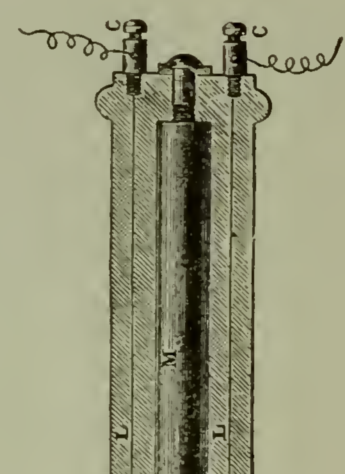
In the line sketch shown below the connections of an arc lamp on an incandescent circuit call for the installation of a branch block, an adequate resistance and switch. Each lamp is calculated to consume about fifty or sixty volts; two lamps generally burning on one circuit. In those cases where enclosed arc lamps are used 80 volts is consumed by the lamp and the balance taken up by resistance and line drop. The resistance must therefore be adjusted to meet both cases, whether an open or enclosed arc lamp.

THE ELECTRICAL RESISTANCE OF THE BLOOD.

It is no easy task to measure the electrical resistance of the blood of a living individual. The principal difficulty depends upon the fact that only very small quantities of blood can generally be obtained at a time. The best results were obtained by placing five cubic millimetres of freshly drawn blood between two cup-shaped spongy platinum, and fixed at 0.75 millimetres apart. The average resistance of normal blood at 60 deg. F., electrodes three millimetres in diameter, coated with an electric element in which the electrodes were of carmeasured by Kohlrausch's method, is 550 ohms. A striking change may be observed in pernicious anæmia, the resistance in this disease being sometimes diminished to about one-half that of normal blood. The deduction is that the blood in pernicious anæmia contains an abnormal amount of salts, due to the destructive metabolism going on.—Ex.

THE TELEPHONE RECEIVER.

In the sketch LL represents the line, M the permanent magnet, E the ear piece, D the diaphram, B the coil, and CC the connectors. In speaking into the receiver the diaphram in front of the permanent magnet vibrates imperceptibly. The permeability of the space in front of the magnet is disturbed. It increases and decreases with the vibrations of the diaphram. In consequence of this magnetic change a series of minute currents are produced within the coil BB. The currents follow a law of



Analysis of Telephone Receiver.

oscillation which corresponds practically to that governing the vibration of the diaphragm. They pass through the line by way of the connectors C and affect a similarly constructed instrument in the same manner. If used merely as a receiver the operation is reversed. The coil receives minute and varying currents to which the diaphragm by responding vibrates and produces audible sounds. The receiver is an ideal dynamo when used as a transmitter. It is merely a vibrating device when it accomplishes the transformation of varying currents into sound.

Among the Societies.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 137th meeting of the Institute was held at 12 West 31st street on Wednesday evening, Nov. 22d. A paper was presented by Edward J. Willis on a "Test of a 300 Kilowatt Direct-Connected Railway Unit at Different Loads." In the absence of the author the paper was read by Mr. Geo. F. Sever. The paper was discussed by Messrs. Hill, Mailloux and Sever. The subject of "Possibilities of Wireless Telegraphy" was then taken up, the discussion being opened by Prof. R. A. Fessenden of the University of Western Pennsylvania, and continued by W. J. Clarke, M. I. Pupin and others. A meeting of Western members was also held at the same time at the Technical Club, Chicago. At the meeting of Council in the afternoon the following associate members were elected: E. C. Baugher, Frank George Baum, Louis W. Downes, Clifton V. Edwards, Geo. H. Gibson, Louis T. Grant, Arthur James Hanson, Martin J. Insull, E. D. Jackson, W. O. Layman, John Lundie, Chas. William PenDell, Chas. B. Raub, Allen Davidson Roberts, H. A. Russell, Ferdinand Schwedtmann, Hewlett Scudder, Jr., Joseph Suydam Stout, Jr., Clinton Eugene Whitney, C. M. Wilkes.

The following associate members were transferred to membership: Cummings C. Chesney, Capt. Achilles de Khotinsky.

Business News.

AN ELECTRIC FAN COMBINE.

The electric fan manufacturers of the country, who were in conference at the Imperial Hotel last week, decided to form an organization under the title of the American Association of Electrical Fan Manufacturers. The objects of the association are to secure higher prices and to keep them uniform. The electrical fan industry is in the hands of fourteen firms whose combined capita is $25,000,000.

TELEGRAPHING WITHOUT WIRES. INCORPORATION OF A WIRELESS TELEGRAPH COMPANY.

Isaac L. Rice will be president of the Marconi Wireless Telegraph Company, which has been incorporated with $10,000,000 authorized capital at Trenton. August Belmont will be the treasurer. Mr. Rice said:

"Active operations will be begun by the company as soon as we have obtained suitable quarters and have built our machinery. Probably our factory will be in this city. The company has acquired the right to operate in all the American possessions and in Cuba. There was a contract made recently, prior to the formation of our company, to connect five of the Hawaiian islands by wireless telegraph, but otherwise we will control all Hawaiian wireless telegraph rights. There are all sorts of uses to which the Marconi system can be put, and it is really in its infancy.

"Among the matters to which we will give special attention will be the manufacture of instruments to be used for telegraphing between vessels at sea. We hope also to equip with wireless telegraph instruments the signal and life saving stations along the coast, so that approaching vessels can be warned when fog and storm hide them and their lights."

SPECIAL EXPORT COLUMN. TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING NOVEMBER 25th, 1899, $133,757.

New York, N. Y., Nov. 25, 1889. This port shipped electrical goods during the week ending this date to the following countries:

British West Indies.—93 packages electrical material, $1,557; 1 case electrical material, 20.

Berlin.—112 packages electrical material, $8,740.

British Possessions in Africa.—33 cases electrical material, $34,257.

China.—8 cases electrical material, $1,218.

Cuba.—8 cases electrical material, $519; 3 cases electrical machinery, $209.

Copenhagen.—4 cases of electrical material, $231.

Christiana.—1 case electrical machinery, $50.

Central America.—22 cases electrical material, $277.

Ecuador.—3 cases electrical material, $932.

Glasgow.—1 case electrical material, $20; 1 case electrical machinery, $25.

Havre.—2 cases electrical machinery, $300.

Hull.—7 cases electrical material, $759; 12 cases electrical motors, $400.

Liverpool.—274 cases electrical material, $21,560.

London.—16 cases electrical machinery, $1,200; 112 cases electrical material, $20,416.

Moscow.—8 cases electrical material, $750.

Marseilles.—472 cases electrical material, $36,333.

Mexico.—365 cases electrical material, $2,687.

Newfoundland.—24 cases electrical machinery, $342; 25 cases electrical material, $234.

Odessa.—2 cases electrical material, $111.

Porto Rico.—8 packages electrical material, $180.

Santo Domingo.—5 cases electrical material, $47.

Southampton.—10 cases electrical material, $100; 16 cases electrical machinery, $270.

Venezuela.—2 cases electrical material, $13.

NEW INCORPORATIONS.

Trenton, N. J.—The Shamokin Light, Heat and Power Company has been incorporated; capital, $150,000.

Decatur, Ill.—The Culver Company, of Woweaqua, has been incorporated; capital, $10,000; incorporators, J. H. Culver, J. S. Culver, F. H. Culver.

Alliance, Ohio.—The Alliance Gas & Electric Company, with a capital stock of $165,000, has been incorporated.

Dundee, Ill.—The Citizens' Light, Heat and Power Company has been incorporated with a capital of $10,000. O. C. Fitts, Frederick Rossow and F. A. Johnson.

Reynoldsville, Pa.—The Reynoldsville Electric Company, with a capital stock of $75,000, has been incorporated.

The Oroville (Cal.) Water and Power Company has been incorporated with a capital of $250,000 by L. T. Lott and R. S. Power. The company will develop electric power.

Keokuk, Iowa.—The Garton-Daniels Company, to manufacture and deal in electrical supplies, has been incorporated; capital, $25,000; incorporators, J. C. Daniels, W. R. Garton, L. J. Titus, M. H. Titus, J. V. E. Titus, all of Keokuk.

Clinton, N. Y.—The Clinton Electric Company has been incorporated; capital, $50,000; incorporators, J. N. Williamson, of Ozone Park; T. W. Cantwell, of Albany; T. F. McBride, J. L. Dempsey, of Clinton.

San Francisco, Cal.—The Boynton Vacuum Company has been incorporated to manufacture and sell vacuum pumps; directors, H. G. Walker, Oakland; E. D. Moore, H. M. Graham, James S. Hunt and C. H. Boynton, San Francisco; capital stock, $500,000.

Portland, Me.—The Electric Car Lighting and Ventilating Company has been organized at Portland for the purpose of manufacturing and dealing in electrical appliances of all kinds with $500,000 capital stock. The officers are: President, C. H. Morse, of Cambridge; treasurer, W. M. Chapman, of Needham.

Jersey City, N. J.—The Chaquette Electric Dredge Company, principal office the Corporation Trust Company Building, to build and use dredges, pile drivers, etc.; capital, $1,000,000; incorporators, Ephraeim Chaquette, Berthold Block, Michael J. Fenton, Kenneth K. McLaren.

Cleveland, Ohio.—The Cotter Electric Company, of No. 1254 Case avenue, has been organized; F. L. Browne purchasing a half interest in the property and patents. The new firm will be known as the Cotter-Browne Electric Company, with offices at No. 912 New England Building and factory at the Perkins-Power block. The new concern will manufacture a flashing switch and other electrical specialties.

TELEPHONE CALLS.

Monticello, Ind.—The White County Long-Distance Telephone Company has been incorporated. The capital stock is $5,000, and the directors are David E. Ross, John H. Smeale and Ira Bordner.

Red Lodge, Mont.—The Red Lodge & Wyoming Telephone Company has been incorporated to construct and operate telephone line; capital, $10,000; incorporators, B. E. Vaill, J. L. Robbins, W. A. Talmage, all of Red Lodge.

Yorktown, Va.—The Chesapeake Telephone and Telegraph Company has been incorporated to construct and maintain telephone and telegraph lines; capital, $20,000; incorporators, E. E. Sleight, B. F. Crockett, E. S. Moore, of Crab Neck; G. L. Smith, T. T. Hudgeons, of Yorktown; T. S. Harris, of Tampico; H. R. Wilson, of Yorktown.

Oakland, Cal.—The articles of incorporation of the Oakland Automatic Telephone Company have been filed. The company proposes to equip its plant at once and establish a system. The capital stock is $350,000. The directors of the new company are Albert C. Aitken, of San Francisco; William A. Magee, Charles B. Taylor, Samuel S. Theller and E. C. Dozier, all of this city.

Salt Lake City, Utah.—The Soda Springs & Gray's Lake Telephone Company has been incorporated; the capital stock is $10,000; F. M. Merrill, E. W. Barnes, J. Strachan, H. C. Gorton and F. M. Merrill, Jr., incorporators. The purpose of the company is to construct, maintain and operate a telephone line from Soda Springs north to Gray's Lake, and also a line from Soda Springs south to Preston. At Preston the company's line will connect with the Rocky Mountain Beil Telephone Company's lines and give Soda Springs direct communication with Salt Lake City.

STREET RAILWAY NEWS.

Sheboygan, Wis.—The work on extension of the electric line to Sheboygan Falls will, in all probability, be completed by December 1.

Decatur, Ill.—A new electric railway is to be built at once from Decatur to Springfield, a distance of 38 miles. The cost will be about $300,000.

Concord, N. H.—It is reported that the proposed electric road from Centre Harbor to Ossipee is to be constructed in the Spring. Dr. J. A. Greene, G. W. Armstrong and A. Shuman are said to be interested in the enterprise.

Montclair, N. J.—The Montclair Town Council has granted a franchise to the North Jersey Street Railway Company for a railway to the south end of the town, through Elm street and Orange road to the Orange line. The ordinance provides for a ten-cent fare to Orange from Manhattan when a direct route is made.

Norwalk, Ohio.—The County Commissioners have granted a franchise to W. W. Graham, of Norwalk, and Clark Rude, of Sandusky, the projectors of the Sandusky, Bellevue & Norwalk Electric Railway. By the terms of the franchise the road must be completed by July 1, 1900, unless delayed by compulsory legal process.

Pine Bluff, Ark.—The City Council of Pine Bluff has granted to Matthew Roberts, of Kansas City, a 50-year franchise for an electric street railway. Its requirements are that the company operate six miles of roadway and, at least, five new and modern cars, which shall be run at intervals of not less than 30 minutes. The road is to be completed within 12 months, or the franchise forfeited.

Cleveland, Ohio.—Cleveland capitalists, including M. J. Mandelbaum & Company, F. D. Pomeroy, D. H. Kimberly and A. E. Akins, are back of a project to build the longest trolley line in the world in the Miami Valley, in the southern part of the State. They have already obtained control of the electric railroads connecting Cincinnati, Hamilton and Dayton, and are operating them as one system. The company will soon be incorporated and extend the railway north to the end of the valley.

POSSIBLE INSTALLATIONS.

Boerne, Tex.—A $4,000 electric light plant will be put in by local capitalists.

Anniston, Ala.—A light and power plant will be erected here by the Anniston Electric Company.

Tuscumbia, Ala.—The city will erect an electric light plant. Address the Mayor.

Tallahasse, Fla.—The city has voted to issue $16,000 bonds for electric light plant. Address the City Clerk.

Detroit, Mich.—The Howard City Electric Light Company has decided to rebuild its plant, which was burned some time ago, and expects to have it running in about 30 days.

Crystal Springs, Miss.—The Mayor and Board of Aldermen has passed an ordinance to issue $25,000 in bonds for the purchase of a complete system of waterworks and electric lights. This action is due to the recent expensive fires.

Birdsboro, Pa., Nov. 21, 1899.

The Electrical Age, New York:

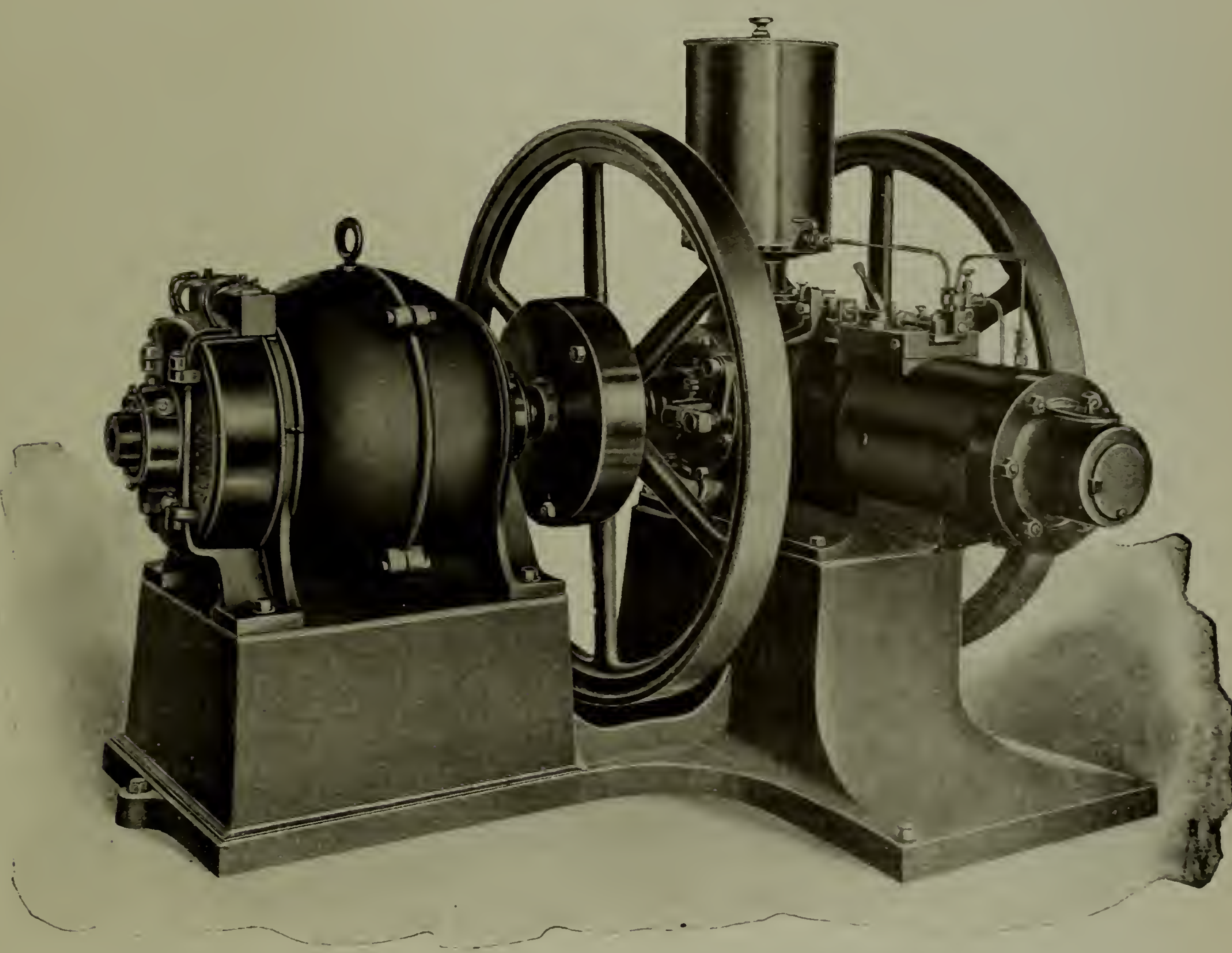
Gentlemen—Franchise has been awarded me for one hundred (100) arc and fifteen hundred (1,500) incandescent light plant.

Respectfully,
(Signed), J. E. SHERIFF.

The Electrical Age.

Vol. XXIV—No. 24. NEW YORK, DECEMBER 9, 1899. Whole No. 656.

Electric Light and Power Installations.

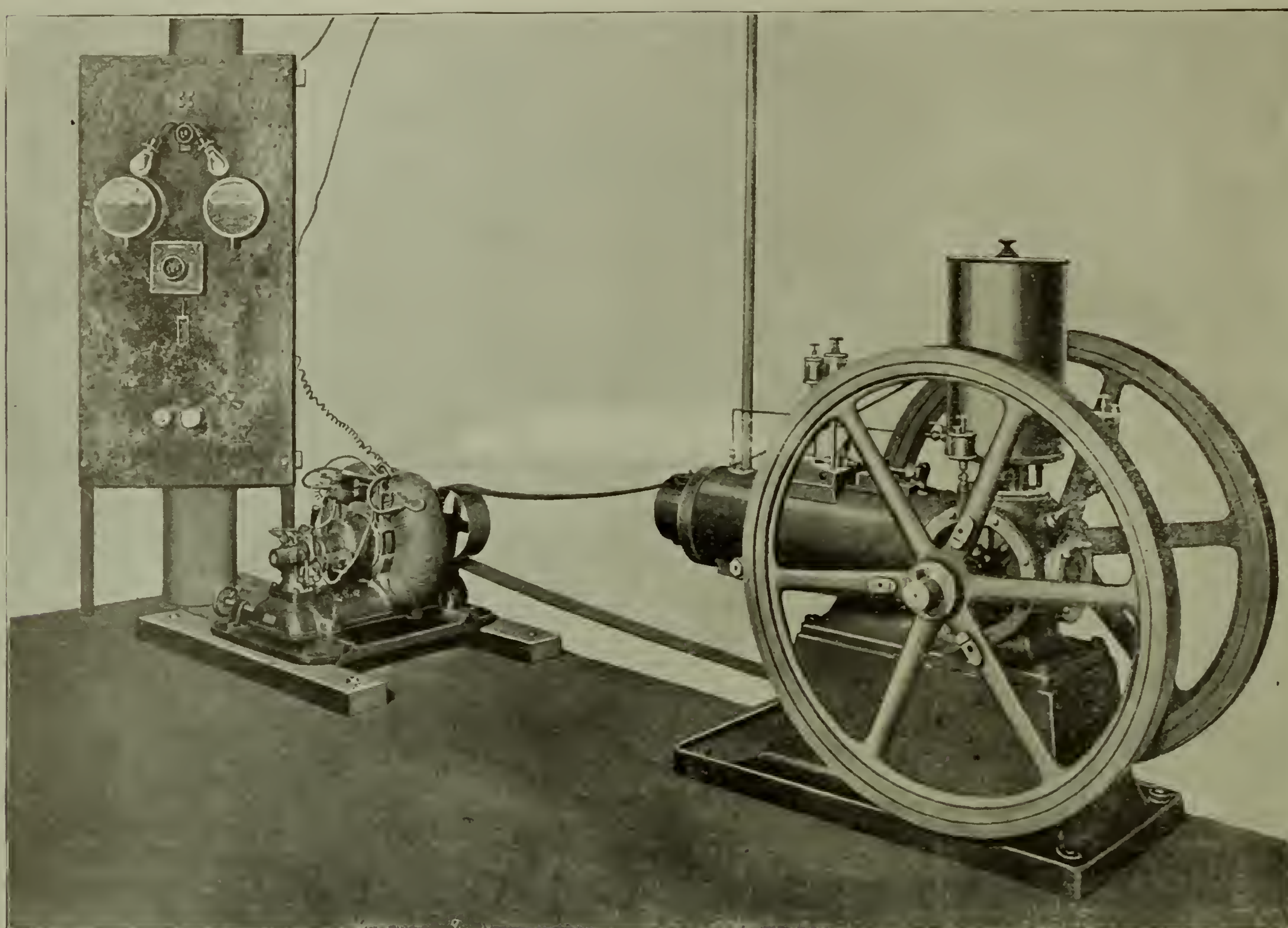


Mietz & Weiss Kerosene Engine Direct Connected to Generator.

KEROSENE ENGINES FOR ELECTRIC LIGHTING.

The spread and development of electric lighting has been the means of causing considerable improvement in various types of engines. What has long been regarded as an ideal combination is a plant consisting of a generator driven by a gas or kerosene engine. The improvements to date in kerosene engines are most noticeable in those constructed by August Mietz, under the name of the Mietz & Weiss kerosene engine. In these engines kerosene is the motive power. They are of the two-cycle compression type; each revolution an impulse is transmitted to the fly wheel. The governing device operates directly from the main shaft, regulates the supply of kerosene according to the demand for power and effects a uniformity in speed that renders it capable of doing electric lighting without a flicker. In the illustrations are shown two eamples of direct connected and belted plants. The coupling is shown in the illustration of the direct connected outfit to consist of a disk with three studs, one hundred and twenty degrees apart. A similar disk, attached to the fly wheel of the engine enables adjustment to be made between the two through the aid of rubber rings. The elasticity and stretch of these rings takes up all lack of alignment and extra strain on the bearings. This excellent mechanical adjustment insures noiseless operation and long life to the working parts. In the direct connected plant we have a four-horse engine, at four hundred revolutions a minute, driving a forty light generator with a total consumption of 1.32 pounds of kerosene per horse-power hour.

The governor of the engine operates a small pump, controlling its delivery of kerosene in the motor cylinder in which vaporization and mixture with air takes plaec. By this method of regulation waste is eliminated and excess of power or the reverse an impossibility. The fuel consumption and the power required, controlled as above described, together with the minimum of care an engine of this type requires, its cheapness of operation and smoothness in running makes it highly desirable for isolated plant work or where small power in the shop would be welcome. The manufacturer, August Mietz, of 128-138 Mott street, and 87 Elizabeth street, New York city, will be pleased to correspond with interested parties, regarding the installation of a gas or kerosene engine for any purpose whatsoever.



Mietz & Weiss Kerosene Engine and Dynamo.

Applications of Electric Power.

THE PRACTICAL APPLICATION OF ELECTRIC MOTORS TO PRINTING PRESS MACHINERY.

BY W. H. TAPLEY.

(Concluded from page 279.)

Geared vs. Direct shows that up to 5 horse-power the geared is more economical. In 5 to 15 horse-power, there is not much difference. Economy of operation should not be the guiding spirit in the selection of motors of these sizes. From 25 horse-power up, the direct motor has many advantages, especially for newspaper work.

Cost of Presswork.—A web press, printing at the rate of 6,000 impressions per hour—this includes cutting, folding and printing four signatures of 16mo or 64 pages, including all stoppages—will produce in a day 2,304,000 pages, an average of 384,000 pages for each hour. The average current, including "make-ready," etc., is .7 watt hour per impression; 91,428 pages per hour per kilowatt; at 5 cents per kilowatt hour, there will be printed, cut and folded 18,285 pages for 1 cent.

A good day's work for a flat-bed press, bed 42 x 52 inches, running at 20 impressions per minute, is 8,400 impresions in eight hours, of 32 pages each, with a total of 256,000 pages for the day.

Average current consumption is 1.5 watt hours per impression, or 21,333 pages per kilowatt hour; at 5 cents per kilowatt hour is produced 4,266 pages, as against 18,285 by the web preses for the same money (1 cent), making an output for the webs four and one-half times that of the flat-bed presses, with same current consumption. The quality of the work of the former is not always as good as the latter, yet is more than compensated for by the folding and cutting.

A card-press, which prints both sides, making slitting and cross-cut from a web of cardboard, is not a usual press. The following is the output and power consumption for five months:

Impressions	8,362,750
Kilowatt hours..................	580.6
Kilowatt hours per impression.....	.0694

Four cards being printed at each impression, there was a total of 33,451,000 cards. With current at 5 cents per kilowatt hour, 11,500 cards were printed for 1 cent.

Main Pressroom, Government Printing Office.—In this room are forty-nine presses, including three large web presses; of the balance one-half are large-size book preses, the remainder of double-medium size, attached to which is an aggregate of 190 horse-power in motors.

During the month of November, 1898, the presses made 5,403,032 impressions, consuming 6,542.8 kilowatt hours, an average of 1.21 watt hours per impression.

6,542.8 kilowatt hours at 5 cents, $327.14; or 165 impressions, allowing 12 pages for each impression, we have 2,000 pages for 1 cent.

Power Plant, Government Printing Office.—The entire power, exclusive of heating, lighting, fans, etc., consumed during the month of December, 1898, from 8 a.m. to 4 p.m., during 27 working days, 22,516 kilowatt hours, 834 kilowatt hours per day, or 104 kilowatts per hour. Connected to the power circuits are 700 electric horse-power, including electric elevators; 575 electric horse-power, without electric elevators. Daily consumption is about 100 kilowatt hours for elevators, thus giving the following ratios:

5.1 horse-power connected to power used.

6.2 horse-power connected (exclusive of elevators) used.

Largest swinging power load we have ever had is 180 kilowatt, or a ratio of 2.9.

Current consumption during November, 1898, for foundry, 3,025.2 kilowatt hours, average 12.2 per hour; folding room, 1,295.8 kilowatt hours, average 5.4 per hour; bindery, 1,875.2 kilowatt hours, average 9.7 per hour.

Advantage to be gained from changing over from belting to individual electric motor for printing-press work is not alone in power saved, but better grade of work, less repairs to machinery, and, most of all, an increased product without a corresponding decrease in value of presses by running at too high speed.

Output of the government printing office pressroom has been increased 15 per cent. A few calculations will show what this means in an establishment operating continuously 100 presses, each earning, at the smallest figure, $10 per day, or $300,000 for the year. 15 per cent. of this is $45,000, a sum that makes the saving in motive power dwindle into insignificance. A few years will pay for the entire electric equipment, including the lighting.

If there is any printing office in the country where a reliable power must be had, it is the government printing office. We run 24 hours daily during Congress, and keep lights going throughout the year, never shutting down our power plant. We issue a daily paper, the Congressional Record, having to catch mails same as any other daily. Then all bills introduced together with the proceedings of Congress the day before, have to be on each member's desk by 10 a.m. To this must be added the printing furnished the various branches of the government, consuming a daily average of 25 to 30 tons of paper.

Our recent war with Spain has made demands in excess of anything heretofore.

At the end of the recent popular bond issue, the Treasury Department wanted 2,000,000 copies of circulars Monday, copy for which was received late Saturday. They had wagon-loads waiting at their doors Monday morning. This is but one instance of many we have been called upon to execute.

There has never been a hitch in the motive power; not a motor has given out. In fact, such a freedom from interruption of power has never been known in the history of the office as during the past three years, or since we have adopted electric power.

The most brilliant achievement during the year was the printing of the "Maine Report." "This consisted of 208 pages of text, twenty-four full-page engravings and one lithograph in colors, and although the originals of the illustrations were not in the possessions of this office until 3 o'clock p. m. of March 28th, and the manuscript of the text was not received until 6 o'clock p. m. of the same day, complete printed copies, in paper covers, were placed upon the desks of Senators and Representatives by 10 o'clock of the following morning."

In the treatment of this subject, necessarily many times subdivided, I have tried to mention, in a brief way, all essential points, a detailed consideration of which would exceed the limits of this paper, yet hope in the future, at your discretion, that these may be clearly explained by illustrations and carefully prepared tables of data now in course of compilation.

Suburban Trolley Road.
(See page 261.)

Technical Notes.

THE SUBURBAN TROLLEY ROAD.

In suburban trolley service one of the great difficulties arises from the fact that a line is continually leaking in wet weather. When a ton of coal is burnt at the power house under the best of conditions not more than forty per cent. of its energy can be utilized in the form of electricity. When the weather is wet and moisture has affected the insulation to any considerable extent these figures will drop down to twenty or twenty-five per cent. The lack of attention which some suburban trolley circuits receive in wet weather can be partially compensated by the use of the most modern insulators and poles thoroughly impregnated with an insulating material, such as asphaltic paint. Under these circumstances not only is coal saved, but the losses in the line so reduced that distant cars can make schedule time.

Stray Currents.

AN AUTOMOBILE SAVES A COW.

All Paris has been laughing at a comical occurrence in which the well-known Bordeaux automobilist, M. Lanneluc-Sanson, took a leading part. He might well have fancied himself Don Quixote and his automobile a fin-de-siecle Rosinante, gallantly coming to the rescue of a fair dame fallen into great danger. On his way back from a service of twenty-eight days as chauffeur to the commanding general of the Eighteenth Army Corps, he reached the Village of Merignac, in Gironde, at nightfall There he found the whole place in commotion. Inquiring as to the cause of the excitement he learned that a cow had fallen into a well. Repairing to the spot he found a crowd of peasants at their wits ends, vainly trying to hoist the cow out with a rope. But the cow was heavy, and the poor creature bellowed and groaned in vain. A brilliant inspiration seized M. Lanneluc-Sanson. He attached her halter rope to his auto., mounted his machine and started ahead The rope grew taut, and under the weight at the other end the automobile almost came to a stop. But gradually it went ahead, coughing mightily with the exertion. A great shout of joy from the assembled peasants. The cow's head came peering above the rim of the well and she was landed securely on the surface.—The Automobile Magazine.

WIRELESS TELEGRAPHY IN THE TRANSVAAL.

The British military authorities hope to have the wireless telegraph in operation in South Africa very shortly, when, it is hoped, the difficulties experienced from the cutting of wires will be obviated, as it will only be necessary to establish communication with a point at which the ordinary wires are intact.

VACUUM TUBE LIGHTING.

The Moore system of vacuum tube lighting with the method of illumination, as shown in illustration, possessing as one of its most important features a vacuum tube break, also illustrated, calls for consideration at this present hour, since it has become evident that low watt lamps, including the Nernst, have become permanent commercial features. The preservation of vacuums in tubes, used for this unique system of lighting, has been a difficult question to solve. The efficiency of the system, cost of its installation and remarkable clearness and purity of the light produced have led to much speculation as to future value for practical purposes. The tubes certainly appear to be unaffected by use and the present method of producing light in vacuum tubes is an ideal one. It therefore seems to be more a question of cost than safety or durability. Were light rated at only one watt per candle power it would certainly be regarded as a method of electric lighting that would meet with widespread application. These questions, unfortunately, have not been decided upon for the reason that vacuum tube lighting at present belongs largely to the field of experimental science.

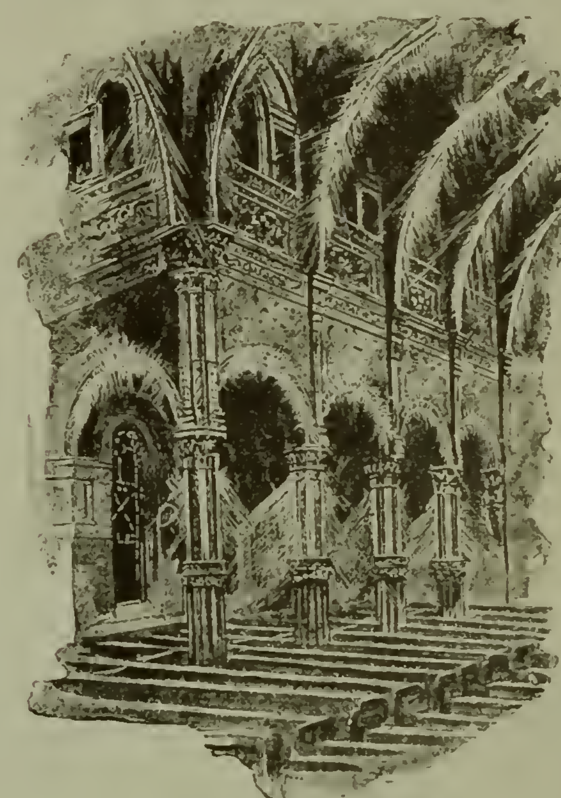
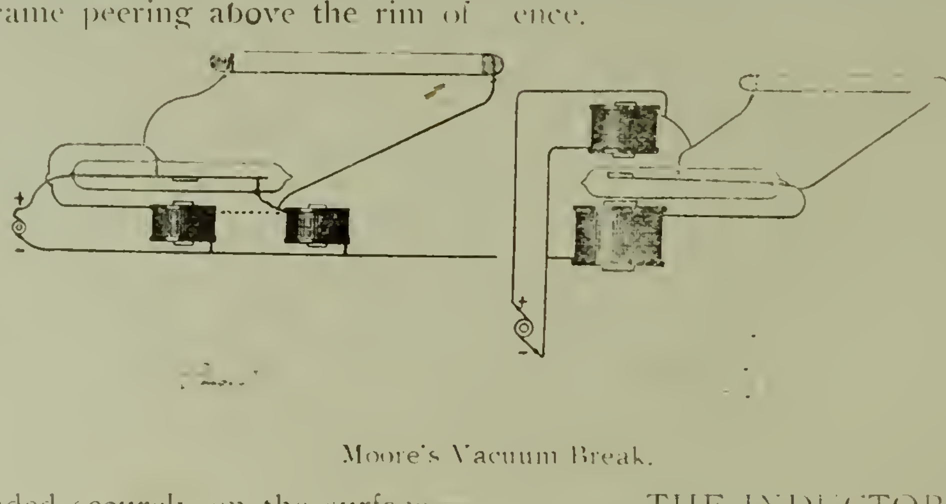


Fig. 32

One Application of Vacuum Tubes.



Moore's Vacuum Break.

THE INDUCTOR ALTERNATOR.

The inductor alternator consists of a machine in which all wire is at rest and only the core of the electro magnet rotated. It being devoid of commutator and other parts requiring attention it is certainly the cheapest machine to install for general long distance electric lighting. It has found great favor in the West and in mining plants from which power must be transmitted for lighting and other purposes into various parts of the mine and its appartenances. The inductor alternator has durable qualities which make it unusually cheap when the number of

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NEW YORK, DECEMBER 9, 1899.

CONTENTS:

ELECTRICITY ON NEW YORK'S ELEVATED ROADS.

The latest news, though long expected in the electrical world, is that concerning the substitution of electricity for steam on New York's elevated roads. Orders have been placed with the Westinghouse people for generators aggregating more than fifty thousand horse-power. They will consist of eight five thousand kilowatt, three-phase alternators, with the necessary rotary converters, step-down transformers, etc., for its complete equipment. In total this outfit will represent an outlay involving several millions of dollars on account of the complete transformation that will have to be made in every part of the road.

It has often been claimed by the citizens of other business centres that New York is very slow in adopting improvements and is gradually developing a characteristic, decidedly English, in being too conservative. The advantage of proceeding with deliberation is shown by the change that has been made in all the surface lines of any importance in New York city. A system has been adopted which is certainly the most complete in the world and answers better than any other to the requirements laid down by the municipal body and the people. In the same manner steam roads with their noise, dirt and inefficiency have been preserved in the present elevated roads until the directors of the same thoroughly understood the necessity of making a change which would please their patrons and, incidentally, add to their own resources. After a thorough examination and test of the prevailing systems the final adoption of the third rail on the Manhatan elevated road closes the question. The Fire Department seems to have some doubts as to the advisability of this change, but the chances are not more than one in a thousand that the third rail of the future system will ever interfere with the heroic efforts of Chief Croker's men. At any rate, the rubber boots of the firemen will amply protect them if they have occasion to cross the tracks so that little need be feared in that direction. On the other hand the absence of noise and the cleanliness of the new system will be best appreciated in the dog days of summer. Electricity on the elevated roads will make them more popular than ever and certainly lead to a more economical utilization of the thousands of tons of coal consumed each day.

WIRELESS TELEGRAPHY.

The possibilities of wireless telegraphy have been roughly outlined by all the journals in the United States. The anticipations of some writers have been verified, but the surface has been barely scratched as yet. The coherer and, in fact, the present system of wireless telegraphy as a whole is deficient. The public are amazed at experiments performed between distant points but as this emotion dissipates itself they inevitably inquire into the limitations of the present system. Their surprise generally turns into mild interest when told that a dozen receivers within the radius of the transmitter can command the intelligence traveling through the ether. It is just at this point that the system is weak and a prize awaits the man who will make it selective.

A selective system can be designed on theoretical grounds by developing what is technically called resonance in electric circuits. It would be necessary to construct two circuits in which the resistance, self-induction and capacity are so adjusted that this selective quality is manifested between them. Under these circumstances a transmitting system would be able to affect only one of a given number of receiving devices and thereby add that element of privacy to wireless telegraphy at present so lacking. This tuning of two circuits has been carefully studied by some of the best electrical engineers in the country. The best authority is undoubtedly Prof. M. I. Pupin of Columbia University, whose experimental research and invention of a high speed telegraphic system, as well as his familiarity with the subject of resonance would be apt to make us hope to hear from him in this respect. Marconi's system is in about the same stage of development as the simple Morse system of years ago. It will be the greatest invention of the century when it becomes selective.

THE ELECTRIC TOY TRADE.

The electric toy trade is booming at this time of the year. The demand for electric toys has grown so rapidly within the last few years that the sale of purely mechanical toys seems to have been seriously affected. A visit to any of the manufacturers of small motors, medical batteries, telephone and telegraph outfits will demonstrate this immediately. The modern child does certainly want a modern toy. Five years ago small steam engines, printing presses, singing tops and a variety of other juvenile devices flooded the market. To-day the cheap phonograph and the articles above-mentioned are sold by the hundreds of thousands and even cross the ocean to gladden the hearts of French, English and German children. It is remarkable to realize how rapidly electric toys sprang into existence so as to constitute a definite and permanent branch of the toy industry. The child of the future may want a model telephone exchange or a wireless telegraph outfit. Who can tell?

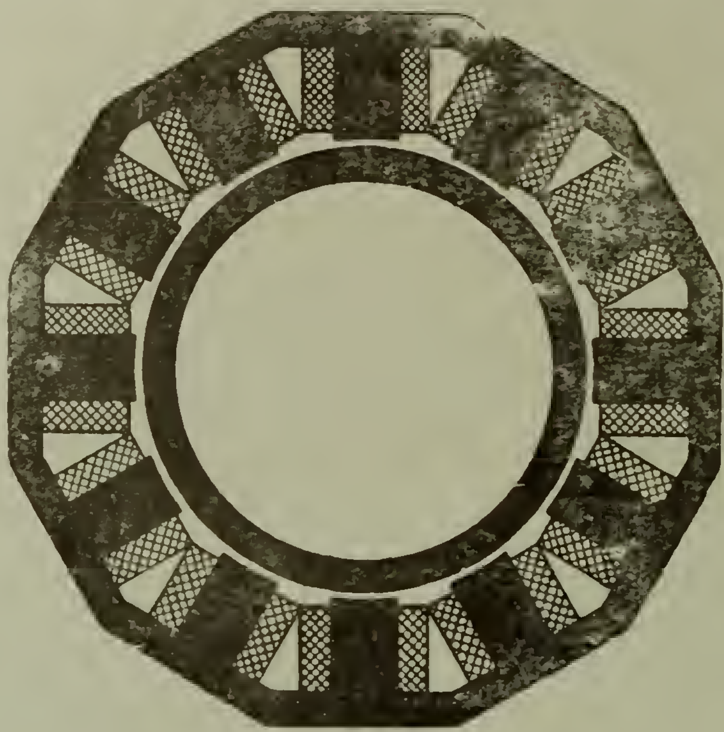
years of service are considered of which it is capable. Its efficiency is generally acknowledged to be fairly high, thus removing any question of its importance for power transmission plants.

THE MULTIPOLAR FIELD.

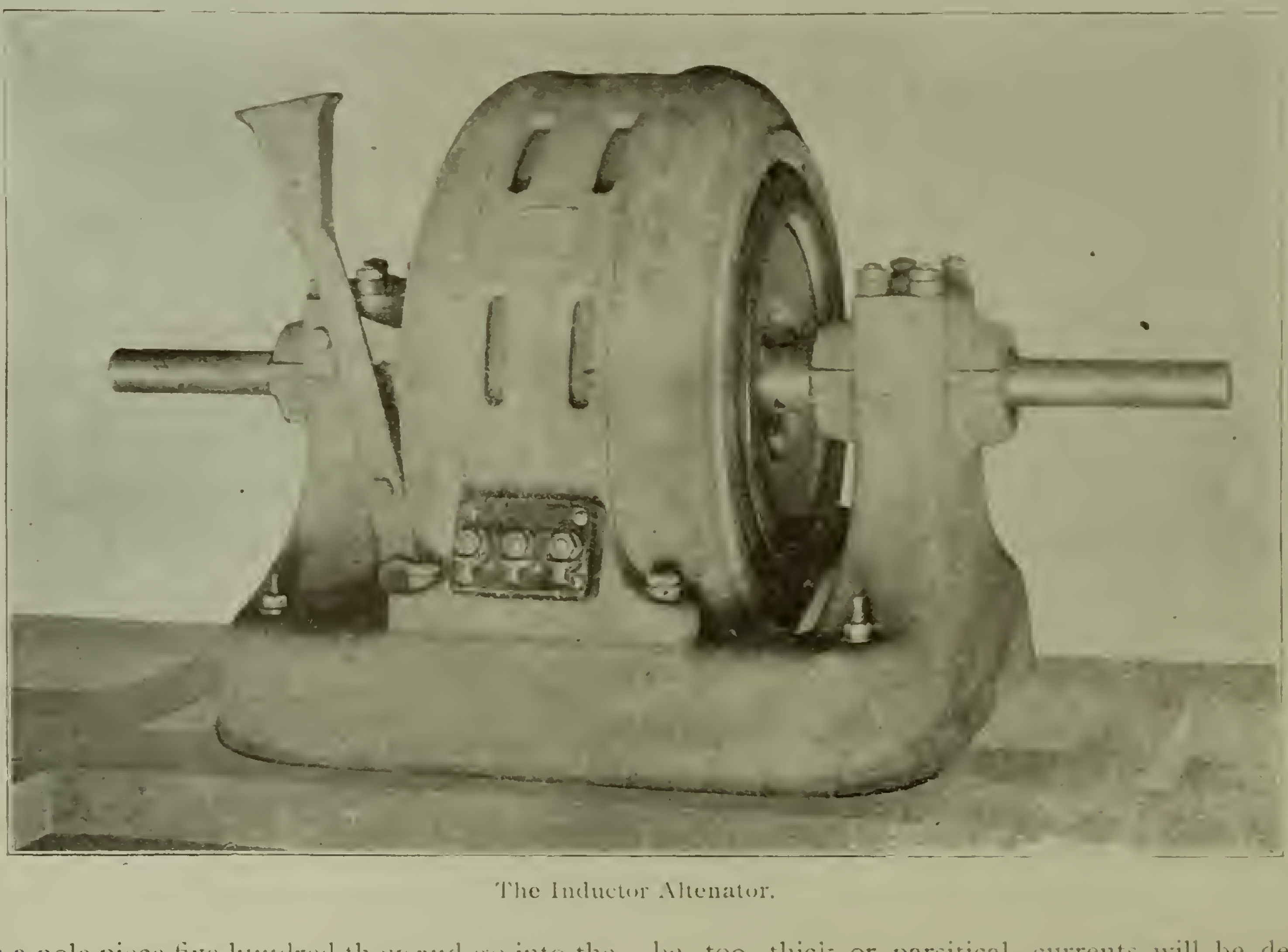
The multipolar field offers certain technical advantages due to the fact that the magnetizing force of the coil plays directly upon the pole pieces. In the sketch shown this fact is represented and it may be noted that the cross section of the ring armature is one half that of the pole pieces. The lines of force, considered in the case of three adjoining coils, pass into each other, half on one side and half on the other; therefore if one million lines of force issue from a pole piece five hundred thousand go into the pole piece on one side and five hundred thousand into the pole piece on the other. As the lines of force transverse the core only one-half the cross section is required.

ARRANGEMENT OF VATS IN A PLATING PLANT.

The arrangement of vats in a plating plant, as shown in sketch, with dynamo and connections, as shown, is a practical arrangement by saving floor space and accomplishing results in the most convenient manner. The generator is insulated from the floor and tanks supported on saw-horses, as shown. In permanent installations tanks may be built to the floor, but as this takes time the quickest and cheapest way to earn money with a plant at once is to follow the method shown in illustration. In the construction of platers abundance of copper is a prime requisite. The armature conductors, however, must not be too thick or parsitical currents will be developed, causing intense heating at no load. The conductors must be stranded in this case, although no such precaution is necessary in any other part of the machine.



The Multipolar Field.



The Inductor Altenator.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING DEC. 2, 1899, $109,013.

New York, N. Y., Dec. 2, 1898.—This port shipped electrical goods during the week ending this date to the following countries:

Amsterdam.—1 package electrical material, $100.

Argentine Republic.—310 cases electrical material, $17,064; 35 cases electrical machinery, $5,671.

British Australia.—158 packages electrical material, $17,994; 51 packages electrical machinery $8,150.

British East Indies.—23 cases electrical material, $1,163.

British Possessions in Africa.—20 cases electrical material, $1,893.

Bristol.—5 cases electrical machinery, $50.

Cuba.—44 cases electrical material, $1,334; 15 cases electrical machinery, $155.

Central America.—34 cases electrical material, $1,544.

Chili.—1 case batteries, $25.

Canada.—13 cases electrical material, $104.

Cadiz.—4 cases electrical material, $215.

Cork.—3 cases electrical material, $4,000.

Dutch East Indies.—1 case electrical material, $32.

Ecuador.—25 packages electrical material, $1,294.

Florence.—8 cases electrical material, $1,294.

Glasgow.—6 cases electrical material, $500.

Genoa.—7 cases electrical material, $262.

Havre.—6 cases electrical material, $384; 41 cases electrical machinery, $1,551.

Hamburg.—222 packages electrical material, $5,663; 4 cases electrical machinery, $4,859; 25 cases electrical material, $3,080.

Liverpool.—20 cases electrical machinery, $1,208.

London.—180 cases electrical material, $4,266; 27 cases electrical material, $1,020.

Mexico.—65 cases electrical material, $140.

Marseilles.—89 cases electrical material, $15,032.

Naples.—68 cases electrical material, $3,186.

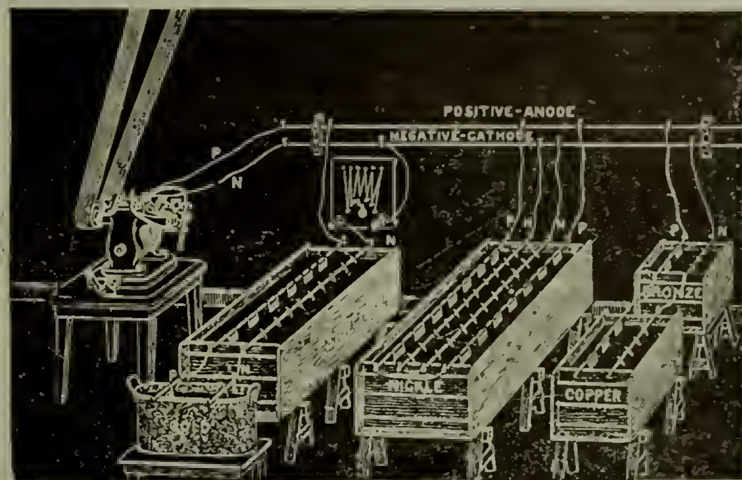
Peru.—20 cases electrical material, $652.

Sandwich Islands.—6 cases electrical material, $2,200.

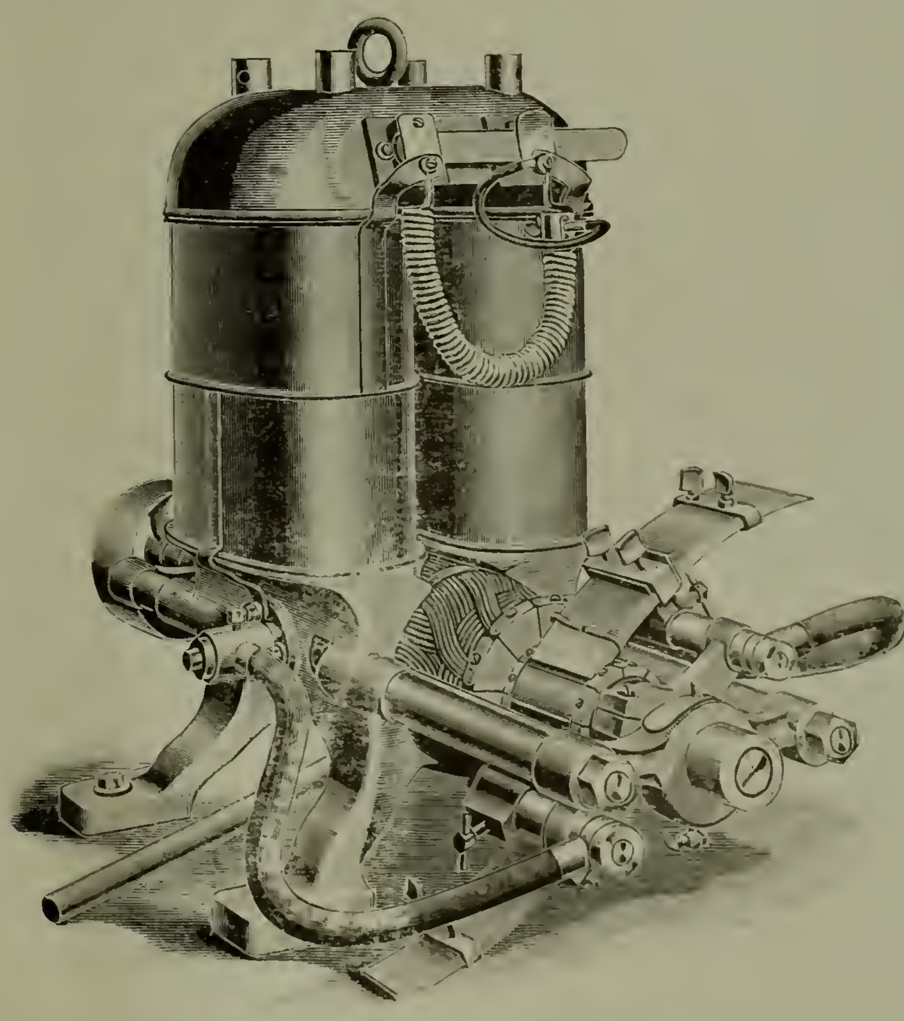
St. Petersburg.—5 cases electrical material, $305.

Swansea.—8 cases electrical machinery, $2,990.

U. S. Colombia.—8 cases electrical material, $471.



Arrangement of Vats.
(See page 294.)



A Well Constructed Plater.
(See page 294.)

NEW INCORPORATIONS.

Blissfield, Mich.—The Blissfield Electric Power Company has been incorporated; capital, $10,000; incorporators, W. Schroder, Caroline P. Schroder, C. F. Seeger, J. E. Forsyth, J. Baily, all of Blissfield.

Denver, Colo.—The Gold Belt Consolidated Electric Company has been incorporaated; capital, $300,000; Syl T. Smitk, George E. Ross-Lewin, C. F. Lacombe, M. L. Stern, Thomas Keely; Denver and El Paso, Fremont and Teller counties.

San Francisco, Cal.—The Merced Falls Gas and Electric Company has been incorporated; capital, $250,000; incorporators, G. Crocker, C. E. Green, A. F. Morrison, C. H. Shaw, all of San Francisco; J. D. Bradley, of Merced.

Ridge Farm, Ill.—The Ridge Farm Electric Light, Heat and Power Company has been incorporated; capital, $5,000; generating electricity for light, heat and power purposes. Incorporators, William Bedinger, Everett A. Little, Charles T. Lourig.

Jersey City, N. J.—The Forto Electric Company, principal office, No. 76 Montgomery street, has been incorporated to manufacture goods, wares and merchandise; capital, $100,000. Incorporators, Maurice Maas, Henry R. Blauvelt, Elisha S. Coldwell, all of New York city.

Newmarket, N. H.—The Newmarket Electric Light, Heat and Power Company has been incorporated; capital, $1,000; incorporators, J. Pinkham, C. E. Tasker, A. C. Haines, C. A. Morse, C. W. Rogers, all of Newmarket; A. W. Griffiths, J. W. Burnham, both of Durham.

Albany, N. Y.—The Norwich Gas and Electric Company has been incorporated with a capital stock of $100,000. The directors are Edward L. Smith, E. Floyd Kiser, Charles P. Nelles, N. N. Betts, of Tonawanda, Pa.; James H. Throop, Norwich; Robert E. Drake, Syracuse; Selwyn N. Blake, Elmira.

TELEPHONE CALLS.

Galion, Ohio.—An independent telephone company has been organized at this place.

Wilmington, Del.—The Central Telephone and Telegraph Company has been incorporated; capital, $125,000; incorporators, W. D. Bannard, of Philadelphia; W. C. Mayne, of Bristol, Pa.; G. W. Kimball, of Wilmington.

Jackson, Mich.—A stock company is being organized at this place, for the purpose of building a telephone line from that city to Mason, to connect with the Leslie exchange and the new State telephone line at Jackson and Mason.

Cincinnati, Ohio.—The Fitzsimmons Telephone Manufacturing Company has been incorporated to manufacture telephones; capital, $5,000; incorporators, P. Fitzsimmons, W. C. Weidling, D. J. Hauss, C. F. Deise, Ida Heitz, all of Cincinnati.

Waterville, Me.—The Gray Telephone Company has been incorporated; capital, $300,000; incorporators, H. W. Whitney, of Brookline; E. Gray, J. B. Millet, A. J. Mundy, all of Boston, H. M. Soule, of Newtonville, Mass.; C. W. Davis, of Waterville, Me.

STREET RAILWAY NEWS.

Burlington, Vt.—The Burlington & Hinesburg Railroad Company will build an electric railroad from this city to Shelburne.

McKeesport, Pa.—The United Traction Company has decided to extend its line now running to Glassport as far as Elizabeth, and work will be commenced in a few days.

Cleveland, Ohio.—The Little Consolidated Railway Company, of which Senator Hanna is president, has decided to change the motive power on the Superior street and Payne avenue cable lines to the overhead trolley.

Athol, Mass.—There is a prospect of an electric road from Athol to Templeton, a distance of nine miles. P. S. Hirsh, of New York city, one of the promoters of the Gardner & Templeton road, which is nearly completed, is interested in the matter.

Warsaw, Ind.—The contract has been signed by eastern capitalists for the building of an electric road between Logansport and Kendallville. It will pass through the richest part of the country, giving the people remote from railroads the advantages of quick transit.

Jefferson, Tex.—The Jefferson & Northwestern Railway Company has been incorporated; capital stock, $20,000. Purpose is to construct and maintain line of railway from Jefferson through the counties of Marion and Cass in a northwesterly direction, 20 miles to a point on the Moses D. Frazer survey, four miles southwest of the town of Linden, in Cass County. Incorporators, E. Bancker, of Jackson, Mich.; M. S. Clark, of Dallas; J. R. Darnell, of Jefferson, and others.

POSSIBLE INSTALLATIONS.

Paint Rock, Tex.—J. F. Ford & Son contemplate putting in an electric light plant. They will operate with water power.

Brillion, Wis.—An electric light plant is to be established here. A 15-year franchise has been granted to C. Behnke & Son, of this village.

Canandaigua, N. Y.—M. D. Munger is circulating a petition asking the trustees to grant him a franchise for establishing a mercantile electric lighting system in this village.

Waterbury, Conn.—The Board of Control, which consists of Gov. G. E. Lounsbury, Comptroller Grant and Treasurer Mersick, have under consideration the matter of establishing an electric light plant in the capitol, for the purpose of lighting the building and grounds with electricity.

Ilion, N. Y.—The Herkimer County Light and Power Company, which operates in Ilion, Herkimer and Mohawk, has decided to put in a system of incandescent lighting in Ilion. Operations will commence at once, and the work pushed to completion as soon as possible.

TELEGRAPH NEWS.

Sioux Falls S. D.—The American District Telegraph Company has been incorporated with a capital of $100,000; incorporators, J. M. O'Neill, I. McMichael and J. Levin.

Kamloops, B. C.—The new Dominion government telegraph line from Kamloops to Lower Nicola has just been completed, and it is expected that the first message will be sent over the wire early next week. The line is 70 miles in length.

The Electrical Age.

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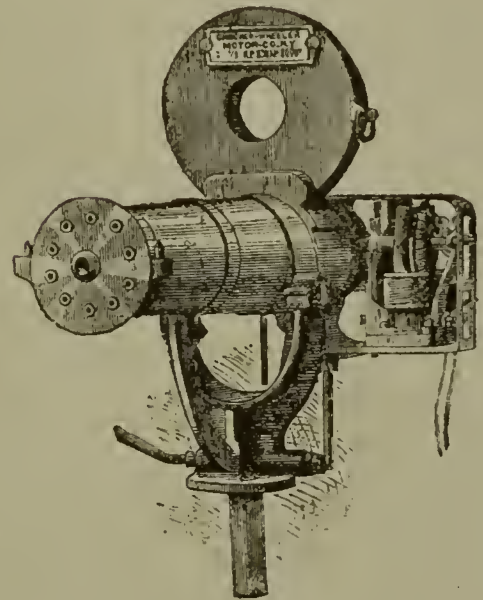
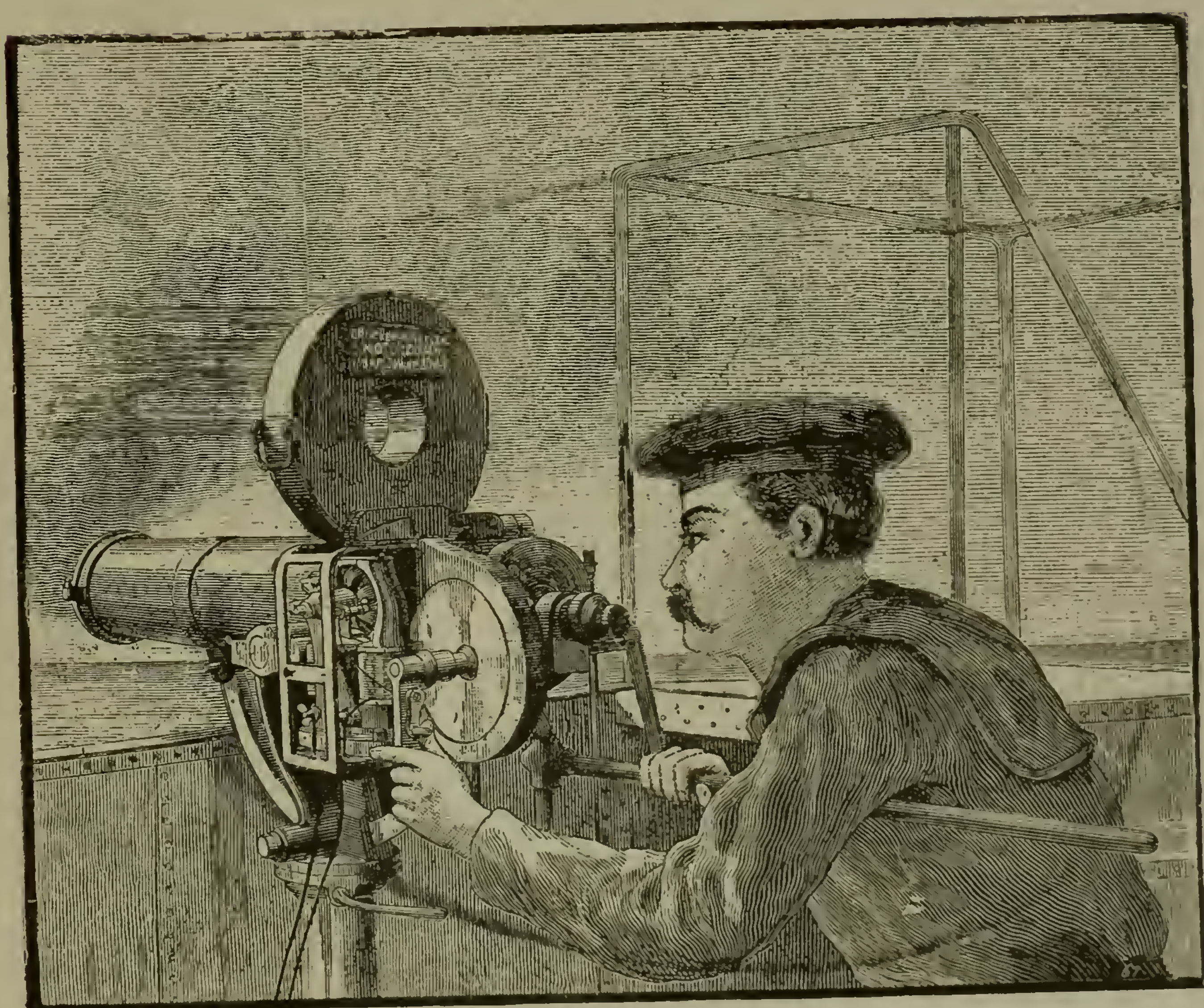
Applications of Electric Power.



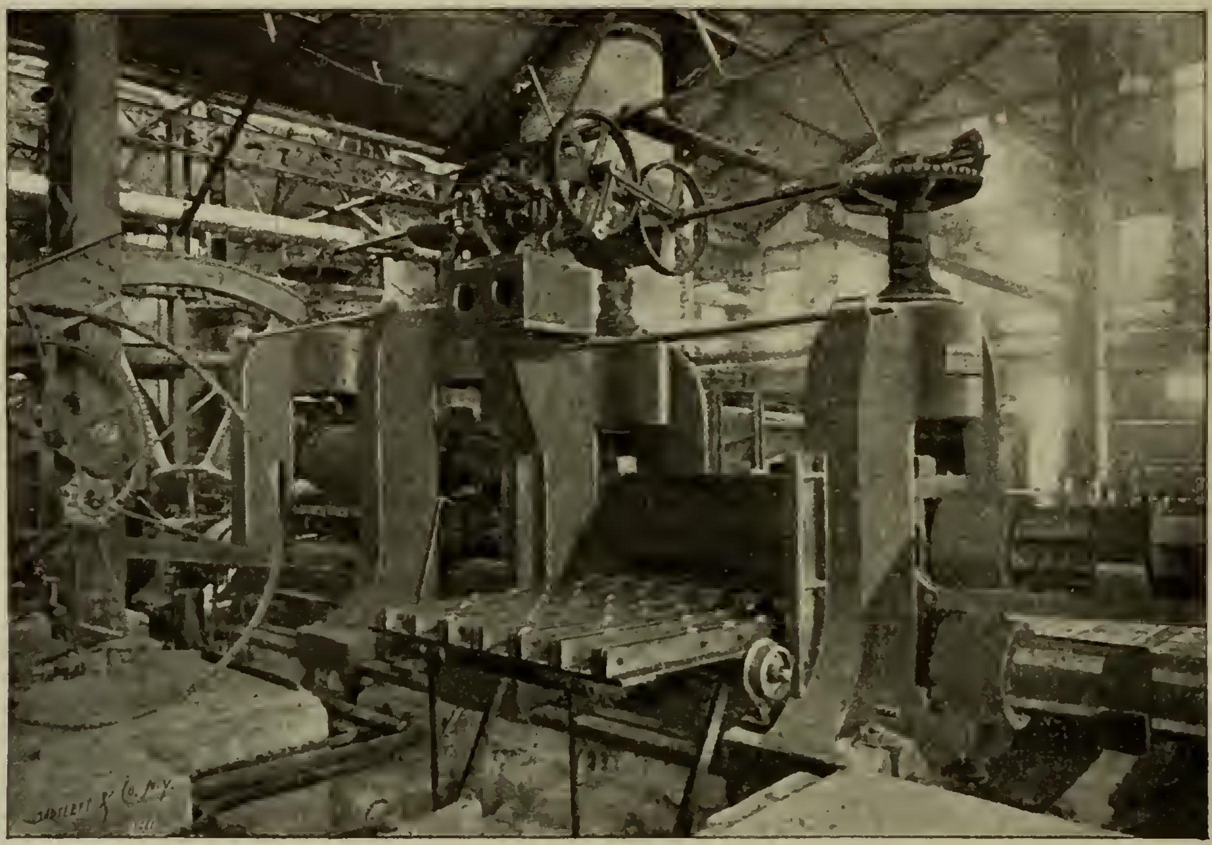
Gatling Gun Operated by C. W. Motor, Muzzle,



Gatling Gun Operated by C. Motor, Breech.

ELECTRICITY IN NAVAL WARFARE.

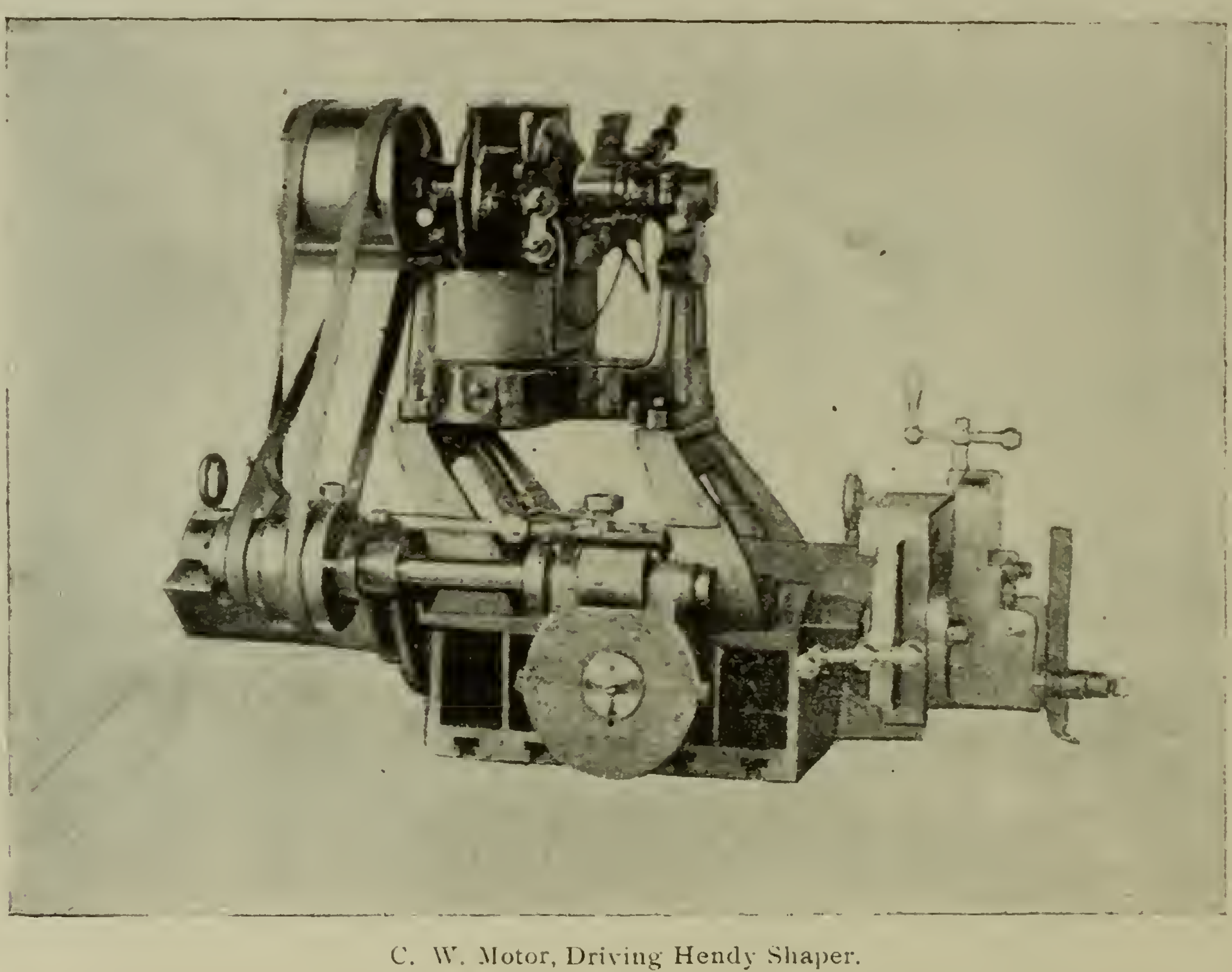
The application of electricity on board ships of the line has developed extensively within the last few years. The quickly moving armored cruisers and first-class battle ships are fully equipped with generating plants and electric appliances of all descriptions, in connection with naval requirements. The electric windlass, the searchlight, the signalling system, hoisting machinery and, at present, even wireless telegraph outfits bring certain option with this subject we find motors employed for operating Gatling guns, as illustrated. By means of the motor attachment the gun can be driven at a high rate of speed and its rate of firing thereby increased greatly.



C. W. Automatic Brake Motor with Counter-shaft Through Base, Geared to "Screw Down" on Blooming Mill Rolls, Granite City Steel Co.

The introduction of motors for this purpose has led to their use for larger machine guns and for the purpose of controlling the motion and range of them. The torpedo boat is fully equipped in this respect, particularly when below water. This type of submarine vessel is forced to employ machinery which does not call upon the stock of air. Electrical machinery in this respect is ideal. The rotary motion, reducing vibration to a minimum, and the development of power being unattended by any consumption of air, makes it most likely that electricity for this purpose will ultimately be the only agency employed.

In an article by Lieut. W. S. Hughes, U. S. N., on the same subject, the writer speaks of the employment of electricity on some of the vessels of the British Navy for the purpose of rendering visible the sights of the guns when firing at night. By means of a few Leclanche cells and a fine platinum wire running across the bottom of the sight notch this difficulty is removed. The author also states that for submarine boats no motive power yet discovered seems comparable with electricity. High speed in vessels of this respect will probably never be of the first importance since they are mainly designed for attacking ships at anchor.



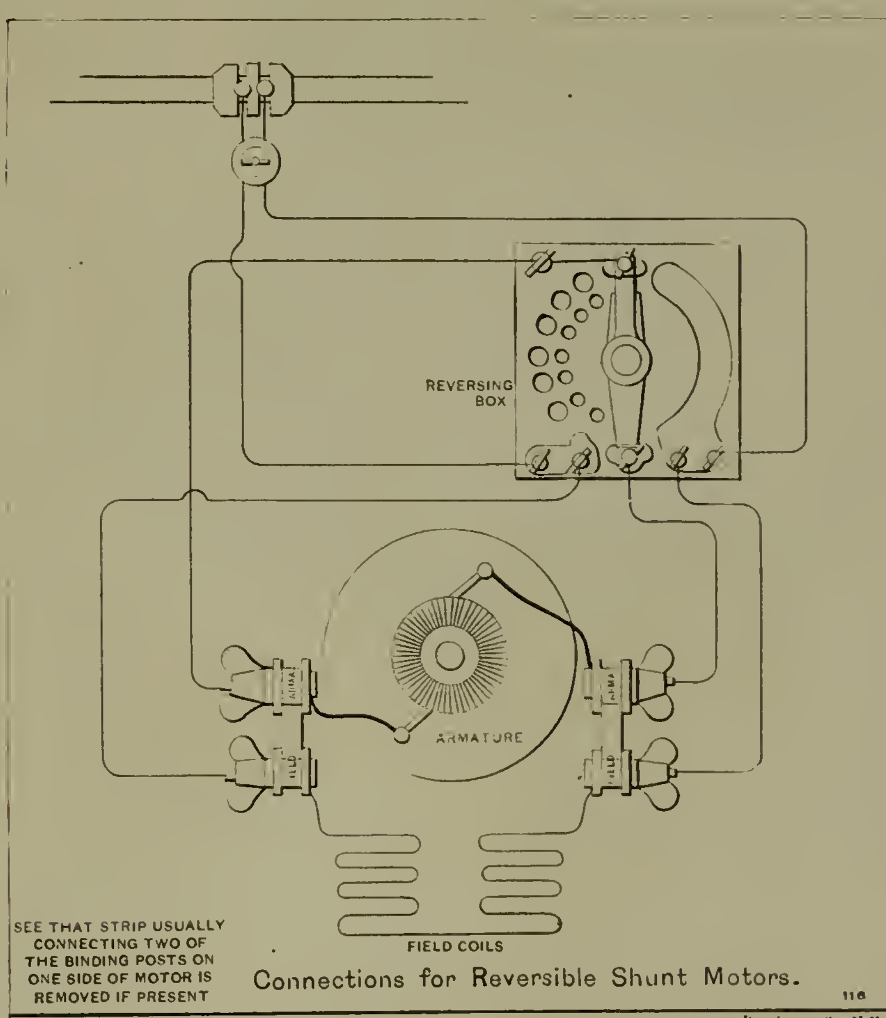
C. W. Motor, Driving Hendy Shaper.

CONNECTIONS OF MOTORS.

Motors are generally divided into three classes according to their winding, series, shunt and differentially wound. In the series motor the direction of rotation remains the same, whether the current is reversed or not. For this reason a series motor of low induction can be run on an alternating current circuit. The shunt and differentially wound motor also runs in a fixed direction, whether the current is reversed or not. The connections of a standard shunt motor, showing the fields led independently from the mains and the armature in series with the starting box, are illustrated. In order to reverse the motor it is either necessary to reverse the field connections or those of the armature. It is generally the simplest method to reverse the armature connections automatically. In the second sketch are shown the connections for reversible shunt motors. The reversing is done by the starting box, as indicated, which throws in and out the armature conections. The field remaining fixed and the current in the armature reversing the armature naturally rotates in the opposite direction.

THE EFFICIENCY OF DIRECT CONNECTED MACHINE TOOLS.

The machine shop has been transformed from a forest of belts and rattling countershafts to a clean, orderly and efficiently operating establishment in which the machines are driven and governed separately. Strange as it may seem the losses of power in a machine shop remained unknown for years. These losses were due to the friction of bearings, the slipping of belts and the waste of power when machine tools were not in use. A series of tests were instituted for the purpose of discovering how much power was wasted in the ordinary belt driven shop. The results showed that out of every hundred horse-power applied to the main shaft about forty horse-power was wasted; sixty being available for industrial purposes. This comparatively great waste of power drew the attention of several electrical manufacturers to the situation and experiments were tried with direct conected motors. The results were surprising, it being shown that the loss of power was reduced to a little over ten per cent. and the average loss during the year did not exceed fifteen per cent. The direct connected motor wastes no power in mechanical transmission. It does not run when not in use and the wear and tear under such circumstances is reduced to a minimum. A waste of forty horse-power per annum at an average cost of one hundred dollars per horse-power for that period of time will represent a loss of four thousand dollars, which during a period of ten years would represent a small fortune. An outlay of ten thousand dollars in a well-equipped machine shop for the purpose of driving machines by motors would probably cause an actual saving at the end of the time specified instead of the loss sustained through belting. In the above article are represented cases of C.-W. motors attached to machines, such as shapers, blooming mill rolls, etc.



Connections for Reversible Shunt Motors.

ELECTRIC RAILWAYS IN BORDEAUX.

American manufacturers of electric railway supplies may find it to their interest to note the fact that the Tram and Omnibus Company of Bordeaux, a company having the exclusive right to operate street cars and omnibuses in this city, whose charter had still several years to run, has recently sold out to a new company, which will operate under a new charter. It is understood that the old company is to receive 12,000,000 francs ($2,316,000) for its property and rights for the unexpired term of its charter, stockholders being allowed the option of stock in the new company on favorable terms instead of cash. The former company was English, with headquarters in London; the new one is French. The chairman of the board of directors is M. Mercet, 10 rue de Londres, Paris. It is understood that the present managing director, M. Bretherton, will continue to hold the same position under the new management. As the legal formalities are not yet complete, the terms of the new concession cannot be given. It is understood, however, that they require an immediate increase of the service in the city and vicinity, and that the new company will at once proceed to substitute electric power for horse-power, which has been used heretofore. Information can be obtained by addressing M. Bretherton, managing director, Tram and Omnibus Company, rue Tivoli, Bordeaux, France.

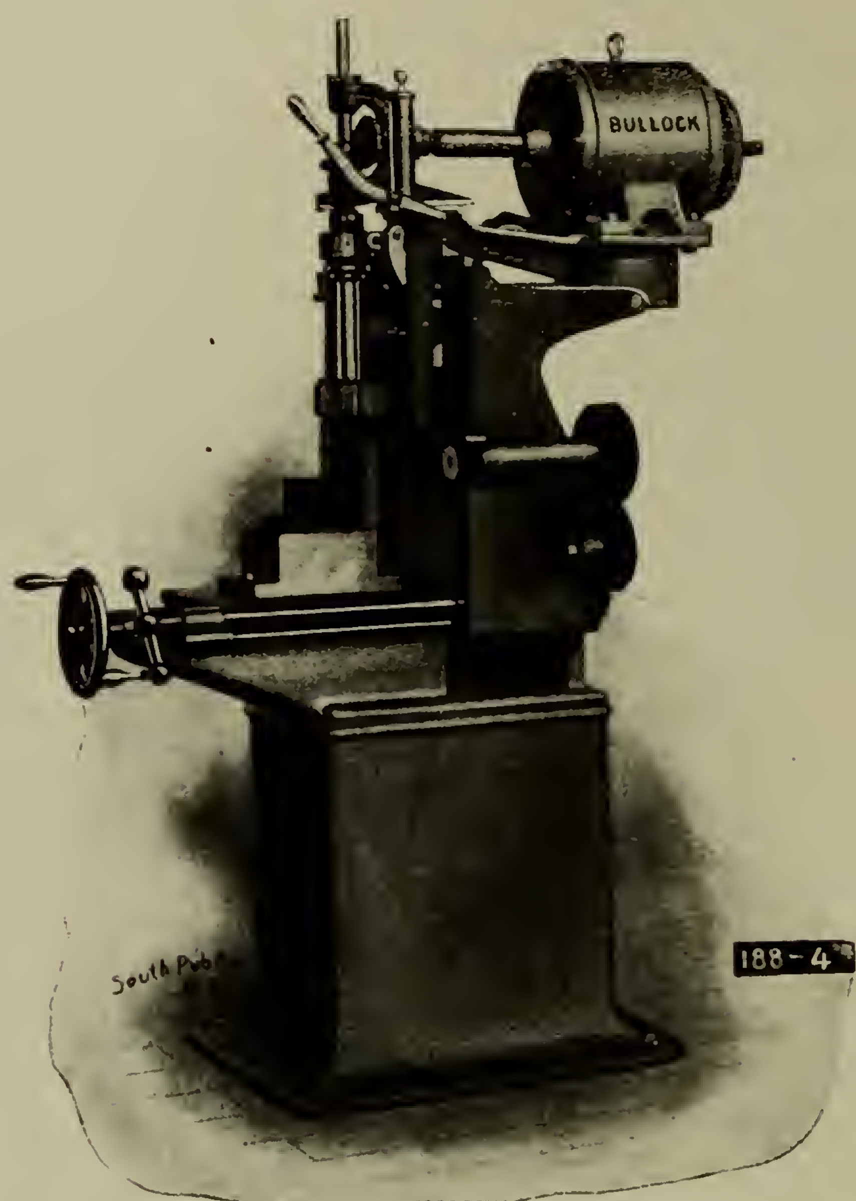
ALBION W. TOURGEE, Consul.

A NEAT APPLICATION OF ELECTRIC POWER.

A profiler is a difficult machine to directly apply an electric motor without intermediate belting, owing to the fact that the distance between motor and spindle varies by reason of the constant shifting of the carriage.

To surmount the difficulty of a constantly changing length of shaft, the Bullock Electric Mfg. Co. place the motor upon a revolving base and connect the motor and spindle by a splined shaft and sleeve. The shaft sliding within the sleeve allows for the variable distance between motor and spindle.

The motor is described in Bulletin No. 6,935, which may be had by addressing the Company at Cincinnati, Ohio.



Bullock Motor Direct Connected to Profiler.

DRAWBACKS IN THE NERNST LAMP.

Industries and Iron formulates many objections to the Nernst lamp. There is no automatic heating arrangement for the small power lamps, and they require about eight seconds of artificial heating before they can be brought to incandescence. There are as yet no lamps of small candle power, and as each lamp has three wires, their connection is not always convenient. There have been no practical tests of the light of the lamp outside of the laboratory, and there are as yet no lamps of this design in commercial use. It is thought by some that the Nernst patent cannot be held valid, owing to the same principle being involved in the Jablochkoff candle.—Ex.

Stray Currents.

A SUBSTITUTE FOR THE SKULL AND CROSS-BONES.

In Germany at points where there is danger of high voltage electric currents, there is a conventional representation of a zigzag bolt of lightning. This is painted on transformer chambers, poles and similar places.—Ex.

LIGHTING LAMPS FROM WATER PIPES.

Prof. Blake, of the University of Kansas City, Kansas, who has been lately studying the effect of electrolysis upon water mains and gas pipes, states that there are some places in that city where an incandescent lamp can be lighted by simply attaching it to a fire hydrant. Some of the water pipes taken up seemed ready to go to pieces, and in some of the pipes it was possible to penetrate the metal with the blade of a knife.—Ex.

TIMING THE BEATS OF A CHRONOMETER BY ELECTRICITY.

Mr. A. Berget has recently described before the Academie des Sciences an arrangement he has devised to obtain from an ordinary chronometer records of the beats of the escapement. The method is especially applicable for use on board ship, where the seconds pendulum with the usual relay circuit for recording seconds cannot be used. It consists of playing a delicate microphone on the chronometer connected with a magnifying telephone, on the diaphragm of which a relay is attached. The almost imperceptible vibration of the chronometer due to the escapement is thus magnetically recorded on a moving cylinder. One of the most common uses to which the apparatus will be put will be in comparing the time-keeping of a chronometer with that of a standard clock. Of course the method is equally applicable to astronomical clocks.—Ex.

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ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

Seventh Floor, World Building,

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NEW YORK, DECEMBER 16, 1899.

CONTENTS:

HOW FAR CAN ELECTRIC POWER BE TRANSMITTED?

The transmission of many thousands of horse-power over a line is already an accomplished fact. The question, therefore, need not arise in relation to the possibility of actually transmitting large quantities of power but would be better framed in relation to the distance over which transmission is possible. In erecting a plant and line from which economical transmission is expected the limitations are expressed in terms of insulation and voltage. Experiments have been tried with temporary lines through which currents pass of more than forty thousand volts pressure. It was noticed during the course of these experiments that the insulation became less and less reliable, the leakage increased and the risk and losses rendered the practical equipment of a line at this pressure almost an impossibility. In fact, an examination of the conditions expressing the limits of electric transmission prove that the question of insulation is in certain respects more important than any other.

The rules governing the electro-motive force is as follows: "If the weight of the copper is fixed with any given amount of power transmitted and given loss in distribution the distance over which the power can be transmitted will vary directly as the electro-motive force." In other words if the electro-motive force is doubled, other conditions remaining the same, the distance is increased in proprtion. The probabilities are, therefore, that a power transmission line extending from New York to Niagara Falls would require an insulation of such a character that it would be able to withstand several hundreds of thousands of volts. The remarks of Dr. Louis Bell on the limitations of electric power transmission assume the following form: "as we get to working higher and higher voltages at longer and longer distances the electrical phenomena most likely to cause trouble are those connected with electric capacity, chiefly resonance and lightning. To get these under control a good bit of hard study and experimentation will be necessary. * * * For working out the matter practically a transmission of a thousand or two kilowatts over one hundred or two hundred miles in a favorable climate is a step greatly to be desired."

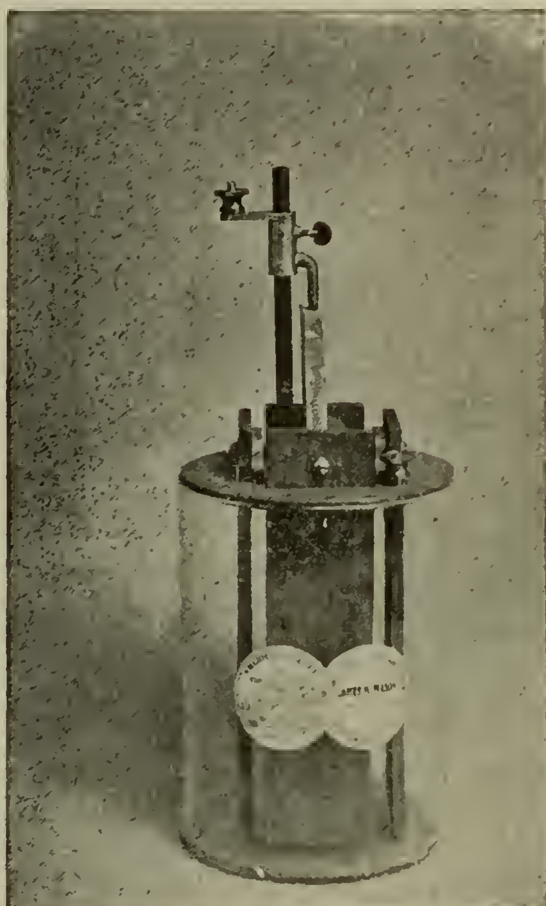
The difficulties Dr. Bell refers to above are not as great as he imagines. The capacity effects in a long distance transmission plant are not very serious neither can limitations be expected from other causes. The main trouble, which will not cease to arise if the climate is apt to be severe, is lack of proper insulation. The Niagara plant, sending power a distance of some twelve or fifteen miles to Buffalo, generates five thousand volts and the efficiency is over seventy per cent. The voltage of a one hundred mile plant would be between fifty and seventy thousand volts. That of a four hundred mile plant would be from two hundred to three hundred thousand volts. From these figures it would seem evident to the general reader that means must be taken to thoroughly insulate a line in order to protect it from severe leakages. In the dark a line carrying a pressure half as great as this would be visible as a series of corruscations. An unusually heavy insulation would be required for the conductor as well as its permanent support. But in spite of these difficulties there is no theoretical reason why long distance transmission should not be a success.

An interesting subject, being discussed by some of the magazines, is "When Coal Gives Out." The thought is a painful one and the theme certainly presents a rather gloomy future to the civilized world. It would lead to many changes of a nature that can only be speculated on at present and in all probability plunge the unhappy earth into a condition worse than that experienced by her during the glacial periods. It is some consolation to know that for five thousand years at least there will be coal to burn and it certainly seems as if that was sufficient time for many budding geniuses to perfect solar engines, devices for storing up heat, and certain chemical, electrical and magnetic means of protecting a virtuous mankind from deep snows and March winds.

At the present rate at which coal is being consumed, with many future industries in sight calling for more, a five thousand year estimate may be subject to criticism as the length of time coal will last. Only one-third of the coal mined reaches the large cities; the balance is wasted; in addition the engineering fraternity is well acquainted with the fact that only ten per cent. of the coal consumed gives any return. On this basis we utilize one-tenth of one-third or about one thirtieth of the coal mined. The danger seems to lie in our not being able to perfect a heat engine sufficiently to overcome this waste of fuel. The field is open to those whose training will enable them to investigate the chemical and electrical possiblities. A chemical method of consuming coal by which the oxygen is insidiously introduced, bringing about complete combustion and not too great a rise of temperature, might help to solve the problem. The human body is a fair example of this and its efficiency as a heat engine is more than twenty per cent. A thermo-electric device or a battery in which the energy of coal is directly transformed into electricity is a speculation many inventors have indulged in.

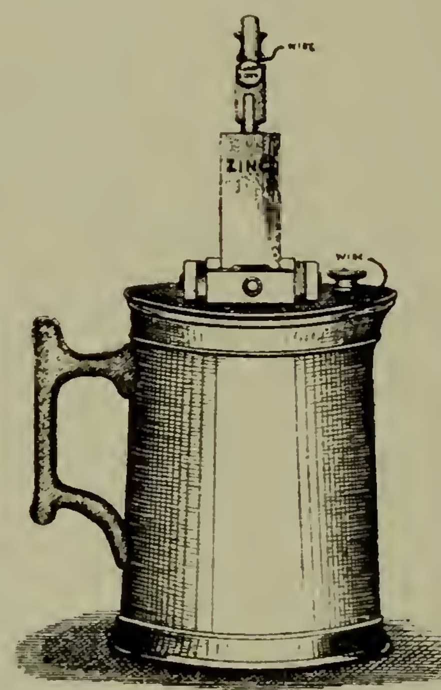
VENTILATION AND POWER.

The refinement of the art of motor construction has brought with it additional improvements in battery construction. The general public require and are willing to pay for a light, convenient electric fan and a briskly run-



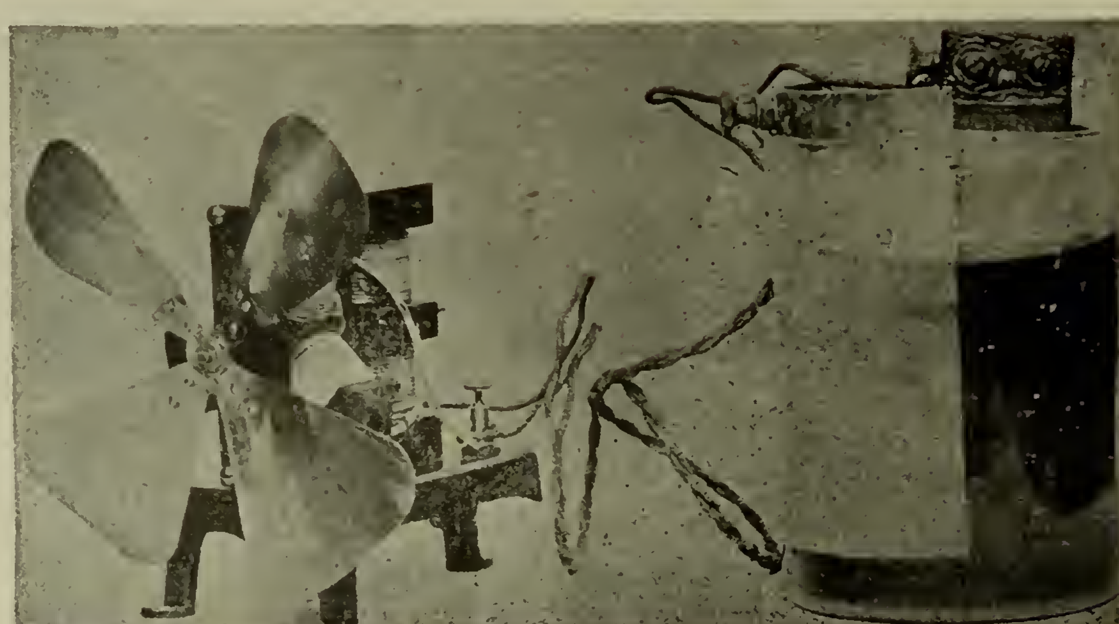
The "Prize" Battery.

ning motor for sewing machines or an equivalent purpose. Receiving a small motor by mail for $2 net is certainly indicative of improvement in the design and construction of the same if a guarantee goes with it. The American Oddity Company manufacture motors of this description with a speed of over two thousand revolutions a minute, and operated by a single Mason battery. It will then run a five inch fan, various toys, model machinery, etc., revolving show windows and quite a long list of devices where small power and high speed can be applied. Outfits of more importance than this, producing greater power and running larger fans, are supplied by the above company with two cells of battery, which will run for ten hours without attention. Eight inch four bladed fans with fan guards, battery cord and a charge of battery salt for $12 net, or a smaller outfit consisting of one battery with fan running for at least twenty hours, costing only $9 complete. Not only are these little motors and batteries perfectly serviceable for ven-



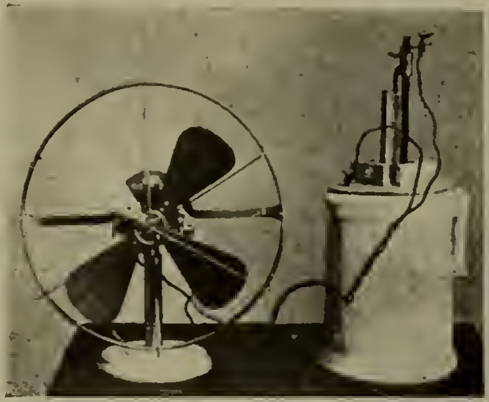
The Adjustable Battery.

tilation at the invalid's bed, in the merchant's office, or any other place occasion demands, but physicians and dentists, as well as a large host of small power users, find them exceptionally good. No unusual claims are made for this battery or motor in any of its sizes. Everything is carefully and conservatively calculated as regards the life of the battery, the cost of operating it, the speed and power of the motor. A $10 outfit, consisting of a motor



Fan Motor Complete with Battery.

with fan guard, running an eight and a half inch, four blade fan, and two dry cells, is manufactured for purposes of a purely hygienic nature. Only a five or ten minute run is expected at a time, but for the purposes to which it is devoted this is not an objection. Zincs are supplied with the Mason battery which will last through three charges of battery salts for twenty cents a piece; in larger lots at a correspondingly lower price. Neither the motor nor the battery wears away, except the liquid and the zinc, which can be readily replenished or renewed



Portable Electric Fan Outfit.

after a certain number of hours' use. These interesting outfits, well within the reach of the general public, are fully described and on exhibition at the sales rooms of H. J. Linder & Co., 123 Liberty Street, New York.

Legal.

VICTORY FOR THE GOLD CAR HEATING COMPANY.

The suit recently brought by the Consolidated Car Heating Company against Palmer and Monson Street Railway Company on the McElroy patent for system of heating by electricity, No. 608,211, dated August 2d, 1898, has been dismissed. The Palmer and Monson Street Railway Company adopted the Gold system of

Unassembled Fan Motor.

electric car heating and the Consolidated Car Heating Company brought suit for alleged infringement of the above patent with the result above stated, because the Gold system does not infringe that patent nor any other existing patent.

The Gold Car Heating Company voluntarily defended the suit by its own counsel and at its own expense, relieving the Palmer and Monson Street Railway Company of all trouble and expense whatsoever in connection therewith. The two interference suits in the United States Patent Office relating to valuable improvements in electric heaters prosecuted by the Consolidated Car Heating Company in support of the application of James F. McElroy and by the Gold Car Heating Company in support of the application of Edward E. Gold, have both been decided in favor of the Gold Car Heating Company, not only on the original hearings but also on appeal. As a consequence on the 17th day of October, 1899, some more very important patents covering electric heaters were issued to the Gold Car Heating Company.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING DEC. 9, 1899, $32,393.

New York, N. Y., Dec. 9, 1899.—The following were the exports of electrical material and kindred lines from the port of New York during the week just ended:

British Guiana.—11 cases electrical material, $215.

British East Indies.—41 cases electrical material, $5,777.

British Possessions in Africa.—7 cases electrical machinery, $3,956; 52 cases electrical material, $3,234.

British West Indies.—64 cases electrical material, $2,314; 1 case electrical machinery, $48.

British Australia.—39 cases electrical material, $688; 7 cases electrical material, $426.

Central America.—2 packages electrical material, $48.

Canada.—3 cases electrical material, $106.

Dutch West Indies.—1 case electrical material, $1,150.

French Possessions in Africa.—7 cases electrical material, $1,015.

Hamburg.—3 cases electrical material, $1,172; 14 cases electrical material, $328.

Havre.—117 cases electrical material, $8,521.

London.—23 cases electrical material, $584; 9 cases electrical machinery, $335.

Porto Rico.—2 packages electrical material, $29.

Rotterdam.—1 package electrical material, $40.

Southampton.—23 packages electrical material, $1,694.
U. S. Colombia.—3 packages electrical material, $85.
Venezuela.—12 packages electrical material, $628.

New Incorporations.

Charleroi, Pa.—The West Side Light, Heat and Power Company has been chartered with a capital of $1,000. W. M. Murdock is the treasurer.

Minneapolis, Minn.—The G. W. Frey Company has been incorporated; capital stock, $15,000, for the purpose of manufacturing lighting apparatus.

Kokomo, Ind.—The La Clede Battery Company has been incorporated for the manufacture and sale of batteries and electrical supplies; capital, $25,000.

Hazelhurst, Miss.—The Hazelhurst Electric Light Company has been incorporated; capital stock, $5,000; I. N. Ellien and G. T. Ragsdale, incorporators.

Charlotte, Mich.—The Charlotte General Electric Company has been incorporated; capital, $40,000; incorporators, J. C. Farrar, W. Farrar, W. H. Halleck, E. Halleck, H. A. Homes, all of Brighton.

San Francisco, Cal.—The Martel Power Company has been incorporated to generate power, light and heat; capital, $100,000; incorporators, A. F. Martel, E. F. Sagar, M. D. Levenson, J. Newbauer, E. Martel, B. A. Goldsmith, A. I. Black, all of San Francisco.

New York, N. Y.—The American Power Transmission Company has been incorporated to manufacture and deal in heat, light and power; capital, $500,000; incorporators, S. A. Bennett, A. S. Fisher, T. N. Riprom, L. R. Mestaniz, E. F. Perry, all of New York city.

Sing Sing, N. Y.—The Sing Sing Lighting Company has been incorporated to supply gas and electricity in Sing Sing and other towns and villages of Westchester County. Capital, $50,000; directors, John T. Kirk and B. F. Williams, of Brooklyn, and L. B. Lampmann, of Coxsackie.

TELEPHONE CALLS.

Tifton, Ga.—A new telephone line is soon to be built from this place to Ashburn.

New York, N. Y.—A fourth telephone company, to be known as the Universal Telephone Company, has been organized to do business in this city. The capital stock is $5,000,000.

Mt. Vernon, Ind.—The Posey County Telephone Company has been incorporated to operate telephone lines; capital, $10,000; incorporators, W. M. Fird, W. M. McGregor, E. Reed, J. Bailey, all of Mt. Vernon.

Albany, N. Y.—The Rochester Telephone Company, with a capital of $100,000, has been incorporated. The general route of the company, besides operating in Rochester, will connect with Syracuse, Utica, Oswego, Watertown, Ogdensburg, Buffalo, Niagara Falls, Mayville, Corning, Elmira and Binghamton.

Waterbury, Conn.—The Waterbury Automatic Telephone Company has been incorporated; capital, $10,000; incorporators, G. F. Hughes, M. J. Byrne, W. L. Hall, W. D. Richardson, W. S. Jones, J. Blair, all of Waterbury; B. F. Mahon, of New London.

Boston, Mass.—The Clark Telephone and Telegraph Manufacturing Company has been incorporated to manufacture and deal in telephone and telegraph apparatus; capital, $100,000; incorporators, D. J. O'Connor, L. A. Frink, F. O. Emerson, J. M. Conlan, E. L. Tierney, all of Boston, Mass.

Albany, N. Y.—The Independent Telephone Company, of New York city, was recently incorporated here. Its capital stock is $100,000, which may be increased to $20,000,000. The directors are Frederick Myers, James Russell, C. W. Phillips, Henry Teneyck Wendell, of New York, and Franklin Noble, Charles Tremaine and James C. Merwin, of Brooklyn.

STREET RAILWAY NEWS.

Tacoma, Wash.—Rydstrom & Goerig have been awarded the contract for constructing the Tacoma-Seattle Electric Railway.

Oil City, Pa.—The Citizens' Traction Company has been incorporated; capital, $150,000; incorporators, W. Hasson, D. G. Geary, H. I. Beers, P. Boyle and E. Liebel.

Guthrie, O. T.—A charter has been issued for the construction of an electric line between the cities of Shawnee and Tecumseh, in Pottawatomie County.

Galesburg, Ill.—The Galesburg & Monmouth Rapid Transit Company has been incorporated; capital, $200,000; incorporators, F. Seacord, of Monmouth; H. Knowles, R. Chappel, both of Galesburg.

Norfolk, Va.—The Hampton Roads Development Company has been chartered at Portsmouth with a capital of $300,000. The company proposes to build an electric railroad from Portsmouth to Pig Point, on Nasemond River, opposite Newport News; operate a ferry across the James, and build a town at Pig Point. Parties closely connected with the Seaboard Air Line Railway are believed to be behind the project.

POSSIBLE INSTALLATIONS.

Chickasha, Ind. Ty.—Chickasha will have an electric light plant.

McAdoo, Pa.—An electric light plant is to be erected here at a cost of $5,000.

Gillman, Ill.—A franchise has been granted to F. L. West for installing an electric light plant at this place.

Ligonier, Pa.—The Byers-Allen Lumber Company, of this place, is contemplating the erection of an electric light plant in its factories.

Valley Stream, L. I.—A movement is on foot here to again introduce the electric light, and petitions are now being circulated for the necessary signatures.

Norwich, Conn.—The Aldrich Manufacturing Company is preparing to light its large plant in Moosup by electricity. A large dynamo, capable of sustaining 1,000 lights, will soon be put in position.

Muscoda, Fla.—Muscoda is to have an electric lighting system of about 600 lamps. The plant will be operated by water-power, located at the mill situated on a lake about three miles from Muscoda.

Pine Bluff, Ark.—An ordinance has been adopted authorizing the expenditure of $90,000 for the purpose of providing the city of Pine Bluff with arc and incandescent lights for a period of fifteen years.

Rutland, Ill.—S. Milliken, of Walnut, Ill., has been granted a 20-year franchise by the village board, and will at once install a complete electric light plant. The village street will be illuminated with 16 2,000-candle-power arcs.

The Electrical Age.

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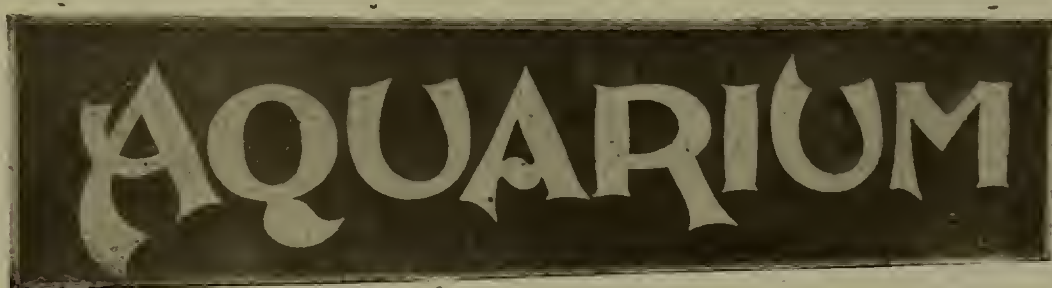
Illumination.

Designing Department.

Blacksmith Shop.



Sheet-Metal Working Department.

Assembling Room.

The Making of an Electric Sign; From the Sketch to the Finished Article.

ELECTRIC SIGNS; THEIR ORIGIN AND CONSTRUCTION.

The remarkable fertility of the commercial soil in metropolitan cities is manifested by the rapid growth of the electric sign industry. A process has taken place in this department of applied science which is the very reverse of that generally met with in the spreading of a new idea. When the necessity for an article arises it passes through evolutionary stages less and less utilitarian and more artistic with each advance. The crudest applications appear first to be followed later by a product representing the outcome of aesthetic taste. In the case of electric signs, we first find them applied indoors in various beautiful forms for purposes that were originally entirely artis-

One of the Famous "Writing" Signs.
Lamps are thrown into Circuit in Rapid Succession, Producing effect of Writing.

tic. To-day they have become of considerable practical importance as a means of advertising, but have lost none of those qualities which have made them a most interesting novelty. The skill now manifested in electric sign construction is something extraordinary. Various magic effects are simulated and delusions created that give rise in every case to wonder and surprise. The rippling of a flag in the breeze, the gradual growth and disappearance of a characteristic signature in letters of electric fire, and

A Well-known Sign.

the changing of color in the appearance of an electric sign have become comparatively familiar sights to the residents of large cities. The means by which these remarkable effects are produced are simple enough yet a vast amount of skill, labor and ingenuity is represented by the completed article. The demands of a customer are first carefully considered and the designing department applies its energies to the task of evolving approximately what he wants in the shape of a sketch. The preparation of this sketch, which forms the basis of a commercial estimate, is necessarily the work of an experienced electrician. The design once accepted, the various departments are put to work, as illustrated in the views, to produce the letters and sheet metal forms of which the sign is to be composed. For this purpose a plant is re-

Sign 75 Feet Long. Maximum Height of Letters, 15 Feet.

quired roomy enough to allow speed to be made without there being a lack of "elbow room."

The Electric Motor & Equipment Company, 12-14

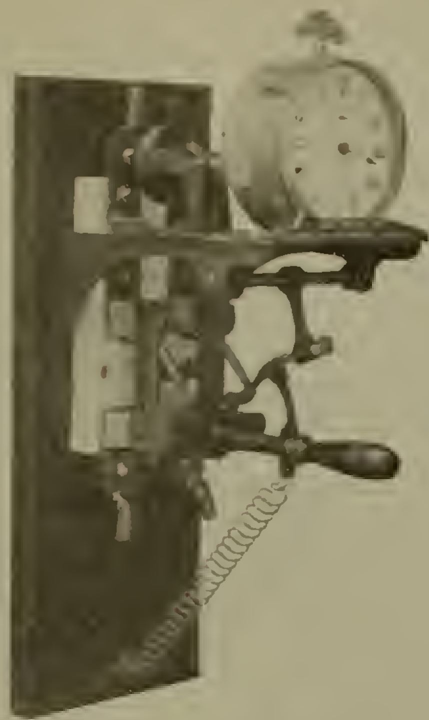
A Conspicuous Example of "Flush Letter" Type of Sign Construction.

Beaver street, Newark, N. J., operate along the lines above outlined. The designing and construction departments are under the personal supervision of Mr. E. J. McAllister, who had complete charge of all decorative and sign work of the Edison Decorative and Miniature Lamp Department of the General Electric Company. His remarkable aptitude in this particular field of work is shown by various illustrations which have been inserted in the text of this article. Not only is engineering skill required for the final accomplishment of any particular problem in electric sign construction but an artistic sense as well and this rare combination is but infrequently met

Knights Templar Emblem.

with among the engineering fraternity. The mechanism by means of which these various changes are brought about is a rotary commutating switch which throws in

matic time switch, also illustrated, is an excellent addition and forms an integral part of an electric sign system. It



Automatic Time Switch.

opens the circuit automatically and prevents the wasting of current in case the watchman forgets to throw it off.

Another Writing Sign.

and out the various sections of a circuit automatically.

L. A. W. Emblem.

This operation is performed by a small motor which is built for either alternating or direct current. An auto-

An electric sign supplied with the commutating device and automatic time switch represents the ne plus ultra of

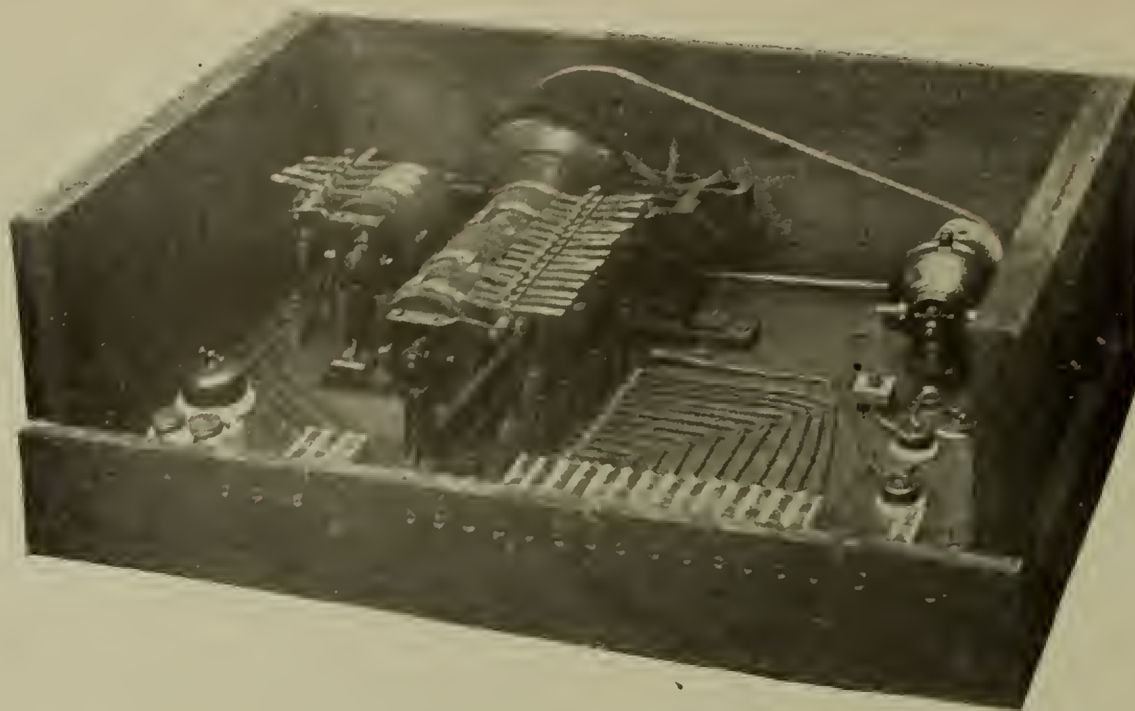
A Novel Effect

(The flags appear to wave.)

electric invention and human ingenuity in this particular department of work.

A NEW COHERER SUBSTANCE.

Peroxide of lead, when used as a coherer substance, shows the peculiar property of decreasing in conductivity under the influence of electric waves. This property has hitherto been held to disprove Lodge's theory of the coherer, based upon the formation of conducting chains by the welding together of successive particles. T. Sundorph has studied the behavior of this substance, and found that a cell containing PbO_2 powder transmitted a current of 8.5 milliamperes to begin with. After two minutes' exposure to electric waves, the current was reduced to 5 milliamperes, and after twenty minutes to 5 milliamperes. At the same time, the amount of PbO_2 was slightly reduced, but the author does not seem to be able to find the reason of this reduction. The only clew he gives is that PbO_2 contains some moisture, and this, of course, might be evaporated by the sparks. But whatever change takes place seems to be confined to the neighborhood of the terminals, and the positive pole becomes hotter than the negative pole.—Ex.



Commutating Device for Electric Signs.

Brazilian Coat-of-Arms.

The Electrical Age.

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NEW YORK, DECEMBER 23, 1899.

CONTENTS:

INSULATION FOR HIGH POTENTIALS.

It is well understood by practical men that the thorough insulation of high potential circuits calls for a more intimate knowledge of the insulating properties of dielectrics. Some of those in use at present will resist enormous potential differences for a considerable period of time. Others, when exposed to the influence of an alternating current of high potential deteriorate very rapidly. The breaking down of a dielectric therefore remains to be discovered for all the conditions met with in the transmission of high potentials over long lines. From calculation it can be assumed that in air under the ordinary conditions of normal temperature, pressure and moisture an isolated metal sphere of ten centimetres radius will resist a potential of about two hundred and forty thousand volts. The value of other insulating media, as far as their dielectric strength is concerned, reaches enormously high figures. Paraffined paper, according to Macfarlane and Pierce will resist a strength of three hundred and sixty thousand volts per centimetre; beeswaxed paper reaching as high as five hundred and forty thousand volts. From these facts it is evident that many of the insulating materials in use have enormous resisting power but seem unable to meet the exigencies of practice. A curious phenomenon occurs in relation to high potential discharges; the gas near the surface of a negatively charged metal conductor seems to possess a greater electric strength than that in other portions of the circuit. What this may be due to only careful analysis can explain. But it would be most interesting for certain of our wire manufacturers in testing the finished product to find out whether the insulation used is more apt to break down on the negative leg than the positive when tested with a high potential continuous current.

In connection with the electric strength of dielectrics, their resisting power is a fixed quantity determined solely by the molecular condition of the material. In addition to this the mechanical mixture, unless strongly coherent or homogeneous, is apt to lose in insulating value. In tests that have been made with two cylinders of metal, charged to high potentials in dry air, particles of floating dust were quite sufficient to change this insulating property of the air. This subject has been well treated by J. J. Thomson, and he states that the least roughness of the surfaces or of clinging or floating particles of dust produce great variations in the resisting power of air as a dielectric.

LIGHTNING ARRESTERS.

The improvements noticed in the design and construction of lightning arresters are mainly due to a more thorough knowledge of this electro-static phenomenon. Lightning in its mad pranks has been known to avoid lightning arresters and to cause the same damage as though they were not present. This irregularity of conduct has produced a feeling of uncertainty in the minds of many regarding the reliability of this indispensable attachment to an electric plant. The protective action of a lightning arrester depends almost entirely upon self-induction. The electric discharge, as it were, is allowed the choice of two things: one is a circuit of considerable self-induction, the other is a circuit leading to the earth. It is presumed according to the laws governing the path of discharge of this nature that the grounded circuit is preferable through which the charge will dissipate itself. If the self-induction of the arrester is not sufficient it will not prevent a static discharge of low frequency from entering or leaping across from helix to helix and thereby entering the forbidden path. In other words, the rate of oscillation of the electro-static discharge and the amount of self-induction in the lightning arrester must be so related to each other that co-operation results. In many arresters we find an automatic device actuated by an electro-magnet to move the blocks farther apart after the lightning stroke. In others an electro-magnetic device is supplied with an intense magnetic field playing upon the spark gap. These are all ill chosen means to an unfortunate end. The efficient and practical lighting arrester designed and built on scientific principles should be one in which no necessity arises for such auxiliary appliances. An arrester tested experimentally to meet all rates of oscillation and successfully withstanding such a test is the best for electric light and power circuits. Were it possible to so adjust them that the spark gap can be automatically adjusted then low and high oscillations in the lightning discharge would be met with equal satisfaction.

In incandescent lamps the candle power and rise in temperature are so related that up to a certain point a proportion exists between them. This proportion rapidly disappears when the temperature of the carbon exceeds a certain figure. The additional heat is supplied by a heavier current until incandescence is reached. When only seventy-five per cent of the current is supplied to an incandescent lamp about ten candle power is given. A rise of about twenty-five per cent. in current strength gives six more candle power and an excess of from fifty to one hundred per cent. would raise the illuminating power to fifty or one hundred candle.

The Storage Battery.

TESTING STORAGE BATTERIES.

A brief review of the method of testing storage batteries may possess some interest for the technical reader as well as the manufacturer of electrical apparatus. The points of primary interest are those relating to the capacity, life and watts per pound of the cell complete.

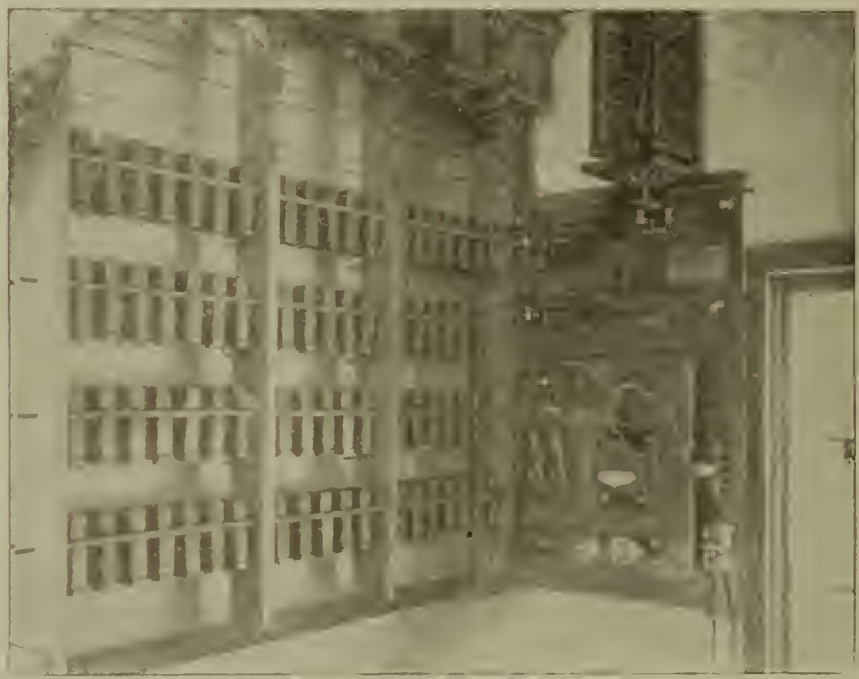
CAPACITY.—The capacity of a storage battery is governed largely by the amount of active surface exposed. In order to obtain the best results in this respect the lead is subdivided in a variety of ways, either by corrugation, the casting of ribs, slotting, etc. In the interstices thus formed, or the channels left open, oxide of lead is applied. Peroxide of lead then forms by electrolytic action and becomes an integral part of the frame work. The frame work is either composed of an alloy of lead or is made sufficiently thick, when composed of pure lead, to resist the strains incident to heavy discharges. The thickness of the active material, when in the form of peroxide, represents the number of ampere hours the

Testing Laboratory.

plate is capable of delivering; a thin film of peroxide possessing proportionately less than a thick one. Instead of the above types of plates grids are frequently used and the paste is either pressed into the openings or formed there from ribbons of lead. In testing for capacity the cell is charged and when discharged the current passed through an ammeter and the number of hours recorded during which the pressure remains at approximately 1.9 volts. A ten ampere discharge for ten hours, at approximately the above pressure, would indicate a capacity of one hundred ampere hours. At a twenty ampere rate of discharge in the same cell a three or four hour discharge may be all that is obtainable, the total number of ampere hours diminishing as the discharge rate is increased.

LIFE OF BATTERY.—The life of the cell is determined by the rate of discharge and the mechanical construction. If the mechanical construction is weak, that is, if the plate is very thin and the frame work likely to yield to much pressure, a heavy discharge will cause buckling, the plugs will fall out and the life of the plate come to a premature end. With a moderate discharge rate and a plate of sufficient thickness to withstand the strain, other things being equal, the life of the battery is pretty well assured. Cells used for street railway purposes have a life of about six months. For stationary work they last from a year to two years. For automobile purposes, daily service, the period of usefulness would not extend over a year. The plates most frequently renewed are the positive, a stock of which must be kept on hand in all cases for rapid renewals. A negative will outlast a positive at the rate of three and sometimes five to one.

WATTS PER POUND.—The watts per pound of a storage battery are very easily obtained, with reference to the plates, or the cell complete with acid solution, by



Small Storage Battery Installation.

dividing the watts output by the weight in pounds. The number of watts output per pound of cell varies with the character of the cell. In the Plante or lead plate cell it is less than for the Faure cell. In a certain type of standard battery on the market this rating varies from two to three ampere hours, or from four to six watt hours per pound weight. In certain other types of storage batteries, in which the weight of acid and jar bears a lesser proportion to that of the plates, an output of ten watt hours per pound of cell is obtained.

Marion, Ind.—The Marion Transit Railway Company has been incorporated; capital, $150,000; incorporators, E. H. Ferroe, J. A. Gauntt, A. S. Wade, P. Peslle, W. T. Caumack, H. Williamson, M. Petrie, all of Marion.

Bedford Station, N. Y.—The Bedford & Eastern Railway Company has been incorporated; capital, $30,000; incorporators, C. Haines, W. H. Lyon, of Bedford Station; W. V. Malloy, of New Rochelle; G. Jeungst, Jr., H. B. Thacken, C. J. Oecker, all of Croton Falls.

Educational.

HOW TO BECOME AN ELECTRICAL ENGINEER.

Until the past few years, men and women who wished to study professions or trades which demand skilled experts, were compelled to go to college or to a technical school in order to acquire the necessary information. That is the principal reason why only a very small proportion of the population could enter said fields of labor, for it is plain to anyone that the vast majority of people have to earn their own living by daily work, and therefore they could not spare the time or the money necessary for attendance upon one of the old educational institutions. Now, however, The United Correspondence Schools, of New York, have developed a system whereby any person living within reach of the mails may take a thorough course of study in one of the many professions and trades and equip himself or herself for successful work therein.

One of the most important courses offered by The United Correspondence Schools is that of electrical engineering, and the field is so great for skilled workmen that it offers endless opportunities and excellent incomes to those who are capable of doing good work. Any ambitious man of average intelligence can take this course of study and fit himself to become an electrical engineer, motorman, draughtsman, telegraph operator, lineman, designer, dynamo tender, etc. It does not matter where he lives so long as he is within reach of the mails, for upon enrolling as a student he receives printed instruction papers, which have been prepared especially for this course by instructors who are recognized experts, and his course of study is carried on entirely by mail. Those of our readers who are thinking seriously of becoming electrical engineers would do well to write for particulars to The United Correspondence Schools Company, 154-156-158 Fifth avenue, New York. The cost of tuition is moderate and may be met by easy monthly payments.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING DEC. 16, 1899, $61,507.

New York, N. Y., Dec. 16, 1899.—The following is a list of the exports of electrical material from the port of New York for the week just ended:

Antwerp.—22 cases electrical material, $1,711.

Argentine Republic.—20 cases electrical material, $133; 145 cases electrical material, $6,844; 3 cases electrical machinery, $664.

British West Indies.—21 packages electrical material, $1,347.

Brazil.—104 packages electrical material, $3,177.

Belfast.—53 packages electrical material, $970.

British Australia.—102 packages electrical car material, $11,851.

Bradford.—2 cases electrical material, $150.

Cuba.—8 cases electrical material, $183.

Chili.—60 cases electrical material, $1,302.

China.—1 case electrical machinery, $50.

Central America.—67 cases electrical material, $1,207; 3 cases electrical machinery, $48.

Havre.—1 case electrical machinery, $60.

London.—222 cases electrical material, $17,651; 21 cases electrical machinery, $930.

Liverpool.—100 cases electrical material, $7,055; 17 cases electrical machinery, $2,464.

Manchester.—16 cases electrical machinery, $1,065.

Mexico.—56 cases electrical material, $450.

Newcastle.—6 cases electrical material, $325.

Porto Rico.—6 cases electrical material, $210.

Peru.—32 packages electrical material, $1,541.

U. S. Colombia.—2 packages electrical material, $29 .

NEW INCORPORATIONS.

South Bethlehem, Pa.—A movement is on foot to incorporate a local electric light company.

Dover, Del.—The Trenton Company, of Chicago, has been incorporated for the operating of water and electric light works; capital, $250,000.

Chicago, Ill.—Karas Electric Manufacturing Company, Chicago; capital, $15,000; general electrical manufacturing; incorporators, Joseph Karas, V. T. Kissinger, R. Buhrke.

Chicago, Ill.—The International Electric Indicator Company has been formed; capital stock, $15,000; incorporators, L. E. Davidson, John P. Martin and Edward A. DeLasaux.

Los Angeles, Cal.—Electrozone Manufacturing Company, to manufacture electrozone; capital, $150,000; incorporators, A. G. Hall, B. White, D. C. Burrey, H. M. Johnson, C. A. Cole, all of Los Angeles.

Wildwood, N. J.—The Seacoast Electric Light Company, of Five Mile Beach, has been reorganized, and the new management promises to soon light this place and Holly Beach and also build a trolley road along the island.

Essex Falls, N. J.—The Essex Falls Electric Light and Water Company, principal office, Essex Falls, Essex county, N. J., has been formed to furnish electricity for light, etc. Capital, $10,000; incorporators, Herman Wendell, Frederick H. Treat, of Wayne, Delaware county, Pa., Charles O. A. Maunle, Essex Falls, Essex county, N. J.

Trenton, N. J.—The Columbus Electric Light Company, which will furnish electric light to southern towns, has been incorporated in the office of the New Jersey Corporation Agency, Jersey City. Papers have been filed in Trenton. The capital of the company is placed at $800,000, with these incorporators: Albert McMahon, John J. Mulvany and Charles N. King.

TELEPHONE CALLS.

Albion, Neb.—The Albion Telephone Company has been formed to erect and construct a telephone line; capital, $4,000; incorporators, A. Harris, M. G. Needham, T. F. Marlens, all of Albion.

Columbus, Ohio.—The Putnam Telephone Company of Ottawa, has been formed to operate a telephone line; capital, $40,000; incorporators, W. H. Harper, O. C. Handy, F. H. Wolf, J. T. Bisser, G. W. Bisser.

Guthrie, Okla.—A charter has been granted by the Secretary of State to the Independent Telephone Company, of Enid; capital stock, $5,000; incorporators, Geo. E. Holdredge, George W. Welsh and Charles J. West.

Sennett, N. Y.—The Sennett Telephone Company has been formed to operate in Sennett and Weedsport, Cayuga county; Eldridge and Jordan, and other towns in Onondaga and Cayuga counties; capital $500; directors, H. C. Crocker, S. C. Depew and Walter E. Spurr, of Sennett, Cayuga county.

West Oneonta, N. Y.—The Butternut Valley Telephone Company, of Otsego county, to maintain lines in Gilbertsville, Maple Grove, Morris and other villages in the county, with terminus at West Oneonta, has been formed; capital, $3,500; directors, G. C. Peck, E. E. Steele, New Lisbon; W. F. Ward, E. C. Brewer, Gilbertsville; Frank Hull, Jas. Martindale, George Williams of Morris.

STREET RAILWAY NEWS.

Toledo, Ohio.—The Northwestern and Eastern Railway Co. has been formed to operate a railroad; capital, $50,000; incorporators, J. Caldwell, W. Sheridan, F. C. Stulz, H. A. Conlin, C. C. Wilson.

Danville, N. Y.—The Danville Street Railway and Light Company has been formed to furnish electricity for all purposes; capital, $700,000; incorporators, F. Lindley, A. R. Samuel, O. W. Cannon, all of Danville.

Danvers, Mass.—Work has begun in earnest on the construction of the Middletown & Danvers Electric Railway, with a large force of men. It has been delayed because rails and other materials could not be obtained sooner.

Bridgeton, Pa.—The Bridgeon & Millville Traction Company has begun the work of erecting a large new building in the centre of the city, in which their power house and the electric lighting plant, which is now controlled by them, will be consolidated.

Louisville, Ky.—The Louisville Street Railway Company is contemplating extensive improvements in its lines and service during the year, and when the improvements are made Louisville will have not only a modern and up-to-date railway in every particular, but will have one that willl compare with the larger lines of other cities.

Latrobe, Pa.—A company composed of Captain James H. Peters, John B. Anderson, Joseph Head, Dr. J. W. Hughes, and others, with a capital of $45,000, is to construct an electric railway line eight miles long, beginning at the corner of Depot and Ligioner streets and running to Youngstown, Bagaley, Whitney and Lippencott, with a branch to Dorothy coke works.

Newburyport, Mass.—The Citizens' Street Railway Company held its annual meeting last week, when E. R. McPherson, of Boston, A. B. Bruce, of Lawrence, H. Fisher Eldredge, of Portsmouth, A. D. Besson, of Chelsea, E. P. Shaw, Jr., of Brookline, Phineas W. Sprague, Albert C. Titcomb, of Newburyport, and George A. Marden, of Malden, were elected directors.

Charleston, W. Va.—Articles of incorporation have been obtained here by the Clarksburg Street Railway Company, which proposes to construct a street car line at that place. The company is composed of Virgil H. Highland, Frank B. Haymaker, Sherman C. Denham, Marcellus M. Thompson and Leonard Peck, all of Clarksburg. The subscribed capital is $600, 10 per cent paid up, and authorized capital of $500,000.

Frederick, Md.—A preliminary survey for the proposed Frederick, Liberty & Emmitsburg Electric Railroad has been made between Frederick and Liberty, and from the latter point will be continued to Woodsboro. It is not intended to go beyond the latter point at present, the object being to construct a railway which will give transportation facilities to the towns of Mount Pleasant and Liberty and the interlying country. The line surveyed follows the Frederick and Liberty turnpike most of the way.

Newark, N. J.—Articles of incorporation of the Murphy Safety Third-Rail Electric Company, which has a capital stock of $2,500,000, have been recorded. It will equip railroads and vehicles with electrical power and apparatus, "or other power," and may build central stations for the generation of electricity. The capital stock is divided into 25,000 shares, of which 12,500 shares will be preferred stock. The amount paid in is $3,500. Mathias Plum, Alexander Beach, William M. Keepers, of this city; George H. Carey, John B. Renwick, of Broklyn; Lauron Ingels, of New York, and Charles T. Hayman, of Cincinnati, are the incorporators. They each hold $500 worth of common stock. The principal office will be in this city.

POSSIBLE INSTALLATIONS.

Pratville, Ala.—Pratville is discussing a new system of street lighting.

Kansas City, Mo.—The problem of electric lighting for Kansas City has been revived for discussion by the request of the Home Electric Lighting Company for a franchise.

Kokomo, Md.—As a result of a recent advance in the price of electric lighting, a meeting of Kokomo merchants was held last week to organize the Merchants' Mutual Light Company.

Yonkers, N. Y.—Mayor Sutherland's message to the Common Council contains a recommendation that the city should own and operate its own electric lighting plant. He said that municipal ownership should begin with the expiration of the next year of the contract with the present company.

New Wilmington, Pa.—W. J. Shields, of New Wilmington, Pa., is working on the final drawings for a new electric light plant, to be erected at the same place early next spring. It will embrace a power house and cost about $5,000. G. H. Getty, president of the Council, is the head of the project.

THE BULLOCK COMPANY ENLARGE THEIR PLANT.

The Bullock Electric Manufacturing Company, of Cincinnati, Ohio, are advertising for bids to extend their main building two hundred feet. This will make their main machine shop five hundred feet long by one hundred and one feet wide. The tremendous volume of business that has come to the Bullock Company from all parts of the world during the last six months has overwhelmed them, and it is now imperative that the above extension to their works be made with all possible haste.

NEW YORK NOTES.

MR. J. ELLIOTT SMITH, who was removed from his position of superintendent of Fire Alarm Telegraph and Electrical Appliances in the Fire Department of the City of New York in March of last year, when that office was ordered abolished by Fire Commissioner Scannell, has been reinstated in accordance with a peremptory writ of mandamus, issued by Supreme Court Judge Gildersleeve. Mr. Smith was also entitled to recover arrears of salary, together with costs, amounting to $3,786.23.

MR. A. W. KOENIG, of 9 Maiden Lane, New York city, representing the Belknap Motor Company, of Portland, Me., states that orders for the company's Chapman voltage regulators have been closed with the Suburban Electric Co., Elizabeth, N. J., Poughkeepsie (N. Y.) Electric Light & Power Co., Oneonta (N. Y.) Electric Light & Power Co. and the Jersey City Electric Light & Power Co., Jersey City, N. J.

ANNOUNCEMENT IS made of the organization of the New York Air Compressor Co. under the laws of the State of New Jersey. The capital stock of the company is $100,000, and a complete foundry and machine shop has been purchased on the line of the New York and Greenwood Lake Railroad at Arlington, N. J. Contracts have already been let for a full modern equipment of tools. It is intended to manufacture a complete line of air compressing machinery at the new plant. The officers of the company are: J. W. Duntley, president; Alexander MacKay, vice-president; W. P. Pressinger, secretary and treasurer. The directors are: J. W. Duntley, Alexander MacKay, W. P. Pressinger, William B. Albright., W. O. Duntley, Thomas Aldcorn and Austin E. Pressinger. The New York offices of the company are at 120 Liberty street.

The Electrical Age.

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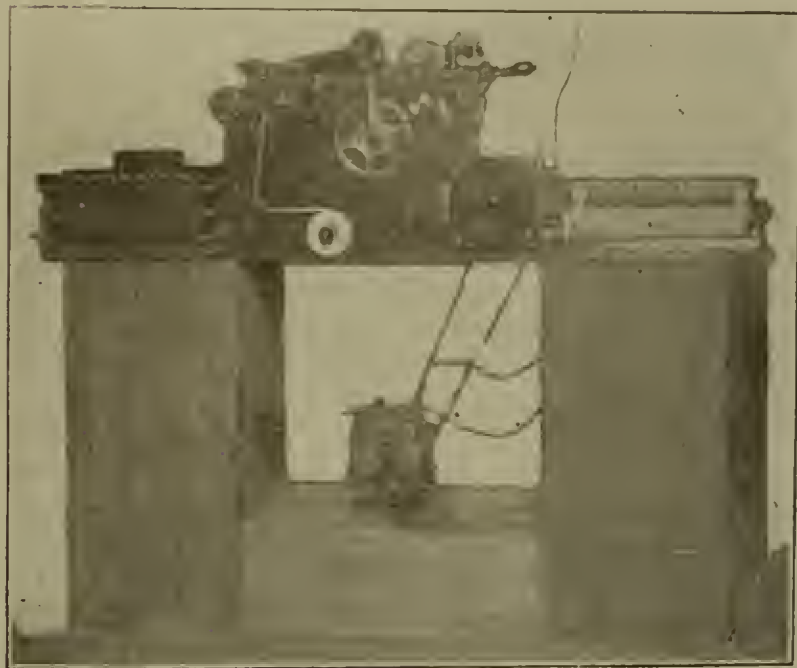
Telegraphy.



The Craig Machine Telegraph.

Perforator to the left, Receiver and Transmitter in center receiving message on right, the sending apparatus with message ready to transmit on left, Resistance box on right, 1/8 H. P. motor below, furnishing power sufficient to receive, transmit and perforate.

MACHINE TELEGRAPHY OF TO-DAY.

For nearly twenty-five years much of the best electrical ability and mechanical skill of this country has been applied to the perfection of machine telegraphy. Its possibilities have long been understood, but the perfection of a complete system, adaptable to every phase of telegraphy, presented great obstacles. Every difficulty has now been surmounted, as has been abundantly proven by the most thorough tests, on good wires and on bad, in all kinds of weather, and for distances ranging from 100 to 1,000 miles.

THESE ARE THE RESULTS.

Thirty days' test between New York and Chicago, 1,027 miles, copper wire, about two ohms electrical resistance per mile, 600 to 800 words per minute.

Test between New York and Washington, 351 miles, copper wire, 3,000 words per minute.

Test February 22, 1892, between Jersey City and Philadelphia, about 100 miles over an iron wire having a resistance of 25 ohms per mile, 1,500 words per minute, with a reserved transmitting capacity of about 500 words per minute.

WHAT THIS SPEED MEANS.

It means cheap and instantaneous telegraphing, many times quicker and cheaper than telephoning:

Letter correspondence by telegraph. One hundred words by day and two hundred words by night for 25c., in 1,000 mile circuits:

Absolute secrecy of messages. Persons of limited experience may do with accuracy and facility half of the whole work of telegraphing:

That we have increased the carrying capacity of a single Morse wire from 25 to 3,000 words per minute:

That one machine wire is equal to thirty-six Morse wire-circuits:

That fifteen thirty-word messages can be telegraphed complete, over one wire in one minute, from New York to Chicago:

That editors of daily journals within 1,500 miles of New York can be served with special and exclusive news reports from their own special correspondents, at the rate of 1,000 words per minute, at less than one-fourth part of what they now pay for inferior associated reports:

The end of hand telegraphy between cities:

Postal telegraphy by private enterprise:

Unlimited facilities for individual journals or associated presses at one-half of current charges.

REASONS WHY.

Because, according to the testimony of the president of the Western Union Company before a committee of Congress in 1890, the average cost to that company of handling all its business was 22 4-10 cents per message, and according to the testimony of the president of the Postal Telegraph Company, before the same committee, the average cost to that company was 26 cents per message. Both these companies use the quadruplex system, the limit of which is three artificial circuits over a single wire, while the Machine System yields the equivalent of 40 to 100 artificial circuits over a single wire, according to distance.

This speed means that in the very near future all cities of importance throughout the country will be in communication by the Machine System, carrying 95 per cent. of all the telegraphing, and that the Morse hand system will be confined to small towns and private lines.

It has been frequently remarked of late among those who have taken note of the progress of electrical development, that the first and most important branch of electric science, telegraphy, has made the least advance.

With the exception of the Delany Multiplex System, it may be said that no important improvement in telegraphy has been introduced since the invention of the duplex and quadruplex systems twenty years ago; and as these improvements retain the hand method of operation, the gain has been simply an amplification of that slow method, limited in speed to the expertness of the operator in the manipulation of the Morse key.

The limit of enlargement of facilities over one wire today in this country is four Morse circuits over a single wire, by the quadruplex system. By reason of this addition of circuits over a single wire, the distance over which the wire may be operated is greatly limited, and the conditions of wire, weather, etc., must be very favorable, so that it cannot be said that the "phantom" or artificial circuits are equal to separate and independent wires, operated simplex. The average rate of transmission over a single wire operated on single circuit during the entire day cannot, under the most favorable conditions, exceed 15 to 25 words per minute. The quadruplex circuits do not average, in good weather, over 15 words per minute, so that to-day the greatest capacity of a wire in this country, operated on the most approved plan of hand telegraphy, is 60 words per minute, requiring eight first-class operators—a fraction over 7 words per minute for each operator.

LOWER RATES IMPOSSIBLE, WITH PRESENT SYSTEMS.

The president of the Western Union Telegraph Company, testified in 1890, before a committe of Congress, that the average cost of telegraphing to the company was 22 4-10 cents each message. The president of the Postal Telegraph Company testified, that each despatch handled by that company cost 26 cents. These figures may be safely accepted as the minimum average cost of handling messages to-day, under the most careful and economical management, by the several systems now in use. The only other system of telegraphy in use, besides those mentioned, is the Wheatstone System, which is extensively employed in England, principally for carrying newspaper reports, and on a small scale in this country for general business. As a whole, the Wheatstone System, for commercial telegraphing, is inferior to the quadruplex system.

It will be obvious, therefore, that, with the highest development of the most approved methods of telegraphy now in use, the minimum rate for carrying messages has been reached, and no better evidence of the correctness of this statement can be asked for than the failure of the Baltimore and Ohio Company a few years since in an endeavor to carry messages at an average cost of 20 cents.

Jungfrau Mountain Electric Railway, Switzerland.

It must be plain, therefore, that if we are ever to have cheaper telegraphy, it must be brought about by the employment of a more rapid system of operation, and that the extent to which the rates may be reduced will be directly proportioned to the increased speed of operation; that is, the increase of the number of words delivered at the receiving end of a wire within a given time. It has already been well known that but a small part of the actual carrying capacity of the wire has been obtained by the systems now in use. The facilities of the wire have always been many times greater than the demands made upon it by the hand systems of operation; and, as the limit of manual operation has only been raised two words per minute during the past ten years, nothing more may be looked for in that direction.

(To be Continued.)

Electric Railways.

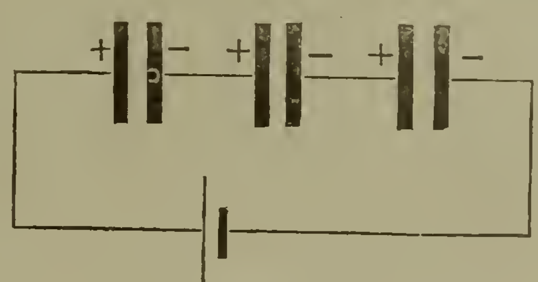
SOME DIFFICULTIES IN ELECTRIC RAILWAY WORK.

The great Horse Shoe Bend is regarded as a triumph of engineering and is frequently referred to by civil engineers. In the western section of the United States there are several other illustrations of difficult and even hazardous surveying and construction work; but few, if any of these cases, can exceed in enterprise the building of an electric road through the Alps. There is in the Alps, of Switzerland, an inclined railway which drags passengers thousands of feet up the mountain side. It is an example of rack and pinion work that excites considerable surprise. This is now of secondary importance in comparison with the new electric road running along the mountains and thus allowing convenient and rapid transportation. The storms that sweep over the Jungfrau and the dangers associated with it in the minds of travelers have made its name famous among the cultured public. Transportation from point to point, by means of an electric road, has stripped these dangers of many of their most trying qualities and adds to the wild grandeur of the scene that little touch of civilization that a descending tourist views with considerable approbation. Some of the difficulties confronting engineers in the installation of this road were as great as those attending the erection of the famous Niagara Gorge railway. The above road will soon be completed; then tourists will be able to spin through Switzerland with all the conveniences of home surroundings.

Technical Notes.

CONDENSER DISCHARGES AND CONNECTIONS.

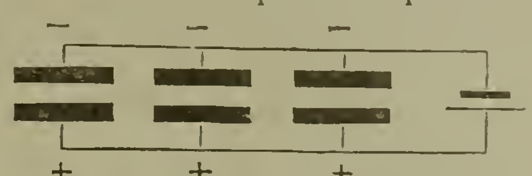
The application of a condenser to circuits containing self induction has been sufficiently understood to give rise to many interesting experiments of practical and also purely scientific value. The famous lecture of Nikola Tesla was termed by him "Condenser Reactions" and



—Condensers in Series.

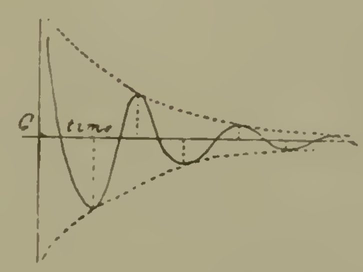
illustrated in a startling manner the consequences of a few novel applications of this device.

Condensers in series give the total voltage of the series as if each were a separate cell of battery. Condensers in multiple give the voltage of one, but represent a capacity equal to the sum of their respective capacities. Condensers in series have a total capacity equal to the reciprocal of the sum of the reciprocals of their individual capacities.



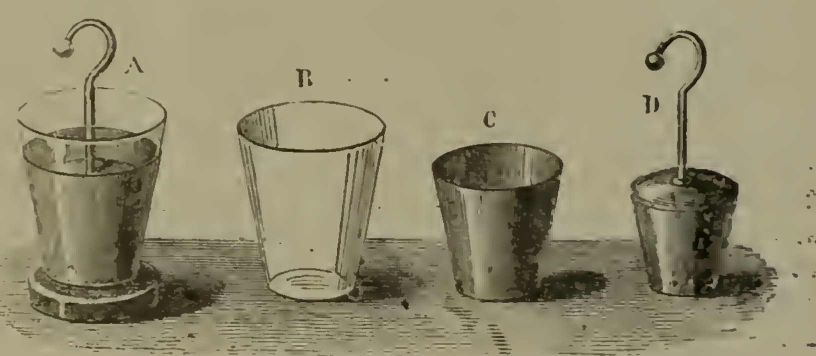
17 —Condensers in Multiple Arc.

The simple condenser or Leyden jar offers a study in dielectrics and electrical oscillations which led to many of the famous conclusions of Clerk Maxwell and Dr. Hertz. A Leyden jar discharge occurring through a low resistance sets up a series of waves in the ether and oscillations in the circuit, as diagramatically represented. "According to Dr. Lodge, a microfarad condenser discharging through a good conducting coil of one henry self induction gives a curent alternating 160 times a second and emits ether waves about 1,200 miles long. A



Discharge of a Condenser Through a Resistance.

gallon Leyden jar (capacity about .003 microfarad) discharging through a stout wire, suspended around an ordinary size room, emits ether waves between three and four hundred yards in length, its current alternating at



Elements of a Leyden Jar.

the rate of about 1,000,000 per second. An ordinary electro-static charge on a sphere two-feet in diameter, if disturbed in any way, will surge to and fro at the rate of 300,000,000 vibrations per second, emitting ether waves a yard long."

THE GROTTHUES HYPOTHESIS OF ELECTROLYTIC DISSOCIATION.

The various reactions due to electrolytic dissociation may be classed under the head of the following:

Simple decomposition.
The analysis of a complex solution.
Reactions in an accumulator.

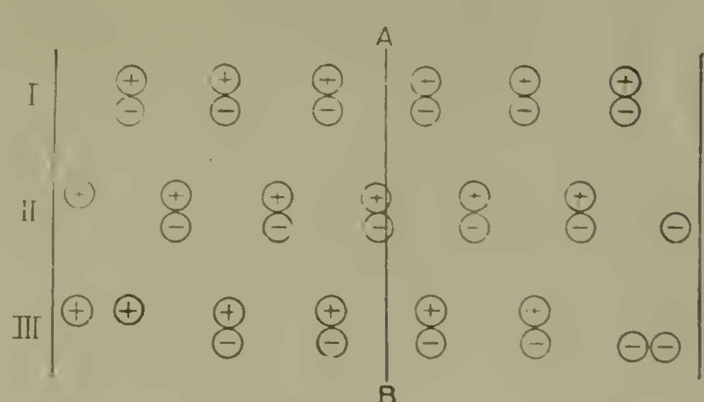


Fig. 1.

With electrodes present, as in a plating bath, complex actions occur which puzzle even the savant. According to Grotthues an interchange or transferance of atoms takes place during electrolysis, as shown in sketch 1. The actions are threefold:

(i). The normal condition of the fluid.

(ii). A positive and negative element separated, i. e., oxygen and hydrogen.

(iii). Decomposition as manifested by the visible escape of the elementary constituents.

In the second sketch this action is somewhat prolonged but similar in all other respects. In fact, the iv. stage of the process, as shown in sketch 2, indicates the ultimate resolution of all the liquid into atoms. It further illustrates the presumption of Grotthues that the atomic affinity is due to a positive and negative electrification, native to the elements and thereby responding to the influence of a superior eletrification at the two electrodes. The above hypothesis is often referred to the change of partners in a dance, that illustrating the passing on or transferance of atoms.

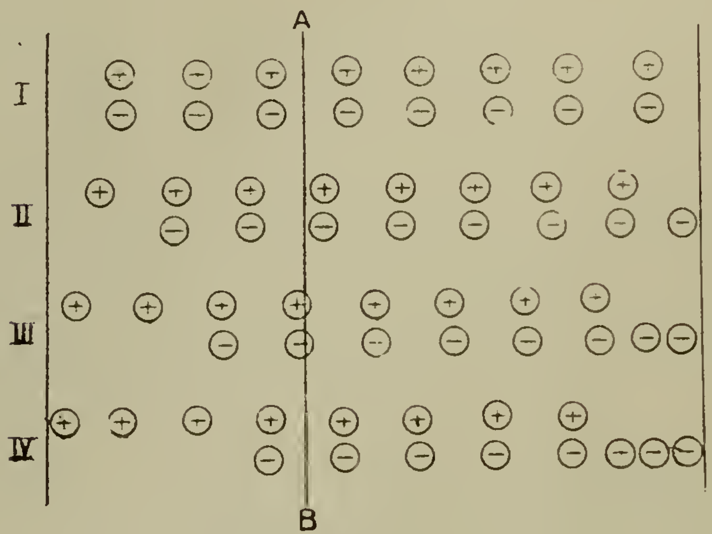


Fig. 2.

Stray Currents.

THE SAFETY THIRD RAIL ON THE LONG ISLAND RAILROAD.

The practical working section of five miles in length of the patent safety third rail, which has been thoroughly tested on a half-mile length of track, south of Jamaica, for twelve or fifteen months past, is to be laid on the line of the Long Island Railroad. It will be placed on the Far Rockaway division, and the regular trains of the Long Island Railroad running over that branch will be operated by electric power. The application of this principle, if found to be successful, it is said, will in a few years revolutionize the motive power on the steam railroads of the country. If successful and feasible it will, as soon as practicable, probably be adopted on all the lines of the Long Island Railroad in the borough of Queens west of Jamaica and on the North Side division.—Ex.

A LARGE SUBMARINE TELEPHONE CABLE.

What is claimed to be the longest submarine cable of its size was recently laid in Lake Michigan for the Erie Telephone Company. It crosses the Straits of Mackinaw, between the city of that name and St. Ignace. The cable consists of 20 strands, laid together in tape and jute, and armored with a No. 6 iron wire. In this way 10 telephone circuits are provided for by the cable. Two of the conductors used are larger than the others, their sectional area being equivalent to a No. 8 wire. The other nine pairs of wires have a sectional area of copper equivalent to a No. 12 wire. The outside diameter of the cable over the armoring is about $2\frac{1}{2}$ inches, while the total length which is laid in the water is 5 miles 170 feet. The greatest depth of water on the line of route is 256 feet. The cable, after being joined up into a continuous length, was placed upon a barge, which was then towed across the straits by two steam tugs.—Ex.

EFFECT OF MAGNETIZATION ON THE MODULUS OF ELASTICITY.

It has already been found that temperature changes affect the modulus of elasticity, and Professor J. B. Stevens shows the result of an experiment to test the effect of magnetization. Steel and wrought iron bars 60 x 1 x 0.64 cm. were used, and loads of 1 kg. and $\frac{1}{2}$ kg. fastened to the centre. These caused a deflection. When the rods were magnetized by forces ranging from 19.9 to 126 C.G.S. units, the deflection was decreased, showing that magnetization increases the modulus. The change in deflection was increased by an interferometer, one plate of which was fastened to the bar, and the motion read in wave lengths of light. Temperature changes were guarded against—(1) by a stream of water flowing between coil and rod; (2) by testing with a sensitive thermometer; (3) by noticing that the change in deflection was always sudden; (4) by discovering no change in a copper rod. The measurements were not considered sufficiently exact to enable it to be stated that there is a regular relation between magnetic force and the modulus increased with the magnetizing force.—Ex.

GENERAL GREELY'S REPORT ON THE CUBAN TELEGRAPH SYSTEM.

A report by General Greely, of the chief signal office, on the telegraph system of Cuba has just been issued. This report shows that since the system was taken over no less than 600 miles of new line have been added to those previously in use at Cuba, and at the close of the year there were in all some 2,500 miles of telegraph line in operation. In the conclusion of his report, General Greely discusses the various questions connected with the Cuban cable and telephone concessions, as well as the practical conditions under which the military cable lines are kept in order. He recommends the immediate laying of a deep-sea cable between Porto Rico and Cuba at a cost of $600,000. In the same report figures are also given of the signal office in the Philippines. In this part of the report the value of an all-American Pacific cable is naturally referred to. General Greely states that wireless telegraphy has received the careful attention of his office, and that the system should prove of great value in connecting the different islands of the Philippines and Hawaii. It seems that the signal corps have already tried this system between Fire Island and the Fire Island Lightship. In this case the distance was about 10 miles. —Ex.

ELECTRIC CANAL HAULAGE IN GERMANY.

Some very interesting experiments in the electrical hauling of canal boats are being made at Tinow, under the auspices of the German Government, says an English contemporary. The first system being experimented with is due to Messrs. Siemens & Halske and is in general design not unlike the Thwaites-Cowley system. Instead, however, of having an elevated rail for the hauling carriage to run on, in this system an electric cable is used. This cable is used as the earth conductor, and the trolley wire placed over it serves as the other. The disadvantage of the system will be the uneven hauling motion due to the sagging of the cable. Thus, at every point of support the motor carriage will meet with an up-grade which will check its speed, and immediately the support has been passed the motor will receive considerable impetus while running down the sloping cable. But for this drawback the system can be very cheaply arranged, and it does not involve so much structural work on the limited space usually available on the towpath. The other system employs a small locomotive to do the hauling, and is remarkable from the fact that only one rail has to be laid down for this locomotive. The other wheels are made broad to run on the towpath.—Ex.

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CONTENTS:

A LIGHTER STORAGE BATTERY.

With the invention of a lighter storage battery a series of advantages are gained in automobile work which will lead to a revolution in the streets of cosmopolitan cities. Aside from this fact there are certain other fields of work, in which the application of a storage battery when it is radically lighter and more economical, which are still commercially inchoate but would then develop with enormous rapidity to a successful culmination. The great problem then is to build a storage battery of much greater lightness for these particular purposes. The uncertain actions taking place in a storage battery during the process of charging and discharging prevent a thorough analysis being made of the exact nature of the charges taking place. It is not thoroughly understood as yet whether it is hydrated peroxide of lead or ordinary lead peroxide that is formed on the positive plate. In fact, manufacturers have adopted the method in many cases of using lead sulphate as the active material. The amount of electricity obtainable from lead sulphate, lead peroxide or hydrated peroxide of lead is dependent upon certain extraneous conditions which may be classed under the heads of active surface, active material and density of the solution.

Aside from these facts, which relate purely to the chemical features of the case, the weight of a storage battery is to be mainly found in the grid or supporting device for the oxides. Many experiments have been tried with heavy and light grids and a variety of oxides for the purpose of discovering the least possible weight for a given output of energy. Practice has reduced these figures down to two or three watt hours per pound weight. Further investigation has shown that of the total weight of electrodes used only about fifteen or twenty per cent. is actually available in the form of active material. This low percentage of plate efficiency is entirely due to the heavy weight of the material employed. Theoretically a pound of lead is not capable of giving up as much power as an equivalent weight of zinc, iron or copper. Its advantage mainly lies in the insolubility of its sulphate, a fact not generally recognized by others than experts. A quarter of a pound of iron, copper or zinc possesses more latent energy than one pound of lead; yet the other metals are useless, due to their sulphates being highly soluble.

According to many of our authorities about fifty ampere hours per pound of weight are the theoretical limits expressing their storage capacity and represented by the active material attached to them. In actual practice, however, these figures are considerably reduced, falling to as low as eight and reaching in normal cases no more than sixteen ampere hours per pound. The reason why this deficiency is so recurrent and apparently ineradicable is because the materials used are not entirely porous. The coating of active material from which the energy is to be drawn after having been stored is only penetrated electrolytically about ten or twenty per cent. during discharge. In other words, a cell from which a full discharge has apparently been obtained, if its plates were rendered more porous, would be capable of giving three or four times the output over again without strain or rapid deterioration. Storage battery plates therefore contain within themselves a deficiency which can only be obviated by a form of construction which bares every interstice to the action of the acid and the effect of the currents. The present type of storage battery is stronger, more durable and, in many respects, more efficient than any of its predecessors; the greatest fault to be found is that of weight and this is only of consequence when their application to automobiles is under consideration.

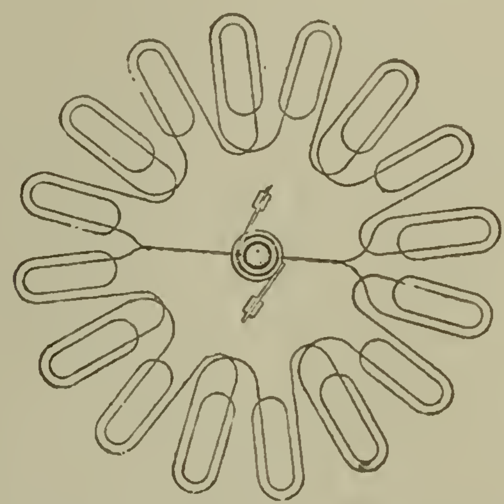
In a middling sized electric light station, not very far from New York city, business so improved that the normal load of two thousand lights threatened to rise to three thousand. The dividends the station paid were of a most satisfactory character to the original investors, and they would have been considerably reduced for a few years if the additional five hundred to one thousand lights required the installation of new boilers, engine and generator. Unless immediate action took place the station would not be able to withstand the increasing load and a rival company would assimilate a certain interesting income. To overcome this dilemma, which, like many others, had two horns, an expert electrical engineer was engaged to see what could be done. It was evident that the cost of the new machinery and the time required for its installation would be very great. In addition it would only be put to a few hours' use each day. The engineer immediately recommended the use of storage batteries, the installation of which, for the service required, saved the dividend and routed the rival company.

A plant of moving machinery to be used but a few hours each day does not yield adequate returns for the investment unless no substitute can be possible employed. One thousand lights for four hours is equal to two thousand ampere hours in total, at one half ampere per lamp. For a hundred and ten volt system sixty station cells can be readily installed, charged and operated within three days. In addition, during the hours of light load the storage batteries can make the plant pay by directing the energy into themselves. By this means the load during the day remains nearly uniform, the batteries being taken off when it rises above its normal value. When night comes and the thousand extra lights are called for the batteries are thrown on, in addition to the generators running at full load, and service is rendered outside without strain or risk to the plant in operation.

Dynamo Design.

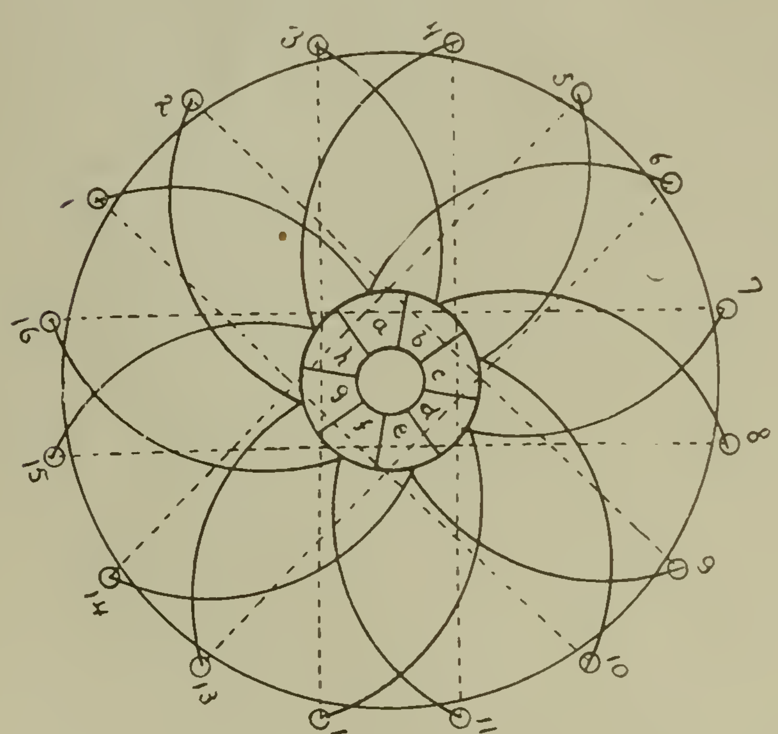
DYNAMO ELECTRIC MACHINERY.

The general configuration of a motor or generator is determined by the conditions of its operation. The simple alternating current dynamo, with its armature wound as shown and terminals ending in two rings, represents the foundation of an extensive series of armature windings. In the particular illustration referred to a departure is made in having the two halves in multiple. This idea is



Simple Alternating Current Armature.

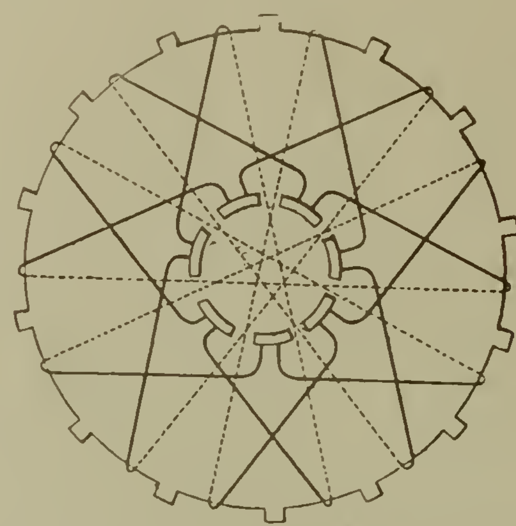
more fully developed in armatures of continuous current dynamos. Each section in this case and the connections leading to each commutator bar throw two equal windings in multiple. Except in those cases where a higher potential is required a lap winding is generally employed. In multipolar generators lap winding necessitates the use of as many brushes as there are poles to the generator. In other words, the armature is so sub-divided by these parallel flows of current that in a six pole ma-



Lap Wound Continuous Current Armature, Smooth Core.

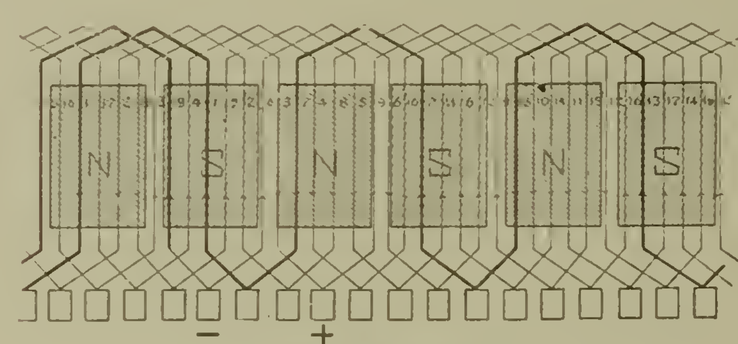
chine there are six separate circuits operating in multiple and hence six brushes are required.

In the illustrations diagrams of lap winding are shown, in one case for a smooth core armature of sixteen conductors and eight commutators segments; in the other, of fourteen armature conductors and seven commutator segments. An uneven number of segments in the commutator is to be found in the early types of the Edison machine. In contradistinction to the lap winding the development of a wave winding is shown for a six pole miltipolar generator. The single pair of brushes are indicated by the positive and negative symbol, and the



Lap Wound Continuous Current Armature, Toothed.

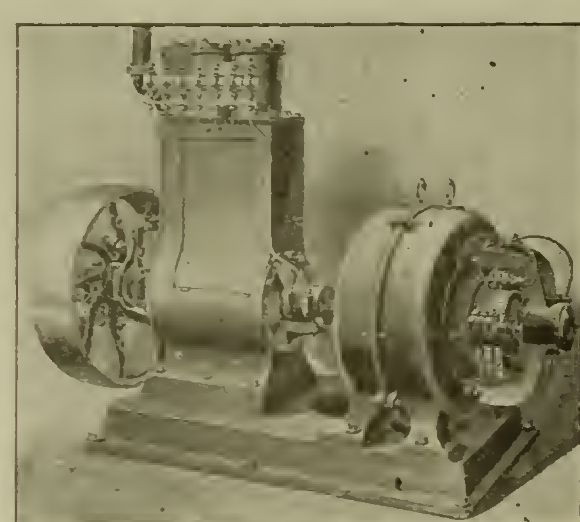
conditions of the conductors superposed on the pole faces clearly shown. In this case the total winding is the equivalent of a lap winding in a bipolar dynamo, whose polar area is equal to that of three north poles or three south poles in the sketch. The electro-motive force generated is led in series through each half of the winding and in consequence can be removed by means of two



Wave Winding.

brushes, as shown.

In fitting together the parts of generators, as, for instance, the core of an inverted horse shoe type into the keeper, the rule to be observed is as follows: If the core



Small Direct Connected Plant.

is wrought iron the surface that enters in contact with the keeper should possess twice the area of its own cross section, provided the keeper is cast iron. By this means the joint instituted betwen the cast and wrought iron will be the magnetic equivalent of each other. For instance, if the cross section of the core is one square inch two square inches of the core must enter the cast iron; otherwise the surface of cast iron in contact will not be sufficiently great to carry the lines of force without undue saturation.

Where small direct connected plants are in operation the speed of the generator largely governs the period of active operation, rate of deterioration, etc. It is a general practice to use lap wound armatures, through which more than one pair of brushes are required, to provide an intense field in the generator, so that an armature of large diameter and many conductors will rotate slowly. By this means slow speed is secured although at the expense of a slight increase in weight but a direct gain is made in less vibration and more wear to the machinery. In the illustration a small plant is shown running at a maximum speed of three hundred per minute, the generator capable of running one hundred and fifty lights.

Business News.

SPECIAL EXPORT COLUMN.
TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK END- DEC. 23, 1899, $100,654.

New York, N. Y., Dec. 23, 1899.—The following were the exports of electrical materials and kindred lines from the Port of New York for the week just ended:

Argentine Republic.—283 cases electrical material, $36,628; 5 cases electros, $29; 87 cases electrical machinery, $5,131.

Alexandria.—7 cases electrical material, $315.

Brussels.—12 cases electrical material, $1,020.

British Australia.—1 case electrical material, $90.

British East Indies.—4 cases electrical material, $242; 3 cases electrical machinery, $130.

Berlin.—1 case electrical machinery, $28.

Bremenhaven.—1 case electros, $13.

British West Indies.—63 packages electrical material, $456.

Barcelona.—66 cases electrical material, $11,276.

Central America.—21 case electrical material, $437.

Chili.—14 cases electrical material, $806.

Cuba.—1 case electros, $13; 1 electric light plant, $3,964.

Ecuador.—19 cases electrical material, $250.

Glasgow.—1 case electrical machinery, $4,750.

Hong Kong.—11 cases electrical material, $300.

Havre.—1 case electrical machinery, $83.

Hamburg.—57 cases electrical machinery, $1,100.

Japan.—32 cases electrical machinery, $2,104.

Leicester.—3 cases electrical material, $132.

Marseilles.— 258 packages electrical material, $8,520.

Manchester.—216 cases electrical material, $4,343.

Nova Scotia.— 1 case electrical material, $37.

Naples.—42 cases electrical material, $14,452.

Newfoundland.—10 cases electrical material, $313.

Peru.—67 cases electrical material, $2,154.

Southampton.—5 cases electrical material, $100.

St. Petersburg.—3 cases electrical material, $157.

Turin.—9 cases electrical material, $1,294.

NEW INCORPORATIONS.

Philadelphia, Pa.—The Hudson Valley Electric Company has been incorporated to operate railroads and electric plants; capital, $400,000; incorporators, H. D. Long, E. A. Lyon, C. E. Lent, G. S. Wertsner, A. A. Sparks, all of Philadelphia, Pa.

Waterville, N. Y.—The Waterville Electric Light and Power Company has been chartered to operate in Waterville, and the towns of Sangerfield, Marsal and Augusta, Oneida County; capital, $15,000; directors, Marinus W. Terry and C. M. Wickwire, of Waterville, and H. B. Sweet, of Utica.

New Brunswick, N. J.—Articles of incorporation of the New Brunswick Light, Heat and Power Company have been filed. The company is incorporated by the Newark and Paterson capitalists who recently bought out the New Brunswick Gas Light Company.

Jersey City, N. J.—The Lehigh Power Company, with its principal office at No. 243 Washington street, Jersey City, N. J., has been incorporated to manufacture electricity for light,, heat and power; capital, $500,000; incorporators, George W. Griffith, Henry G. Cavanaugh, Charles N. King, all of Jersey City.

Tampa, Fla.—Letters patent have been granted for the incorporation of the Tampa Electric Company, with a capital of $500,000. The company is organized for the purpose of furnishing light, heat and power for railways and other purposes. The incorporators are George J. Baldwin, Peter O. Knight, Eliot Wadsworth, W. H. Blood, Jr., and H. G. Bradlee.

Columbus, Ohio.—The Morrow County Illuminating Company was recently incorporated, with a capital stock of $25,000. The incorporators are E. W. Radder, George W. Cleveland, George R. McKay, N. C. Whipple and M. Fisher.

Los Angeles, Cal.—Articles of incorporation have been filed of the Boyle Heights Electric Company. Its purpose is to make and use electricity for lighting purposes, and to exercise the privilege of occupying the public streets with poles and wires, under the laws. Capital stock is $100,000, divided into 1,000 shares; $500 has been actually subscribed. The directors are W. B. Palmer, W. C. Petchner, D. E. Skaggs, James Adams and C. M. Buck.

Utica, N. Y.—The Utica Electric Light Company and Trenton Falls Electric Light and Power Company have consolidated under the name of the Utica Electric Light and Power Company. The new company will furnish light, heat or power to villages and towns of Oneida and Herkimer counties. The capital stock is $1,000,000, and the directors are Henry D. Pizley, Daniel N. Crouse, T. Solomon Griffiths, M. Jesse Brayton, William E. Lewis, of Utica; William G. Phelps, Binghamton; Joseph Fox, New York city.

TELEPHONE CALLS.

Philadelphia, Pa.—A charter has been granted in Delaware to the Eastern Telegraph and Telephone Company, of Philadelphia; capital stock, $1,000,000.

Dover, Del.—A charter has been granted to the Interstate Telephone and Telegraph Company to operate telephone lines; capital, $2,000,000; incorporators, J. C. Landes, of Morristown, Pa.; T. Dougherty, of Allentown; A. M. Worstall, of Philadelphia, Pa.

Fall River, Mass.—The Fall River Automatic Telephone Company has been incorporated; the capital stock is $135,000, and the par value of shares is $50; R. T. Davis is president, and B. D. Davoll is treasurer. The company is to engage in a general telephone business in and outside the State.

Slatington, Pa.—A charter has been granted to the Slate Belt Telephone Company, of Slatington, for the porte and Michigan City.
construction and maintenance of telephone lines, etc.; capital, $10,000; incorporators, J. D. Zellner, W. H. Gish, A. J. Kern, all of Slatington; F. Jacobs, F. H. Trexler, of Allentown.

New York, N. Y.—The General Telephone and Electric Company, of New York city, has been chartered to manufacture appliances; capital, $10,000; directors, Richard C. Weithas, of Brooklyn, and J. M. Dunscomb, Frank M. Holahan and W. H. Carr, of New York city.

delphia, Pa.; George W. Beers, Fort Wayne, Ind.; James E. Hays, Camden, N. J.

Albany, N. Y.—The Columbia Long-Distance Telephone Company has been incorporated with a capital of $50,000. It is expected that the line will be extended from Albany to Troy and to Fonda, Little Falls and Utica. There will be connections with intermediate villages, and radiating lines will be connected. Troy will thus be the eastern terminus of the system.

STREET RAILWAY NEWS.

Boston, Mass.—Counsel for the Worcester Consolidated Street Railway Company appeared before the Railroad Commissioners last week, asking for authority to issue $150,000 additional stock and an equal amount in bonds.

Warren, Ohio.—G. B. Stern and J. D. Elkington, representing Philadelphia capitalists, have completed a tour over the route of the proposed electric railways between Warren and Ashtabula, Burton and Meadville, Pa. They will report favorably to the enterprise.

Moundsville, W. Va.—The Moundsville, Benwood & Wheeling Railway Company is reported to have sold its electric line between Moundsville and Benwood to a syndicate, composed of Wheeling gentlemen, who are interested also in the Wheeling Railway Company.

Guthrie, O. T.—The Guthrie City Council has granted a franchise to a New York syndicate, represented by Mrs. A. C. Beckwith, of Los Angeles, Cal., to construct and operate an electric railway system here for a period of forty years. The Council required a forfeit of $500 from the company to commence within a year.

Bloomsburg, Pa.—For some time past Columbia Co. capitalists have been agitating the building of a trolley line between Berwick and Bloomsburg, and to co-operate with Mountour County moneyed men to extend the road to Danville and thence on to Sunbury. The right of way has been secured, and the project now looks favorable.

Kansas City, Mo.—The County Court was asked recently for a franchise to Albert E. Holmes, A. H. Green, J. D. Strother, F. P. Swan and A. N. Gossett for an electric railway along certain roads in the county. The matter was referred to County Counselor Sebree, who is to make a report as to the power of the court to give a franchise along public roads.

Pottsville, Pa.—A new trolley line is to be constructed from Pottsville to Tamaqua, a distance of 17 1-2 miles, and thence to Shenandoah. The right of way has been secured in all of the towns and townships along the route except Port Carbon and Pottsville. Shenandoah and Philadelphia capitalists are back of it. They have no connection with the Pottsvile Union Traction Company, which operates the lines in this own and vicinity.

Elkhart, Ind.—The Indiana Railway Company, which owns and controls the Interurban electric line connecting South Bend, Mishawaka, Elkhart and Goshen, and the city lines at each place, is compelled to double the capacity of the large power plants at midway stations, Osceola and Dunlap, and to build a new plant at South Bend. The work will be done as early in the spring as possible. The company is also preparing to extend its lines to Laporte and Michigan City.

POSSIBLE INSTALLATIONS.

West Orange, N. J.—The West Orange Electric Light and Power Company has given notice that it will make application at the next meeting of the South Orange Village Board of Trustees for a franchise to do business in the village. The company will also make an effort, it is said, to secure a franchise in Vailsburgh.

NEW YORK NOTES.

NORTHWEST FIXTURE COMPANY, of Seattle, Wash., have opened up an eastern office at the Havemeyer Building, 26 Cortlandt street, New York city, Room 921, in charge of Mr. C. J. Purdy, as purchasing agent, for the purpose of purchasing goods for the various lines they represent in the west. The company handles a complete line of electric supplies, electric, gas and combination fixtures, dynamos, motors, etc.; the officers of the company are A. L. Kasson, president and manager, and A. I. Gould, secretary and treasurer.

A LARGE ORDER has just been received by the Sprague Electric Company, New York, for sixteen motors to be used in running the presses and machinery in a lithographing establishment in Tokio, Japan. It will be one of the finest equipped plants in Japan and will be operated under the supervision of a Japanese expert who is now in this country gathering ideas. The selection of the Lundell motors demonstrates the ability of the Japanese to recognize the importance of electrically operated machinery and also the best motors.

G. A. NESBET & COMPANY, 39-41 Cortlandt street, New York city, manufacturers' agents and electrical specialists, make a special feature of installations of all kinds from a push button to an electric light or power plant for manufacturers of electrical apparatus, supply houses, etc. Messrs. Nesbet and Joyce, the two members of the company, have had a large experience in the manufacturing and installation of all kinds of apparatus, elevator plants, electric light and power plants, dynamos, motors, etc., and the writer has heard nothing but the highest praise for their trustworthiness and reliability on all sides.

JOHN A. ROBLING'S SONS COMPANY, 117-119 Liberty street, New York city, are distributing among their friends and customers a handsome leather-bound vest-pocket calendar and stamp receptacle, one of the daintest of its kind which we have yet received and fit alike for my lady's pocketbook and my lord's waistcoat pocket.

THE FIRMS of Wilbur B. Driver & Co., of New York, and F. R. Harris, of Waterbury, Conn., have been consolidated under the name of Driver-Harris Wire Co. The business of the two concerns will be carried on as heretofore with increased facilities. Their attention will be devoted particularly to the manufacture of resistance wires and fine wires in all metals, ranging from No. 15 B. & S. (.057) to .001", and they are prepared to furnish brass, copper, phosphor bronze, German silver, iron, steel, and any other material that can be drawn. All outstanding accounts should be settled with Driver-Harris Wire Co.

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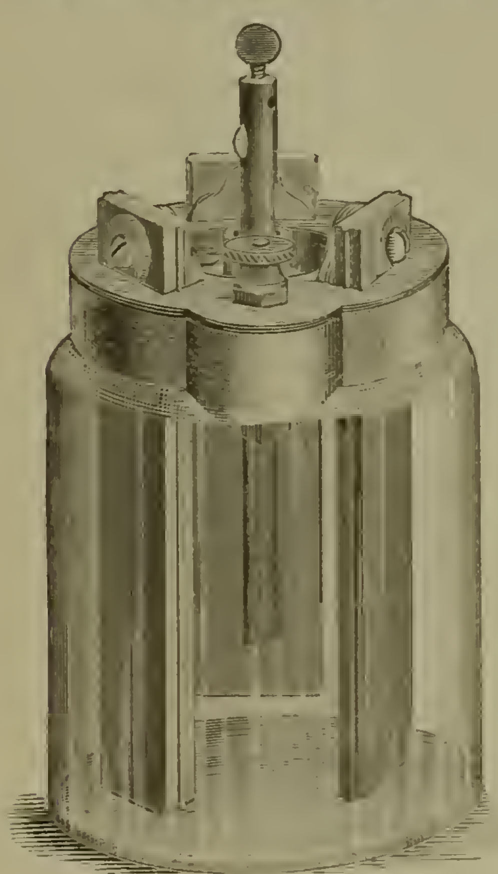

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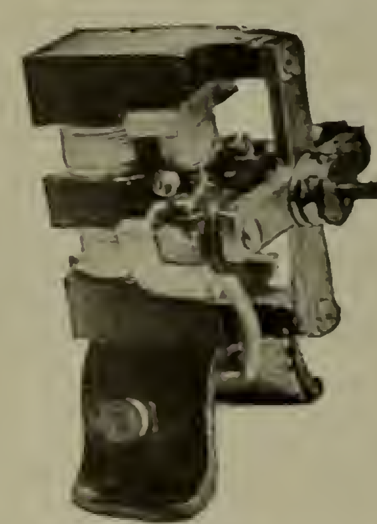

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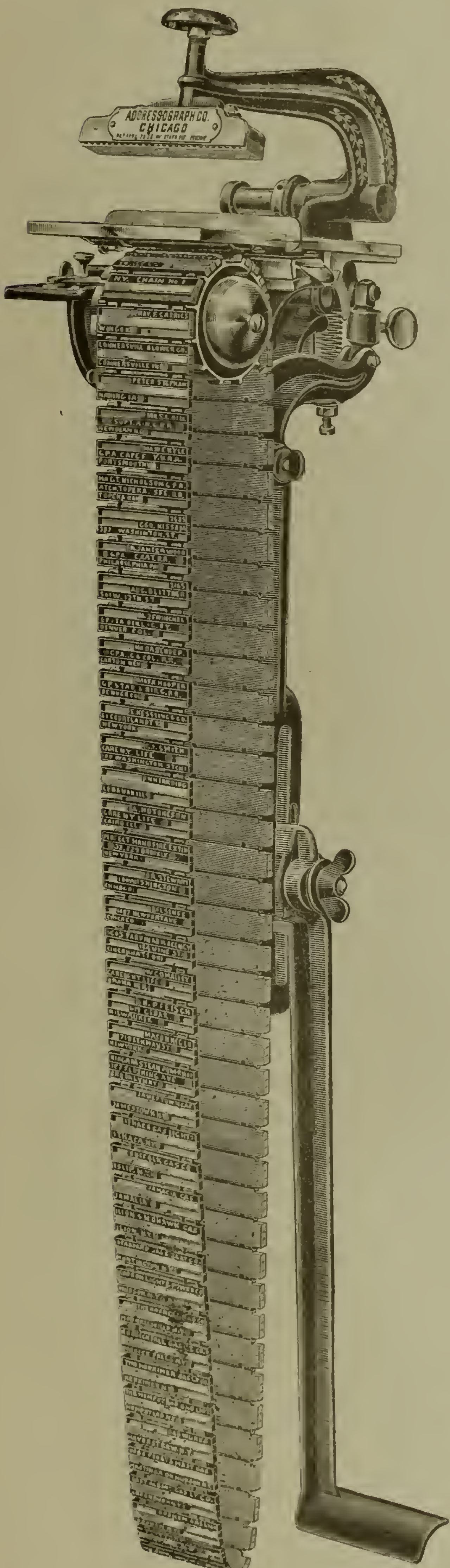
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