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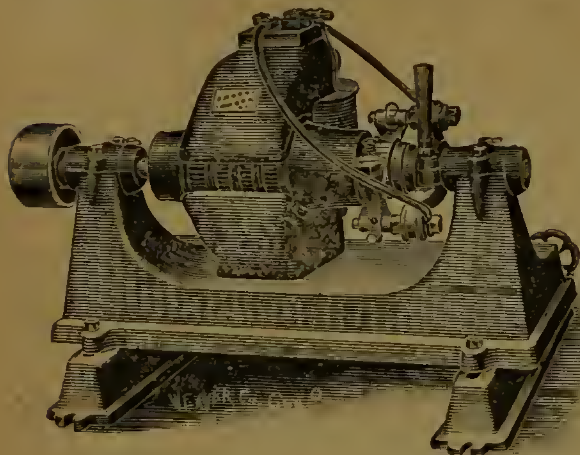

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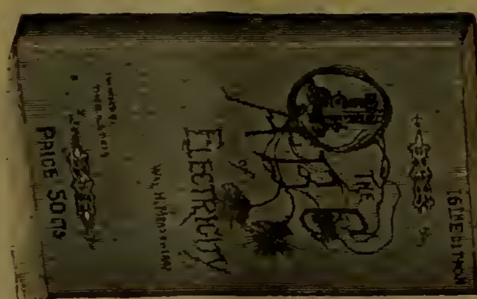

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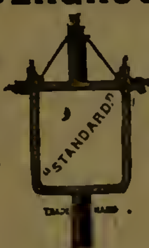

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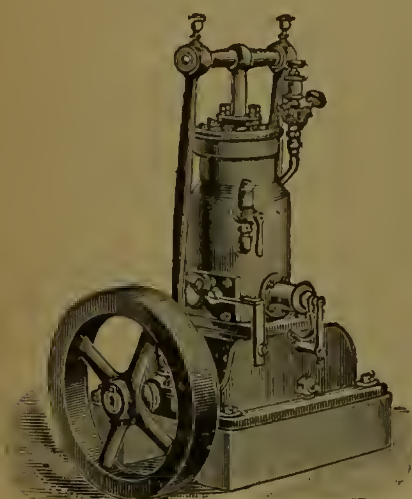

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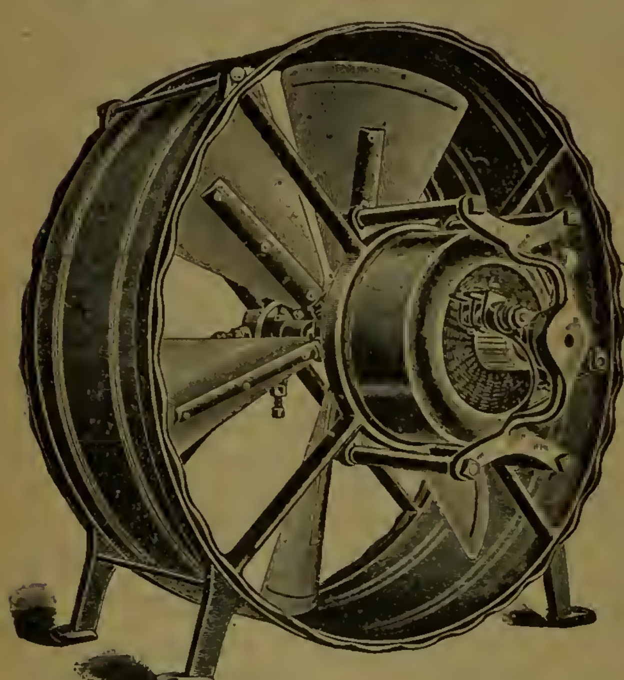

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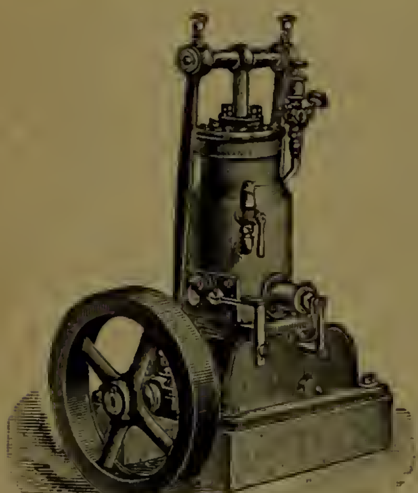

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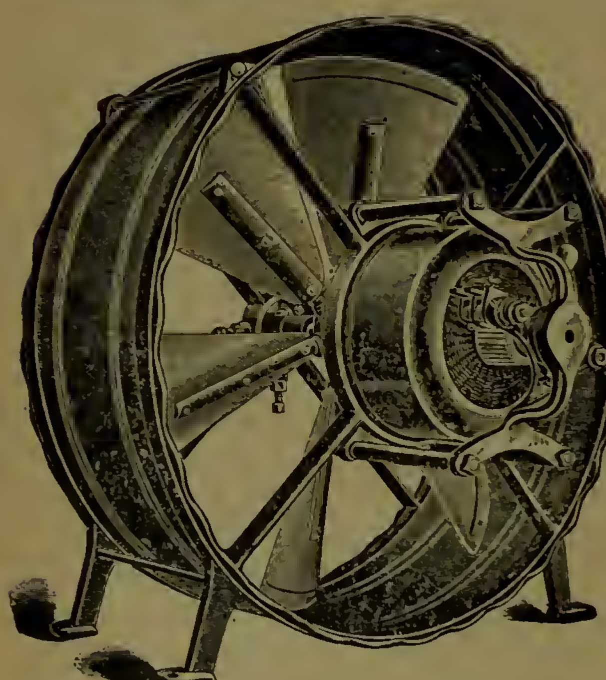

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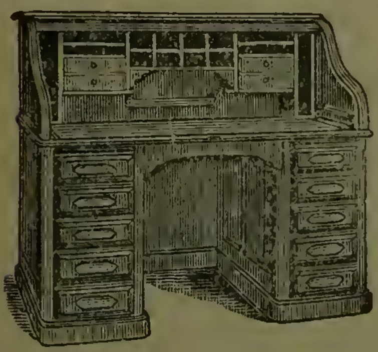

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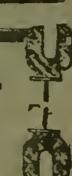

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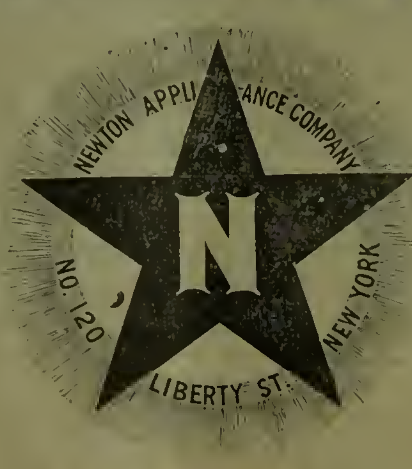

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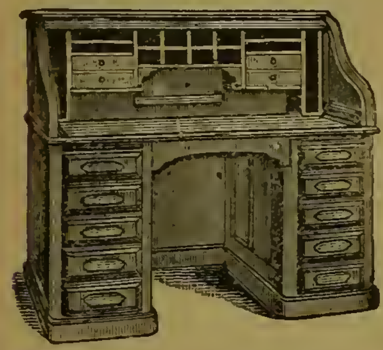

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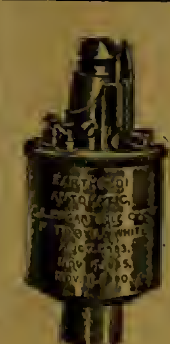

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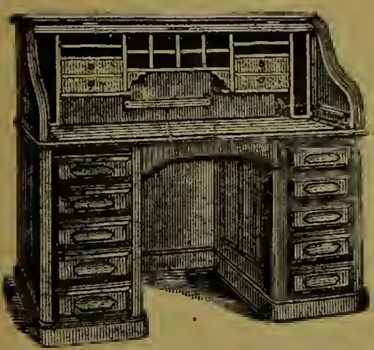

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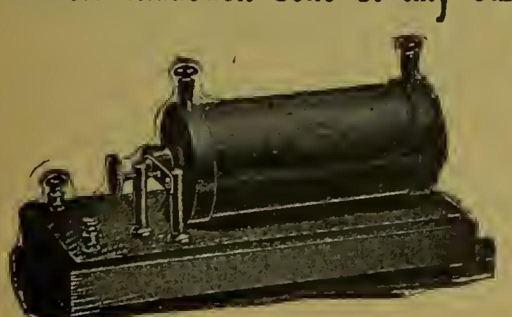

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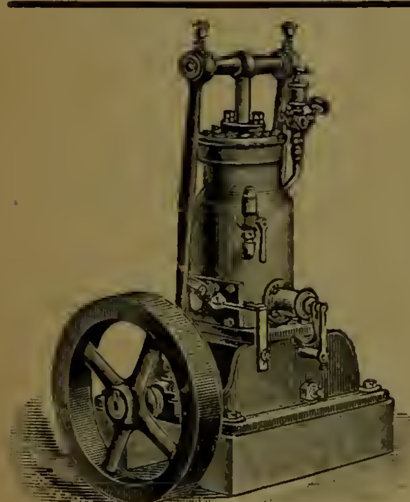

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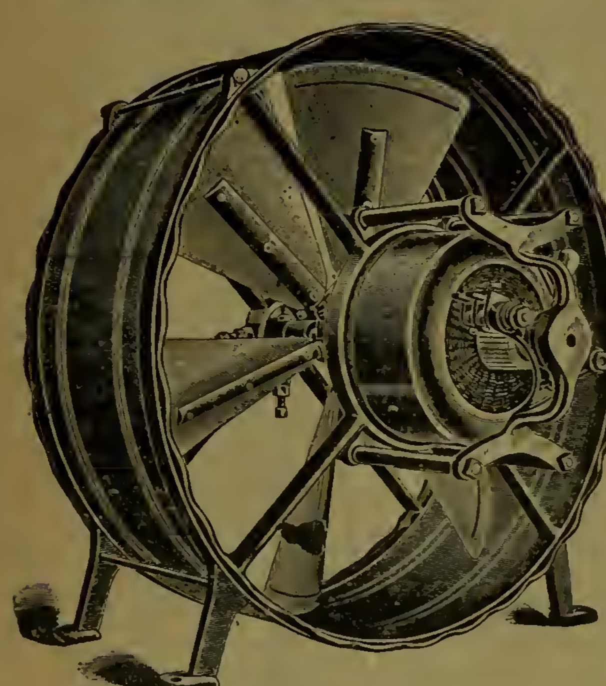

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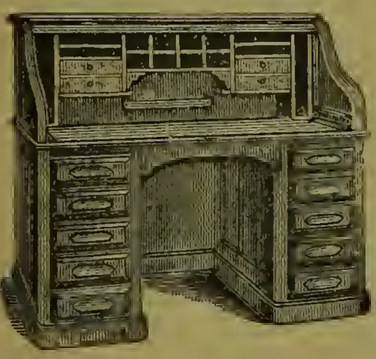

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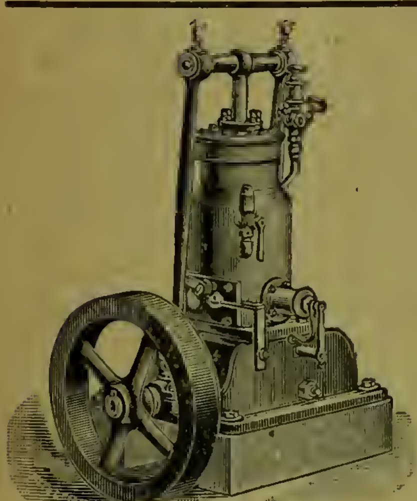

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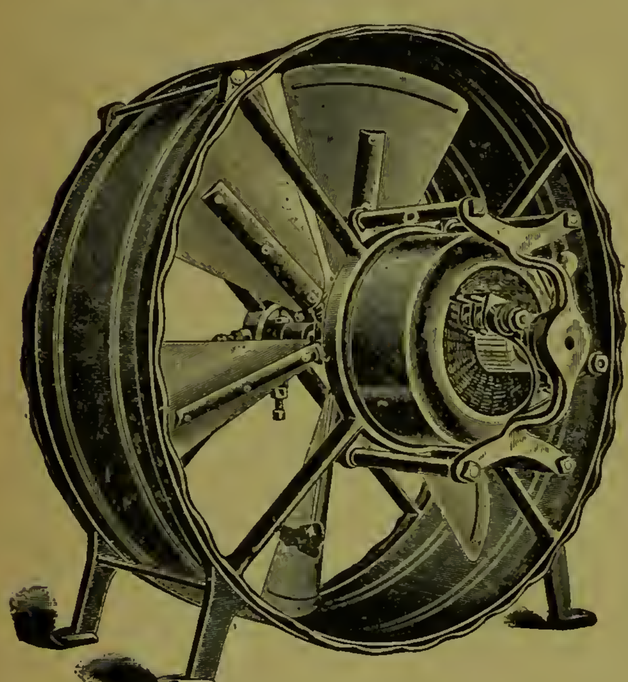

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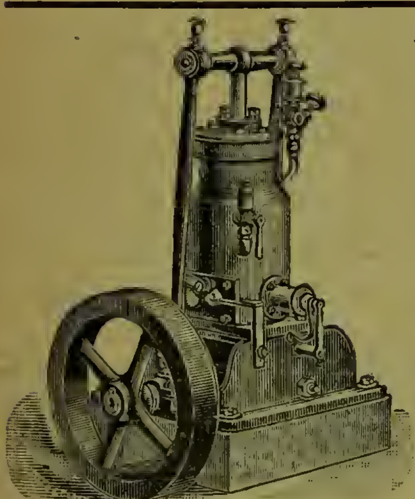

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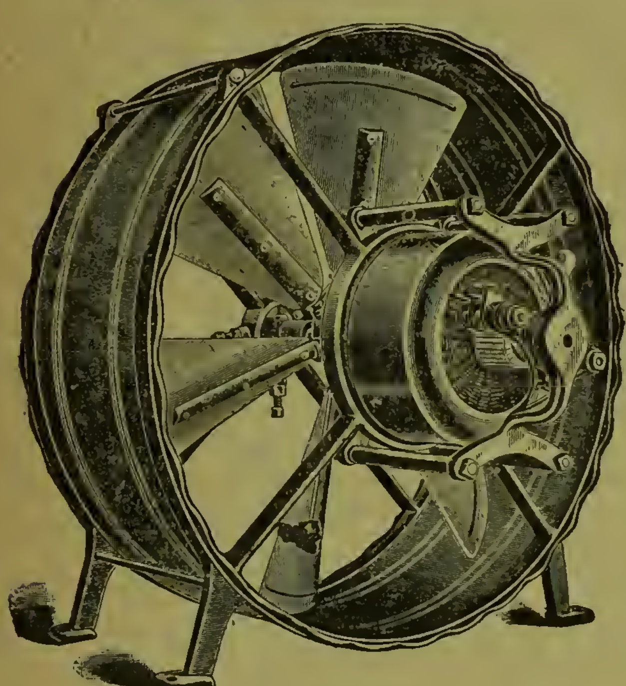

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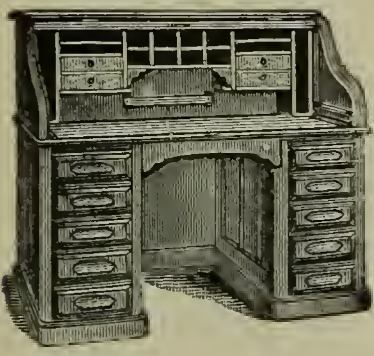

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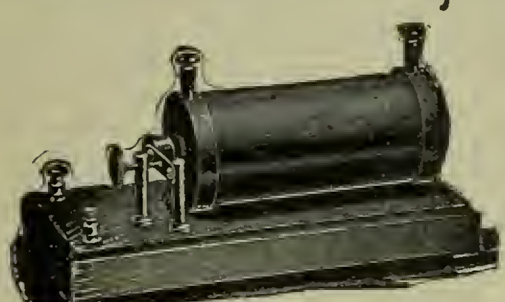

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168 William St., New York.

The Electrical Age.

Vol. XX., No. 1. NEW YORK, JULY 3, 1897. Whole No. 529

Showing construction of Tellmic Conduit to convey Electrical Power from The Cataract Construction Co.'s Colossal Electrical Generating Plant at Niagara Falls, New York, the greatest electrical power in the world carried underground.

INSULATION FOR THOUSANDS OF VOLTS.

If a man stepped upon a can of nitro-glycerine, his nervous system would receive a shock that might almost produce hysteria. Yet a perfect sense of security would be felt if the nitro-glycerine were contained in a can that could not be fractured and in which the explosive, whatever its potential powers, or disruptive qualities, could be handled without a qualm of fear. The insulation of death-dealing wires is one of greater importance than this because it is a matter of sad experience that escape from destruction when in contact with high tension wires must mean nothing short of a miracle. It is the intention of the writer to lay stress upon a most important department, if not the most important of electrical engineering. Recent developments of power transmission plants on a huge scale have forced the engineer to look for an insulation for his wires that will protect and insulate them without the public having the "can of nitro-glycerine" feeling when in their vicinity, or himself wondering when the wire will send its current leaking into the earth through a poor, insufficient and entirely useless covering. Fortunately a kind of conduit has been perfected in which these defects have been eliminated; the Cataract Construction Company of Niagara Falls making use of it in conveying its power underground, depending upon it for the transferance of thousands of horse-power from point to point. The Tellmic Manufacturing Company, of 80 Wall street, New York, manufacture glazed ducts for electric wires and cables which they consider the best from a standpoint of practicability and durability. Their fireproof qualities hardly require mentioning, as the use of stoneware conduits draws forth the inevitable conclusion that they are absolutely fireproof. All sorts of wires can be safely carried in these ducts with a confidence in their security from harm that nothing can shake. It will be instructive and interesting to the reader of this article to hear of the advantages of this conduit which when enumerated will give him an idea of the demand made upon conduit manufacturers. These ducts for electrical wires in buildings are easily accessible on every floor. Mechanically smooth and strong. Absolutely fireproof and indestructible. Afford no space in walls or between floors, sufficient to conduct a fire or act as a flue. They are more perfect insulators than the best rubber insulation ever put on wires. They afford an insulation that never deteriorates with age. They do not take up space in a building, or weaken a wall. They accomodate all electric wires for all classes of service required in any building. The number of wires in a building may be increased or decreased at will by pulling in or pulling out after a building is complete, provided the walls are properly equipped with the tellmic system of ducts and distribution boxes.

The material used is fire clay, carefully selected to ensure freedom from the oxides of iron; in fact, the Company's plant is located contiguous to banks of clay, free from iron oxides and great enough in area to furnish raw material for the business requirements of the next fifty years. Plastic clays are found in all parts of the world, their chief constituent being hydrous silicate of aluminia. When taken from the bank the clay is ground or dessicated by passing it through grindstones or pug mills, to secure perfect homogeneity, and then materials are added which have been found by extended experiment to result in the best combinations for the special manufacture intended, one principal requirement being to secure a uniform shrinkage; this particular quality in the mixture is effected by grinding vitrified earthenware and mixing the resultant grog or dust with the raw clay in the desired proportions, which have to be ascertained by experimental burning of the mixture.

The smooth, glassy surface on earthenware is technically called "glaze" and is secured in two ways, by "slip glazing" or by "salt glazing." In slip glazing the earthenware article is first dried or baked and is then coated with a solution which will melt at a lower temperature than the earthenware. This coating is done by dipping the article in a tub of the slip solution, or by putting the solution on with a brush or a spray. The coated article is then subjected to a heat which melts the coating and results in a surface glaze firmly attached to its base. The coating ordinarily used for stoneware in this country is the "Albany slip," a clay which melts at a comparatively low temperature. For the finer grades of earthenware many glazing compounds and fluxes are used.

The advantages of non-absorptive, glass-lined conduits for electrical wires are manifold; the glazed or glass-lined tubes render impossible the gradual deterioration of the total insulation of any system of wires placed in them, such as always occurs on wires in a building, or set of buildings where rubber, or compounds are depended upon as insulators. It is this gradual weakening, due to the destructive effects of air and moisture on insulations used on wires that causes most of the troubles of the electrician, and makes desirable frequent inspections of all wires by fire-insurance companies. The best insulated electric systems of a few years ago have today become almost universally second or third class in degree of insulation. This is due to loss of insulating qualities of the material used on the wires. Most of the fires that start from electric-light wires originate from the distributed leakage over a system of wires, causing an extra strain on some weak part of the system that produces a "ground" or "burnt out" and starts a fire.

In the Tellmic system the wires or cables are not chafed or abraded in drawing them through the ducts, and the surfaces throughout, with which the wires come in contact, are neutral; no chemical action destructive to the materials in the wires or cables can result in the deterioration incident to contact with lime, cement or tar compounds; the glass surfaces maintain a strong insulating resistance to escaping or ground currents, and produce a very high efficiency of the wires and cables used, thereby securing a perfect conduction of the currents and indefinite life of the wires by protecting the wires or cables from corrosive contact with wet, porous materials.

ELECTRICAL EFFECTS.

At the present time the electrician is able to give the theatrical manager a true imitation of sunrise and sunset; a perfect moonlight effect—full moon or crescent; an effect—to produce moon and sunlight eclipses. He can furnish an instrument that will produce a red glow at dawn, and, as the sun continues its motion, the color being gradually changed to a bright sunlight; a natural optical illusion applied to scenery to reproduce the reflection of the sun or moon on the rippling water; a waterfall device, so adjusted to each painting that it imitates the falling of the water on the canvas. Mr. Denman Thompson owns the exclusive right of an effect by means of which a shower is seemingly produced on the stage, without a drop of water. This scene created a great sensation when it was produced in "The Old Homestead." There is now an electrical device which does away with the old-fashioned paper snow, and which is so real and powerful in its effects as to give the painting a miraculous perspective. A remarkable and realistic imitation of the dashing of the waves of the ocean at night can now be given. By means of another wonderful optical instrument the representation of a rainbow can be produced in the most realistic manner. This is not done by means of painted slides and the old stereopticon methods. By the new method the rays of a powerful arc of 8000 candle-power passing through adjustable double prisms are diverted, and, by an adjustable mechanical device, a partial primary or secondary rainbow can be produced.

Some very beautiful cloud effects are represented by the modern electrician—for instance, the gathering of clouds, which pass slowly over the sky in the background, imitating, most naturally, a cloudy sky without the scene-painter's aid; another beautiful effect is moving clouds with morning glow, from twilight to dawn of day; still another is moonlight flooding the stage and clouds passing in front. The electrician can represent a conflagration of prairie fire; as the fire spreads the smoke clouds appear in a reddish color, which changes again to white as the fire is extinguished. A realistic representation of reddish clouds of drifting sand has been successfully used in the opera of "The Queen of Sheba," and, in the same production, an electrical instrument is used which gives a true imitation of a caravan marching through the desert.

Memphis, Tenn., June 21, 1897.

The Editor The Electrical Age.

Sir: I see in the daily papers that Mr. Tesla claims to have practically demonstrated his ability to telegraph between distant points of the earth without wires, and he illustrates the principle of his method by comparing the earth to a rubber ball filled with water into which if water be forced at one place an equivalent quantity must escape at another place.

It has long been recognized that the earth is a reservoir of electricity and the present writer has often said and has printed it in your own columns, two or three years ago, that no electricity can be put into the earth at one place unless an equal quantity of electricity is taken or escapes out of it at another place. And you will find the same statements in the Journal of the telegraph, when I was discussing the ground wire with Prescott, twenty or twenty-five years ago, and I think in other journals since then.

There will also be found in the same journals the statement under my signatnre that electricity is a concomitant of matter inseparable from it, and I understand that this principle Mr. Tesla and Lord Kelvin have or are about to demonstrate, my deductions, as facts.

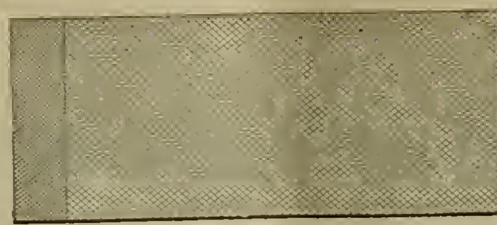
With Mr. Tesla's method of telegraphing I have but little concern, not being for some time engaged in practical telegraphy; but the principles upon which he and Lord Kelvin are working are mine, first announced by me, and it will be a source of great satisfaction to me to have proved what an old telegrapher thought out for himself a quarter of a century before them.

Yours very sincerely,
David Flanery.

A MODERN INDUSTRY.

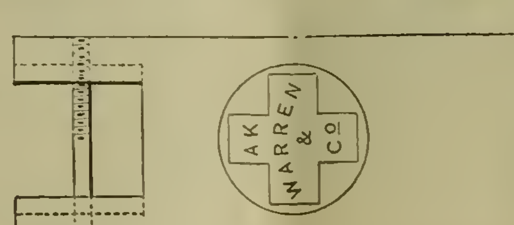
The repairing of electrical machinery has developed into a definite and indispensable department of electrical engineering which requires in many cases more judgment and ingenuity on the part of those undertaking repairs than that supplied in the first case by the original manufacturers. That this is so is easily understood by the repair man particularly when but a mere skeleton-frame is given him to rewind with the armature wire entirely gone and the fields a charred mass of ash-like ruins. The owners of injured and maimed machines in such a case expect them to be returned perfect in every respect, resurrected as it were, from the junk heap, to grace the engine room and live out another lease of life. All types of dynamos and motors find their way to a trustworthy repair shop and a thorough insight into the peculiar characteristics of each machine must be possessed by those undertaking the repair of them. Not one type of machine is found in such a shop, but many; not one style of arc lamp given a chance to shine, but all. Repairs, renewals and entire renovations occupy the time of its sorely tried physicians. The firm of A. K. Warren & Company, of 451–453 Greenwich street, New York, are engaged in this class of peculiarly interesting work. They undertake all sorts of repairs in line with those so briefly de-

Dynamo Room.

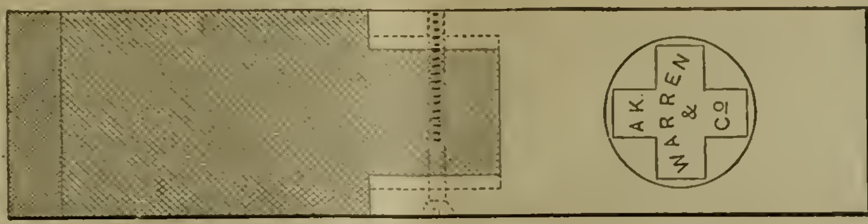


ORDINARY WASTE

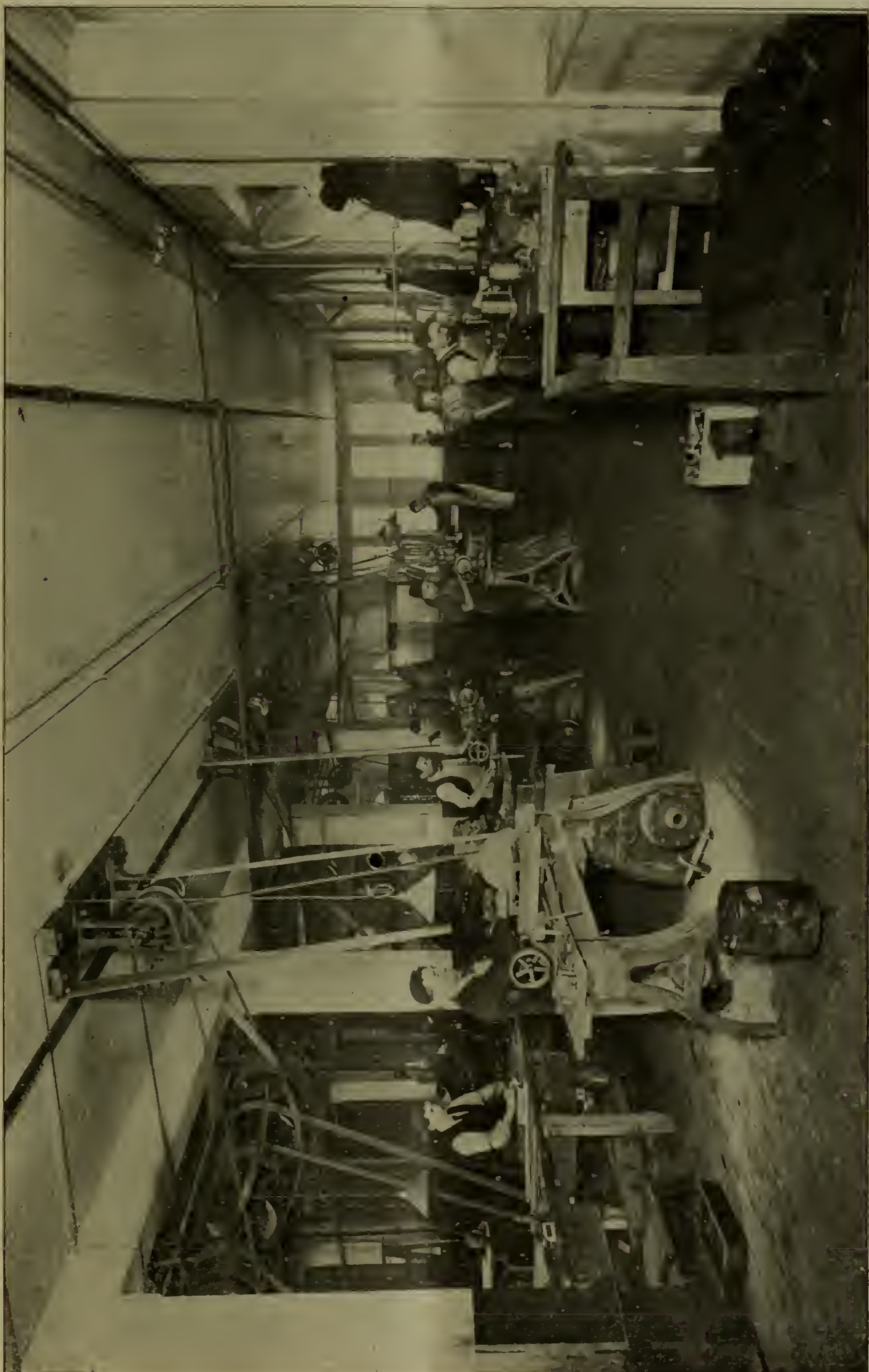
Armature Winding Department.



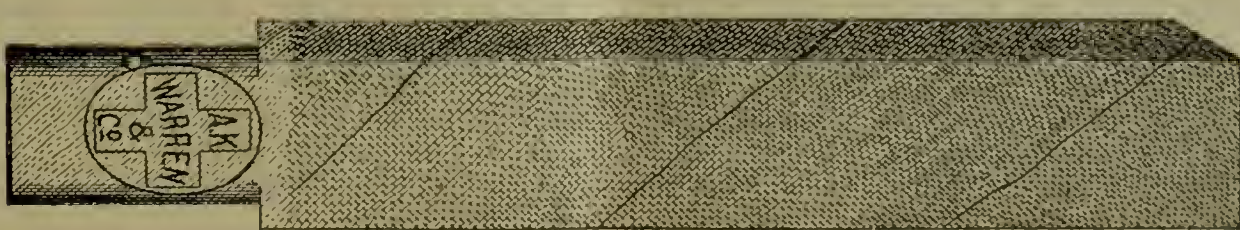
EXTENSION



COMBINATION.

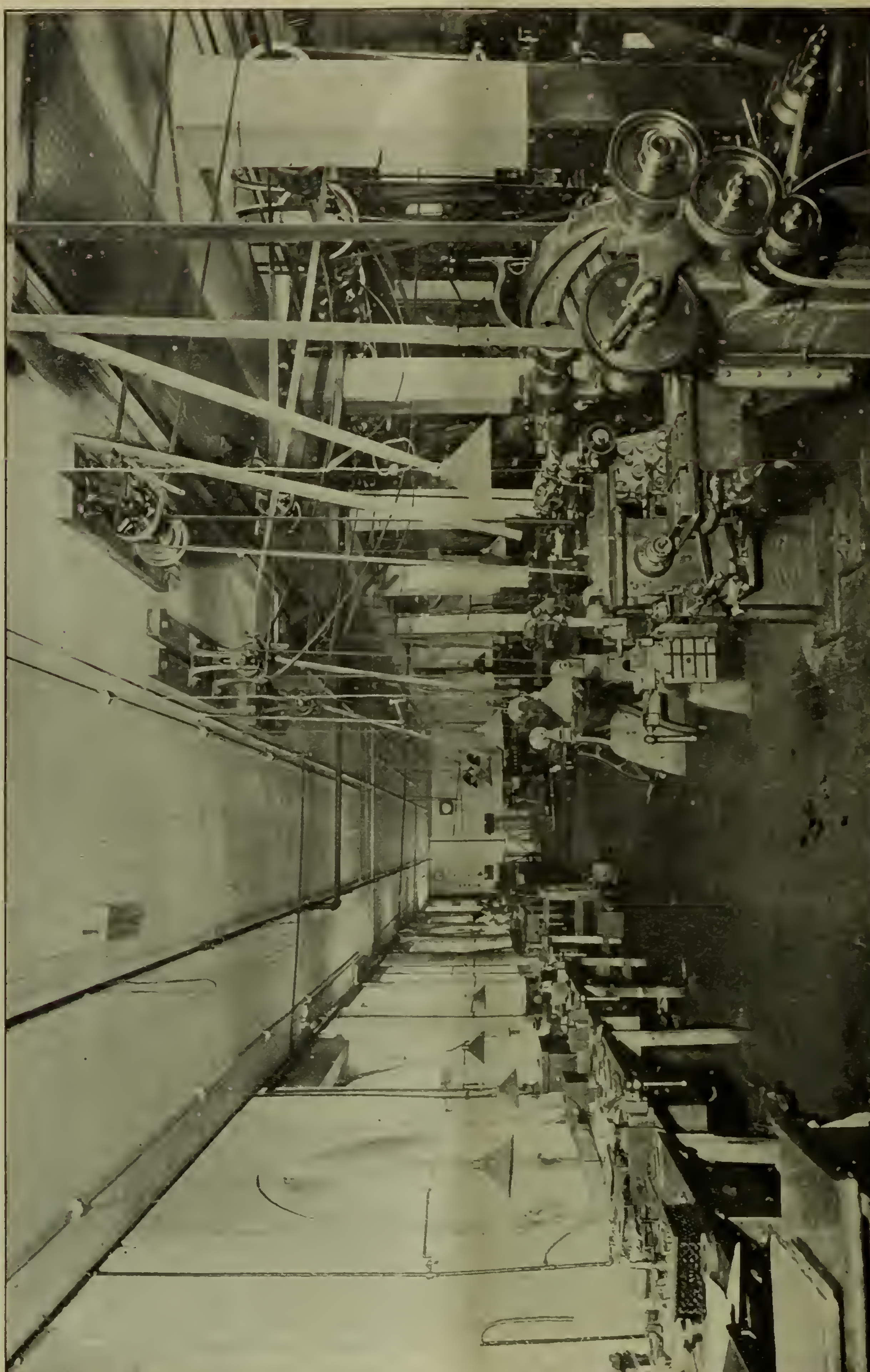


Commutator Shop.



Woven Wire Brass Gauze Brush.

scribed and in addition supply everything required for the proper equipment of a lighting plant, motor installation or wiring of a building. Reference to their new catalogue will quickly illuminate the mind of the reader regarding the scope of their work. Everything is arranged on its pages alphabetically, thus dispensing entirely with the customary index. The electrical supplies they sell comprise all imaginable devices in use and covers the field of the contractor's work in every respect. Lamps, arc and incandescent, generators, motors, switchboards, circuit-breakers, rheostats, and in fact the entire schedule of electric-light fittings and dynamo and motor accessories may be found catalogued and arranged in accordance with this new plan. For the benefit of readers and as a useful memorandum to older engineers some very valuable tables relative to lighting and power, electrical expressions, etc., are to be found in its last few pages. A very ingenious device that will enable the dynamo tender to successfully economize with his brushes, is manufactured and sold by them. It is represented in the illustration which in truth speaks for itself. The amount of brush originally wasted, the extension used for saving it and



Machine Shops.

the combination in total as represented are indicative of its ready usefulness. It is of the greatest assistance in using up the brush to its last fragment without risk. It can be readily adjusted to all kinds and makes of brushes and is therefore above criticism. The interior views of the armature-winding department, commutator shop and dynamo room of A. K. Warren & Company show the facilities they possess for heavy work and hurry jobs. They

The Electrical Age.

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NEW YORK.

NEW YORK, JULY 3, 1897.

CONTENTS.

X RAYS FROM THE SUN.

It would not be strange to hear of the sun as a huge centre of electrical energy. The experiments of Prof. Pupin have indicated to us the presence of tremendous electrical forces at play in its fiery atmosphere. When the glorious corona appears during eclipse the great nimbus of light is analyzed by thousands of spectroscopes. They all discover the presence of a highly tenuous gas of finer fabric than any known on earth. An electrical discharge would speak to the spectroscope in the same mysterious tongue. From the sun, then, in all probability, radiate streams of etheric force pulsating through the universe across millions of miles of space to planets like our own. Under the influence of a temperature far above our highest estimate, world matter in its simplest state is undergoing a gradual crystallization. Why electrical waves do not manifest themselves freely in sunlight is explained by Elihu Thomson, as follows: "the absence of the lower or Hertzian waves from sunlight probably depends on their existing no molecules or atomic aggregations in ordinary matter which can possibly vibrate electrically at such low rates. So in the hot primordial matter no ordinary light waves need be generated, but only the higher order known as Roentgen rays. The latter are the normal vibrations occurring in such matter. The spectroscope cannot help us in the analysis of these higher waves and the forms of matter giving rise to them. Further, if in the universe some of the hotter nebulæ contain this ultra elemental matter, the eye will not discover it and the air around the earth is too absorptive for these higher rays to penetrate it and to reach us.

A "fire-mist of primordial matter must remain invisible until some parts cool sufficiently to form aggregations which we call elements, which are perhaps only extremely stable forms resembling in stability most of our known compounds at near absolute zero." This extremely interesting theory, which involves a conception of how complex forms of matter or so-called elements originate, is likewise dove-tailed in with the above speculation regarding the source of solar X rays.

THE DETERIORATION OF HIGH INSULATION.

The expression insulation is one that is constantly used in a purely relative sense. There is no absolute insulator in this world any more than there is a perfect conductor. Lying between the two ideal extremes we find a class of substances more or less worthy of the title of insulator or conductor—materials that for practical purposes conduct an electric current freely, likewise materials that resist its flow and act in the common capacity of insulators. There is so much to be hoped for from a study of insulators and insulating materials that it might be said much of our future knowledge of this great science is contained within the systematically vibrating molecules of the insulator—vibrations and reactions that will betray to us in a clearer and better sense the true nature of an electric current. When high potential discharges or high frequency and high-pressure currents are allowed to exercise their influence upon an insulating material, totally unexpected phenomena arise which from a practical standpoint are of the greatest importance. The best of insulating materials is in the line of such evolution as we have referred to, merely one link in a chain of substances whose extremes represent perfect conduction and absolute insulation. Relatively speaking, such materials can be conceived of as a partial conductor with respect to some superior insulating material, even though only existing in an ideal sense. It may be impossible to actually compare these two grades of insulation, the least of which is of very high insulating properties, but they can both be exposed to high tension and high-frequency currents to awake within them such weaknesses as may cause disruption. Such experiments have been tried and it is today a common experience to hear of insulation gradually deteriorating in an electrical sense under the influence of a high pressure. The expression used is that the insulator "fatigues." It acts like an organism whose muscular power gradually depreciates under a constant but uniform strain—such organism that without visible change of any other description would gradually lose its grip, so to speak, by becoming fatigued. We have no knowledge of a chemical change occurring in the insulation of a wire undergoing a heavy strain, but the failure of which we speak is inevitable with a high enough pressure. There is this to be said about so strange and interesting a phenomenon: It is greater with high frequency than low-frequency currents, although taking a longer time with the latter than the former. It is of course more highly evident with high pressure than low-pressure currents. In other words, frequency and pressure induce within the covering some dielectric change of a most serious character. The danger may not become apparent for a considerable period of time and for this reason, if no other, insulation should be tested with the primary object of discovering when the condition of fatigue occurs, thus making it possible to give data that is better than that relative to the "break-down" test, in view of the fact that though in many respects similar, it really gives the pressure at which the insulation gives, which may be considerably less than that of the "break-down" test.

The ordinary conduit used for the protection of high-tension wires is not apt to be affected in the manner described. But in the near future, when the use of high pressures will invite greater success in the transmission of power, it will be necessary to look more deeply into this highly interesting and instructive department of electro technics.

are thoroughly equipped for all classes of work such as repairing, construction, commutator-refilling and rewinding of every description. The isolated plant view illustrates a switchboard equipment that gives the reader an idea of their ability in this line. A particular field of their work being the erection of new switchboards and the alteration of old to meet with the fire department's demands. This progressive and wide-awake firm are well known in electrical circles as being fully competent to meet the wants of customers and able to undertake any and all classes of work requiring haste, experience and skill.

RECENT PROGRESS IN ARC LIGHTING.*

BY ELIHU THOMSON.

It is now six years since I read a paper on "The Electric Arc and Its Use in Lighting" before this association. In that paper a general outline of the history and nature of the electric arc was given, together with a number of considerations relating to the arc as a source of illumination. The means for supplying current to the lamps and controlling the feed of the carbons were also touched upon.

Since that time considerable technical advances have taken place in this important field, and a continuous commercial expansion of arc lighting as an industry has resulted.

The purpose of the present paper is not, however, to deal with the commercial aspect of the case, except in so far as it is evidently the result of the improved devices which have been brought out in the past few years. In looking over the ground we find, also, that it is certainly not possible to deal very comprehensively with the several divisions of the subject within the limits natural to a paper such as the present one is intended to be. Should it serve as a foundation on which a general practical discussion of the various topics can be based, the writer's purpose will have been fulfilled.

We have today in actual commercial use arc lamps running under quite a variety of conditions as to nature of current, regulation of the current, and conditions concerning the arc itself as a source of light.

* Read before the National Electric Light Convention, held at Niagara Falls, June 8, 9, 10, 1897.

According to the manner in which the arc lights are worked on an electric circuit, we are enabled to make several general divisions, about as follows:

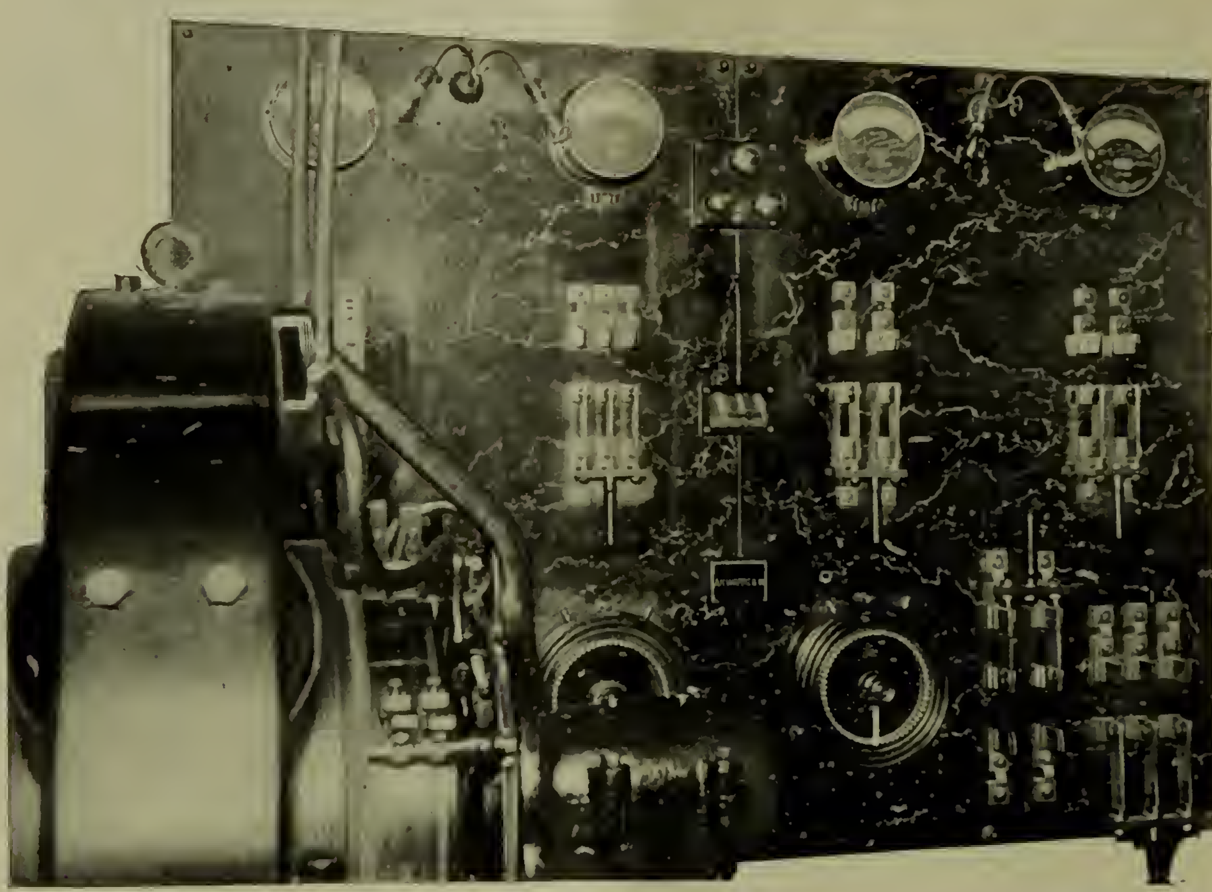
Series arcs on:
- Constant continuous-current circuits.
- Constant pulsating-current circuits.
- Constant-potential, continuous-current circuits.
- Constant alernating-current circuits.

Single arcs on:
- Branch of constant-potential, continuous-current circuit.
- Branch of constant-potential, alternating-current circuit.
- Compensators with alternating current.
- Constant-current transformers.

The above schedule will cover most of the practical cases that have hitherto arisen, and each case can be considered both in its relation to the use of an open arc, an inclosed arc or a partially inclosed arc.

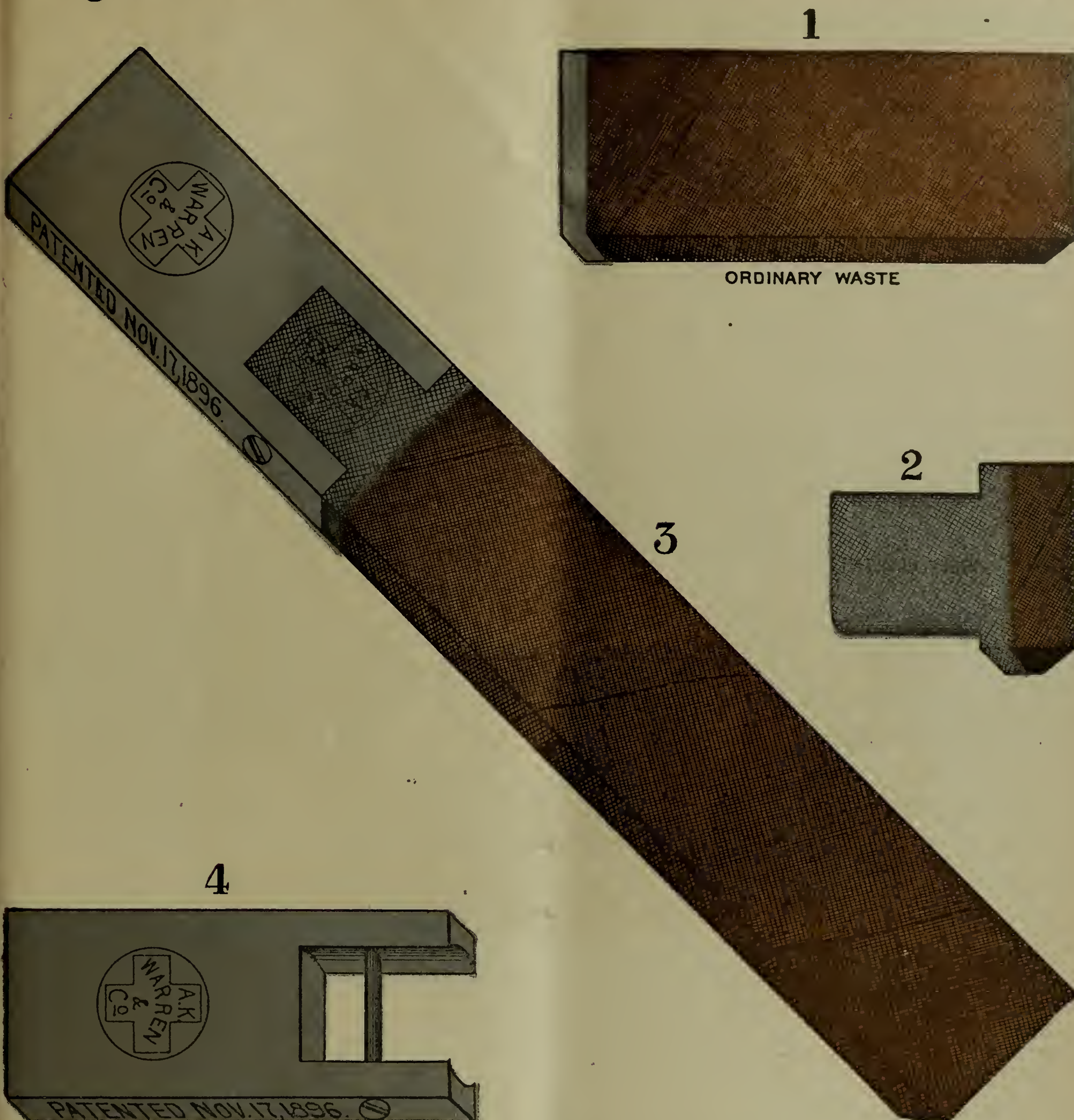
It will, at this time, be scarcely necessary to dwell upon the main features of several of the cases above enumerated, as they are too well known to call for comment here. Thus, the case of arcs in series upon a continuous, constant-current circuit is the oldest and best known. It has the peculiar merit of permitting economical transmission by currents of potentials of several thousand volts; gives ease of regulation and great simplicity of circuits and connections, and does not demand the highest grades of carbons for the open arcs. On account of the relatively higher potential demanded by an inclosed arc, or a partially inclosed arc, and the consequent restriction of the number of lights in a series with a given permissible voltage, there has naturally resulted thus far very little real commercial use of series inclosed arcs, and where they have been on trial use they have, in most cases, so far as the writer is aware, been discontinued.

The dynamos for constant-current arc lighting are not, of course, so efficient as high-class, constant-potential machines, but as the running of arcs with constant-potential, continuous currents demands that, for steadiness or stability, dead resistance or other additional apparatus more or less wasteful of energy, be used in the



Isolated Plant, Switchboard View.—A. K. Warren & Co.

Dynamo AND Motor Brushes.



1.—Shows waste of brush, hitherto useless scrap metal, actual size.

2.—Shows small waste, which is not charged for in our brushes, as we send always one inch over the usual length.

3.—Shows entire brush with EXTENSION PIECE fitted.

4.—Shows EXTENSION PIECE. This is made to fit all brushes of same width and thickness, and can be used on any number.

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lamp branches, what may be gained in one way is likely to be lost in another. And this remark it will be found, is applicable still more generally in the comparison of methods of working arc lights.

In recent years the tendency in series arc lighting with constant current has been to increase of voltage of the dynamo, and machines capable of working 125 to 150 arc lights in a series have been developed successfully. But the potentials between terminals in such a case may be 7,000 volts—often too high for security, and in some places forbidden by special legislation. An ingenious method of employing such machines when, as is the case with the Brush machine, several commutators are present in series relation, has been devised by Mr. Green, of the Brush company. This plan demands that separate pairs of wires be run from the machine to the switchboard for each circuit, but the unquestionable effect of the new connection is to limit the difference of potential which is possible to be manifested betweeen any two parts of the circuit through the machine and lamps. A simple diagram like Figure 1 will make the connection and its general effect on the distribution of potentials clear to those who may not have given attention to the subject. Let F be the field circuit of the dynamo; we may for simplicity neglect its resistance and that of the wire of the circuit. If C¹, C², and C³ represent the sections of armature conductor, and L¹, L², L³ the series of lights connected between the commutators of the machine, it will be seen that each armature section, C¹, C², C³, with its appropriate commutator, acts to produce a difference of potential, which may be represented by the vertical a¹, b¹, = a², b², and a³, b³, while the fall of potential through each series of lights, L¹, L², L³, results in bringing the line potential down, as it were, for another raising. In such a system, evenly loaded, the highest difference of potential anywhere to be found will evidently be that required to run a series of lights looped between two successive commutators. If lights are cut off from any set or loop the potential difference between the terminals of that loop falls accordingly without any corresponding or proportional rise between any other parts of the circuit. If, however, lights are cut off one set and added to another, so as to keep the machine in full work with unbalanced loads, then the potential distribution is, of course, disturbed, and the system approaches the condition of all commutators connected directly in series, and the light all in one series—the old plan. Where the conditions of the circuits leaving the station are such as to permit inductional effects on parallel wires—such as those of a telephone system—the new plan of circuit connections may give, as appears to have been already noticed, a greater inductive disturbance. This must be owing to the relatively simpler commutation per loop of lamps. In the old series connection all the commutators in series acted virtually as one of many segments, which tended to give a smoother potential, or prevent waves in the potential of the line. In the new plan each commutator of few parts acts, in a measure, independently of the others, and impresses its own variations of potential more directly on the lamp lines, giving rise to electrostatic inductional effects.

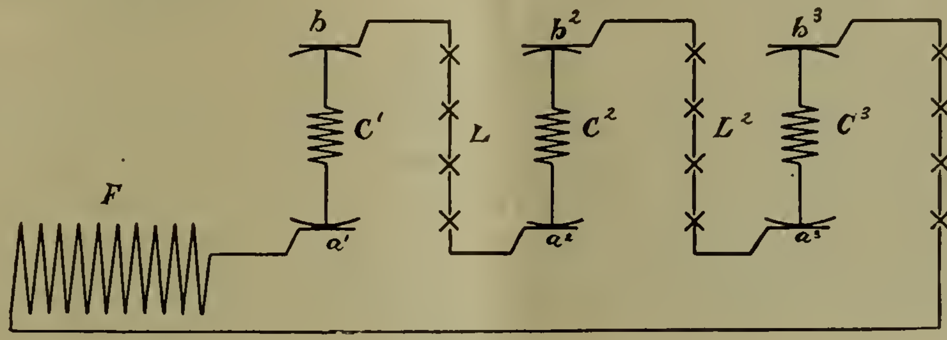


FIG. 1.

The immediate future of the series arc lighting system appears to be in the development of large dynamos, up to, say, 300 arc lights each, running at such speeds that one or a pair may be easily coupled directly to the shaft of a moderately high-speed engine. The use of a regulated constant current in the series system, besides giving a simple system as to wiring, etc., is seemingly best adapted to the use of the cheaper carbons. For extended districts the series arc lighting system is still likely to hold its own, but displacement by constant-potential arcs and inclosed arcs on constant-potential circuits will doubtless continue in cities supplied by underground low-pressure systems with continuous systems.

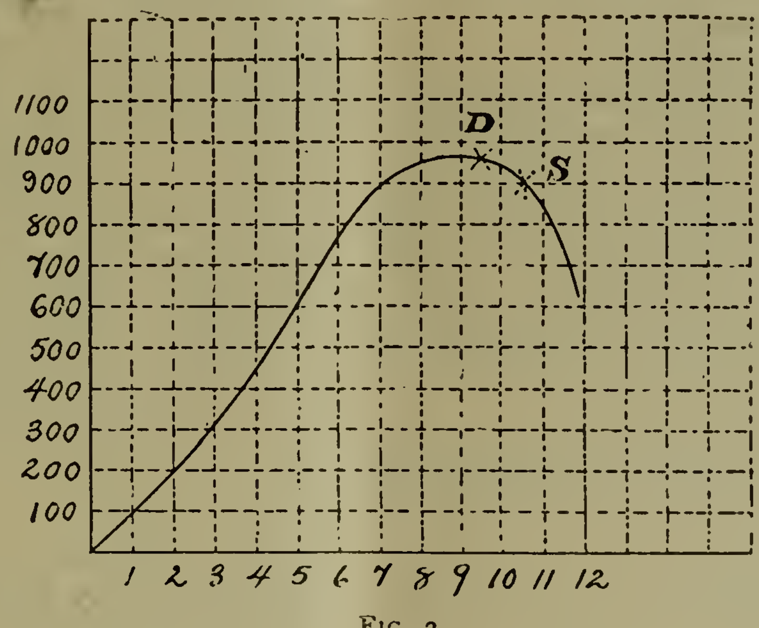


FIG. 2.

While it is true that in the open coil types of dynamos —such as the Brush and Thomson-Houston—the current, as set up by the armature, must necessarily be wavy, still it must be borne in mind that the field magnet coils, the line and the series lamp magnets have, together, a considerable inductance, the effect of which is to smooth out the minor fluctuations, so that the current becomes fairly uniform. A slight tremor in the current, with differential magnet lamps, is an assistance in preventing tardy feeding. In the pure shunt type of lamp, this is of less effect on the feed.

It has been thought by many that arc lamps are interchangeable (if made or adjusted for the same current) from the circuit of one type of series arc dynamo to that of another, without difficulty. In a general way this is true, but not by any means necessarily true. Thus, an arc machine may easily have that proportioning which enables it to run a circuit of differential lamps at a certain current strength and be wrong in proportioning for pure shunt feeding lamps such as the Thomson-Rice M. & K. The latter require a more rapid droop in the curve called the "characteristic" of the dynamo, than the differentials. Also, it may happen that a dynamo which will take a certain load of differential lamps at a certain strength of line current, can only work with satisfaction on pure shunt lamps with a ten per cent. to twenty per cent. increase of line current, and fewer lamps in series. In this case the differentials secure a stable current when working on a part of the characteristic curve back of that where the heavy droop occurs, D Figure 2, while the shunt lamps are only given stable current at S. Instability or quick rise and fall with flashing and possible intermittent extinguishment otherwise result.

On the other hand, any circuit of pure shunt-feed lamps will take differentials adjusted for the same current without difficulty. But in such case if the current fluctuates in value and there be but few differential lamps on the circuit, with a large proportion of the shunt-feeding type, the differentials are the ones to suffer and not the others. The former are sensitive to current variations, the latter indifferent thereto.

(To be Continued.)

ELECTRIC WELDING, FORGING AND HEATING.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

One of the most familiar effects of our electric current is the production of heat. The light of the incandescent lamp depends upon the heat localized for its degree of brilliancy. The arc lamp only reaches a point of sun-like brightness when the heat of the arc intensifies with an increased current. The production of heat in an electric circuit can be controlled and reduced to be either imperceptible or too great to bear with hand or eye.

In any electric circuit the heat evolved is calculated by the rule—

$$\text{Heat} = C \times C \times R = \text{watts}.$$

Thus the power consumed in producing heat in a circuit having

Resistance = 10 ohms.
Current = 10 amperes.

$$\text{Watts} = 10 \times 10 \times 10 = 1{,}000.$$

An amount of energy exceeding one horse-power would be absorbed under these conditions.

To apply sufficient heat to a piece of metal to melt it requires current dependent upon its resistance. The greatest heat we have had actual experience with, is that of the electric arc. All the metals, oxides, quartz and granite formations become volatilized in it.

Carbon becomes a plastic mass; the diamond, a bit of ash.

Welding by electricity depends entirely upon the heat produced by the imperfect contact between two pieces of metal. The resistance of the joint causes the heat to localize itself there until the ends in contact become semi-liquefied and ready for permanent junction.

Steel, copper and iron are generally employed for the illustration of this process. The current used is alternating, being transformed down to a few volts when used.

The Thomson Electric Welding Co. have completed machines for practical use which will weld pieces of metal of given cross-section.

One size of welder will successfully join pieces of three square inches in cross-section; the smaller size can weld 1.2 square inches; also welders for the joining of pipe six inches in diameter are manufactured.

The objects in view when welding is attempted should be

Sufficient pressure at joint.
Sufficient current.
No oxidation.

The current used for the purpose is generated in an alternator at about 300 volts pressure; it is then transformed down to from 3 to 12 volts, according to the nature of the work to be done.

Many experiments have proven an alternating current the best for welding purposes. The positive pole of an attempted weld with continuous current would be very much hotter than the negative. This would seriously interfere with the weld, while if an alternating current be used the current heats each end equally. If a slight oxidation occurs at the joint, the weld may bind at the edges but be perfectly insecure inside. The instant the heat has arrived at the right point, the two bars of metal must be pressed together as forcibly as possible. This creates a burr on the outside which may be hammered down flush with the rest or removed in the lathe. The resulting surface should be smooth, unseamed and continuous when finished, without any signs of the juncture visible.

When steel is welded it sometimes happens that a black, burnt-looking mass forms at the welded point. This is caused by overheating, which drives out the carbon and changes the nature of the metal.

It can be restored by resting in a bed of red charcoal until carbon has been reabsorbed.

If a pail filled with a solution of soda or sal ammoniac and water have a metal plate connected to an insulated wire placed at the bottom, any piece of metal connected to another wire will, when dipped, become rapidly white hot *in the water;* the two wires being connected to a source of current. If one wire is disconnected, the same water serves to cool the metal instead.

Blacksmiths in the neighborhood of Niagara Falls use current from the trolley roads for this purpose, their forge consisting of a pail of water and a pair of insulated tongs.

For purposes of forging, the following figures are given for an 80-lb. bar measuring 1 × 8 × 36 inches.*

Cost of heating by coal	$1.25
" " " " electricity.	0.78
Saving - -	$0.47

The advantages of an electric forge are therefore not merely those of convenience alone, but to be figured in dollars and cents.

* [Electricity at World's Columbian Exposition.]

THE SYNCHRONOGRAPH.

(Concluded.)

Concerning the daily correspondence of the large business houses between cities which are the terminals of the trunk lines, it might be an advantage for them to have exclusive use of the line for a certain number of minutes daily at a certain fixed time of day, by subscribing and paying an annual rental to the company. Knowing definitely at what hour the mail would be dispatched daily, it would then be possible for each house to send by messenger its daily mail already prepared for transmission to the general transmission office, where it could be placed in boxes prepared for the subscribers, to be taken out and transmitted when its time arrives. The distribution at the receiving end of the line could be accomplished as now by the regular mail service.

In the limited use of rapid automatic intelligence transmission at present, the sending and receiving records are made upon prepared paper in the form of tape. In the larger volume of business which is being considered here, it does not seem certain that tape would be the best form for the sending and receiving paper. It would be an advantage to have the letters received upon sheets of paper with the dots ond dashes arranged in parallel lines. Besides facilitating the reading, this form would be more convenient for mailing. It would also easily permit reference to any part of the letter at a glance. The amount of paper required by the use of sheet form instead of tape would be reduced, which is an item of importance where such a volume of business is being handled. Sending and receiving from the surface of a cylinder seems entirely practicable.

Another point which must be considered is whether with these systems the induced currents from neighboring wires along the line or from any other cause will affect the legitimate signals materially, as has been at times the case with the Wheatstone system. In reply to this it can be said that these receivers for telegraphy are not necessarily more sensitive to small currents because they are rapid. On the contrary, they may be made to require as much current as is found desirable to rid them of the effects of outside influences, and at the same time retain the property of quick action in response to currents of the proper magnitude. In this connection it may be said that the utility of a single line wire becomes so great that more attention will be given in the future to the line construction and maintenance. If millions of dollars are invested in the construction of a single railroad, is it not as necessary to make the telegraph lines which carry important and profitable business as perfect in their construction ?

The telegraph line of the future will comprise substantial poles carrying a few copper wires worked to their full capacity for transmitting electric signals. The cost of maintenance of such a line when once constructed will be little more than for an ordinary iron wire now used, while its carrying capacity for intelligence at 3,000 words per minute simplex will be about equal to 160 wires used for hand transmission simplex. By duplexing the line, the carrying capacity is doubled and becomes 6,000 words per minute, which is about equal to 160 wires worked duplex, or to 80 wires worked by hand quadruplex.

It is thought that the influence which the inauguration of a telegraph letter system would have upon the existing telegraph and telephone business would be to increase rather than diminish it. Each of these services has its own special field of usefulness but little affected by the others. A new field would be occupied rather than an old field supplanted. The present telegraph and telephone would still have their natural field of operation, even though the best hopes for a telegraph letter service are realized.

A single line capable of sending 6,000 words per minute between New York and Chicago, becomes a different kind of investment from a long distance telephone line where the number of words per minute with the fastest rate a speaker can talk is very slow in comparison, and the charge is $9 for five minutes' use of this line.

The application under government control of a rapid system of correspondence transmission such as has been outlined, operating in conjunction with the present postal system, by supplementing and relieving their service could hardly fail to prove of benefit to the people of the United States. This comes within the proper duty of the Post-Office Department, and would be under the direct control of the Postmaster-General. The simplification in operation and expense which would result from uniting directly with the general post-offices of large cities the telegraph letter service would soon be realized by the people and a better service insured.

As a practical means toward ultimately assuming the direct responsibility of this new service, it would probably be easy to secure private companies which would be willing to contract with the Post-Office Department to transmit telegraph letters at a fixed rate for a term of years. In this manner the Department could gradually absorb this branch of its business and be relieved of any sudden new responsibility and radical reorganization.

It is not thought that the development of a rapid intelligence transmission service to the extent suggested could be accomplished before many years, nor indeed that the manner or means of this development should closely follow the lines indicated, but that something analogous to this development seems among the possibilities if not the probabilities of the near future.

The persistent efforts of Mr. Delany and the great system which he has developed are well known, and the ideas which he has advanced in regard to the applications of rapid systems are in the main in accordance with those stated herein.

THE ELECTRIC STORAGE BATTERY SEEMINGLY LOSING GROUND.

Another Storage Battery.

A private Chicago special says that the Pullman Co. was the first to use storage batteries for car lighting and for ten years the company has been the largest consumer of storage batteries for this purpose. It has tested nearly every type of battery to obtain the most economical and most serviceable kind. The company has adopted what is known as the Morrison battery, which was formerly made in Chicago, but is now being made at the Pullman works at Pullman. The company has engaged the services of Mr. Morrison, the inventor, and on the ground of economy will make its own batteries.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION OF THE U. S. OF AMERICA.

A meeting was held at Detroit, on June the 22d, of the above association; the first convention in their history. Its purpose is the establishment of a field of independent telephony, to advance its interests and have a rallying ground for those that will join with heart and hand.

The position taken by the delegates is one against a far stretching and colossal monopoly that must be opposed at all hazards. More than 1,200 corporations, concerns, and private individuals were invited to attend. The meetings were crowded and lots of work done. Regular sessions were held. Judge James M. Thomas was elected president by acclamation. First vice-president, Col. H. C. Young, Columbia, Pa.; second vice-president, E. K. Hines, Oskaloosa, Ia.; third vice-president, Thos. Fricker, Ashtabula, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind.; treasurer, L. A. Carr, Durham, N. C. The constitution of the organization was signed by fifty-one telephone exchanges.

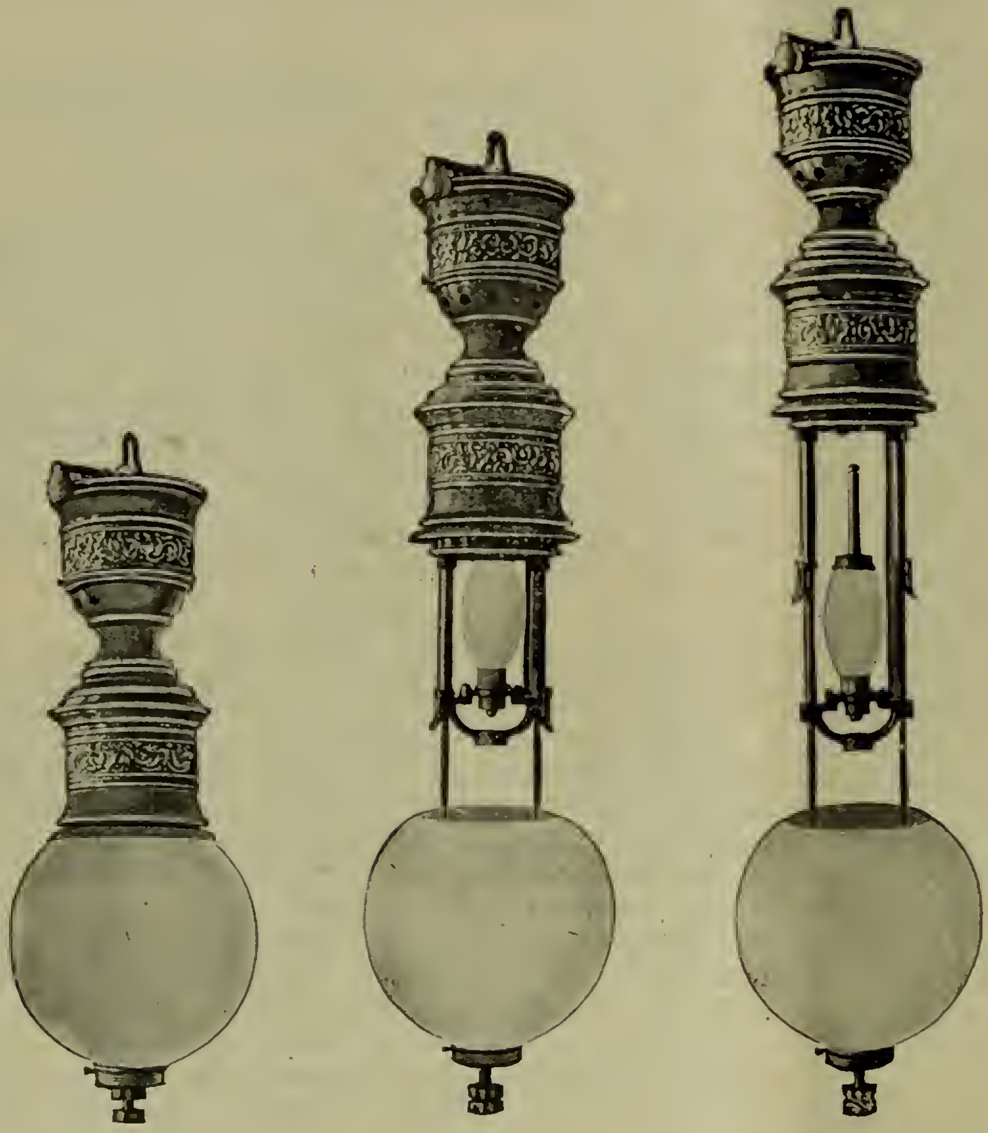
When the New York Central's Empire State Express was first placed in service, one of the chief daily newspapers in London published an article on that event, in which it was stated that the train might run for a few days possibly, but it would be preposterous to suppose that it could be made permanent, as there was no "road-bed in America on which a train could be run at the speed of the Empire State Express for any length of time without shaking the cars all to pieces." After five years of daily evidence that such a train is entirely practicable, our British cousins are now fully convinced of this, as seen by an article in the New York Mail and Express on the exhibition of the Biograph in London headed "Royal Parade Here."

UNIQUE LONG LIFE ARC LAMPS.

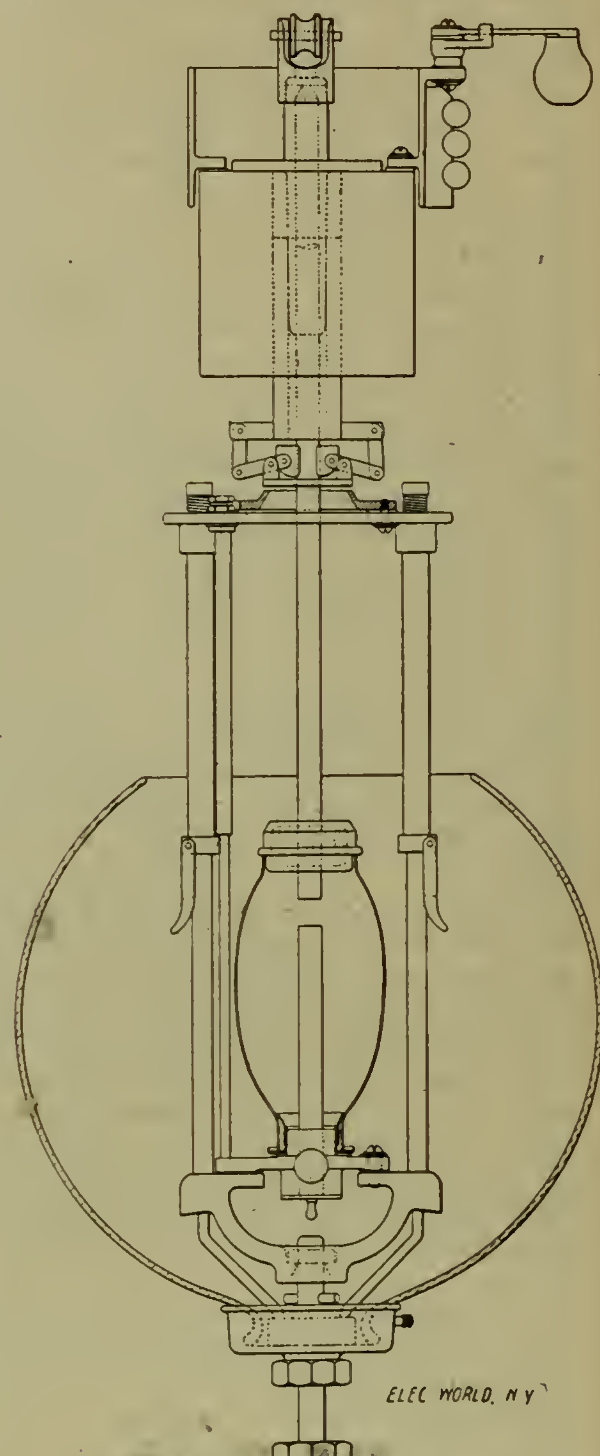
There seems to be an evolution going on in even the oldest departments of electrical work at present. This tendency has had its parallel in the development of steam engines, locomotives, motors and dynamos, and it has exercised a most beneficial influence in the field of arc lighting. For at least twenty years the arc lamp lay untouched, except in so far as it was improved from a purely mechanical standpoint to meet the exigencies of practical life. Changes in the mechanism, method of feeding, etc., were those of the most noticeable kind. But happily a fertile mind turned its attention to the lamp with the object of improving its light and life, and it is to this radical departure we owe much of the healthy change that followed.

A firm that may pride itself upon its encouraging attitude when improvements were added to the lamps of its time is the General Incandescent Arc Light Co., of 572 to 578 First Avenue, New York. It evinced a most progressive spirit from the start and favored all improvements that tended to make the arc lamp an automatic and perfectly reliable piece of mechanism. It wasted no time in immediately testing the merits of the long life or closed globe system of arc lighting and was the first to place lamps of this kind upon the market, guaranteed by them to serve the public economically and well.

In the Unique arc lamps, styles of which are represented in the illustrations, we meet a class of apparatus designed for constant potential circuits. When burning alone, the current consumption averages five amperes for each lamp. It is a simple matter to secure a life of from 100 to 125 hours by using a twelve-inch $\frac{7}{16}$-carbon in the upper holder and a $\frac{7}{16}$ five-inch carbon in the lower. When thus supplied the lamp lies within 28 inches full length.



(Closed.) (Open.)
Unique Long Life Arc Lamps.



General Details of Construction Showing Clutch.

The Standard Brass Long Life Arc Lamp, for indoor use, has a life of from 100 to 150 hours, is 38 inches long and finished in bright brass. The upper carbon is twelve inches by seven-sixteenths of an inch solid; the lower, five by seven-sixteenths solid.

The inner globe surrounding the arc is made of clear or alabaster glass; a double combination of alabaster outer and inner globe provides a soft, pure light.

The feeding device consists of a series coil, within which is placed a hollow iron core; when this is drawn into the coil, a pair of shoes are brought against the upper carbon, lifting it from the lower and starting an arc. A dash-pot is dispensed with, as the core practically acts in that capacity in the operation of the lamp.

There is a simplicity of construction to the Unique lamps which will always provide a good recommendation for them aside from their perfect action.

The resistance employed is wound around the upper end of the rod supporting the lamp. It is wound on porcelain insulators and it can be controlled in a very satisfactory, not to say ingenious manner, by plugging in and out so as to adjust it exactly to the voltage supplied.

The unique features of this lamp are not at an end when the means of handling the outer globe are considered. Telescopic rods allow of this adjustment, the globe being

Bijou Long Life Arc Lamps.

Standard Plain Long Life Arc Lamp.
For Street and Municipal Lighting.

firmly held on the globe cup while the operation of cleaning and trimming are performed.

The clutch employed in the Unique lamps is of the double grip type, an exposition of simple and effective construction.

The various styles represented are types of the same

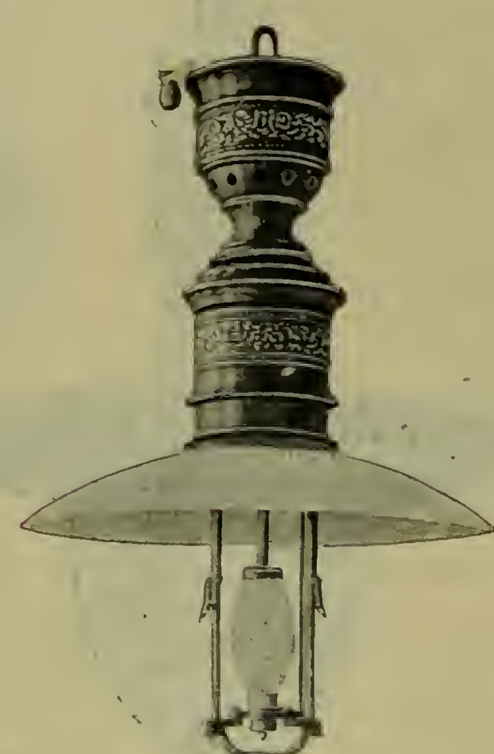
Bergmann Street Lamp Pole Fixtures.

general mechanical design. The Standard Plain Long Life Arc Lamp burns from 100 to 150 hours and is japan finished and forty inches long. The same is represented with a reflector and the Unique long life arc lamp proper with the lamp prepared for trimming; the telescopic device being plainly shown. The Unique lamp

Standard Brass Long Life Arc Lamp.

with reflector is also shown burning, as before mentioned, 125 hours and only twenty-four inches in length.

The Bijou Long Life Arc Lamps, with opal reflectors, burn 75 hours, are twenty-seven inches long and take



Unique Long Life Arc Lamps.

only three amperes; a five-sixteenth-inch carbon being used.

Bergmann Steel Lamp Pole Fixtures, with support plain or ornamental, are likewise supplied by the General Incandescent Arc Light C).

Brunswick, Ga.—W. N. Cheney, of Jacksonville, Fla., will establish a telephone system and exchange in Brunswick.

Pulaski, Va.—The Pulaski Electric Co. has been granted franchise for the erection of an electric-light plant. Work on same to be commenced immediately.

Standard Plain Long Life Arc Lamp.

MR. WILLIAM CROOKES, F. R. S., who has been experimenting with the alleged new element "lucium," has arrived at the conclusion that it is not an elemental substance at all, but simply impure yttrium.

THE DAYLIGHT WORK OF CENTRAL STATIONS.

(Continued from page 414.)

If the stationary motor work, whose claims I ventured to urge on this association eleven years ago, had been left to the local lighting companies, I fear it would not have made much headway. The 327 and other companies with day circuits do an enormous amount of power work, but a careful analysis of somewhat incomplete data would lead one to believe that the isolated plants are the real backbone of the electric power industry today. Why this should be so, it is difficult to explain, except on the hypothesis that station current, when obtainable, often costs too much, and is generally not obtainable. It will, I trust, be understood that this paper is not offered in any wise as a criticism of central station management, but simply a presentation of the puzzling facts that confront students of the situation. No one can know the inwardness of the problem so well as the central station manager himself, and no one can be more deeply interested than he in dealing with it wisely and well.

It might be said that, in a general survey, four new factors have presented themselves in the last ten years for the consideration and approval of the central station manager. These are motors, alternating current supply, storage batteries and electric heating. The alternating current is, for most stations, still restricted to night-work, and will be, probably, until more single-phase motors of successful character are on the market. This form of current has given such a tremendous stimulus to lighting that it deserves a wider range of usefulness, so that, in time, alternating-current stations may compete with direct-current stations as earners of dividend.

Allusion has already been made incidentally to motor work. What is possible in this direction is best judged from what the large stations do. Of course, this is in some respects an erroneous guide, but in the same manner as great men are exemplars for those of less heroic bulk, so the large stations indicate the actual possibilities even for a lower plane of execution. The following are figures of a large western central station, showing the horse-power of motors connected to the circuits, and the percentage that the power consumption bears to the total output. The data come down to March 31, 1897.

LOW TENSION.

Power connected April 24, 1897,	5,396 horse-power
Power, per cent., of the total output,	23.1 per cent.

HIGH TENSION.

Five hundred-volt power connected April 24, 1897, ...	1,566 horse-power
Power, per cent., of high tension output,	21.4 per cent.

ALL SYSTEMS.

Power connected April 24, 1897.	6,962 horse-power
Power, per cent., of the total switch-board output, ...	22.8 per cent.

Another example is to be found nearer home, in the work of the New York Edison Company. The motors to which that company supplied circuit from its distributing mains represented, on January 1, 1896, a total installation of 11,640 horse-power. On January 1, 1897, the motors connected were the equivalent of 15,930 horse-power, an increase of motors connected in a single year of 4,290 horse-power, or thirty-six per cent. This does not include an installation equivalent to 1,142 horse-power in motors, to which current is supplied from the New York Edison station during minimum hours, or for emergency and break-down connections. It will be seen that this brings the total horse-power in motors connected to the company's mains up to 17,072 horse-power. The average size of these motors is from three and one-half to four horse-power. Of the total motors connected it is estimated that about 5,000 horse-power, equivalent, is installed in connection with direct electric elevators and grip hoists.

In order that the idea should not go abroad that the big companies are monopolizing the power business, but that it is open to all, I would mention that in Massachusetts, where there is only one large city, no fewer than eight companies out of fifty-eight are supplying power from their arc circuits; eighteen from incandescent circuits, and twenty-nine from independent power circuits; the total being about 14,000 horse-power of motors on the circuits. The asking rate for kilowatt hour averages about twenty cents, but runs down as low as ten cents.

Turning next to storage batteries, it is not my intention to agitate old discussions, but simply to give a few figures, which would go to show that the batteries may do more than perform the Alpine feat of taking care of the peak of the load. There are at the present time in America—I blush to give the figures—only fifteen central stations using batteries, with a total capacity of 25,000 horse-power hours output. Four other stations are being equipped. I hope devoutly that some future chronicler will be able to report that 1,500 stations are equipped with batteries, and that by their reservoir capacity they have answered in the affirmatiue the question whether their life was worth living. What batteries can do is best exemplified by the Duane street station of the New York Edison Company, one of the biggest stations in the world, with an engine and generator capacity of 20,000 horse-power. The load, during minimum hours, I am told by Mr. J. W. Lieb, Jr., the general manager of the company, is such that it can be supplied in that period from the storage battery annex at the Bowling Green Building in the southern tip of the tongue of Manhattan Island; or from the storage-battery plant at the Twelfth street station over the feeder tie lines. The supply of stored current from the batteries in the annex stations during the minimum hours enables the big Duane street station to be shut down every night from 10.30 P. M. to 5 A. M.—nearly seven hours; and on Sunday the operation of the generating machinery at Duane street is limited to one watch. I do not hold a brief for storage batteries, but in view of such facts it is hardly possible to do other than press their claims on the attention of central station managers.

(To be continued.)

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—DIFFERENCE BETWEEN MAGNETISM AND ELECTRICITY.

Philadelphia, June 30, 1897.

Electrical Age Pub. Co.

Dear Sirs: A student of electrics is frequently much puzzled over the difference and similarity existing between electrical and magnetic phenomena. As a novice I beg to state this, that there is to my knowledge, only a few facts worth weighing in favor of a difference, both seeming to me to be parallel effects productive of a certain series of results that vary greatly from each other. I have heard of both being ether strains. Without having impressed upon my mind a clear comprehension of the real nature of the strain, a few words from the Inquiry Column would undoubtedly assist me.

Yours truly, L. M. Duffy.

(A.)—Consult Fleming's Alternate Current Transformer; What is Electricity, by Trowbridge; and The Magnetic Circuit, by H. DuBois.

We dare not begin discussing the difference between electricity and magnetism in these pages; they are not large enough for the purpose. The above references will justify our statement in any case.

(Q.)—GAS ENGINE ELECTRIC LIGHTING.

New York, June 29, 1897.

Electrical Age.

Dear Sirs: Can you tell me whether it will pay to install a gas engine and dynamo to run fifty lights? If so, what figures can you supply to substantiate the claim? I have a large basement and every convenience for the electric light plant I speak of. Kindly advise.

Yours truly, J. Simmons.

(A.)—A fifty-light plant will pay with an economical gas engine. There are many standard makes on the market that will do the work. The Electrical Age in its October 17, 1896, issue gave the particulars of a plant of this description. If the gas engine you buy can be depended upon for its regulation, lamps of very low wattage may be used. It might be well for you to know that fifty 16-c. p. lamps can be supplied with

one watt lamps,
two " "
three " "
four " "

the power consumed in each case being

800 watts,	.	1 h. p.
1600 "	.	$2\frac{1}{7}$ "
2400 "	.	$3\frac{1}{5}$ "
3200 "	.	$4\frac{1}{4}$ "

The above figures depend upon the lamps for their veracity. Close regulation will allow 2 or 2.5 watt lamps to be safely used.

(Q.)—REQUISITES OF COIL WINDING.

Brooklyn, June 25, 1897.

Electrical Age Publishing Co.

Dear Sirs: In building a dynamo, what is the first object kept in mind during its construction and design? I feel assured a few words from the Inquiry Column will clear away my difficulties. Yours respectfully,

K. Livingstone.

(A.)—Keep down the temperature of the armature and field by providing the proper radiating surface on each. This is secured by allowing for each watt wasted from 1½ to 2½ square inches of outer surface. Keeping the resistance and current within proper bounds will also assist you in your work.

Observe these rules, the current must not exceed

$$\left\{\begin{array}{l} d^2 = \text{circular mils} \\ c = \text{amperes} \end{array}\right\} \qquad c = \frac{d^2}{1024}$$

in the field coils.

$$\left\{\begin{array}{l} X = \text{mean length of a turn} \\ N = \text{ampere turns} \\ E = \text{volts} \end{array}\right\} \qquad d^2 = \frac{X \times N}{1.106 \times E}$$

POSSIBLE CONTRACTS.

Walker, Minn.—The Village Clerk may give information concerning establishment of electric-light plant.

Carey, Ohio.—A new electric-light plant will be immediately established. About $10,000 worth of bonds will be issued for that purpose.

St. Peter, Minn.—An electric-light plant is to be put in the Rochester Hospital.

Toledo, Ohio.—The Hotel Madison will put in a complete electric-light plant.

Fitzgerald, Ga.—Address the Mayor concerning erection of an electric-light plant.

Providence, Ky.—An electric-light plant will shortly be established.

TELEPHONE NOTES.

Tarboro, N. C.—The Tarboro Telephone & Telegraph Co. has been incorporated by George H. Holderness, James G. Mehegan, W. Newton Smith, Job Cobb, J. W. B. Battle, A. M. Fairley, and W. H. Powell, Jr.

Pulaski, Va.—Laughon & Hull have been granted franchise for the erection of a telephone exchange, by the City Council.

Gower, Mo.—The Seward Telephone Co. has been incorporated by A. J. Hitt, E. A. Bunter, D. P. Cornish, and others. Capital stock, $7,000.

Savannah, Ga.—The Waycross Telephone Co., of Waycross, Ga., has petitioned the City Council for franchise to construct long-distance telephone system to Savannah.

Meridian, Miss.—The East Mississippi Telephone Co. has been incorporated by J. E. Evans, Wm. Henry, V. L. Terrell, and others, to construct telephone lines, etc. Capital stock, $50,000.

Roanoke, Va.—The Interstate Telephone and Telegraph Co. have completed new telephone line from Roanoke to Fincastle, a distance of fifteen miles, and it will be in operation in a few days.

Festus, W. Va.—The Fairmont & Western Telephone Co. has been incorporated by J. F. Martin, S. J. Sturm, R. B. Parrish, and others; for constructing and operating lines of telephone from Fairmont.

Benton, Tenn.—The East Tennessee Telephone Co., Chattanooga, will construct a telephone system at Benton.

The Star Spangled Banner is the title of a beautiful souvenir given out by the American Electrical Works of Providence, R. I. A silken flag having thirteen stars and stripes rises proudly above the bursting shells that threaten a time honored fort. As an emblem of progress no better selection could have been made by the American Electrical Works. It truly indicates their own free spirit of liberality and independence.

The Electrical Age.

Vol. XX., No. 2 NEW YORK, JULY 10, 1897. Whole No. 530

Figure 1.

THE DENNIS FLUOROMETER.

By John Dennis, Telegraph Editor of the *Democrat and Chronicle*, Rochester, N. Y.

The object of the fluorometer, in its use in connection with the Roentgen energy, is to enable the surgeon or physician to ascertain, with exactness, the position which any foreign substance which can be seen on the field of the fluoroscope, occupies in the human body or limb. To accomplish this result it provides:

First.—A position of the body or limb, by which what may be called, for want of a more precise term, a perfected shadow, on the field of the fluoroscope or, in the other case, on the sensitive plate, at the same time giving the surgeon data which will not only enable him to make his measurements, but to reproduce the exact position of the body or limb, for purposes of exploration, or operation. In other words: it eliminates the element of distortion in the shadow caused by the changing position of the body or the limb.

Second.—The fluorometer eliminates the distortion resulting from the radiation of the force or energy known as the X or Roentgen ray.

Third.—The distortion caused by the position of the subject and the distortion caused by the radiation of the energy, having been eliminated, the fluorometer provides an accurate cross-section of the body or limb, and supplies an absolutely correct right-angle, at the intersection of the lines of which the foreign object will be found in the body or limb.

In its last analysis, the fluorometer consists, essentially, in a set of carefully designed metallic angle pieces which conform generally to the shape of the body or limb, and which, in their use in connection with the X rays, are susceptible of being squared with a simple and conveniently-adjustable table. The patient being laid on the table and a fluorometer appliance adjusted, as shown in the accompanying engravings, the fluorometer is brought with the body into the parallelism of the rays; that is, when the proper position of the cross-section is obtained, the two arms of the fluorometer will present the characteristic single shadow on the field of the fluoroscope.

Attachable to the arms of the fluorometer are two pins or sights. By means of these sights, the foreign object having been brought in line with them and the proper adjustment having been made, a correct line is produced, with the sights and foreign object coincident.

By means of a metallic grating, of inch mesh, which is placed adjacent to one side of the body and consequently one side of the fluorometer, exact measurements can be made with the eye from the base line of the fluorometer and from points on the circumference of the body, to the foreign object.

Then, without moving the body or the fluorometer, the Crookes tube is placed directly over the subject for the purpose of obtaining the vertical line. By means of an adjustable cross-piece, which is placed over the arms of the fluorometer, exactly the same results in a vertical way are obtained by viewing the subject from beneath, the same condition of parallelism having been produced, another set of pins having been placed in position.

It will be seen at once, that while the first operation locates the foreign object on an exact cross-section, the second observation shows the exact position occupied by the foreign object in that section.

All the elements of distortion having been eliminated, the foreign body will necessarily be at the intersection of the two lines of right angle.

In practice, the surgeon indicates the first cross-section obtained by a line of India-ink or iodine on the body, and is thus enabled to establish the position of the object by measurements from points on the exterior of the subject, with as much exactness as if the body or limb were actually severed at the first cross-section and presented to view.

If it is desirable to preserve a record of the observa-

Application of Apparatus to the Head.

tions, all that is necessary is to produce a fluorograph, by substituting a sensitive plate for the field of the fluoroscope, back of the grating, and make the necessary exposure.

Wilmington, N. C.—The Wilmington Street-Railway

Figure 2.

Co. has been awarded contract for lighting the city. A resolution was adopted looking to the city owning its lighting, water and sewerage system.

LECTURE ON THE DIRECT CONVERSION OF ELECTRICITY INTO HEAT.

(Concluded from page 415.)

I do not think my theoretical opinions would be of any value; I have very few. My work is entirely practical. I base my entire life's work on the inch by inch or sixteenth of an inch by sixteenth of an inch of daily progress which I can make in the successful solution of a problem; and theory plays little part in the undertaking. As to the future of these machines, as to how large they can be made; are the machines I show the limit of thermo-electric direct converters, I say it is not the limit at all. Thermo-electricity has splendid possibilities before it, so long as it is considered as being a means to the direct conversion of heat. Perhaps my meaning is not clear. I will explain—thermo-electricity as thermo-electricity in my opinion has reached and did reach its limit a long time ago. The thermo-electric element reached its limit almost at the time of Seebeck, the couple from an E.M.F. standpoint having been but little improved. The use of thermo-electricity for the direct conversion of heat is simply a mechanical problem, of which one practical demonstration is shown you to-night. It is not the problem of the couple; it is the problem of the utilization of the power which was discovered. Away back, years ago, this discovery was made. I can take that machine, working with that two-and-a-half feet of gas, and by a careful utilization of that gas, by the skill which I possess, I can show you that same output for less than one foot of gas. If I can show you that, you quite readily think, if you stop to figure out the problem, that I could compete with almost any other form of electrical production. I can do it, as the result of my personal skill. You cannot regulate the machine so that anyone can do it. You cannot spend your time trying to save a foot of gas. Gas is not the problem in this small machine. When we come to the larger output it does. Speaking of the larger output, if I were to use gas, of course, all reductions that I could make in the gas output would be of tremendous importance; but I do not believe gas is going to be used in the larger machines. I have made larger machines and have seen in them indications of a considerable efficiency, one worthy of serious consideration. I have had machines built exactly on the lines of this, only larger, which produced five 16 c.-p. lamps of full photometric value, for one cent per hour. What are my ideas in regard to the future of that as a large device? I never believe in trying to improve thermo-electric couples, except mechanically. My idea on the future of the device is to produce an efficient mechanical working device with a very high amperage output and low voltage. I do not attempt to attain extremely high voltage in the device; I do not believe it pays. In all my experiments on thermo-electricity I give ordinarily no attention to the thermo-electrical efficiency of a couple, and can tell you nothing whatever about it. I never paid the slightest attention to it. I take this device as it is, overcoming its mechanical defects, and that is sufficient; you are not going to have anything in the immediate future which can compete with it. I am not taking up the problem of the production of a high voltage couple. I see nothing in it. I aim to produce a very high amperage output in the larger devices and use some transformer systems to transform the low voltage into higher voltage, utilizing the amperage output instead of attempting to get the voltage. If larger machines are made, the field they will occupy you can best judge.

The water in the machine has very little to do with it in the way I think you judge it does—that the cooler the backs and the hotter the fronts, the greater the output. I do not find that at all. I am a disbeliever in a great many things which have been accepted in connection with thermo-electrics. I have never found any such condition as the one I have just stated, that the hotter you make the hot junction, and the cooler you make the cool junction, the greater the electrical efficiency. I do not believe it. I say if you get the cool junction too cool you reduce the efficiency of the hot junction. We have to be careful in thermo-electrics not to get the device too cool. A temperature on the outside between 60 and 185, only reduces in a five volt machine the electromotive force a few tenths of a volt, and that is not due to the thermo-electric effect, but to the increased internal resistance which of necessity the excess of heat produces and causes a natural drop, from the fact that there is no cooling on the back here (illustrating) and the hotter it gets there, the greater the internal resistance. I have tried it with freezing water, and, thinking possibly you would like to try, have had this ice water provided; you can put on ice water and see if you can increase the output. I do not think you will. Then you are at liberty to take a machine and run it at a high water temperature and see if you can decrease it. I do not think you will, conceding the fact of the few degrees of difference due to increased internal resistance. I believe we can gain time now by having a discussion on the subject. I think the problem before us is a practical one, and we have one form of its solution before us. As practical electrical men, I do not think you want to sit hear waiting, Micawber like, for something to turn up. This has turned up. It is here. I wish you to examine and test the apparatus in any way that you desire; it is an ordinary, practical device, which is on the market, and I take pleasure in introducing it for the first time. (Applause.)

UNDERGROUND RAILWAYS.

The most recent addition to the system of underground railways with which London is provided and the most important of all the present undertakings of a similar character in the world—the Central London Railway (underground)—has an especial interest for Americans. This is due to the fact that the entire system of electrical equipment will be American. With the exception of the elevators the entire electrical contract has been assumed by the British Thomson-Houston Co., Ltd., representing in Great Britain the General Electric Co. of Schenectady, while the elevator contract has been secured by Mr. Frank J. Sprague, of New York.

The road, laid in two deep subway tunnels, driven by the Greathead Shield, stretches from Liverpool Street beneath the station of the Great Eastern Railway Co., near Broad street, the city terminus of the North London Railway and the Bishopgate street station of the Metropolitan Underground Railway, through the very centre of the great commercial district of the city, and runs due West under Holborn, High Holborn, Oxford street and past Hyde Park as far as the generating station located at the terminus at Shepard's Bush. It follows the line of greatest traffic in London. The road will receive passengers from the great underground central depot, now in course of construction by the Central Railway Co. between the Bank of England and the Royal Exchange, passengers brought in by the main lines of the London and Northwestern, Midland and London and Southwestern Railroads. It is especially at this point in the city that crossing is a perilous task, and the railroad company is now engaged in constructing a series of subways immediately below the surface for the convenience of pedestrians and as approaches to its own station below. From this central depot will radiate not less than five underground tunnels, some eighty-five feet below the surface, each feeding a separate and equally popular district of the great agglomeration known as London.

The construction of the road itself has been carried out by the Electric Traction Company, which has also financed it. It is this company that has made the contracts with the British Thomson-Houston Company, and which will turn over the road fully equipped and in working order to the Central London Underground Railway Co. ready for operation.

It was not until three years after the necessary parliamentary act was passed in 1893, that the actual work of building this road could be undertaken. Vertical shafts were driven at six different points to a depth of between 60 feet and 70 feet and the tunnelling was begun in four tunnels at once, two running in each direction from the shaft. At each of the stations were driven two shafts 23 feet in diameter and 87 feet deep and one 18 feet in diameter and 76 feet deep—the two former containing two ingress and two exit elevators and the smaller two spiral stairways, one for ascending the other for descending passengers. The shafts are built up of cast iron plates 1⅛-inch thick and 4½-inch in the flanges. All crevices in the back of the plates are filled with hydraulic lime grout injected under pressure.

The glazed white brick passages leading from the bottom of the shafts to the stations are 8 feet 3 inches wide on the entrance side. On the exit side, where crowds might collect in front of the elevators, they are 13 feet wide.

At the stations the widened tunnel is 21 feet in diameter and 375 feet long. The main tunnels are each 11 feet 6 inches in diameter and are practically steel tubes driven forward through the clay. The plates used to line these tunnels are ⅞-inch thick with flanges 4 inches deep. The shield for driving the small tunnels was 12 feet 8 inches in diameter and was pushed forward by six hydraulic rams giving a pressure of 230 tons. For driving the station tunnels the shield was 23 feet 8 inches in diameter and was pushed forward by 22 rams giving a pressure of 840 tons.

Each tunnel will contain one track, one tunnel carrying the East bound trains, the other, the West bound.

In laying the roadbed the best modern steam railway practice has been followed. The steel rails weigh 100 pounds to the yard and are laid upon heavy cross ties. The system of contact will be the third rail, with the contact rail placed between the service rails of the track and insulated. The conductors will be fed at intervals from a copper feeder cable. This feeding will be controlled from the signal boxes and the operator will be able to cut out any section of the line when necessary. This method of contact is similar to that employed so successfully by the General Electric Co. in the installations on the East Weymouth, Nantasket Beach and Berlin-Hartford branches of the New York, New Haven and Hartford Railroad. The method of traction, however, will differ radically from that used on the branches above mentioned. Instead of passenger-carrying motor cars, with the motors mounted on the forward axle, locomotives similar in appearance to those used on the Belt Line Tunnel service of the Baltimore and Ohio will be used to haul the trains. The reason for this lies in the fact that the tunnel is only 11½ feet in diameter, and that the bottom of the tunnel must accommodate the roadbed. This materially reduces the clearance. The motors require to be suspended between 30-inch wheels, at least, to give the necessary clearance between them and the ground, and this fact has brought about the locomotive in place of the passenger motor car.

The use of the sub-station method of electrical distribution insures a uniform pressure throughout the entire length of the line. Fluctuation, therefore, which would materially interfere with the lighting of the station and trains, is reduced to a minimum.

The limit of variation fixed by the Board of Trade, to the rules of which department all electrical installations in Great Britain must accord, is ten volts. With the method adopted in this installation, the variation in pressure will not exceed three volts.

The locomotives will number 35. Each will consist of a sheet iron cab containing the controller, indicating instruments, air brake, pump and controller, sand boxes, etc., mounted upon a locomotive truck. The motors have been especially designed for this work. They are of the gearless type and, according to the new system of motor nomenclature adopted by the General Electric Company, are known as the G. E. 56. Four of these motors will be mounted on each locomotive, one to each axle, the total draw-bar pull being 14,000 pounds. The controllers will be of the series-parallel type arranged for four motors. Each controller will embody the magnetic blowout principle.

The weight of each locomotive complete will be thirty-five tons of 2240 pounds. The trains will be made up of seven cars weighing when loaded 105 tons additional, giving a total train weight of 140 long tons. The seating capacity is calculated at 336 persons.

Access to and exit from the stations will be effected by means of powerful high speed elevators. These will also be of American manufacture and will be built by the Sprague Electric Elevator Co., of New York. The elevators will be forty-nine in number, each with a capacity of 15,000 pounds, or about 100 passengers per trip. The speed of elevation will be about 150 feet per minute. These elevators will be of the double drum type similar to those built for the War Department at Washington but of much higher carrying capacity.

Underground Lines.

It is estimated that the number of passengers that this road will carry per annum is 48,000,000, which at an average fare of four cents, will give an ample return to ensure dividends upon the capital stock.

RECENT PROGRESS IN ARC LIGHTING.

BY ELIHU THOMSON.

(Continued from page 10.)

There is neither time nor space to devote to the details of arc-lamp mechanism for constant-current circuits, though much might be said in regard to the proportions that should be given to the parts, the character of pull to be secured in the magnets controlling the lamp, the securing in clutch lamps of a slow or "sneak" feed (as it is sometimes expressively, if not elegantly termed) for the carbons, the cut-out switch, etc., in both differential and shunt-magnet-control mechanism. There are two points, however, which may be touched upon in this connection, as tending to secure the best results. First, the variation of pull for a given variation of current in the magnets controlling the lamp should be as great as possible. Second, there should be as little as possible variation in the force required to feed or recover from feeding. The force required to be imparted to the mechanism to release the clutch, detent or escapement should be as little as possible, and but a very small fraction of the total magnetic force in a differential or shunt-feeding system. Otherwise, the lamp will not be a sensitive feeder. Lamps are frequently found which form their arcs well enough, but hang up or delay at the feeding p int, the action of feeding being preceded by quite a rise of potential between the carbons at the arc. This is owing to too much force being required to unclutch or release the mechanism. A good lamp should feed on a variation of three to five volts, and, with certain constructions, a feeding action within one-half to three-quarters of a volt variation for a 45-volt arc can be readily attained.

Passing now to the consideration of the use of pulsating currents in arc lighting, it may be said that at present little or nothing has been done commercially in the United States in the use of such currents. The subject becomes one of importance in connection with what are known as rectifiers. These are machines that take an alternating current and commute the waves, or rectify them, so that the flow of current is in the same direction always, though rising from zero to a maximum for every alternation in an alternating current. The more or less near approach to continuity of current will depend upon the shape of the wave rectified. A rectangular wave, properly rectified, would, as in Figure 3, give a true continuous current. Other forms of wave give less continuity, depending on the sharpness of the individual wave peaks, *c*, *d*, Figure 4. The character of arc produced by the rectified current resembles closely that of the continuous-current arc, in that the crater in the positive carbon is present, and the negative tends to point itself. There is, however, a strong note or sound evolved from the arc, depending for its pitch upon the periodicity or frequency of the alternating current. The inductional effects of the pulsating currents in lines upon neighboring lines will, of course, resemble those of alternating currents, though less musical than the latter when a sound results, as in a telephone. In order to make it easy to commute or rectify such a high potential of alternating current as would be needed to feed, say, a series of forty to fifty arc lamps with pulsating current, certain conditions are very desirable. One of these is that the current to be rectified should be of constant value, though alternating. The writer showed, nearly ten years ago, how a constant-current transformer could be made, using primary current at constant potential to obtain secondary constant current. One of the ways was to so mount a secondary coil, with relation to its primary, that repulsion might be exerted between them and so move one away from the other when a tendency to increase of current in the secondary took place. This method was found to be highly efficient, and was embodied in a number of forms of apparatus, some of which were employed to feed constant current to arc lamps in series. In this case lamps may be cut out and the secondary coil even short-circuited, while the current in it remains practically constant.

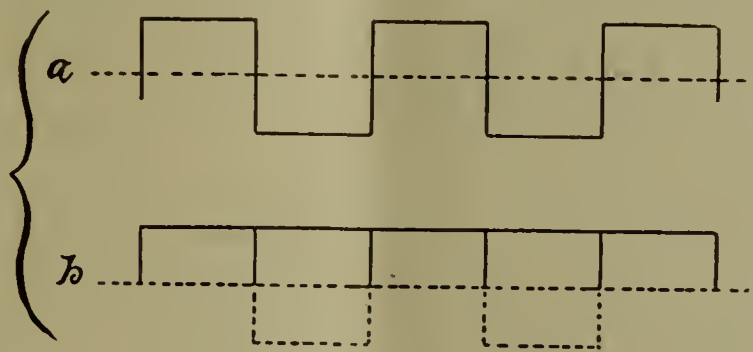


FIG. 3.

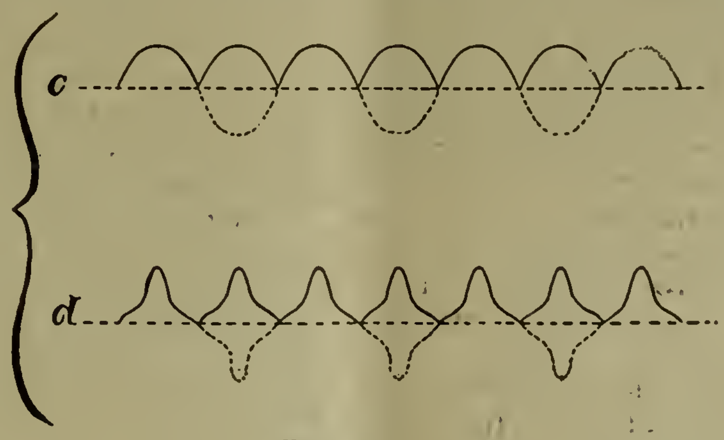


FIG. 4.

When such a current is rectified, the same characters are preserved, and the regulation is all that could be desired for all loads within the capacity of the apparatus. The efficiency of transformation is also quite high, and the apparatus is not of excessive size for a given output. A simple commutator, revolved by a properly constructed synchronous motor, with its arc-machine brushes and air-blast, complete the machine. By the use of the air-blast a single commutator, as in the Thomson-Houston arc machines, serves to rectify a single-alternating current wave of sufficient potential for up to fifty or more lights in a series. Without the air-blast, flashing would be likely to be serious at fifteen to twenty lamps in a series.

The above relates to the rectification of a single-phase current. When, however, two-phase or three-phase currents are to be rectified, there will be at least two or three constant-current transformers, one for each phase, and the secondary current may be combined through commutators resembling those of the Brush arc dynamo for the two-phase, and the Thomson-Houston for the three-phase. In such cases the resulting rectified current is much more nearly a steady or smooth current, and not so much of a pulsating character. This is, of course, owing to the relation of the phases being such as to cover each other's zeros or to overlap. Under proper working conditions there should be a certain field for the use of rectifiers in the United States, as well as in England, where Ferranti has for some time past had some of them in use. It is difficult to adapt a rectifier to periodicities of as high as 125 per second, but with sixty periods the problem is comparatively easy. The use of rectifiers has the one great advantage of permitting the generation of current in a station to be by means of large direct-connected dynamos, a portion of the output of which is used in the ordinary way to feed lights, etc., through the usual constant-potential transformers, while another portion, feeding rectifiers, supplies the arc lamps of the system instead of special arc dynamos, while, if needed, the whole capacity of the generator may be utilized for one or other kind of load, as desired.

The arc lamps worked by rectifiers are like continuous-current arcs in giving the downward distribution of light from the positive crater, a feature of great value in street lighting. There is also complete regulation—such that lights may be cut out *ad libitum* by shunting, while the other lights remain unaffected. Furthermore the efficiency of the rectifier is high, and may easily be made over ninety per cent.

Two or more arc lamps are now often connected in a branch across constant-potential mains or supply lines. Thus on 110-volt circuits, two lamps using about forty-three to forty-five volts each, and with a proper choking resistance, may be found in the branch. On 220 volts there may be four lamps in a series, and on railway circuits of between 500 and 600 volts nine to eleven lamps may be found connected, with in each case a proper resistance. The inevitable use of a choking resistance in series, with arc lamps run from constant-potential lines, is now pretty generally understood. Without it the current in the lamp branch is unstable, owing to the fact that the resistance of an arc is not a definite quantity, but varies for a definite length of arc in inverse ratio to the current flowing, or even falls more rapidly than the current increases, or vice versa.

Therefore, the current strength of the arc lamps in this case is not to be regulated or controlled by adjustments of the lamps alone, but by means of the variation of the choking resistance in addition. The object in each case is to set the value of the resistance at such an amount as will, when the arc lamps are adjusted to feed at, say, forty-four volts, with good cored carbon, give the desired value of current and stability of current. The quality and character of the carbons used has a decided effect on the results as to steadiness and uniformity in constant-potential arc work. Hence, a good cored positive and solid negative are desirable. The writer has seen no more perfect result in arc lighting than can be obtained on constant potentials, with good lamps and carbons burning open arcs. Much was said, and some considerable amount written, a few years ago about lamps in series on constant potential robbing each other, so that when one was bright the other was dim, and the reverse. This phenomenon does not occur with properly constructed lamps, which are sufficiently sensitive feeders. Lamps for this service, capable of feeding within one volt variation at the arc, are in use, and the steadiness and reliability obtainable is all that can be desired.

In regard to "inclosed arc lamps," it may be said that they are beginning to be applied in a series of five upon circuits of 500 volts potential, but the consideration of this type of arc will be deferred till later, when the subject of single lamps on constant potentials is discussed.

The distribution of current for arc lighting at constant potentials has undoubted advantages, one of which is the relatively low tension and absence of danger. Another is the facility of installation along with incandescent lights, and ease in metering the supply. The loss of energy in the distribution may, at full load of lines and moderate distances from the supply station, be, say, ten per cent. or more, chargeable chiefly to feeder drop, and about fifteen to twenty per cent. in dead resistance in the lamp branch. We may take, then, twenty-five per cent. as an average loss in reaching the lamps. This loss, which is much greater than the percentage of loss on the series system, is yet largely, if not wholly, made up by the superior efficiency of the constant-potential, low pressure generators of large capacity over that of arc machines of relatively smaller output, and by the higher engine efficiency which may readily be attained in driving large generators, especially when working with economical loads. It must not be forgotten, however, that for equally good results a better and more expensive carbon will be required for constant-potential work than for plain series arc lighting. These observations relate, of course, to ordinary open arcs with full supply of air reaching the hot ends of the carbons. The conditions existing with long-burning lamps or inclosed arcs will be alluded to later.

One serious objection to the arrangement of lamps in series between constant potential mains, especially those of 220 to 500 volts, is the inflexibility, or inability to cut off some lamps in a branch without substitution of equivalent resistance, which substitution, of course, means that the same watts are consumed whether the lights burn or not. We lose the advantage of the constant-current system, which enables us to shunt lamps and save power, and also that of the simple multiple or parallel system at constant potentials, in which each lamp is in its individual branch circuit. Open-circuiting the branch extinguishes the light and saves power. With alternating current at constant potential there is greater flexibility, but, unfortunately, no alternating current arc lamp is likely to equal in its effects lamps making use of continuous currents or undirectional currents.

There are two ways in which alternating currents may be used to work arc lights in series. We may either take a constant-potential system, such as one with main lines at 1,000 volts, and connect between them a series of arc lamps at about thirty volts each and about thirty-five lamps, or we may transform so as to feed the lamps in series with a current of constant value, or with a current which does not vary more than a given per cent. from light to full load—fifteen per cent. for example. In the former arrangement some provision must be made to allow lamps to be extinguished without breaking the circuit, and this cannot be done by shunting, unless equivalent resistance be substituted, for the shunting of a lamp or lamps in a series would result at once in a great increase of current in the others and a serious departure from normal working.

(To be continued.)

A contract for the transmission of power of the river running through the Santa Ana Canyon to Los Angeles and Pasadena, a distance of eighty miles, has been concluded between the Southern California Power Co. and the General Electric Co. The amount of power to be transmitted at first is four thousand horse-power. The station will be located in the Santa Ana Canyon, twelve miles from Redlands and about eighty miles from the towns in which the electric power will be utilized.

(Continued on Page 24.)

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CONTENTS.

DEVELOPMENTS IN THE WEST.

We have lost that picturesque vision which rose like a mirage from the high hills and wide-stretching plains of the West; it has passed, with its prairie schooners, bands of whooping indians and devil-may-care cowboys, into tradition and ancient history. The West, in accepting civilization, has undergone enchantment and transformation. It is no longer wild and woolly, but a great centre of industries, healthy development and potential wealth. Towns have sprung up from the wilderness and mining centres have become populous cities. And in viewing this change we cannot forget our own maturing science, and see, with pride, its influence upon the welfare of many prominent western towns. To such an extent has this influence been felt that, in the Trans-Mississippi exposition a special department has been devoted to its interests, in charge of Prof. R. B. Owens, a Columbia College graduate of '91; at present the head of the electrical and steam engineering course at Nebraska University. At a time well within the memory of some of our friends not past the meridian of life, a trip to Nebraska, or any other distant western state, was as worthy of note as a voyage to the Kamtchatka peninsula. Not only has transit to this point been rendered easy, but all the evidences of busy city life, educational resources and modern industry are there as though they had always been, and this great Trans-Mississippi exposition will be like a great bridge of enlightenment to the conservative East, bringing both into closer communion for mutual good. Those that live in some of our old fashioned eastern cities, on attending this exposition, will realize in surprise how great a spirit of advancement is animating these distant centres; how powerful the incentive that within half a century built up these great monuments to western civilization and, lastly, what force of character, hardihood, vigor and intelligence were required to lay the foundations of a city in such inimical surroundings. We should congratulate the West for their efforts in strengthening this mighty brotherhood that reaches from ocean to ocean.

A PERTH AMBOY ELECTROLYTIC PLANT.

It will probably be interesting to our readers to realize that one of the latest and most complete electrolytic refining plants erected is to be found at Perth Amboy, N. J. This great plant has an annual capacity of nearly ten thousand of copper and thirty thousand ounces of silver. It may be understood that commercial copper such as that employed in electrical work must be of a very high degree of purity, and it has therefore become advisable to refine the crude copper by electro-deposition. During the last two years nearly one-third of the entire copper output of the United States was refined by electrical means, and today more than one-half of the entire copper output is thus refined. This method has become so necessary from an economical standpoint that all the old plants have been transformed into electric power stations, the energy of the current being used to do that which with the most expensive machinery was only half-done in the past. The copper refined at Perth Amboy holds a large percentage of gold and silver, which repays all the efforts they have made to obtain pure copper by this process. It pays the expenses of refining, in fact, of the entire running of the plant, and therefore turns over the pure copper in reality as clear profit. Possibly one of the best fields of engineering to enter into is that of electro-metallurgy. The pioneers in this branch of work have become wealthy men. To give an idea how valuable this process is to the proprietors of a copper mine we will say that the copper refined at Perth Amboy sometimes carries six hundred ounces of silver and four ounces of gold per ton. Ever since Tubal Cain handled metals copper-mine owners have been throwing away this additional wealth. Now it is the only thing that makes them rich, and the great copper industries in the West owe their present prosperity entirely to the introduction of electrolytic methods.

RECIPROCITY OF FEELING.

During the past week some kind friends, in an outburst of heartbreaking kindness, said that Mr. W. T. Hunt of The Electrical Age had connected himself with a rival contemporary. Mr. Hunt wishes it distinctly understood that he subdued the ambition of the publisher of this rival publication to enjoin him, by law, from soliciting advertisements for The Electrical Age. A great many in the trade know that W. J. Johnston sneaked into court in September, 1891, without either Mr. Hunt's or his lawyer's knowledge, and got an injunction restraining Mr. Hunt from soliciting advertisements for The Electrical Age. A great many also know how the trade would not give Mr. Hunt advertisements, fearing that they would be drawn into this suit. After two months of hard work Mr. Hunt finally got before the same judge who granted the injunction mentioned above. We do not have to repeat what the judge said; he dismissed the injunction, which was then appealed twice and both times set aside. When Mr. Hunt's name is seen associated with W. J. Johnston's, it can be understood that Mr. Hunt has received the $10,000.00 he demanded for his stock in 1889, when he resigned his position with the W. J. Johnston Company.

The water will be taken from the river through canal, flume and tunnel along the side of the canyon. Here it will be led into a pipe line 2,200 feet long, giving what will be equivalent to a vertical fall in the water of 750 feet.

The wheels will be of the impact type, directly connected to the generators, of which there will be four each of 750-kilowatt (1,000 H. P.) capacity. The maximum line protection will be 33,000 volts, to which potential the initial voltage will be raised by twelve 250 K. W. step-up transformers.

This transmission will be the longest commercial electrical power transmission as yet undertaken, as well as that using the highest voltage. At present the longest is that transmitting the power of the waters of the Ogden Canyon in Utah to Salt Lake City, a distance of 36 miles. The Los Angeles transmission will be over twice that distance, and three times the longest distance yet tried with the power of Niagara, which to date has only been transmitted to Buffalo, a distance of 26 miles.

Two models in a recent exhibit represent Page's Farmer's electric motors. The first of these was brought out in 1857, and attained a speed of nineteen miles an hour on the B. & O. track between Washington and Bladensburg, Md. In 1857 Farmer ran his machine on a track laid around a hall for the instructive benefit of those to whom he was lecturing on electricity. It was evidently not a speed-maker. At the end of the motor shaft was a cog-wheel which engages another of its kind at the upper end of a vertical rod that carries at its lower end a similar wheel fitting into the cogs of the one on the rail.

A telephone invented by John Phillipp Reis in 1860, and made in Paris, is seen in the electrical collection. There have been many changes made in the telephone, among them those which concern the transmitter. In the first instrument of this kind the transmitter was made in the shape of a human ear; but, though altered in shape, the principle remains the same.

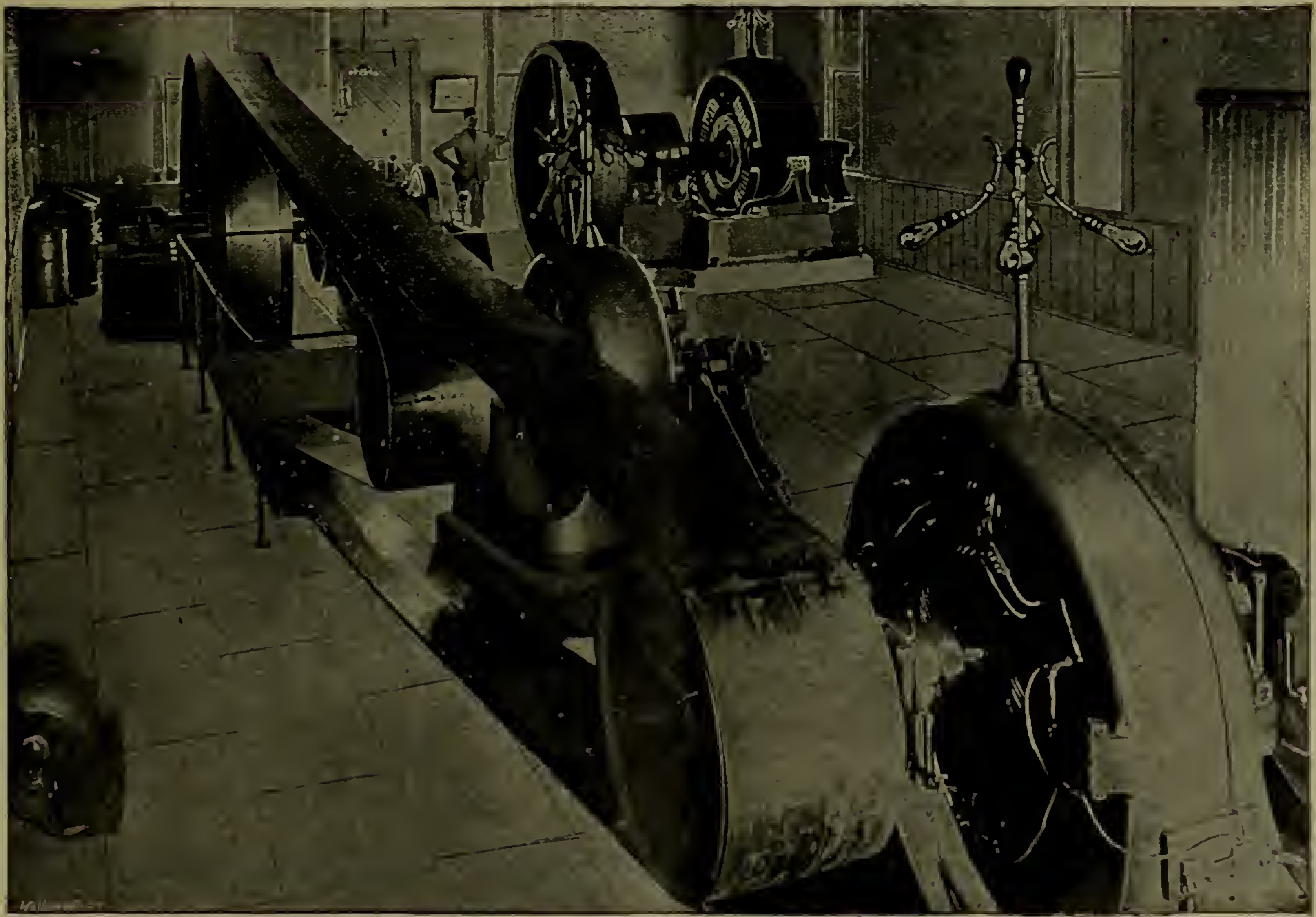
In the case with this old French sound-receiver, one gets a pretty good illustrated history of electric lighting and telegraphy. In the latter exhibit are some beautiful specimens of sections of deep-sea cables. One of these is a portion of the first Atlantic cable, submerged in 1858. It is about five-eighths of an inch in diameter, and is in good state of preservation. The others, cut and arranged to show their structural parts to best advantage, were laid at various times and places. The most of them belonged to cables of the Direct United States Cable Company. They range in size from less than an inch in diameter to about three inches. Although the strain on a deep-sea cable is enormous if by chance it becomes suspended across an ocean valley, the great three-inch compound rope looks capable of being swung from the top of one mountain to that of another.

AN INDEPENDENT MANUFACTURING CONCERN.

This last decade has been eventful in many important respects. It has seen a great change occur in methods of manufacture, and has marked a stage in the history of progress that shall forever after be spoken of with wonder and admiration. Development has been very rapid in the direction of improvements in electrical machinery, and it is our pleasure to speak of a manufacturing concern that has preserved its independence in that special capacity and secured by persistent and conscientious work an enviable reputation. Triumph apparatus manufactured by the Triumph Electric Company of Cincinnati, Ohio, has been so long and favorably known that little of an introductory character need be said. A few words, however, concerning the rapid growth of their business during the past few years may not be inappropriate. The chief cause of the popularity of their apparatus is undoubtedly due to the careful attention given every detail and the rigid factory inspection and tests to which every machine is subjected before shipment, insuring as it does its satisfactory and successful operation when erected. The fall of '95 made it clearly evident to the Triumph

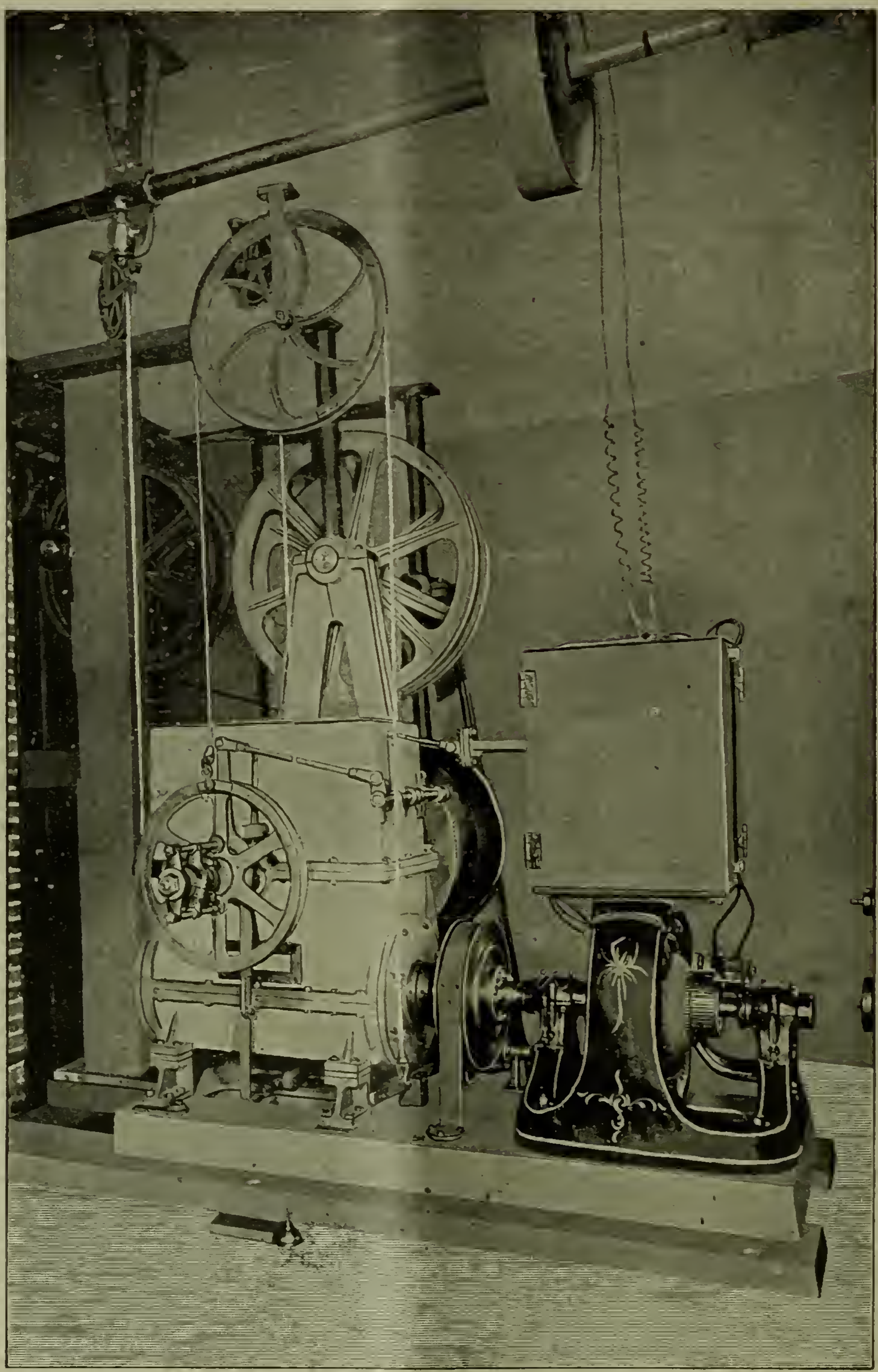
Erecting Floor. (Triumph Elec. Co.)

100 K. W. Belted Generator, Plant of the Lane & Bodley, Cincinnati, O.
(Triumph Elec. Co.)

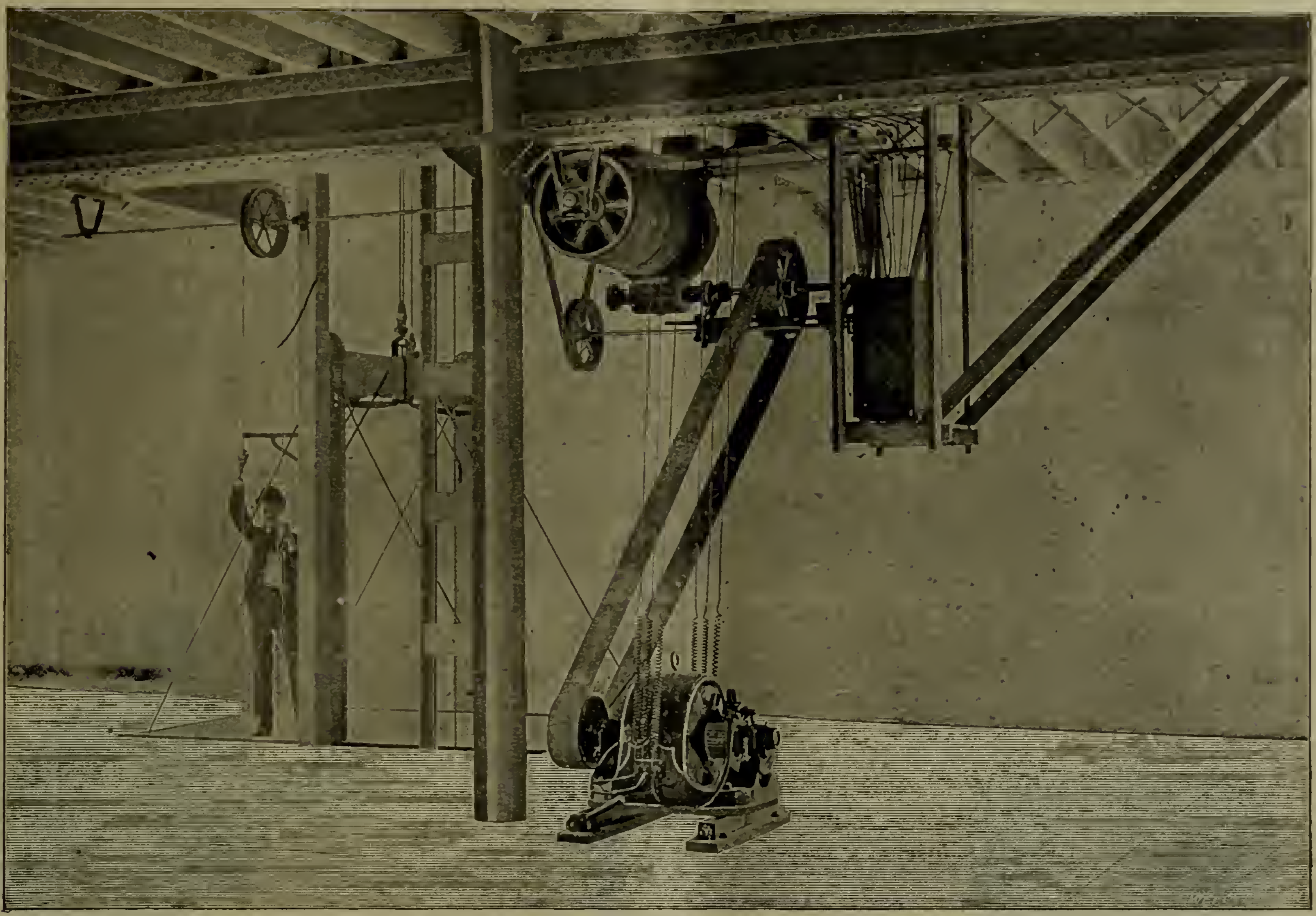


Power House, Owosso & Corrunna Traction Co., Owosso, Mich.
(Triumph Elec. Co.)

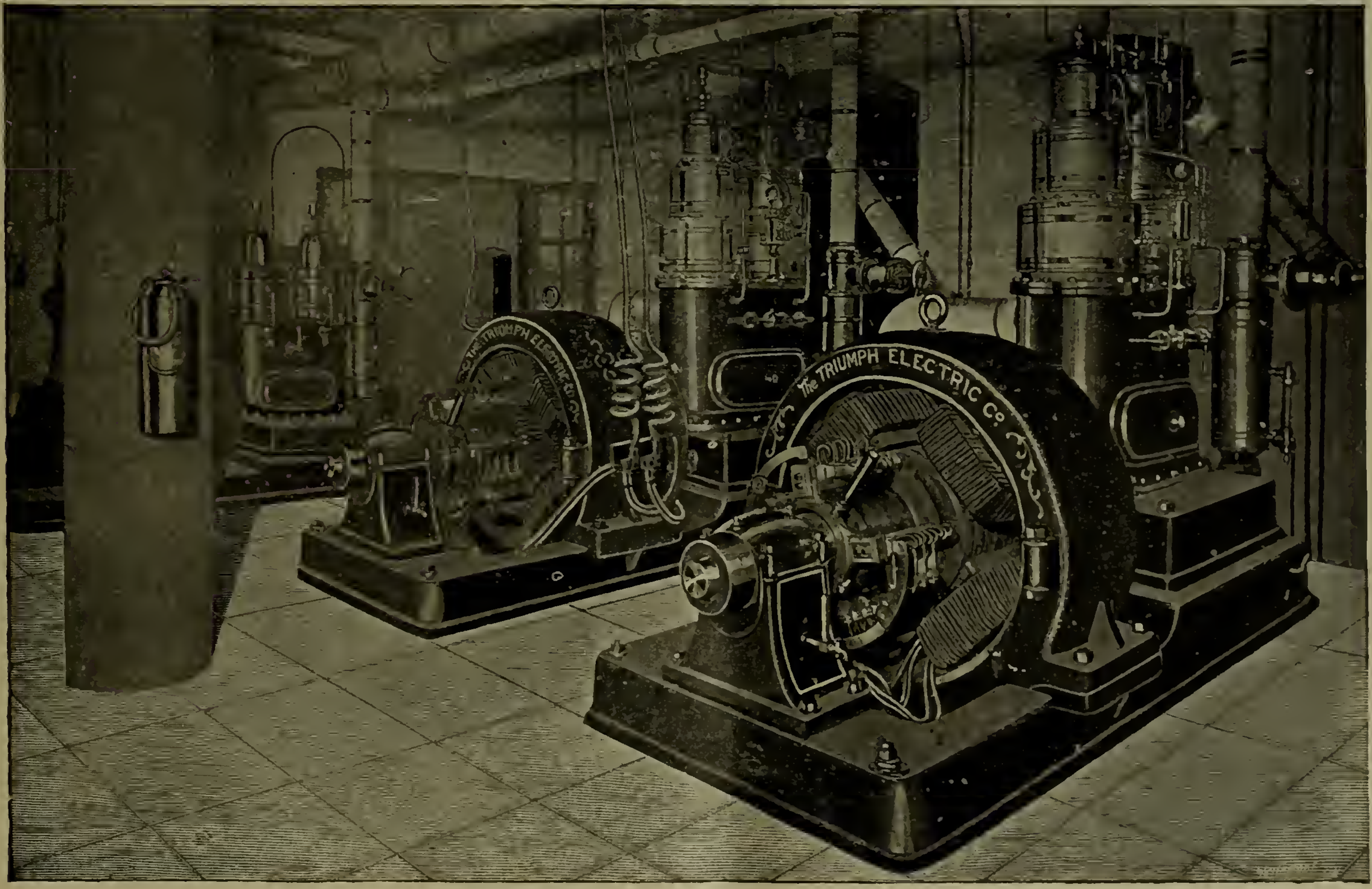
Electric Company that the facilities at their command had become inadequate, and the increasing size of the business made it absolutely necessary to procure larger and better quarters. With this object in view the purchase of the entire plant and good-will of the Waddell-Entz Company of Bridgeport, Conn., was consummated. As now equipped their facilities for the production of first-class work at low cost are equal to those of any other manufacturer. This company does not deem it advisable to place fictitious values on their products, being able and competent to assure to their customers, all rights and such protection as the use of the goods used might call for. They welcome careful investigation of all claims advanced by them and will be only too happy to show interested parties their equipment and the many special devices by which they are able to produce the very best of work and sell their apparatus at the very lowest prices. The Triumph Electric Company have long realized that considerable loss of power is occasioned by the use of belts, and that in addition valuable floor space is consumed by a belted plant. For these reasons they have placed upon the market direct-connected plants which run slowly, noiselessly and economically. Some illustrations are herewith given of Triumph Eleciric Company direct-connected plants. Another branch of work in which this concern has secured a great reputation is the manufacture of street-railway generators, in the details of whose construction simplicity reigns supreme. The freedom from liability of repairs and the ease and rapidity with which incidental repairs can be made, make their street railway and power generators particularly desirable pieces of machinery. The special type of winding and commutator construction employed makes it practically impossible to burn out these machines. The general construction of the armature and commutator of direct-connected generators is very simple. They are mounted on an independent spider which is keyed to the shaft, thus insuring alignment and reducing vibration to a minimum. The field casting is built of two parts, whose vertical faces meet, and are held together by large bolts fitting into reamed holes. The field coils are held in place by small, light keepers. The brush holders are operated by a hand-



Direct-Connected Elevator Motor.



Belted Freight Elevator.

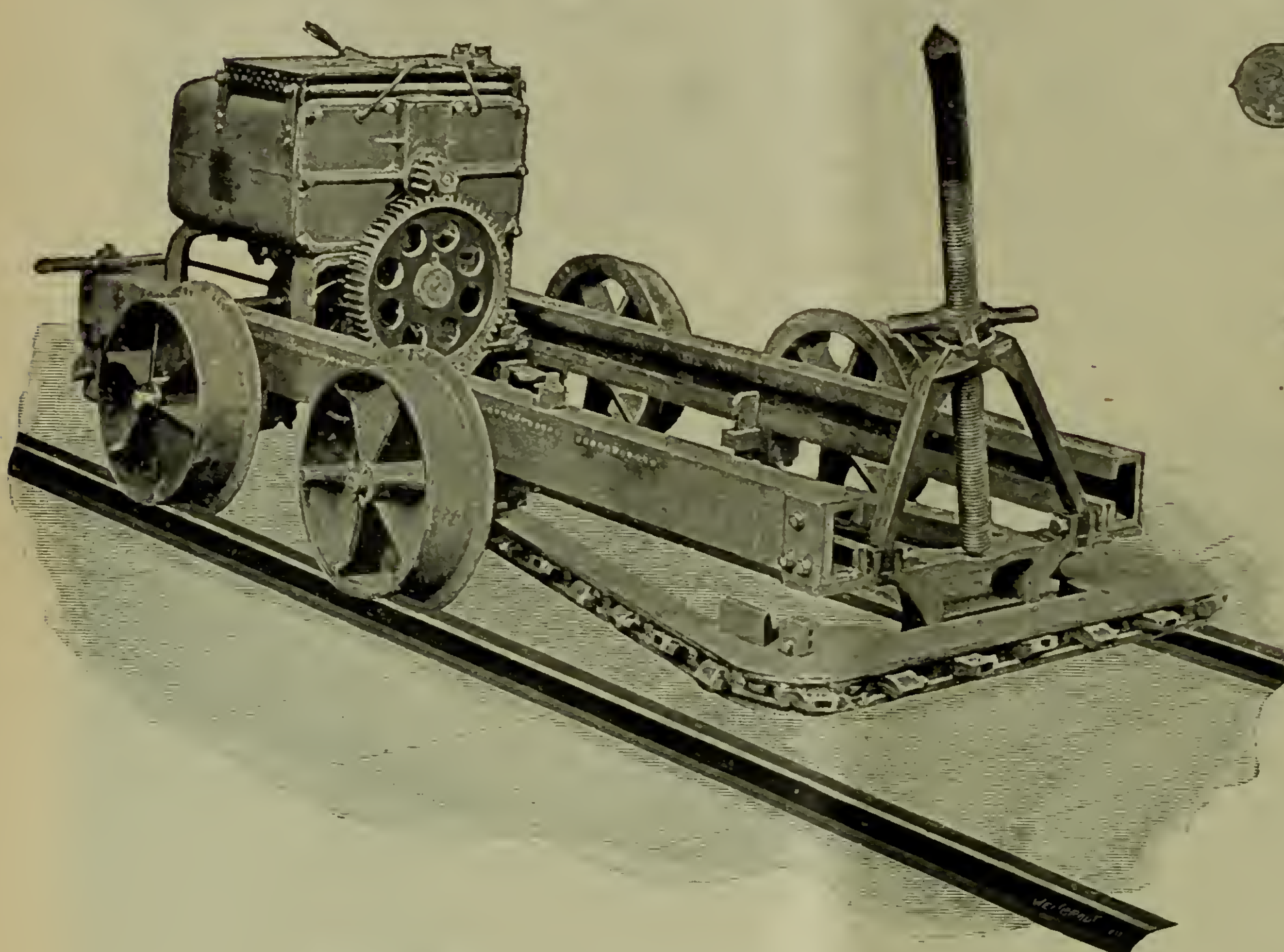


Plant of the Krippendorf-Dittmann Co., Cincinnati, O.

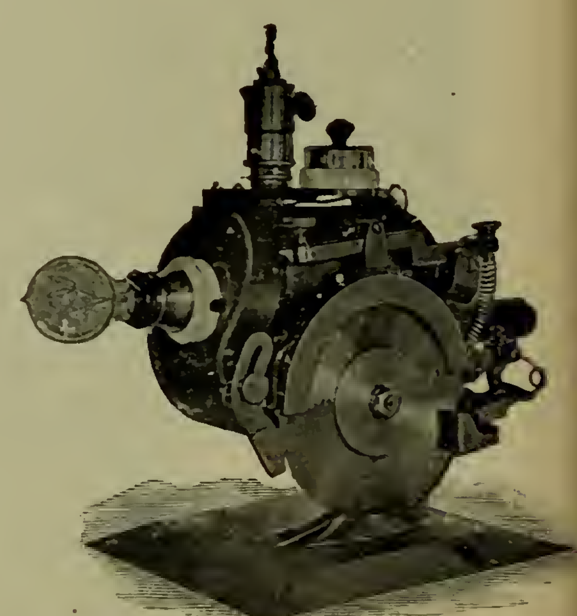
wheel adjustment and are carried on a subtantial yoke supported on the outboard bearing. Carbon brushes are used whose reliability is a matter of common knowledge. Power generators for street-railway work and outfits for marine and municipal lighting are supplied by this concern.

Since the use of arc and incandescent lamps on the same circuit has become a matter of common practice, and the safety of such systems is being better appreciated, a great call has come upon this concern for all sorts of equipments. The ease with which an electric-light plant is nowadays operated has led many sceptical and conservative-minded people to adopt electric lighting for illumination of homes, etc., and having become accustomed to it regard it henceforth as an indispensable necessity. The use of slow-speed machinery has prevented any complaint from arising on account of the wear of parts and cost of renewal, such as were met with and are still met with in the use of high-speed machinery.

All of the apparatus turned out by the Triumph Electrical Company, whether it be of a special nature or but one of their regular line of goods, is finished with such particular attention to details that in no instance have complaints arisen due to a failure in construction or operation. Switchboards are completed and designed by this concern of any size and fitted with any special apparatus that may be desired. In addition they manufacture a class of bi-polar motors which in price meet the demands for an economical and reliable machine. These machines are ironclad, with readily removable fields and a commutator built of the best of copper, insulated with pure mica. They have been designed and constructed on principles that neither modern science nor practice have reason to complain of, and have in every case ably done the work they were called upon to do with the utmost satisfaction to both the company that made them and the consumer that used them.



Mining Machine. (Triumph Elec. Co.)



Cloth Cutter.

THE DAYLIGHT WORK OF CENTRAL STATIONS.

(Concluded from page 15.)

A word in conclusion as to electric heating. When I hazarded, eleven years ago, before this body the expression of an opinion that motors ought to be pushed, it was regarded in many quarters as premature and visionary. From a conservative standpoint, it was so undoubtedly; but in everything success is not to be gauged by the point you are at. The real test is the way you are going; and if the tendency is right, all else that is desirable comes in due time. Now, in central station work, we can and must recognize but one tendency as the underlying and ultimate; namely, to increase the demand for current, and whatever does that is to be welcomed. Today, electric heating, using that term in its generic sense to cover a variety of uses and purposes, stands just where electric power did ten years ago. It is a parvenu, hardly admitted or recognized in good electrical society, but a "pushing young particle" that there is no snubbing or subduing. Much more recently than ten years ago, I was involved in a hot daily newspaper controversy in New York, with the object of proving that electric power had the ghost of a show; and now the advocates of electric heating are similarly put on their mettle. The main argument they have to contend against is an elaborate formulation of caloric theories and laws, all going to demonstrate the terrific loss and cost of heat units when delivered electrically to the man who wants them.

It is said that, with current sold on the basis of twenty cents a kilowatt hour, no business can be done in heating, and that, even if the price be cut in two, the inducement to possible customers is not great. If this were true, the matter of price of current might forbid the operation of a single fan motor from central stations. Making a rough calculation of one cent per hour for the ordinary fan motor, that is ten cents a day for ten hours steady running, or, say, $3 per month or $36 a year. Allowing twelve such motors to the horse-power, the local companies are selling current to thousands of willing customers in the summer time at the rate of $430 a year per horse-power, for a working day of only ten hours. Other quotations can be made showing the high price got readily for current in small quantities from purchasers who are perfectly satisfied with the bargain, and find it pays them also very handsomely in some element of comfort, pleasure, convenience or even economy.

A test taken three years ago, for twelve weeks, of current consumed in cooking a dinner of several dishes daily for a large number of persons, showed that for ninety-seven persons the current fell as low as 307 watt hours per person. This would make 29,779 watt hours, or, in round figures, thirty kilowatt hours. At ten cents per kilowatt hour, that means an expense of $3 per day, or, say, $90 per month. It will, of course, be objected that, in a great many isolated plants, the current made on the spot does not cost to exceed five cents per kilowatt hour, which would, in the building where the test was made, have brought the sum down to $45. I have tried to get some basis of comparison between this and an equal amount of work on a gas-stove or range, for an equal number of persons, but it is not easy to obtain. In one family I know, which consists of six persons, they have been cooking by gas for some five years. It costs, with gas at $1.25 per 1,000 cubic feet, on an average, $5 to $6 per month, or from sixteen to twenty cents per day, or about three and one-half cents per head per day, if all are at home to every one of the three daily meals, which is far from being the case. If the same expense averaged for the ninety-seven persons for three meals daily, the outlay for gas in cooking would be between $90 and $100 per month, or about as much, if my figures are approximately right, as electricity would cost, if the current were supplied at five cents per kilowatt hour. This is certainly a very encouraging showing for electricity, but we must not forget that central stations do not exhibit much anxiety to sell their current at five cents per kilowatt hour, or even per horse-power hour, and this is one reason why isolated plants have multiplied so tremendously in our cities. I might add, as one point of interest, that, when the family I mention began to cook with gas, it bought a gas-range for $25 and paid $2 or $3 more to get it set. The range has worn out, and the family is now hiring a good one from the local gas company for $3 a year.

From these crude remarks of mine, it will be seen how sadly tentative and experimental the art of electric cooking is for most of us; but is it not the duty of the local lighting companies to go into this matter and see how far they can foster the new art, by introducing the apparatus and furnishing current for it cheaply ? Even if the price falls short of $430 per horse-power per year, for ten hours a day only, they should not feel discouraged.

I have spoken of cooking, but this is but one of many fields of usefulness for electric current heating supply. Our esteemed ex-president, Mr. J. I. Ayer, who has placed at my disposal much interesting data that I cannot produce here, for lack of time, gives me also a variety of information as to work that has lately fallen within his sphere of practical attention as representative of a large electric heating company. Their work includes a wide extent of shoemaking machinery, heated silk-finishing rolls, leather-working machinery, 387 curling-iron sets in the dressing rooms of the combined Waldorf and Astoria hotels, in New York city, seventy-two sets in the Parker House, Boston, and apparatus in the Plankinton and Pfister hotels, Milwaukee, as well as on the American line steamers across the Atlantic. It would not be fair to omit the 14,000 car heaters installed, of one make alone, in the past year and a half. A blank-book manufacturer has had in use since 1894 from thirty-five to forty electric glue pots, and Duryea & Co., the starch makers, are also users of electric heat apparatus. In Knabe & Co.'s piano factory, at Baltimore, twenty electric heaters have recently been placed; and there is a long list of clothing houses throughout the country that use electric irons. The same is true of vulcanizers for bicycle tire agencies and factories, while irons in large numbers have been supplied to State asylums in Indiana, Michigan, Wisconsin, Illinois, New York, Massachusetts, Maine and Maryland. It is simply impossible that all this apparatus should have been put in, unless it was economically or practically worth while; and this being so, is not the electric heat field one in which the local companies can now begin to work with advantage? Surely, here lies opportunity of the largest kind, to help the introduction of apparatus that must serve as a large customer for current at all seasons of the year.

The subjects I have brought up are perhaps inexhaustible, but, in spite of the labor and tax on scant leisure involved in collating some of this data, I shall be repaid if in the smallest degree a stimulus is given to central station work and prosperity. I feel sure that whatever remarks I have made will be accepted in the spirit that prompts them—one of heartiest good wishes for the welfare of the typical comprehensive industry of the age —that of the electric central station.

THE TRANSMISSION OF POWER.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

Power is transmitted by means of

Steam,
Wire Rope,
Electricity,
Compressed Air,
Hydraulic Pressure.

The evident use of each is only to be determined by the existing conditions. At present but two have received such consideration as is required to lift them into prominence.

They are wire rope and electricity. In our busy towns and less settled suburban districts the trolley has been a great success, while the cable is limited in its application on account of the great expense of running and installation. The line must be drawn, however, between those systems which distribute and those which transmit power.

The distribution of power is carried on at the extremity of or along a power line. The transmission, between two distinct centres.

A line stretching from Niagara to New York would be a power transmission line; from the heart of New York to its innumerable streets and adjacent districts, merely distribution would occur. The case that would come more closely in touch with the title of this article would be that of two widely separated centres between which a line is to stretch carrying power from one to another.

To determine the loss in power, weight of copper, volts required and general expense, is a problem having some weight in the transmission of power.

It is in reality all there is to the transmission of power, because it covers the most important points touching all things from the standpoint of economy.

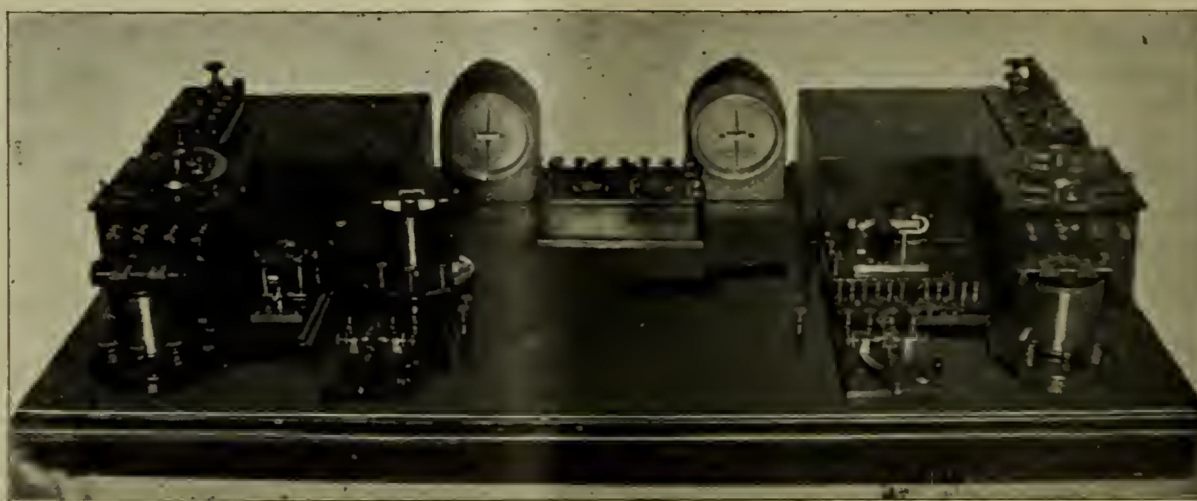
If an electric current could be sent at random over any line without the least attention being given to insulation, pressure or current, then the subject of transmission of power would never have been dignified by such a title. It should be the object of every engineer to send power from point to point with the least possible waste and expense. This happy combination is only secured by investigating the conditions that exist. The efficiency of a system of transmission might be affected by the distance, locality, etc. For instance, the efficiencies of a wire rope transmission plant of the following distances are given by Kapp:

Distance in feet,	300	1,500	3,000	15,000	30,000	60,000
Efficiency,	.96	.93	.90	.60	.37	.13

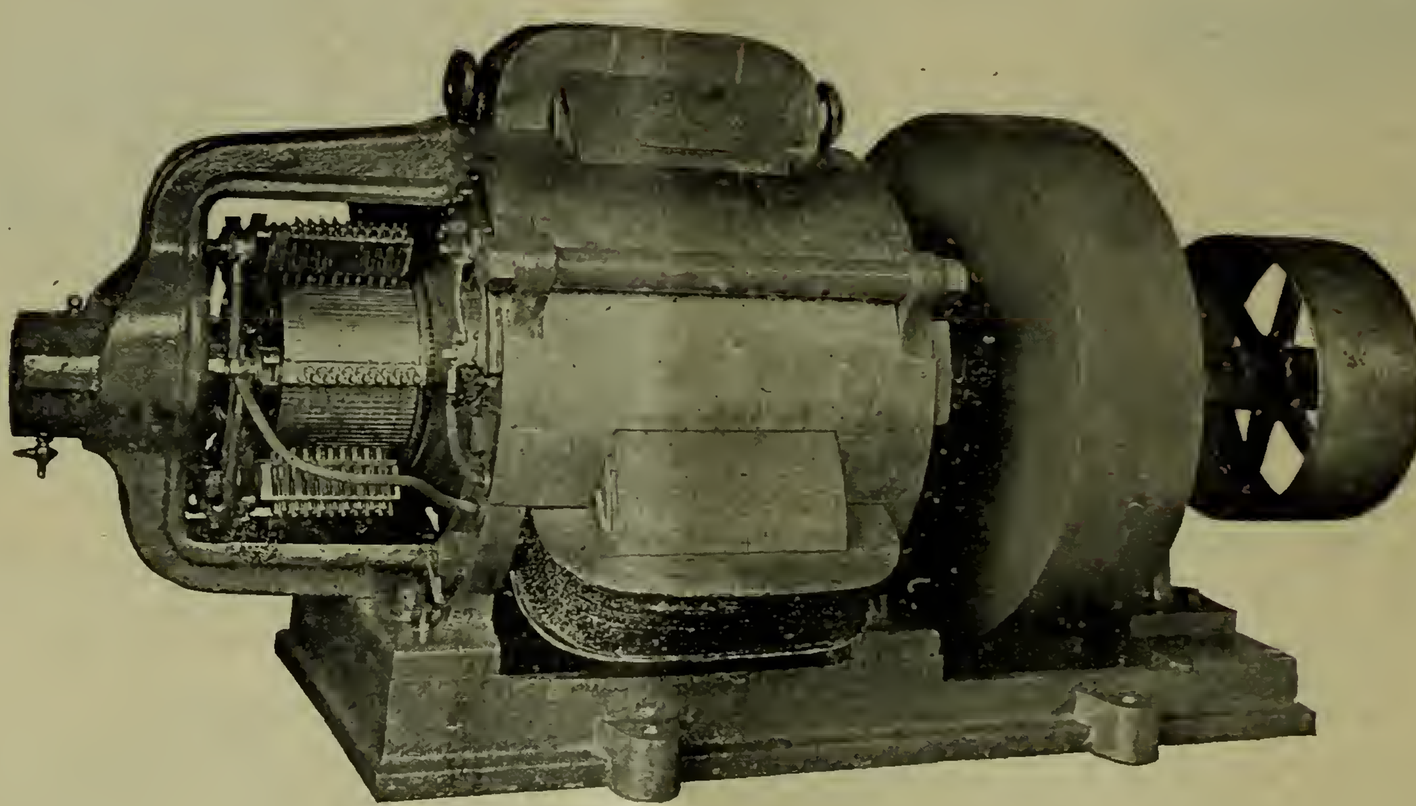
Before 1891 these figures were compiled, and the line of electrical efficiencies is very much higher than the above today. It is not very difficult to send 1,000 horsepower a distance of 100 miles, 528,000 feet, at an efficiency of over 60 per cent. As an example of the limitations imposed by distance and material, take a copper line having 10 per cent. with drop machines at each end of 90 per cent. efficiency—that is, motor and dynamo — what is the efficiency of the system?

The dynamo at 90 per cent. loses 10 per cent. in the line; there is 81 per cent. left for the motor. If the motor has 90 per cent. efficiency, it returns as power 90 per cent. of 81 per cent., which approximates 72 per cent. in total. What conclusions may be drawn from this other than that if motor, dynamo and line each have only 10 per cent. loss, the system is of 72 per cent. efficiency over any distance as long as these conditions with a continuous current are observed.

The latest feat of engineering has been the design and construction of a huge power plant at Niagara Falls. In Germany, between Frankfort and Lauffen, a line 100 miles long was extended. The power was generated at Lauffen. A turbine that gathered energy from the Necker River was used and a three-phase alternator.



Line Testing Outfit.



Continuous Current Transformer.

The same would naturally follow with any other source of power—that the greater the distance over which it extends, the greater the loss in power. As given by Herr Beringer and referred to by Gisbert Kapp, the following interesting table shows the relative efficiencies of each system:

COMMERCIAL EFFICIENCY.

Distance	Electric.	Hydraulic pressure.	Compressed air.	Wire rope.
300 ft	69 per cent.	50 per cent.	55 per cent.	96 per cent.
1,500 "	68 "	50 "	55 "	93 "
3,000 "	66 "	50 "	55 "	90 "
15,000 "	60 "	40 "	50 "	60 "
30,000 "	51 "	35 "	50 "	36 "
60,000 "	32 "	20 "	40 "	13 "

The current generated was 1400 amperes at 50 volts pressure. It was transformed before entering the line to 30,000 volts, and when received at the other end (Frankfort) again reduced to 60 volts. According to an official test, when 80,500 volts were sent out 58,000 were received; the efficiency being 72 per cent. This account of what may be considered the first experiment of any consequence in this direction gives satisfactory results. The distance over which the power was transmitted was 108 miles.

It is not difficult to attempt to transmit heavy power over long lines, as a precedent has been established which today may be looked upon as successful. The difficulty of using continuous current for long-distance transmission is that of transformation.

Power can be economically sent from point to point as long as the pressure is high. The efficiency of a plant depends upon the voltage of the line to a greater extent than anything else. Continuous-current dynamos use commutators which give rise to sparking troubles when high pressures are used. They cannot be safely connected in series, although the idea seems plausible, because the insulation is apt to give.

The economy of transmitting power is somewhat affected by the cost of the repairs. Weak machinery is as detrimental to a plant as poor insulation. There are no continuous-current generators in existence that could safely be used for high tension work. Such pressures, for example, as 10,000 or 20,000 volts. Not requiring commutators, and being easily susceptible to transformation, the alternator is at present superior to all as a generating device.

In 1881 Deprez, of France, proposed that the current be generated at a low pressure, raised to a high potential, sent over the line and reduced to a low pressure again for commercial purposes. To accomplish this, continuous as well as alternating-current transformers may be used. If the plant is a high-pressure continuous-current system, an increase or reduction in pressure is obtained by using a motor and dynamo in one. The armature is wound twice—once for a motor to receive the power, and again as a dynamo with sufficient turns and commutator to produce the pressure required.

The machine is called a motor dynamo or continuous-current transformer. The armature having two windings and two commutators is expensive and unsatisfactory for this purpose, except in special cases.

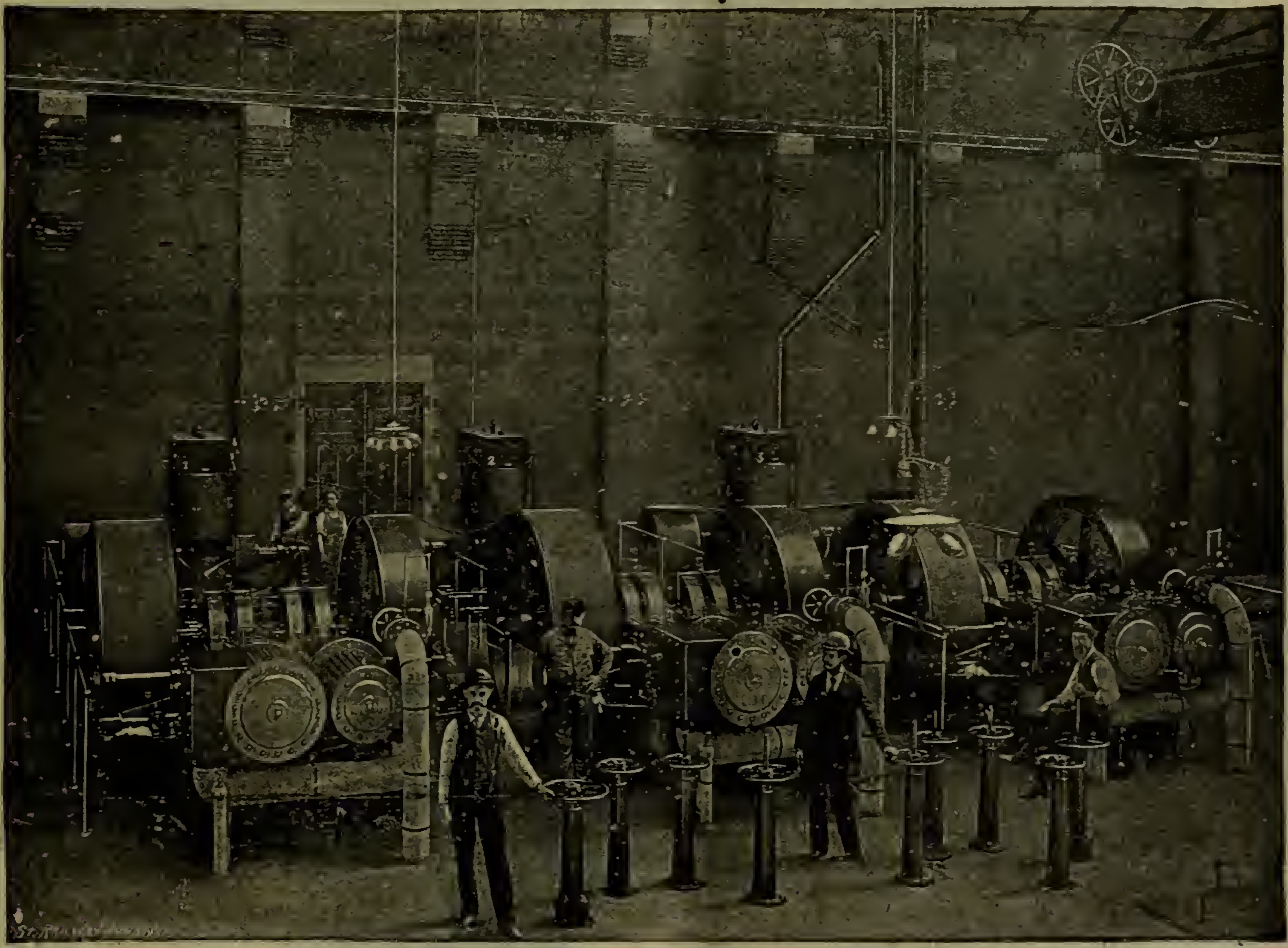
On the other hand a transformer, as previously described, is a simple magnetic circuit interlinked with coils. The absence of moving parts makes its use extremely practical. The difficulty of insulating it has been well overcome.

In transmitting power by alternating current the choice that exists lies between—

Single-phase,
Two-phase,
Three-phase systems.

In certain respects the two-phase has many advantages, but the matter is still in abeyance.

It may be said, however, that single-phase transmission plants are entirely out of the question. This now leads us to the examination of the reasons for choosing between the three.



Continuous Current Transmission Plant.

Before the multiphase motor was invented, the single-phase current could not run a large alternating-current motor unless it was first started by some other source of power and set into synchronism.

The introduction of two and three-phase currents, however, provided a means for overcoming this defect. Motors became self-starting when built on this principle and were introduced as a successful commercial feature of an alternating-current plant.

This, then, in total, may be considered the reason why alternating-current apparatus has become popular. The erection of a plant merely for the purpose of furnishing light is ridiculous, if conducted on a large scale. The transmission of power in one sense defines the object in view, and how is it possible to develop an enterprise so handicapped at the outset? Competition with continuous current plants, even though such installations cost twice as much, would eventually drive from the field those advocating another principle yet unable to meet all of its demands.

The transmission of power is successfully carried on with a high pressure, an easy transformation, efficient motors and good line insulation. Attention to these factors means attention to the very elements of success.

Omahas, June....—Since Professor R. B. Owens was placed in charge of the electrical section, Department of Exhibits of the Trans-Mississippi Exposition, extraordinary interest has been awakened in the minds of electricians and manufacturers of electrical machinery and supplies throughout the country. If ever there was doubt of a creditable display in the electrical section, at this time there is no doubt that electricity—scientific, industrial

Prof. R. B. Owens,

and decorative—will form a highly attractive feature of the exposition.

Prof. Owens is now in the East in the interest of the Exposition. He writes: "I am glad to say a very great interest has been taken in the exhibition by electrical manufacturers, and I have already signed a number for space. The Walker Co., of Cleveland, the Wagner Electric & Manufacturing Co., of St. Louis, the Okonite Co., of New York, the Cutter Electric & Manufacturing Co., of Philadelphia, and the Western Electric Company, the largesi manufacturing concern in the West, are among the electrical manufacturers who will install large exhibits at the Trans-Mississippi Exposition, not to mention the smaller concerns which have contracted for space in the electrical section."

Prof. Owens' appointment as commissioner for the electrical section is regarded with much favor. He is well qualified for the duties of his responsibie position, and he will have full charge of the work of organizing and superintending the electrical department. Beside the convention of the National Electric Light Association, the professor will endeavor to secure other meetings of technical societies for 1898, as of the American Institute of Electric Engineers, American Society of Mechanical Engineers and the American Street Railway Association. It is the intention to make the exposition an irresistible magnet of attraction for every person interested in the scientific and practical study of things electrical.

Prof Owens is in charge of the Department of Electrical and Steam Engineering at the university in Lincoln. As an educator he is distingushed by his desire to give a training to his students that is thoroughly practical and useful. He is a young man of the present generation, alert, progressive, enterprising. His practical experience in electrical affairs is of much assistance to him and will count in his new position with the exposition. Professor Owens is a native of Maryland and obtained his education in that State, studying with Dr. Louis Duncan and other instructors at the Johns Hopkins University in Baltimore, where he stood well in mathematics and physics. In 1891 he obtained the post-graduate degree of E. E. from Columbia, under Professor Crocker, and was a member of the first class in the United States to receive this degree. In the intervals of his school preparation the young student acquired a fund of practical knowledge, first with the old Baxter Motor Company, then with the Excelsior Company, and also as superintendent of a Thomson-Houston station at Greenwich, Conn. Shortiy after receiving his degree Prof Owens was appointed adjunct professor of electrical engineering in the University of Nebraska, and in 1894 he was made full professor, having in the meantime served as one of the judges of electrical exhibits at the World's Fair. Full charge of the Department of Electrical and Steam Engineering was conferred on Prof. Owens in 1895. Prof. Owens believes that the technicai school should be in close touch with the best practice, and usually spends his summers in work that increases his experience in solving actual, every-day problems. His new duties will not make it necessary for him to sever his connection with the university; and it is safe to say that the electrical department of the Trans-Mississippi Exposition will greatly benefit by his reputation, knowledge and experience.

Savannah, Ga.—City Clerk may give information concerning electric light plant.

Rock Rapids, Iowa.—A new electric light plant is to be erected.

Holly Springs, Miss.—Walter G. Kirkpatrick, of Nashville, Tenn., and Canton, Miss., has been engaged to prepare plans and specifications for the proposed water-works and electric light plants.

The Electrical Age.

VOL. XX., No. 3 NEW YORK, JULY 17, 1897. WHOLE No. 531

Fig. 7.—Interior of Power House.

THE POWER PLANT OF THE PIONEER ELECTRIC POWER COMPANY OF OGDEN, UTAH.

Among the sources of energy available for industrial purposes, natural water-powers have long held an important place, and within the past few years the progress made in the methods for converting mechanical into electrical energy, and the increase in the distance to which the latter can be economically transmitted, have led to the utilization of many water powers previously inaccessible. The advantages to any community of cheap and reliable power are so great that a steady growth of enterprises of this kind may be expected.

In the canon of the Ogden River, near the city of Ogden, the latest and most important hydraulic-power plant of that State, and one of the largest works of the kind yet undertaken in this country, has been carried out during the past year by the Pioneer Electric Power Company of Utah.

The city of Ogden is situated in the basin of the Great Salt Lake, at an elevation of 4,300 feet above sea level, about 15 miles east of that body of water, and 35 miles north of Salt Lake city. The city extends eastward to the base of the Wahsatch Mountains, which tower 5,000 feet higher, reaching a total altitude of fully 9,000 feet above sea level. This chain of mountains is intersected by numerous deep valleys or canons, forming the outlet for drainage areas of considerable extent. The outlet of the canon of the Ogden River is east of Ogden and distant about two miles from the business centre. It is a narrow winding gorge, walled in by high and precipitous mountains, nowhere more than a few hundred feet in width at the bottom, while at some points it is so narrow that the construction of the excellent macadamized road that traverses it involved considerable rock excavation. At a point about six miles above its mouth the narrow gorge through which the river flows widens out into a valley, some eight miles long and four miles wide, surrounded by an almost continuous mountain chain. This valley is traversed by three streams which unite at the upper end of the canon to form the Ogden River.

The average annual rainfall in Ogden is 14 inches. In the Ogden Valley it is probably twice as great. The drainage area is about 360 square miles. The flow of the river varies greatly in different years and at different seasons. In May and June, when the snow on the mountains melts, a maximum flow of 4,800 cubic feet per second has been measured, while a minimum of 80 cubic feet in August and September is also on record. The minimum in average years is fully 128 cubic feet per second. The force of the stream in the upper valley is comparatively gradual, while in the six miles of the canon there is a total fall of nearly 500 feet. This portion of the river has long appeared an attractive field for the development of power, but apart from a small saw-mill near its mouth there have been only abortive attempts made at utilizing the fall of the stream.

The plans of the Pioneer Electric Power Company contemplate the utilization of the waters of the entire Ogden River water-shed above the mouth of the canon for the development of power as well as for irrigation. The central features of the plant are: A large storage reservoir and a masonry dam at the upper end of the canon; a pipe conduit six feet in diameter; a powerhouse with water-wheels and electric generators, electric transmission lines and sub-stations for distributing the power to different points, and an extended system of irrigation canals.

The storage reservoir will cover an area of about 2,000 acres, and will have a capacity of nearly 15,000,000,000 gallons. It will be formed by building across the canon, a short distance below its upper end, a dam of concrete masonry built up of isolated piers and arches founded on bed rock. The length of the dam on its crest will be about 400 feet. It will have a total height of 100 feet, sixty feet of which will be above the level of the present river bed. The up-stream face is protected by a steel-plate covering to prevent abrasion and percolation.

A nine-feet tunnel excavated through the solid rock around the south abutment of the dam, forms the outlet for the water of the reservoir. At its upper end it connects to a masonry inlet tower which is in turn connected by a riveted steel pipe, 8 feet 6 inches in diameter, with the main gate house. 100 feet below the tunnel. This contains two 72-inch valves, one controlling the supply of the main conduit, the other discharging the surplus water.

The main conduit is a pipe line six feet in internal diameter. Its total length is 31,600 feet, of which 27,000 feet is wooden stave pipe, and 4,600 feet at the lower end riveted steel pipe. It is laid in a trench 8½-feet wide, and covered with earth to a depth of three feet on top. The selection of smooth wooden stave pipe in lieu of steel pipe throughout, was made on account of the greater cheapness of the former, as well as its less internal resistance to the flow. The pipe is laid along the side of the canon and follows the mountains to a point about half a mile beyond the mouth of the canon. It is built to conform to a hydraulic grade line of two feet per thousand—a slope believed to correspond to the friction in the pipe. At the upper end of the pipe the inlet is funnel-shaped, and the wooden pipe is continuous except at three points where two riveted steel elbows and a short length of tunnel are substituted. There are eight tunnels in the rock, the longest being 667 feet. There are also eight steel bridges with a total length of 560 feet, besides a timber trestle. The maximum hydrostatic head in the wooden pipe is 117 feet, giving a pressure of 50 pounds per square inch.

Fig. 1.—Trench in Ogden Canyon.

From the end of the wooden pipe the steel conduit runs to the power house. The slope of this is quite steep and the pressure is from 50 to 200 pounds per square inch. It is 60 feet in diameter until it reaches a point 100 feet from the power house, where it divides into two branches 54 inches in diameter, which lead to two receivers, one on each side of the power house. There are thirteen elbows in this pipe and its entire weight is over 2,500,000 pounds. The total efficient head from the flow line of the reservoir when it is full to the centre of the receiver is 446 feet.

All the steel-pipe sections were rolled and riveted at Ogden, in a shop built and equipped with machines for that purpose. This was done in order to escape the heavy railroad charges which would have been necessary, had the rolled sections been built at the works. The building was equipped with all the machinery necessary for rolling, punching, riveting and caulking the pipe sections, and an air compressor by which the riveting and caulking machines in the trench were driven. After about July 15, 1896, when the first plate was punched, the work was carried

Fig. 2.—Making Wooden Pipe.

on night and day and seven days in the week. The steel pipe, after it had passed the riveting machines, was given a prolonged bath in asphalt.

The riveting of the pipe in the trench was effected by power riveters, operated by compressed air at a pressure of from 50 to 75 lbs. Five hundred rivets per day of ten hours were driven by each machine. At the steep grades of the steel pipe line it is anchored by means of concrete anchorages built around it, 8 ft. by 10 ft. in section and 10 ft. long.

Fig. 3.—The Pipe Line Along the Side of the Canyon.

The wooden pipe is built up of Douglas fir staves, tongued and grooved, 32 in. the circumference, 16, 18 and 20 ft. lengths and 2 in. thick. All the staves were planed and dressed in a special mill erected near the mouth of the canon. The pipe was laid upon sills set in the trench, and was banded with round steel rods 5/8 in. and 3/4 in. in diameter, the latter being used where the pressure exceeds that due to a head of 100 ft. In order to bring the staves to the non-inaccessible parts of the canon, a cable way 1,000 ft. long, erected on framed towers, was built.

Between the inlet tower at the dam and the power house there are five large gate valves, besides the smaller blow-off and relief valves. Three are 6 ft. in diameter, the other two 42 in. The first two of the larger ones weigh about 23,000 lbs. each, and are in the gate house; the third is placed near elbow No. 2 of the steel pipe line, about 100 ft. below its junction with the wooden pipe. Its purpose is to permit the closing of the wooden pipe, to keep it full of water even when the steel pipe is empty.

Fig. 4.—Exterior of Power House, Showing one Venturi Motor and Receiver.

The head at this point is about 200 ft. The valve has only a single valve-stem, and is operated by a hydraulic lift supplied with pressure water from the main pipe above the valve. The total weight of this valve is 52,000 lbs., the heaviest single piece in it weighing about 20,000 lbs. Besides these large valves there are two smaller, each 24 in. in diameter. These are placed between the lower end of the 5 ft. pipe and the power house, in the 54 in. branches leading to the receivers. These branches are reduced to 42 in. by the use of Venturi meters, thus permitting the use of the smaller valves, which are operated by hand. The pipe is fully provided with air, mud and relief valves. The connection between the main pipe and the branches is made by a breeches casting secured to the steel pipes by cast-steel angle flanges and belts. To withstand the great longitudinal pressure, a heavy concrete block is built around the casting.

Of the nine bridges, the longest is that over the Ogden River. This is a riveted bow-string girder 75 ft. long. The other bridges carry the pipe line over lateral ravines, or were built in place of masonry retaining walls, where a steel structure was cheaper.

The power house is built of pressed brick, with concrete and rubble footings, and cut-stone trimmings. Its outside dimensions are 135 ft. in length by 50 ft. in width. The roof trusses are of steel, and are supported on steel posts imbedded in the brick walls. A travelling crane of 15 tons capacity, operated by hand power, traverses the building, the track girders being carried by the steel posts. This building contains all the hydraulic and electric machinery used. A smaller, separate building serves as a machine and blacksmith shop.

The water is delivered from the pipe conduit into two receivers, buried in the ground, one at either side of the power house. They are 6 ft. in diameter, and, in their general appearance and the material used, closely resemble the regular steel-pipe conduit, the thickness of the metal, however, being increased to ⅞ in. in order to allow for the water hammer.

The receivers are provided with five safety valves each, which discharge when the pressure exceeds 200 lbs. per square inch, and an outlet gate at the bottom. From each of these receivers five 20-in. and one 10-in. intake pipes extend to the walls of the power house to connect with the water-wheel nozzle pipes. Between these intakes and the nozzle pipes are placed the following valves in the order named: One 18-in. geared gate valve, one 18-in. hydraulic gate valve, and one 18-in. butterfly valve.

The 18-in. geared gate valve is only to be used in case of repairs to the particular machines that govern it. The 18-in. hydraulic gate valve is piped up to a small D valve, which is placed back of the switchboard and under the floor. By means of a lever on the switchboard, connected to this D valve, the gate can be opened or closed at the operator's will. This valve is the one which is to be used for starting or stopping a wheel. The 18-in. butterfly valve is operated by means of a worm gear from the governor, and is used in checking the speed of the wheel by reducing the head or pressure near the nozzle, and thus avoiding a sudden fall of head in the main pipe line, which would be detrimental to the proper working of the plant.

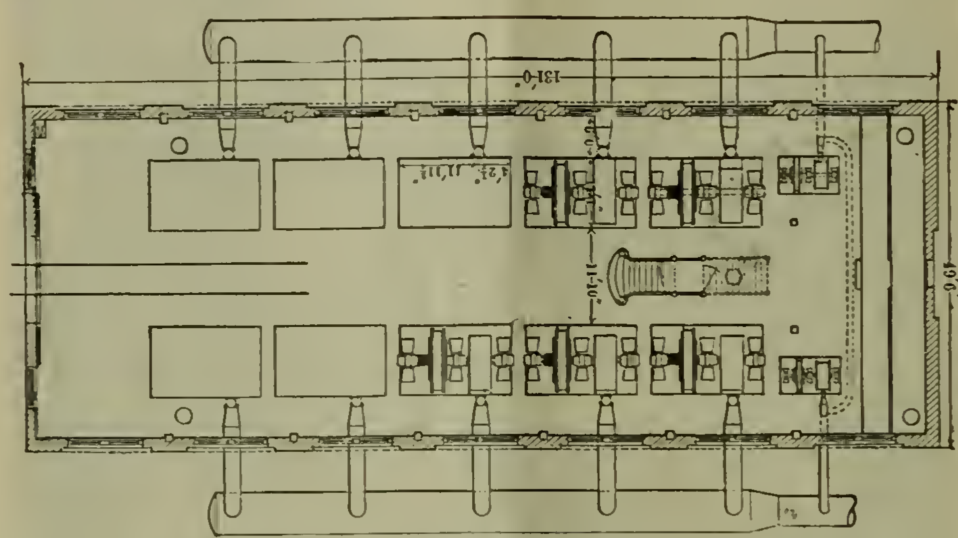


Fig. 5.—Plan of Power House.

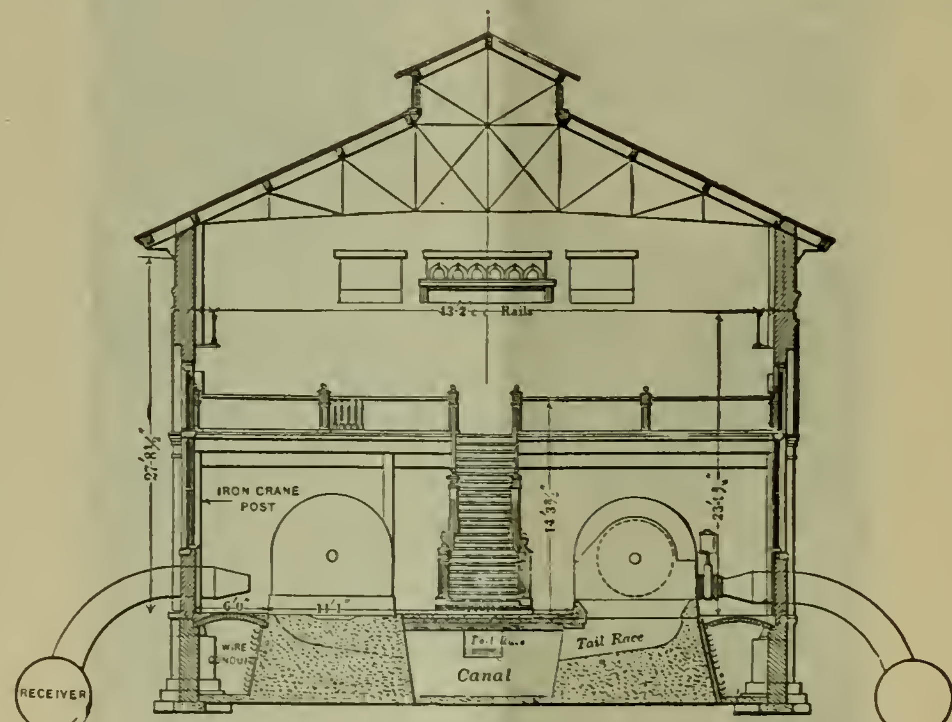


Fig. 6.—Section of Power House.

The nozzle for the water-wheels has six rectangular openings or parts 1 11/16×3½ inches in area, of which the operator is able to close one or more as he may desire. The levers that operate the hydraulic gate and nozzle are placed near the top of the switchboard. The set of levers for each water-wheel is placed in the panel governing the generator which is driven by the wheel in question, so that the operations required in starting or stopping these machines are reduced to a minimum. The wheels are of the impulse type directly connected to the generators. The complete plant will consist of ten units, five being already installed. The power house and receivers being built for the ten, the balance can be readily installed at any time.

The Knight water-wheels are 59 inches in diameter, and have 45 bronze buckets cast in one solid piece; 14 of these will, when the nozzle ports are all open, receive the water at the same instant. The centres of the wheels are made of cast steel, the buckets being pressed on these steel centres and secured with bolts. These wheels are keyed to the generaror shaft. Each wheel has a capacity of 1,200 H. P. at 300 revolutions per minute, and each is provided with two fly-wheels about 70 inches in diameter, each weighing about two tons.

The armature, armature shaft, two fly-wheels and one water-wheel, which comprise the moving parts, weigh 15 tons. This allows a uniform speed to be maintained notwithstanding changes of head in the main pipe, or changes in the generator load. The water-wheel, fly-wheels, nozzle and the two hydraulic cylinders controlling the nozzle ports are encased in a steel housing, bolted to the machine bed-frame.

Between the two lines of machines and down through the centre of the building underneath the concrete floor is the spillway into which the wheels discharge the water, and through which the water is carried back to the river from which it is taken.

The generators used in this plant are of the General Electric Co. three-phase type, with 24 poles and, at 300 revolutions per minute, have an output of 750 K. W. at 2,300 volts and a frequency of 60 cycles per second. The factory tests show that the variation in volts will be less than five per cent. with a constant speed, should the full non-inductive load be thrown off or on.

Between the machine foundations and the building foundation wall, on each side of the building, is a subway which runs the entire length of the building and across the rear, and in this subway are carried all the necessary piping for water-wheel controllers and all the wires between the generators and the switchboards. The cable connecting each generator to its respective panel on the generator switchboard is a three-wire concentric 250,000 C. M. lead-covered cable, and the exciting wires are a two-wire concentric No. 4 B & S. lead-covered cable.

The exciters used on this plant are G. R. six-pole 500-volt machines, and will give 100 K. W. at 550 revolutions per minute. Each of these machines is ample for the entire exciting current that will be needed for the ten 750-K. W. alternators, and they are each direct-connected to a 135-H. P. Knight water-wheel, similar to the 1,200 H. P. water-wheels previously described. These exciter water-wheels are cross-connected to each receiver so that either exciter can be operated from either receiver.

The generator switchboard consists of seven marble panels—five for the alternators, one for the exciter and one for the instrument panel.

These panels are 26 by 90 ins. each. They are built up of blue Vermont marble, with nickel fittings. There are two sets of three-phase bus bars on the back extending the entire length of the seven panels, as well as two bus bars, also running their entire length, from which the exciting current is taken.

From the generator switchboard the current is carried to the distributing board over copper bars, of which there are two sets of three, connecting the two sets of bus bars on the generator board with the two sets of bus bars on the primary panels of the distributing boards.

The distributing board is in a gallery in the rear of the building, and over the generator switchboard. Back of this distributing switchboard are nine 250 K. W. air-blast step-up transformers, the lightning arresters, and the two blowers for cooling the transformers. The distributing board is divided into two sections—the primary section and the secondary section. Each section has six panels. In the primary section four of the panels are for the low tension side of the step-up transformers, the remaining two being for the local distributing lines in the vicinity of the power plant. In the secondary section four of the panels are for the high pressure side of the step-up transformers, and two for the long distance transmission lines.

Back of the distributing switchboard, and on a raised platform, are placed the step-up transformers. These transformers raise the potential of the current from 2,300 to 16,100 volts, at which pressure it goes on to the long distance transmission lines. The transformers are connected up in sets of three, the delta connection being used on both sides. At each end of the building in the gallery are placed the two blowers, directly connected to a 2½-H. P. 500-volt direct-current motor. These blowers are used in cooling the step-up transformers, and force the air up through the bottom of the transformers, around the coils and out at the top.

The transmission line is calculated to deliver about 3,000 H. P. at the sub-station in Salt Lake City, distant about 38 miles, and consists of two circuits, making six wires of No. 1 B. & S. gauge.

The poles used on this line are of Oregon cedar, and are good, clear, straight poles, 30, 40, 50 and 70 ft. long, with 9 in. and 10 in. tops. There are two cross-arms on each pole for the wire; two wires are on the top arm 4 ft. apart, and four wires on the bottom arm each 2 ft. apart, a circuit being on each side of the pole. These wires are so arranged that should a plane be placed perpendicular across the circuit it would show an equilateral triangle, with a wire at each angle, the length of the sides being 2 ft. These wires are transposed about every half mile. By this arrangement of the pole-line wire the inductive effect is reduced to a minimum.

About 6 ft. below the second cross-arm on the pole is a two-pin X cross-arm, on which the telephone wires are strung, being transposed about every four poles, there being an average of about 50 poles per mile.

The current is fed into the transmisson line at the power plant at 16,100 volts, and delivered to the step-down transformers at 13,800 volts. This will give an energy loss of about 10 per cent. in the line, and a potential loss of about 14 per cent. The sub-station step-down transformers deliver this current to the local distributing lines again at 2,300 volts. There are at present nine 250-K. W. step-down transformers at the sub-station connected by the step-up transformers, and the switchboard in the sub-station is similar in every respect to the distributing board in the power plant gallery. The cooling apparatus here is also identical with that used in the power plant, except that the motors used are 60-cycle induction motors.

While the transmission lines are at present capable of delivering 3,000 H. P. at the sub-station, with a 10 per cent. energy loss, if it should become necessary, the step-up transformers can deliver more than this by changing three wires on their high pressure side, and delivering the current into the transmission lines at 27,000 volts. Thus the line capacity would be more than doubled.

The present installation of the power plant is capable of delivering 3,750 K. W. to its lines, but ample provision has been made to increase this amount to 7,500 K. W. by installing five more 750-K. W. machines, as new industries or manufactures spring up as the result of the advantages offered to them in Ogden and Salt Lake City.

There is one important feature in the arrangement of the machinery which should be noticed, viz., the complete duplication of all parts. All portions of the plant below the breeches pipe-casting, at the lower end of the 6 ft. conduit, are absolutely symmetrical about the centre line of the power house, each side being entirely independent of the other. This applies not only to the pipe and the receivers, but to all the parts of the switchboards, etc., as well as to the generators and water-wheels. Either one of the exciters, also, is capable of providing sufficient current for all the large generators, and can be run with water from either receiver. The advantage of this arrangement is that an accident to either receiver, or to one or more wheels or generators, would not result in the shutting down of the entire plant, but, at the worst, of only one side. For a short period all the required power could probably be supplied from one side of the power house.

The current will be used to drive factories, running electric railways from Ogden to Salt Lake City, to the Lake, to the Springs, and to light the towns and cities in the north of the State. The surplus water in the storage reservoir will be utilized to irrigate large tracts of land in the vicinity.

The Pioneer Electric Company was organized November 27th, 1893. The president and treasurer of the company is the Hon. Geo. Q. Cannon, the intellectual and diplomatic head of the Mormon Church. The general manager is Frank J. Cannon, son of the president, and U. S. Senator from the State of Utah. The directorate consists of Wilford Woodruff, president of the Mormon Church; Joseph F. Smith, one of his counsellors; F. D. Richards, one of the apostles; Asahel Woodruff, and A. B. Patton, president of the Ogden Chamber of Commerce. Mr. Patton and the chief engineer and secretary, Mr. C. K. Bannister, are the only men among the directorate not members of the Mormon Church.

The conception and successful completion of the works belonging to the Pioneer Electric Power Company are largely due to the efforts of C. K. Bannister, M. Am. Soc. C. E., who, as chief engineer and secretary of the company, has devoted several years to the careful study of the engineering and financial problems involved. Preliminary surveys were made in 1894 and 1895, but it was not until the beginning of 1896 that the location of the plant was definitely settled and actual construction begun.

Eastman, Ga.—The Eastman Electric Light and Telephone Co., of which W. W. Ashburn is president; M. H. Edwards vice-president, and J. B. Caldwell, secretary-treasurer, will erect new electric light plant.

Sanford, N. C.—J. C. Williams desires correspondence with makers of electric plants.

MODEL PLANTS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

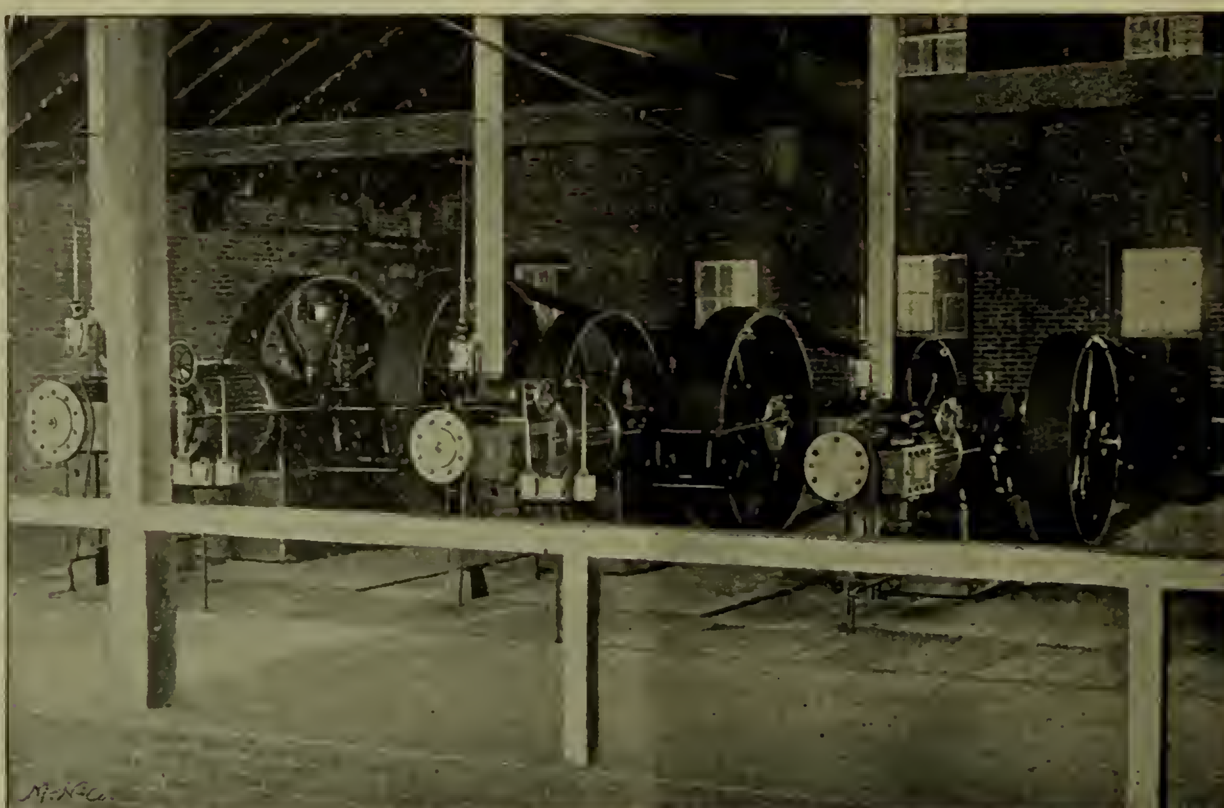
The expression "model plant" is self-explanatory. To the engineer, a perfectly equipped system of electric light appeals as strongly to his sense of beauty and idea of completeness as a work of art, of sculpture or of rare design. A harmony can exist in the engine room or station that suggests at once the touch of a skilled hand and comprehensive view of an experienced mind.

To construct a model plant is not only to set up an engine and dynamo on a substantial foundation, but to have in addition to these the latest and best accessories for its smooth running, its ready supervision and economical handling. A model plant should never be wasteful, as the very object of having an elaborate outfit is to prevent or reduce the expense of operation. A model plant should not be a source of constant bother; it should not necessarily include self-acting devices, which are too impractical and, therefore, unreliable for continued use. It has been discovered, in the majority of cases, that the beauty of a plant begins at the boilers and extends from there to the engine room. The essential parts of a model plant are—

An efficient boiler,
An automatic engine,
A self-regulating dynamo.

An efficient boiler can only be considered as such when its power of making steam is great in comparison with the weight of coal consumed. In all boilers a considerable quantity of unburned fuel escapes as smoke. Heat is wasted from the furnace, boiler shell, steam pipes, etc.; the very smoke that escapes is due to lost heat. An efficient boiler, as ordinarily understood, would be one a little better than the others. But supposing this slight gain in efficiency adds a great item of expense to the price of the boiler or ncessitates such extra labor that the additional efficiency becomes a plague and a nuisance. There is evidently no gain in using a boiler of this kind. Here is a statement which will give an idea of the amount of

(Continued on Page 40.)



A Model Electric Plant.

The Electrical Age.

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CONTENTS.

RISE OF THE ELECTRICAL INDUSTRY IN JAPAN AND THE FAR EAST.

It is not generally known by the American public that changes are occurring in Japan, China and Cochin-China which indicate that a period of renaissance has arrived. This nineteenth century renaissance is as important in its bearing upon their future as a condition of similar title was in earlier times to the great European world. It seems that barriers, whose existence dates back to pre-historic times, have crumbled away, and the entrance of the Western world into these old, yet comparatively new, lands will be swift and effective. The Far East has torn apart the shackles of tradition; it is no longer silent to the great Western world. The experience of centuries is pouring into its great cities, and its rulers have seen the birth of a mighty change. A new dynasty is about to begin, in which each subject shall rule his own province. Reason has supplanted ignorance, and that blind adherence to forms and useless traditions is being slowly but surely broken. Science has placed its standard in every stronghold, and a new period of life is beginning for these ancient countries and the free intellect of each man will be allowed to separate his future from his past. The walls that isolated China and Japan have been beaten down, and the most modern of industries is growing at a rate which promises well for each of them in the next half century. A distinct growth of the electrical industry in Japan and the Far East has been noticed by travellers and commented upon by engineers. Enterprise and ambition have so far succeeded in Japan that they have given issue to an electrical journal that speaks better for its originators than the first journals that occupied a similar position in our own enlightened land. "The Electrical Friend," of Tokio, Japan, acts as an excellent index to the state of trade and progress of all new and important inventions that, having developed in this country or England, have been placed upon this foreign sea. There is nothing stranger nor more impressive than the appearance of a page from "The Electrical Friend;" the latest designs of apparatus described in a tongue that antedates any known language on this earth.

It is probably extremely difficult for the Japanese to invest our technical phrases with the proper dignity, or to give full meaning to words commonly used by us, and which are new and incomprehensible to any but those of experienced and technical education. There is no doubt but that Japan is today a new and great field for all sorts of electrical enterprises, and there is still less doubt but that its colossal neighbor, China, will not forget its lesson of last year and hurry as speedily as possible in the footsteps of Japan. While there is not very much being done of an electrical nature in China, several large electric railway schemes are being discussed and Consul Read sends word from Tientsin that a month or so ago the Imperial Railway opened forty new miles of track beyond Shan-hai-Kwan. The terminus of this new stretch of road is Chung-hou-so. This makes the entire length of road from Tientsin to Chung-hou-so two hundred and fourteen miles. A new line from Tientsin to Pekin is about to be opened up for public use very shortly. We mention these facts in order to act as courier for the news to supply houses and manufacturing concerns, that by securing connections to either of these countries while trade is thus ripening, they will be able to secure the return that can never be found at present in the crowded fields of industrial effort.

The Westminster Gazette, commenting upon the small number of motor cars seen upon the streets of London, attributes the fact to the dearth of skilled drivers. From January 1, 1897, in England, it is proposed to license motor cars; every one of these vehicles between one and two tons will have to pay two guineas ($10.21) and between two and three tons in weight, three guineas ($15.32), in addition to the present carriage duty. Furthermore, it would seem that every self-propelled bicycle and tricycle will be liable to a license at the rate of one guinea ($5.11) per annum. For cars over one ton and under three tons, a guinea ($5.11) will have to be paid unless they are used as public vehicles, when the present hackney carriage rate of 15s. will be applied. The public 'bus of the future will be charged £1 17s. ($8.94) or £3.18s. ($18.92), according to weight. The weights will be on the unladen vehicle and exclusive of accumulator, water, and fuel.

RESULT OF SIX INSERTIONS OF AN ADVERTISEMENT.

JAMES H. MASON COMPANY,
Electric Motors, Fans, Batteries and Supplies,
67 Liberty Street, Brooklyn, N. Y.,
June 22nd, 1897.

Electrical Age, World Building, New York.

Dear Sir: Enclosed please find check in payment of our account for advertising in your publication. We are more than delighted with the results thus far. We are in a position to appreciate a good advertising medium, and as our experience in such matters is extensive, we are only too glad to acknowledge a good paper when we find one. Such we recommend your paper to be.

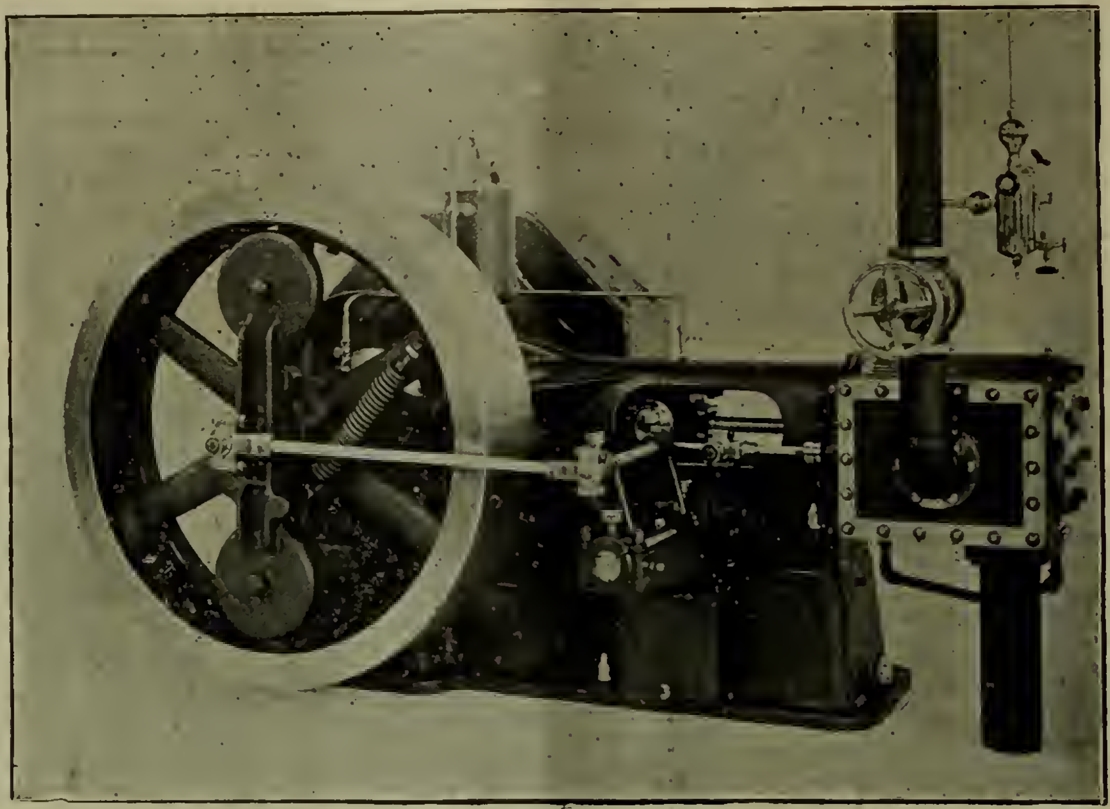
Wishing you continued success, we remain,

Yours very sincerely,
JAMES H. MASON CO.,
JAMES H. MASON, President.

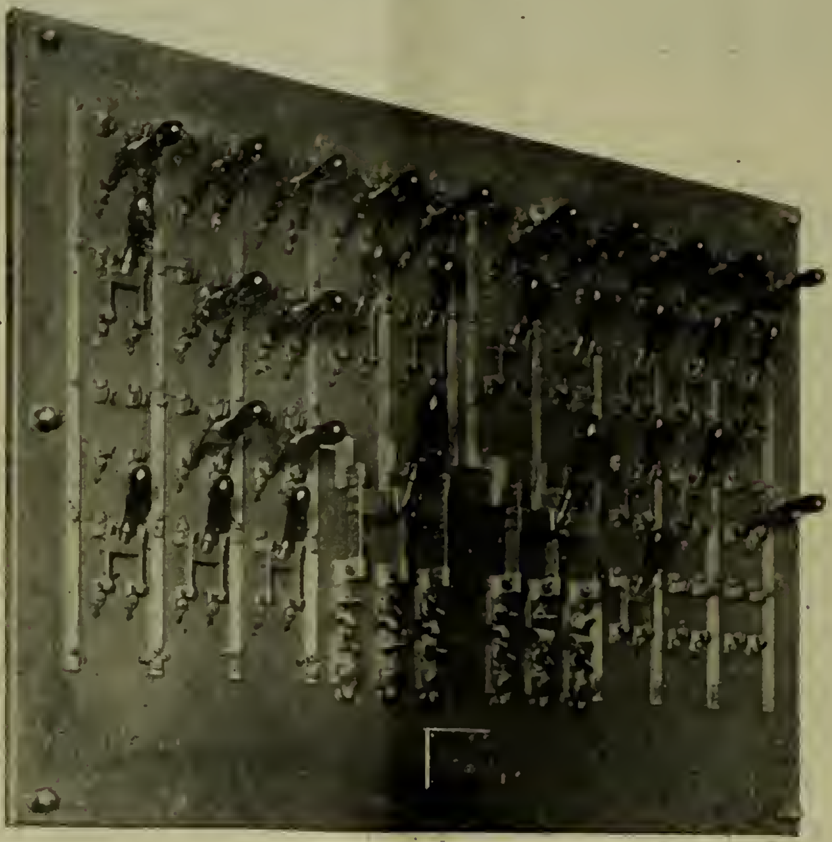
We have a copy of a list of over 400 names of people and firms who saw the advertisement of the James H. Mason Co. in the Electrical Age and wrote for a catalogue.

power wasted between the furnace and the engine: "It has been satisfactorily demonstrated that in the very best engine, even if it were theoretically perfect, and working at ordinary ranges of temperature, only somewhere about one-fourth of the heat which is actually employed is converted into work; that is to say, three-fourths of the coals, or three-fourths of the heat employed, are absolutely wasted under the most favorable circumstances." Boilers are on the market today which are far superior to any previously introduced, which may use culm, the cheapest product of the mine and in cheapness and serviceability highly commendable. The weight of coal consumed for a given quantity of steam can be otherwise put as the weight of coal consumed for a given amount of energy — so many pounds per horse-power hour. About two and a half to three pounds per H.-P. hour is the best point reached in practice with triple expansion engines. The weight of coal may increase as high as five or six pounds per H.-P. hour in poor engine equipments.

An automatic engine is one which can regulate with changes of load; that is to say, keep its speed constant. This is very necessary with a dynamo attached, as a reduction of speed with an increase, or a raising of speed with a decrease of load would mean either a poor light from the lamps or an exceedingly bright light from them. The poor light fading with each new circuit thrown in, the bright light becoming dangerously stronger, to the detriment of its filament with a higher speed, due to the lesser load. A model plant must therefore have an engine of uniform speed, and as unchangeably so as possible. It must have an efficient boiler, which is clean and provided with the proper attachments for its protection, and the necessary heating surface, so as to burn its coal economically and well.



Direct-Connected Model Electric Light Plant.



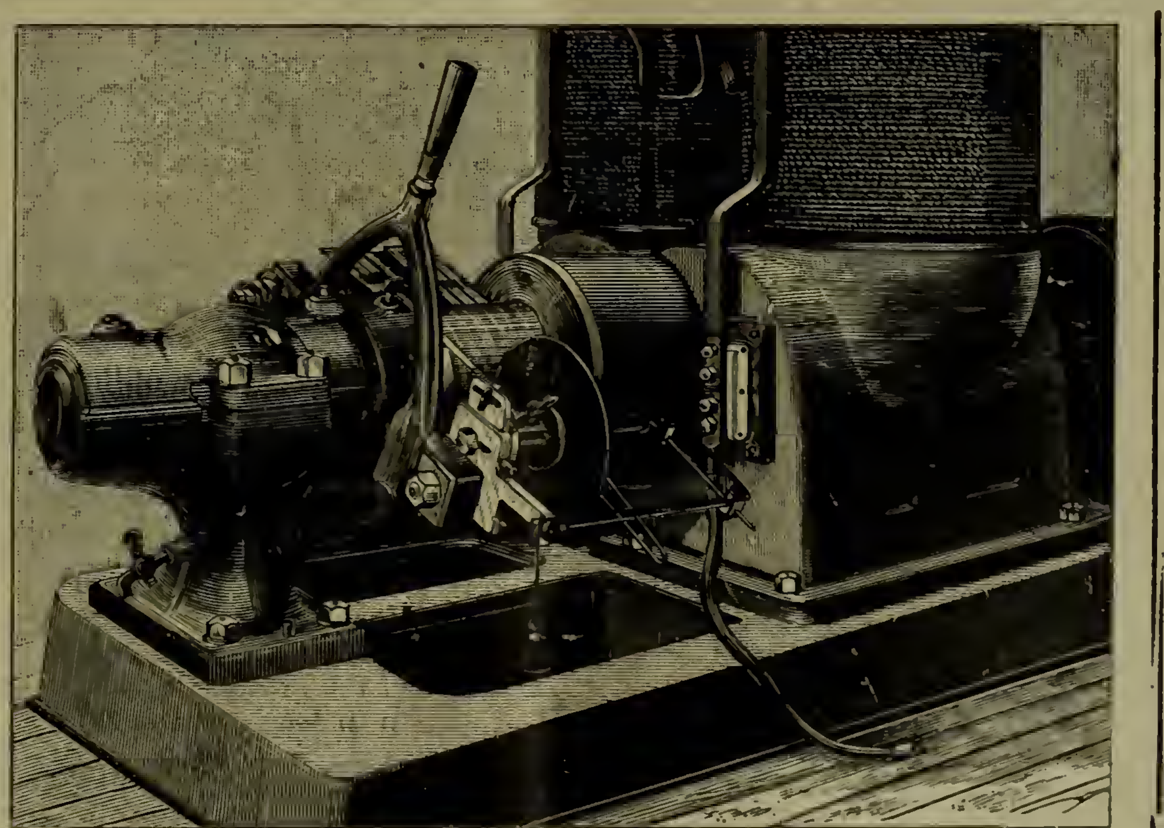
Panel Board for Centre of Distribution—32 Circuits.

A self-regulating dynamo can only be called by that name if it fulfils the functions expected of it—if it sustains one pressure throughout all changes in the lights; if it is automatic; in other words, if it regulates. The best machines of today are of the multipolar type. They are not model machines, and cannot be considered a desirable addition to a model plant unless they regulate; do not heat, either in field armature, bearings or commutator, and do not spark at the brushes. A dynamo from a mechanical standpoint is a simple piece of mechanism. It is not difficult to attain comparative perfection in this respect, and such perfection is essential.

Panel Boards.

The electrical designer must provide the proper surfaces and cross sections for the radiation of heat. The current squared multiplied by the resistance in fields and armature respectively give the value of this in watts. The good design of a dynamo greatly depends upon the ability of its armature to radiate heat. Sparklessness is a feature which above all things should be absent.

A model plant can but begin to be such when a boiler, engine and dynamo meet these purely practical demands herein outlined. A switchboard containing voltmeters and ammeters, automatic cut-outs and ground detectors; a system of switches which places every circuit of consequence under the engineer's control, completes so necessary an adjunct to a complete plant. It becomes a model plant when the room is lofty and well lighted; when the engine and dynamo are upon solid foundations; when vibration is entirely absent and only the low murmur due to the perfection of such mechanism reaches the experienced ear.



Addition for Isolated Plants—A Device for Turning Off Commutators—Cummings Patent.

RECENT PROGRESS IN ARC LIGHTING.

BY ELIHU THOMSON.

(Continued from page 22.)

By shunting each lamp in the series by a specially constructed and carefully proportioned reactive coil, wound upon a laminated core, the difficulty just pointed out is obviated with but small sacrifice. The reactance of the shunting coil is adjusted to give, when two or three amperes of current traverse it, a potential between its terminals just sufficient to work the arc lamp which it shunts, and the gauge of wire of the coil must be ample to carry the full current of the line, for, in this case, the arc lamp is extinguished by simply open-circuiting it, while leaving the reactance in circuit. It is also necessary that the iron core of the coil shall be at, or near, magnetic saturation when the arc lamp is burning, so that its reactance shall not greatly increase when, by accident, the lamp fails to feed or it is purposely open-circuited, and the coil has to carry the full line current. In such a series, provided with shunting reactances, the ordinary series magnet in the lamp, for separating the carbons to form the arc and regulating the same, is all that is needed, since the variations of current alone are sufficient to serve the purpose, no shunt or differential magnets in the lamp being called for. It will be understood that the apparent energy consumed in the reactances is not, in fact, wasted, for the phase relation of the current is such as to make the current in the coils approach a wattless current or one with a low-power factor. For example, a coil which shows two and one-half amperes of current and thirty volts, or approximately seventy-five watts, may in reality not consume more than ten to twenty watts. Another way of accomplishing even a better result, but one which requires that shunt or differential magnets be used in regulating the feeding of the carbons is to substitute, by a special switch, a proper reactance in place of the lamp when it is to be cut out, and also to cause the lamp, on a failure to feed, to cut in as a substitute for itself this reactance. In such a case the construction of the reactance may be such as to waste very little energy, but the existence on a system of a considerable number of arc lamps and many reactances, which would be the case when a large proportion of lamps were cut off, would have the effect of loading the system with inductance to an extent which might interfere with the proper regulation of potential at the generator. In any case, these systems of working may be set aside as not having reached any decided commercial importance. They are mentioned here by way of comparison, as they present instructive features.

When a transformer is so constructed that there may be a considerable magnetic leakage, as it is termed, between the primary and secondary coils, it approximates what is called a constant-current transformer. It will, if connected by its primary terminals across mains at constant potentials, give a secondary current which, even at short-circuit, is only a moderate percentage in excess of that given when the secondary is carrying a considerable load.

In fact, such a transformer has an analogy, which is unmistakable, to a direct-current arc machine with a drooping characteristic, before alluded to. When, however, the amount of magnetic leakage in the transformer is carefully proportioned, or when, as in the rectifier transformer with repelled movable coils, the leakage is allowed to adjust itself, a substantially unvarying value of alternating current is delivered at all loads from short-circuit up to the full load, or highest available working potential. The transformer then resembles an arc machine with an instantaneously acting and perfect regulator, or such a machine with a characteristic curve which droops vertically. This would mean the preservation of the same current at all potentials. By properly proportioning an alternating-current dynamo, the same property of constant current has been given to the machine.

For arc lamps in series on alternating current, this constant-current property is perfectly adapted. But in this case the regulation of the lamp must be by a shunt magnet responding to the potential across the arc, and not to the current passing through it, which is constant. Of course, the shunting reactances before mentioned might be used, but these would have no particular function in this case, since the system of supply permits free shunting of the lamps, and the current is the same even down to short-circuit. Numbers of lamps were installed years ago by the Thomson-Houston Company, and worked in the way indicated, the transformers being of approximate constant-potential property, but the writer does not know to what extent they are still in use. That the system is not entirely dead was indicated by a recent demand for additional transformers of the same type, though for quite a period none were supplied or asked for. The system has its merits, like the series arc system with direct currents. It does not demand the highest grade of carbons, and the lamps are not liable to chatter at starting.

Further consideration of the nature of an alternating arc in relation to the light-giving effect, and to the mechanism which must be used to control the lamp, carbons, etc., will be given later.

We may now consider the use of single arc lamps on the various circuit arrangements adapted to their supply. With the ordinary constant-potential, continuous-current circuits of about 110 volts, it is manifestly not desirable to operate a single lamp, taking, say, from forty to fifty volts, and waste the remainder in resistance; yet oftentimes it is quite undesirable that two lamps in series be connected to the mains, on account of the inability to use one or both, ond one may be quite enough. The gap is filled by the "inclosed arc," and, at the same time, the necessity of frequent trimming, a disadvantage with the open arc, is obviated. The inclosed arc lamp, broadly speaking, is an outcome of the ability to secure very nearly pure carbons, or carbons containing little or no ash, and particularly free from such metals as iron, the oxides of which are deep black or brown, which would soon obscure the small globe around the arc.

The inclosed arc of today merits more than a passing consideration, on account of the general interest which has arisen in regard to it among electric light engineers. The idea of burning an arc in a practically closed and relatively small glass chamber is quite old. It was known also that the carbons would burn blunt or nearly square on the ends, and would require a relatively wider separation to let the light out; that they could be made to burn relatively more or less pointed by letting in more or less air. Early experimenters in this field were met at the outset by the serious difficulty of obscurations of the inclosing vessel by deposits generally brownish, and probably due to oxide of iron, the iron being present in the graphitic carbon used in forming the carbon sticks. The writer met this difficulty in 1879, and for many years after that date there were not to be found such pure carbons as would give so little deposition as is required to work an inclosed arc practically.

Curiously enough, as late as about 1890, there was a revival of the inclosed arc as applied to arc light circuits in place of the ordinary series arc lamp. The sealing of the arc, so to speak, was such that about sixty-five volts were required to work it. A saving of carbons was effected, but the number of lights obtainable from an arc dynamo of any given capacity was seriously reduced, as was also the commercial value of any arc-light line whose potential was limited either by law or circumstance. Contrary to the original expectation of its promoters, the use of inclosed arcs on series circuits did not progress rapidly and soon retrograded. Many causes, besides the one of reduced capacity of lines, had undoubtedly an effect. Cheap carbons for open arcs, impure carbons for inclosed arcs, breakage of inner globes—resulting in rapid consumption of carbon—obscuration of light, etc., must have contributed largely to the result.

When it is remembered that, to get the best results with arc lamps on constant-potential circuits, the use of rather expensive cored carbons is necessary, the saving of carbon and frequent trimming becomes a very important item and permits the employment of more expensive carbons, provided they last long enough. The high voltage demanded by the inclosed arc was soon seen to be not a disadvantage, but a positive advantage for constant-potential circuits, inasmuch as it permitted the use in one lamp of a larger fraction of the total—generally 110 volts. Hence, instead of keeping down the potential, it could even be raised from sixty-five to seventy-five, or to eighty volts with advantage. In fact, it may be that the exclusion of oxygen has the effect of enriching the arc-flame itself, in much the same way that a slightly luminous blue flame of a Bunsen burner becomes far more luminous by cutting off the air. There may, in fact, be free condensed carbon particles in the outer layers of the arc-stream highly heated and, therefore, strongly luminous. The flat ends of the carbons tend also to cause the hot gases to be retained under the positive end, thus extending the heat of the crater and increasing the luminosity. The result of the almost complete exclusion of oxygen is that very little combustion takes place, and the life of the carbon is therefore much extended. The function of the small glass vessel around the arc is not only to keep out the air, but, in addition, to act as a diffuser of the light evolved, and in this sense replace to a considerable extent an opal outer globe of large dimensions, necessarily thick and highly absorptive. The inner globe around the arc is made thin, to withstand heat without cracking from sudden changes of temperature, and is generally of clear glass with a thin coating, either internal or external, of an opal or alabaster-like glass, which, by the materials employed in its composition, gives a large diffusive effect without undue absorption. The inner globe is often also given a yellowish color or absorptive effect for the disagreeable violet rays, of which the long arc-flame is so strong a source.

(To be continued.)

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—USE OF TIDES FOR POWER.

Newark, July, 1897.

Electrical Age Pub. Co.

Dear Sirs: I am applying to your Inquiry Column for information regarding the power of tides. There seems to me to be a great deal of power wasted each year which could be utilized in a thousand and one ways for electric lighting, etc., if properly managed. Have tide motors ever been used, and if so, what success has been met with? By answering this question in a general manner you will greatly oblige,

Yours respectfully,
R. J. Lang.

(A.) Tide motors have been tried at various times with mediocre success. They have not been perfected sufficiently to insure their general adoption; but what you say about the power wasted annually which could be applied to some good purpose through their medium is very true, and its truth has been the cause of a series of unique inventions, which have for their object the use not only of the tide but its ebb and flow and the force of the waves. Millions of horse-power are virtually knocking at our very doors and we are glad to see that you have become impressed with this fact. He that invents a device that will utilize this greatest of natural forces will confer a lasting benefit upon mankind.

Q.—ARMATURE REACTION.

Pittsburgh, July, 1897

Electrical Age.

Dear Sir: If a dynamo sparks worse and worse with a heavy load, though one within its stated capacity, could you attribute this effect to armature reaction or self-induction? The brushes are well set, that is, their present position is one of least sparking though, as I say, even at this point the sparking is very severe. What can you judge from this scrap of information, and which would you adopt as the most reasonable conclusion?

Yours truly,
Charles Wright.

(A.)—Sparking, which you believe to be due to self-induction or armature reaction, might have some other cause at the bottom of it. Accepting your opinions as to its cause as correct we then examine either or at least give you a means of determining whether one or the other exists. A single test will decide this point. To begin with, the color of the spark due to self-induction is characteristic of that trouble. If the neutral point is so badly situated that, by poor design sparklessness is unobtainable, a bluish spark will appear, which is of an inductive nature. The distinction you make between the causes of sparking are not so well defined as you may think. Self-induction, armature reaction, etc., are first cousins to each other and usually exist together, representing collectively symptoms instead of separate and distinct causes, although at times one does preponderate over the other.

Q.—ELECTRIC FORGING.

Niagara, July, 1897.

The Electrical Age.

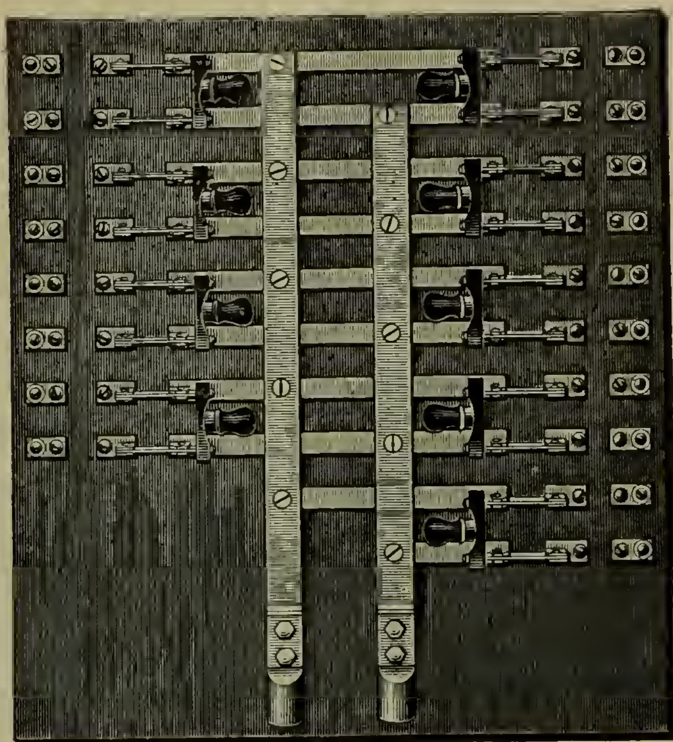
Dear Sir: Having made up my mind to adopt electricity for forging and welding in my shop, if it is even suggestively good, I take this opportunity of inquiring into its cost so that when once adopted I can see my way clear to its continued use. Any information you may have to give will be greatly appreciated by a reader and practical man.

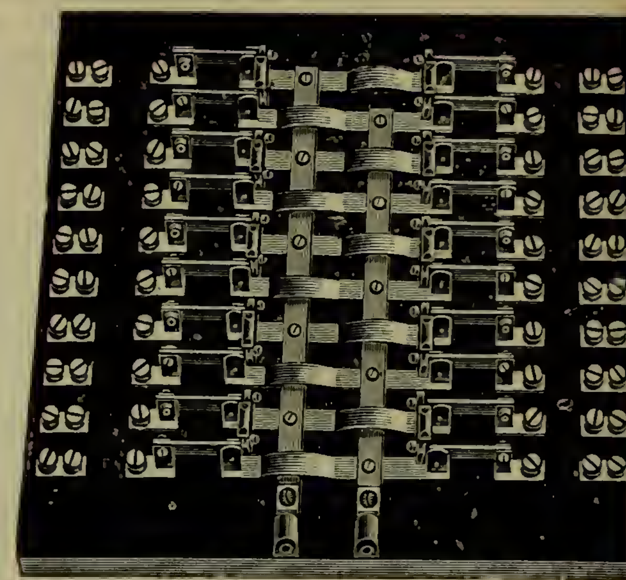
Yours sincerely,
Edward Sims.

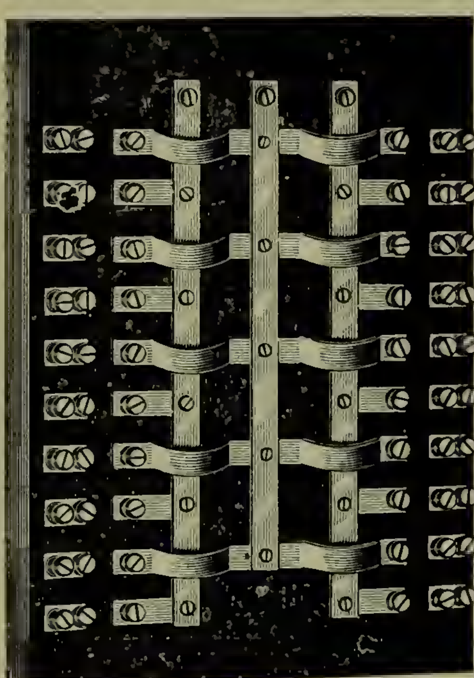
(A.)—Mr. Geo. D. Burton may be written to regarding his achievements in this line of work. Or a practical horseshoer, Wm. Patterson, 415 Main street, Niagara Falls, N. Y., now using electricity for the purpose you describe. It takes eight seconds to heat a piece of iron one quarter inch square in cross-section; one minute if one inchsquare. The cost is one-quarter cent for current. A horseshoe heated by coal costs 5.58 cents; by electricity the expense does not exceed 2.32 cents.

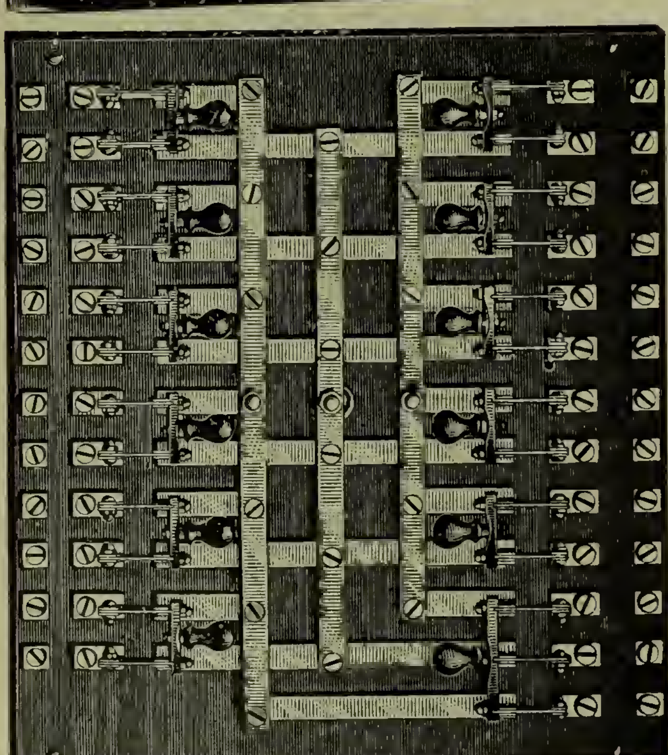
SWITCHES AND PANEL BOARDS.

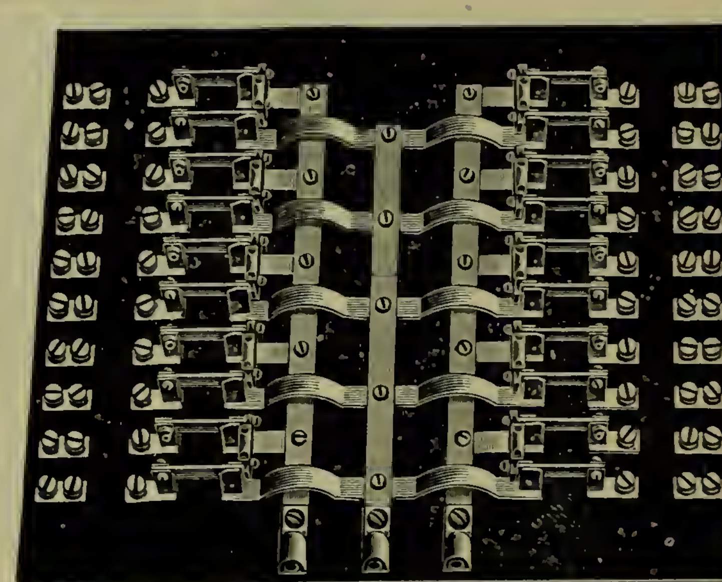
The equipment of large buildings with electric light apparatus has become so important a department of electrical engineering, that the most particular attention is now paid to each special branch of it. The design and construction of switches and panel-boards requires considerable experience on the part of the manufacturer, a knowledge of wiring, and the best method of running circuits to or from a given point. This unique industry has been greatly developed by the firm of J. Jones & Son, 67 Cortlandt street, New York. Their Brooklyn factory is under the charge of J. Jones, Sr., superintendent of the manufacturing department, in which they make and finish all of their own panel-board connections, panel-board switches and switchboards. J. Jones, Jr., is treasurer and buyer, and E. A. Low is manager. The three members of this firm have had many years' experience in this business; J. Jones, Sr., has been established for over thirty years, and his son has been by his side since boyhood. Mr. Lowe formerly representod the Western Electric Company, and











Three-Wire Main, Two-Wire Branches.

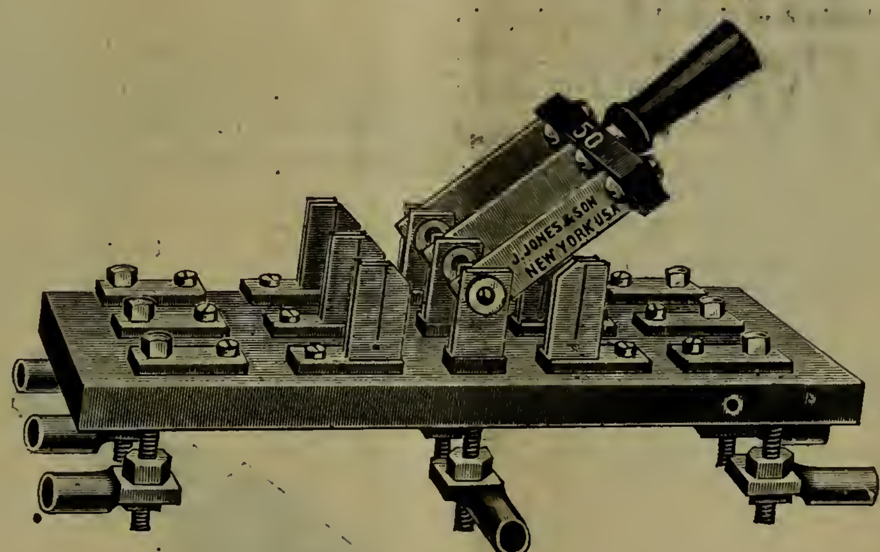
Two-Wire Main, Two-Wire Branches.
Three-Wire Main, " "
" " Two and Three-Wire Branches, all back connections.

Two-Wire Main, Two-Wire Branches.
" " " "
Three-Wire Main, Two-Wire Branches.

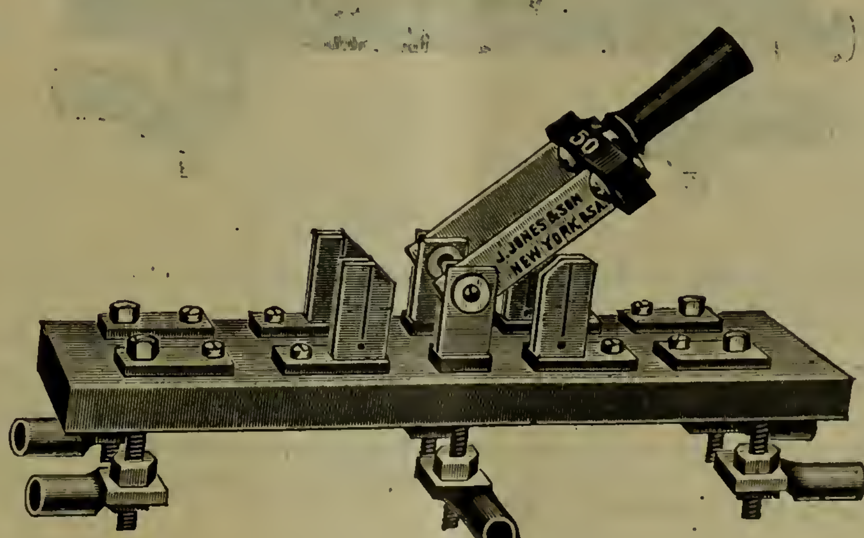
has gained, in common with his colleagues, experience of a ripe order. The oldest and best buyers in the States are their best friends, and this business intimacy has been of mutual value and benefit. The ability and judgment of this firm was well shown when they bought up the stock of the old A. B. C. Company, and made such a successful hit in disposing of it. Many an electrician was benefited thereby, and became better acquainted with the business integrity of this enterprising concern. All sorts of electrical apparatus can be procured in their establishment, from a push-button to a dynamo, and installation work is attended to in detail by them. The panel-board and switch construction referred to in the beginning of this article has been systematically carried out. Illustrations delineating their general appearance are placed before the reader's eyes. Style AA, fitted with all copper, single-break switches, all the metals in circuit being copper, with joints on bus-bars soldered and secured by screws, first meets with our notice. Ample cross-section is allowed right through, lugs be ng made with large contact surfaces. The metal work in this panel-board is all mechanically perfect and true, having highly polished finish, and is mounted on polished black, enamelled or marbleized slate. Style A is of the same construction and appearance as style AA, but has no switches. Style BB marks a new departure in panel-board manufacture. In accordance with style AA, it is fitted with copper, single-break switches, and all the metal in the circuits is copper. The important feature is the "Jones' patented type of bus-bar connection," providing the least possible resistance in joints, and immeasurably increasing the conductivity.

Two-Wire Main.

This panel-board presents a very fine appearance, and is put upon the market as the handsomest, most efficient and cheapest type of panel-board yet manufactured. With their improved type of handle they avoid all chances of making contact with the fingers on the bus-bar, and thus relieve the operator from considerable nervousness. The style BB2 is like style BB, having instead of the all-copper style the regular baby type of switches. Style B, similar to style BB, minus the switches. Style C was designed with the purpose in view of supplying a panel board that would be cheaper than any of the others. Being well proportioned, it has ample carrying capacity and is very well constructed. Brass metal work is used, mounted on plain slate. The branches are so arranged that all the positive poles are on one side, and those of opposite polarity on the other. A great variety of switches

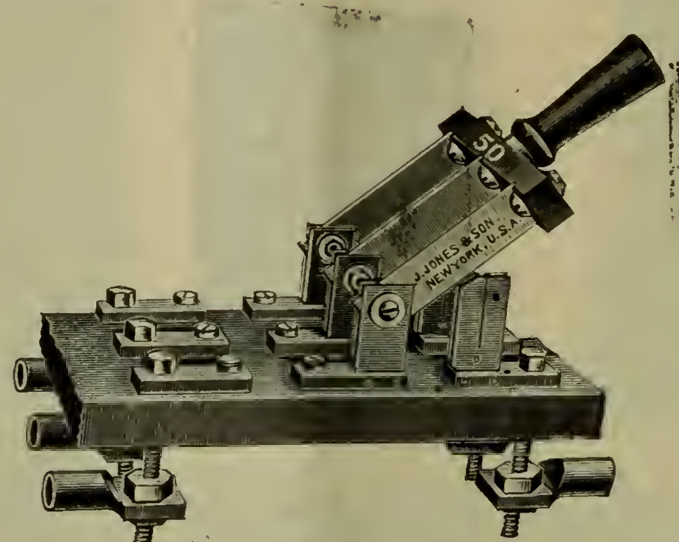


Triple Pole, Double Throw.



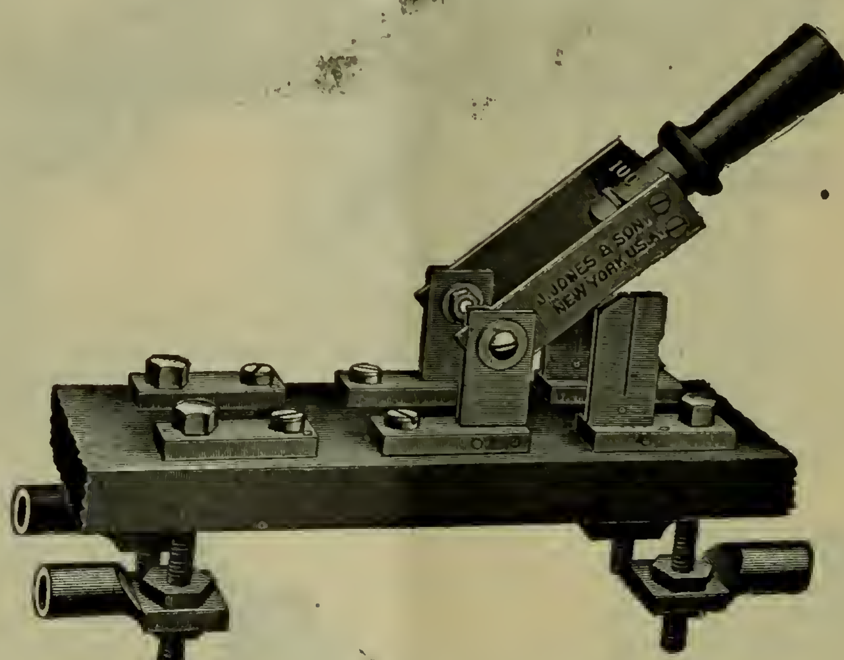
Double Pole, Double Throw.

are manufactured by this concern which, for lack of space, we cannot describe in detail. The capacity of their switches range from fifteen to eighteen hundred amperes. They are of the all-copper style, well finished and substantially made, with or without fuse connections. They make a single pole, single throw, and of the baby-type single pole, double throw. A double pole, single throw; triple pole,



Triple Pole, Single Throw.

single throw; single pole, double throw; double pole, double throw, and triple pole, double throw, are likewise manufactured by them. All of these types are duplicated under the head of baby type. This concern likewise furnishes switchboard slabs of any size; likewise slate and marble. The slate being used for miscellaneous purposes and the marble for a bon-ton switchboard. The rush of orders that this firm have received of late gives promise of a great and extensive business in the future.



Double Pole, Single Throw.

THE INDUCTION FACTOR; A NEW BASIS OF DYNAMO CALCULATION AND CLASSIFICATION.

By Professor Chas. A. Carus-Wilson,
Montreal, Can.

The contents of this paper are, for clearness, divided into sections, as follows:

I. Definition of the *induction factor* and methods of determining it experimentally.
II. Definition of the *force factor*, with examples.
III. Use of the *induction factor* in Dynamo *calculation*. Motors running at a uniform speed. Examples: Street railway motor; elevator motor.
IV. Motors running at a varying speed. Examples: Elevator motor; street railway motor.
V. Use in special design. Example: The motors on the Baltimore & Ohio Railroad.
VI. Use of the *induction factor* in dynamo *classification*. Comparison of two generators of equal kilowatt output and of two motors of equal horse-power.
VII. Classification into types depending on the form of the force factor curve, with examples.

SECTION I.

If a dynamo has A conductors on the surface of the armature, N lines of force per pole and p pairs of poles connected in series, the torque in inch-pounds for C amperes passing through the dynamo can be written

$$t = 1.41\ p\ C\ A\ N\ 10^{-8} \qquad (1)$$

When N is a constant quantity, the only variable in this equation is C; so we can write

$$t = 1.41\ C\ M \qquad (2)$$

where M depends simply upon the number of conductors on the surface of the armature, the number of lines of force per pole and the number of pairs of poles connected in series, and can be expressed thus:

$$M = p\ A\ N\ 10^{-8} \qquad (3)$$

If the armature rotates uniformly at n revolutions per second, the induced volts can be written

$$e = p\ A\ N\ n\ 10^{-8} \qquad (4)$$

Thus $M = \frac{e}{n}$ and may be defined as the induced volts divided by the number of revolutions per second; we may call M the *induction factor* of the dynamo.

Read before the National Electric Light Association, at its Twentieth Convention, held at Niagara Falls, N. Y., June 8, 9, 10, 1897.

We must not suppose that, because M can be defined as the induced volts divided by the revolutions per second, it necessarily depends in any sense on the motion of the armature. Equation (3) shows that M depends only upon the number of conductors, the lines per pole and the number of pairs of poles connected in series, and this equation holds true if the armature is at rest, and does not in any way involve the speed.

The induction factor can be determined experimentally, either by observing the torque for a measured current, or the induced volts at a measured speed; the latter method is the most useful, as the necessary observations are so easily made.

Example 1. We wish to know the torque on the shaft of a direct-coupled generator when delivering a current of 300 amperes. We see by the tachometer that the speed is 400 revolutions per minute, while the voltmeter reads 120 volts on open circuit; dividing the volts by the revolutions per second, we at once find the induction factor to be 18, and the required torque $1.41 \times 300 \times 18$, or 7,610 inch-pounds. Thus, by simple inspection of the tachometer and voltmeter, we can ascertain the forces acting in the machine for any given current in the armature.

If the voltmeter can be read only when a current is passing in the armature, we must, of course, make an allowance for the internal drop, since the value of e used in determining the induction factor is the true induced volts.

Example 2. We have to find the pull on the belt driving a railway generator, the pulley having a diameter of forty inches. The tachometer reads 440 revolutions per minute, while the voltmeter indicates 550 volts, the ammeter reading 400 amperes. Neglecting the internal drop, the induction factor appears to be seventy-five, so that the pull on the belt is given by $1.41 \times 400 \times 75 \div 200$, or 2,110 pounds. If now the internal resistance were 0.0375 ohms, there would be an internal drop of fifteen volts, so that the true value of the induction factor would be seventy-seven, and the actual pull on the belt fifty-six pounds more than we had estimated. The pull thus calculated is, of course, that due to the current in the armature, and does not include that required to make up the core and friction losses.

(To be Continued.)

WIRE GUARDS.

The manufacture of wire guards has been on the increase ever since electric lights and fans came into popular use. It is curious to realize that the birth of one industry brings into existence others of an equally important nature. That this is true of the fan guard and lamp guard trade no one with powers of observation will deny. The electric fan in particular would be a highly dangerous piece of mechanism to have around if it were not for the protecting fan guard, which saves countless fingers from destruction when in the proximity of the rapidly revolving blades.

Wire Guards and Trade Mark of the S. Joseph Ornamental Wire Works.

The S. Joseph Ornamental Wire Works, 45 Washington Sq., South, N. Y., are the manufacturers of wire guards for gas jets, incandescent lamps, electric fans, etc. They have been procuring new and expensive machinery of late for the purpose of putting upon the market guards finished in the most approved style as regards workmanship, appearance and durability.

They are the oldest firm in the business, and the high standard of their work has never been questioned. Some of the accompanying illustrations are indicative of the progress they have made in the especial capacity of guard manufacturers. The designs are ingenious and highly satisfactory to consumers, combining lightness of weight with appropriate ornamentation.

The S. Joseph's improved gas light protector is especially designed for factories, packing, shipping and work rooms, storage and warehouses where inflammable matter may come in contact with an open light or flame. These globes are made in sizes of from 7 to 10 inches in diameter, being the cheapest and most durable on the market.

Irvington, Ind.—Town Clerk may be addressed concerning electric light plant.

J. L. Chapin, 50 East 20th street, New York, the well-known electrical contractor, electrical engineer and expert, has fitted out some of the finest hotels, apartment houses, dwellings, etc., in this section with complete electrical equipments. His specialty is wiring for light and power, and the sale and installation of gas and electric fixtures.

Some of the most important buildings equipped by Mr. Chapin are the Queen office building, down town, for 1,500 lamps, etc.; apartment houses from 113th to 114th streets and Manhattan avenue, 1,000 lamps; the Madison Park, Madison avenue and 25th street, 1,500 lamps, and many others of well-known names.

Wire Guards manufactured by the S. Joseph Ornamental Wire Works.

H. KRANTZ, manufacturer of electric switches and outlet boxes, has moved from 628 Fourth avenue to Ronald Building, corner of State street and Boerum Place, Brooklyn, N. Y. Mr. Krantz found it necessary to move his factory to larger and more convenient quarters. He makes complete switchboards, equipped with his own make of switches for all carrying capacities. The isolated electric-light plants installed in the largest buildings in New York City and vicinity are equipped with his switchboards. When the writer called he had a large staff of fine machine hands at work and a large body of men assembling switches and setting up switchboards, besides his specially constructed outlet boxes. Mr. Krantz has exported over $7,000.00 worth of machines for general work. They include milling machines, monitors, universal cutter-grinders, lathes and shapers. He is now placing orders for a 3¼-inch spindle monitor, 36-inch pulley lathe, a 12-foot planer and transverse shaper, and a drill press.

HARRY SHAW, 126 Liberty street, N. Y., manufacturers' agent, has taken larger quarters and is carrying a full ssock of Partridge carbon brushes for motors and dynamos, ready for immediate delivery. Universal lightning arresters are selling well, likewise the commutator segments, of which he has many sizes in stock, and commutators. Mr. Shaw makes a specialty of duplicating all parts of dynamos, motors and all kinds of electrical apparatus.

Geo. D'Infreville, electrical engineer and expert, 10 Desbrosses street, New York, has an extensive line of printing telegraph machines, registers, motors and valuable apparatus useful to inventors and novices.

ARE YOU GOING TO LA CROSSE?

Next week's meeting of the Northwestern Electrical Association promises to be very attractive and well attended. You ought not to miss it. I have secured a round-trip rate of one-and-a-third fare from Chicago, but must buy all the tickets together, so be sure to get yours through me.

Special sleepers will leave via Chicago and Northwestern Railroad at 10:15 Tuesday Evening, July 20. Shall I reserve a ticket and berth for you? Please let me know at once.

George Cutter,
Local Transportation Manager,
1104 The Rookery, Chicago.

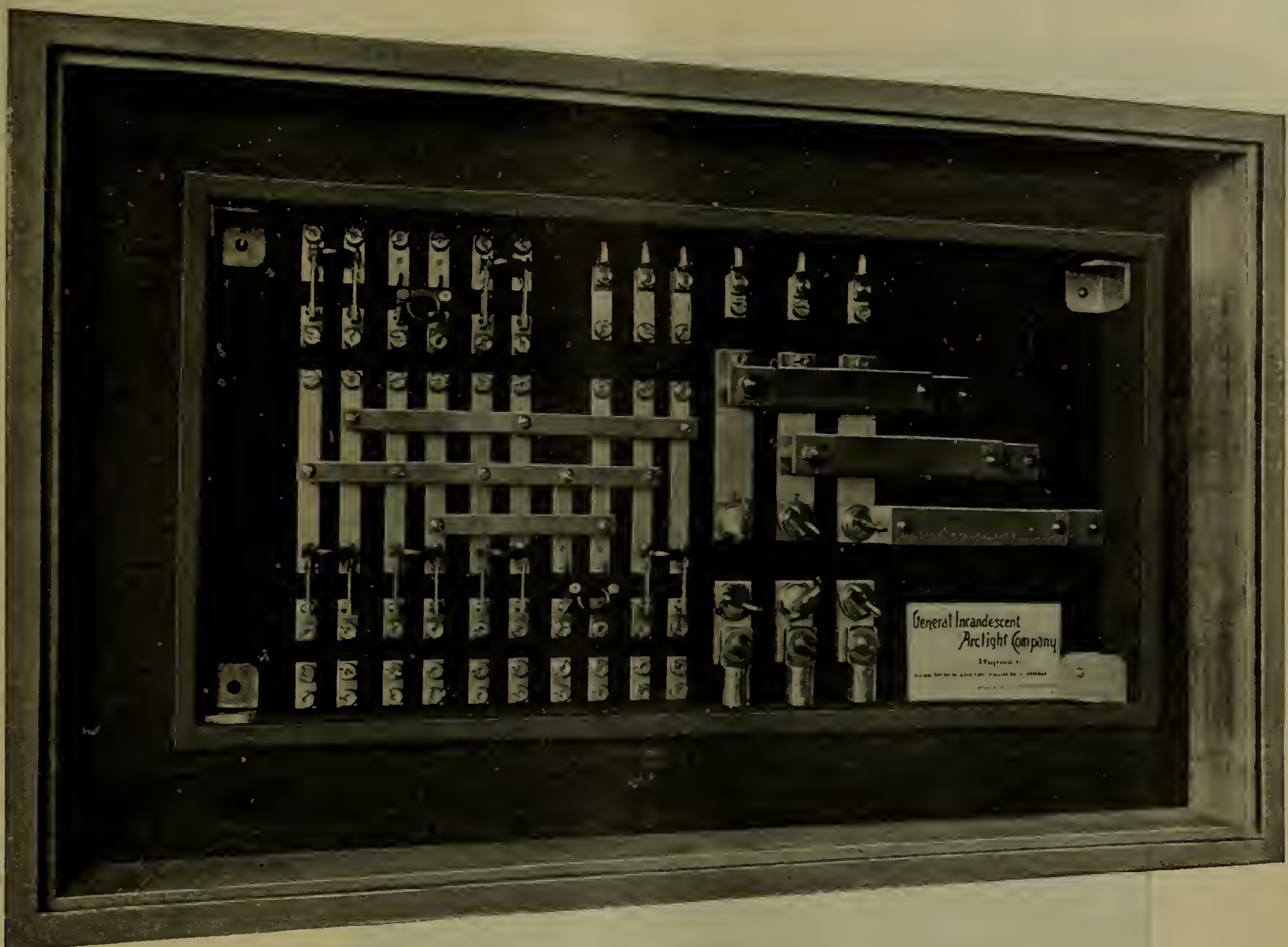
Norton, R. I.—The Norton and Attleboro Electric System will erect new power stations at Barrowsville, and four electric roads are projected to meet at this place.

Jackson, Miss.—C. W. Howard, of Chattanooga, Tenn., can give information concerning proposed construction of an electric power-house.

Brookhaven, Mass.—Address the Mayor concerning erection of electric-light plant, for which $40,000 worth of bonds will be issued.

The Electrical Age.

Vol. XX., No. 4 NEW YORK, JULY 24, 1897. Whole No. 532



Panel with 3-Wire Bus-Bars, Meter Connections, Fusible Feeder Terminal Connections and 2-Wire Branch Circuits

SWITCHBOARDS AND PANEL-BOARDS.

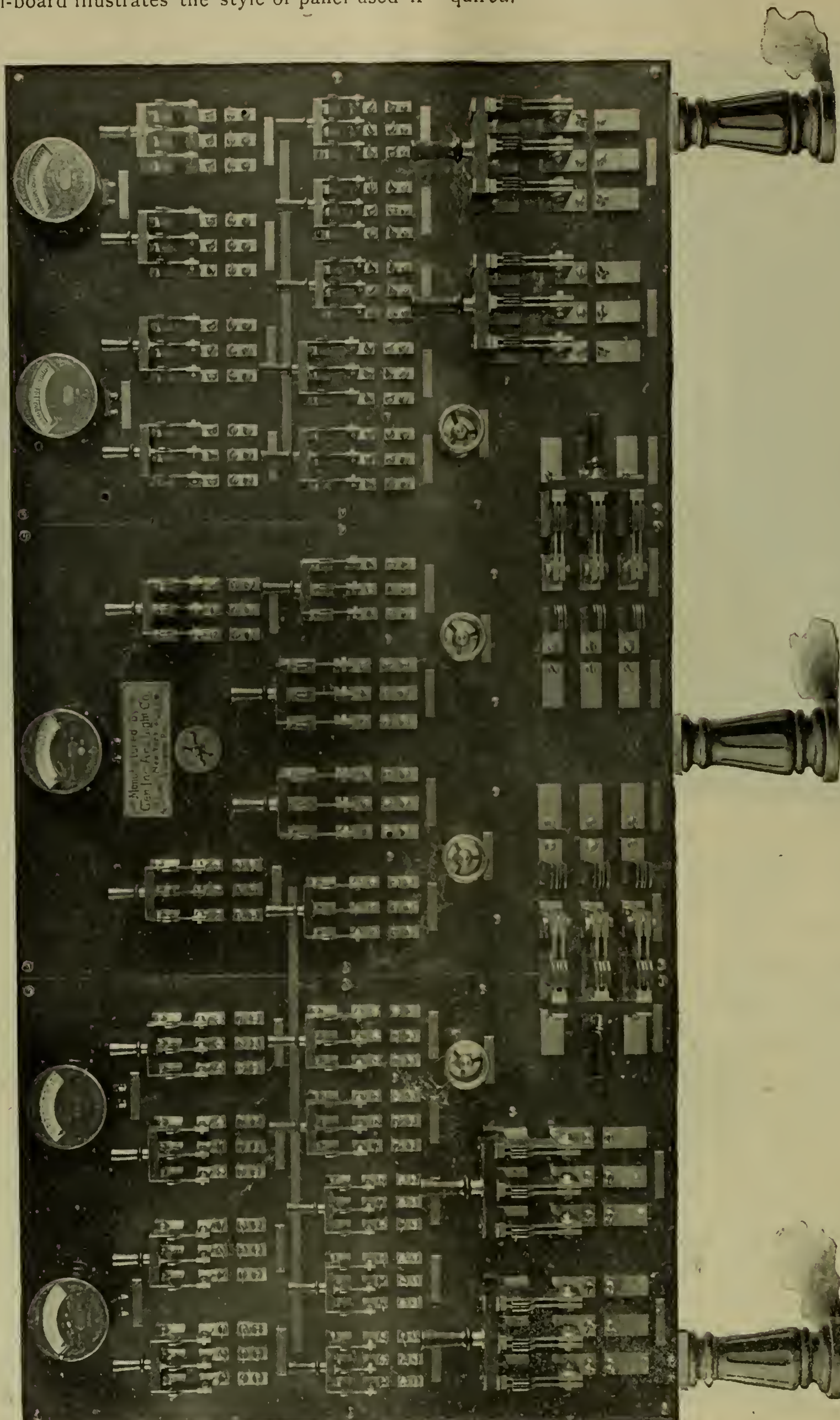
The æsthetic side of electrical engineering has found its greatest development in the equipment of switchboards. Many of the switchboards used in large electric light plants are revelations of beauty. They look like works of engineering art with the glistening marble or slate, and the polish of switches, to dazzle the eye. The engine room is no longer a basement reeking with oil, heated to an unendurable temperature, but a handsomely equipped and well ventilated apartment into which the best dressed persons might enter without receiving so much as a speck of oil or dirt on their clothing. This idea of preserving cleanliness and comfort in the engine room has been carried out to such an extent that mere usefulness is not the only basis upon which apparatus is built, but a design and finish is aimed at which the beholder can never mistake. The General Incandescent Arc Light Co., of 572–578 First Avenue, New York, have made it their object to construct switchboards that will be standards of excellence in execution and of the lowest possible price to the trade.

Many of the largest and finest switchboards installed in New York and the vicinity have been manufactured by the above concern and given in every case unlimited satisfaction. The boards are equipped with switches made by the General Incandescent Arc Light Co. likewise ; the blade switches being composed of the purest drawn copper. The switches range in size from fifteen amperes up to 10,000 amperes, and will carry an overload of at least twenty-five per cent. without injury for a considerable space of time. In the largest illustration may be seen a switchboard completed by the General Incandescent Arc Light Co., and supplied with every requirement for the operation and control of a three-wire system. The reader can judge of the magnificent appearance of this huge board from the engraving without further description. Testimonials from many prominent concerns are in possession of the above company, containing sentiments of appreciation that lack of space will not allow us to reproduce. Panel-boards, illustrations of which are likewise given, are made for any system or combination of circuits. The smaller panel-board carries three-wire bus-bars and two-wire branch circuits for link fuses.

The larger cut illustrates a panel with three-wire bus-bars, meter connections, fusible feeder terminal connections and two-wire branch circuits, having a double-pole knife switch on each (for link fuses).

The panel-boards are finished in every respect with the same attention to detail that characterizes the switchboards. The bus-bars, circuit strips, terminals, switches, etc., are mounted on handsomely-finished slate. All the copper employed is of the finest grade, pure drawn, of the best conductivity and fit.

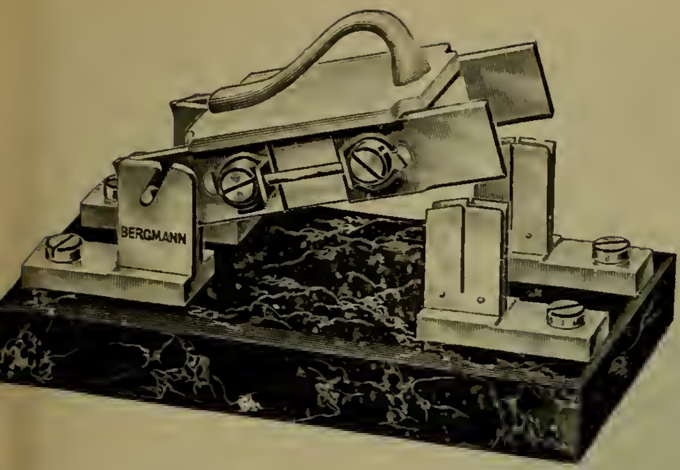
The wiring of buildings is conducted on the general scheme of (1) Feeding each floor separately. (2) Having continuous mains through all floors. (3) Continuous mains with feeder as centre of distribution. The cut of smaller panel-board illustrates the style of panel used if standard Edison receptacles are placed before the reader's notice. The outlet box for flush switches is designed for either concealed or surface work ; the other is used for decorative lighting, where several conduits are required.

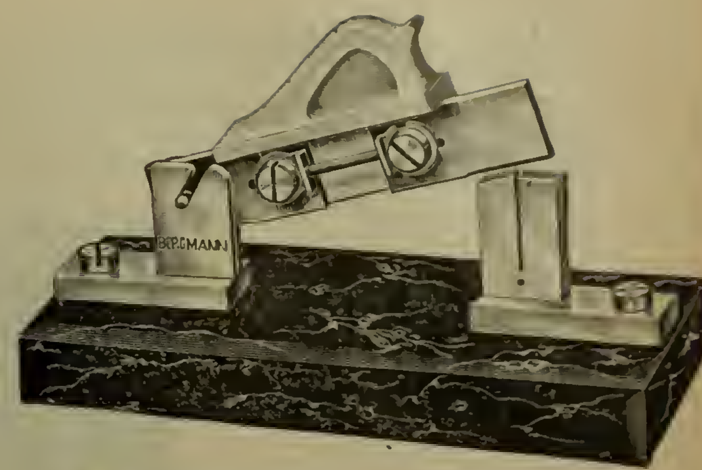


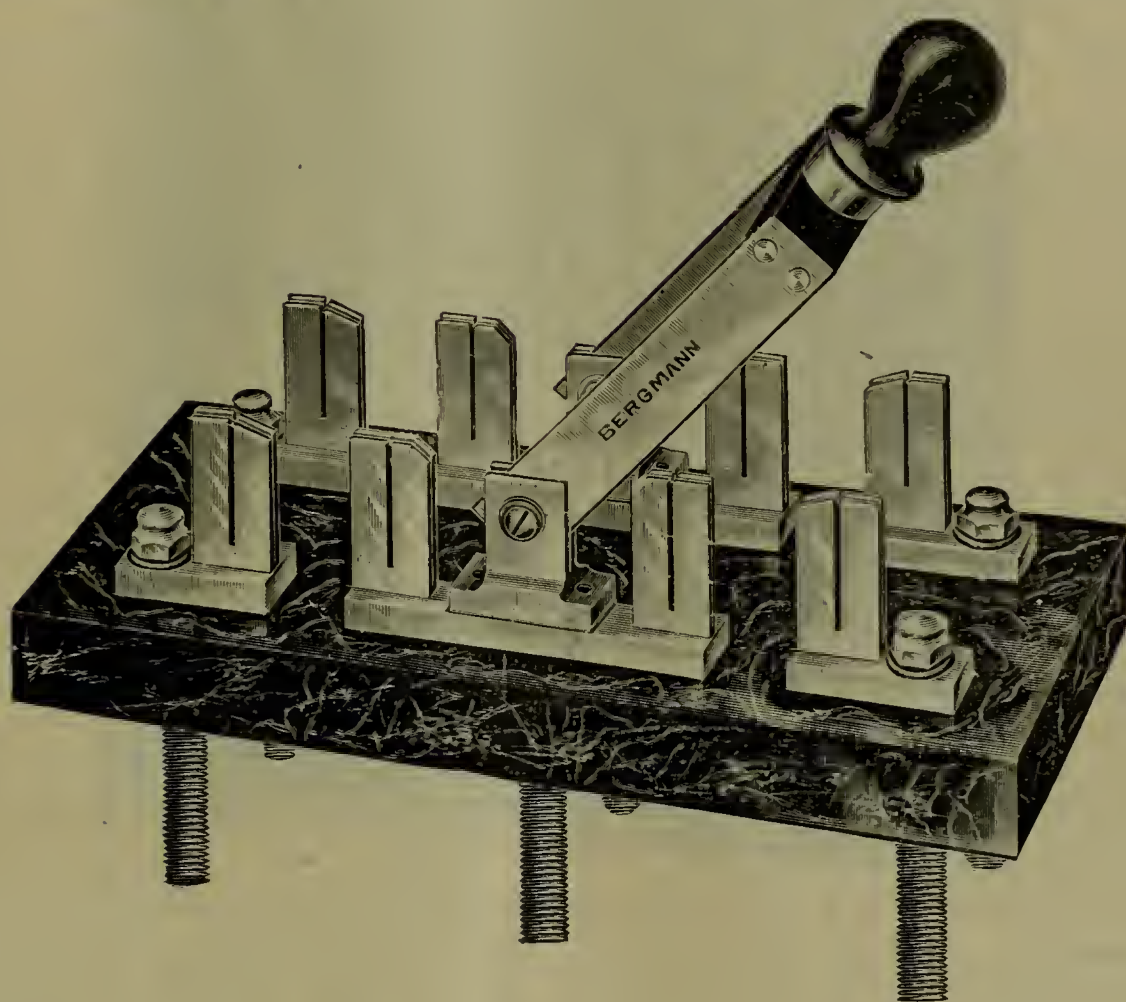
Switchboard Manufactured by the General Incandescent Arc Light Co.

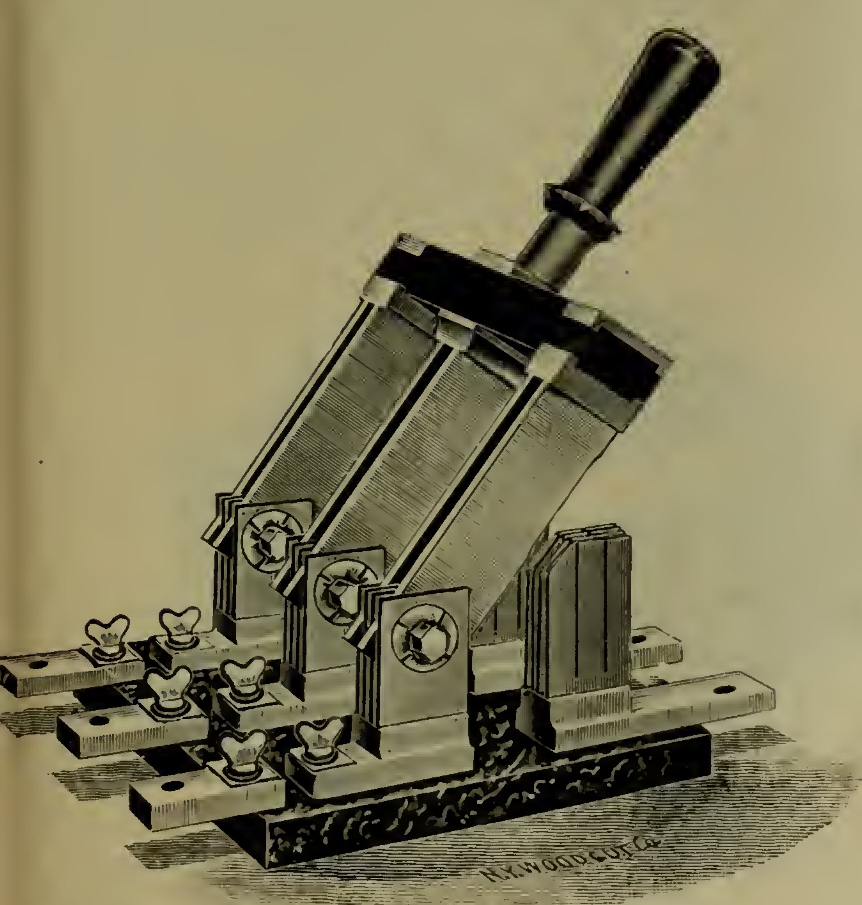
placed at the end of feeder included under class 1. The larger cut shows the style of panel-board used in case 3, to which are connected smaller panels according to their position. Cuts of outlet boxes for flush switches and

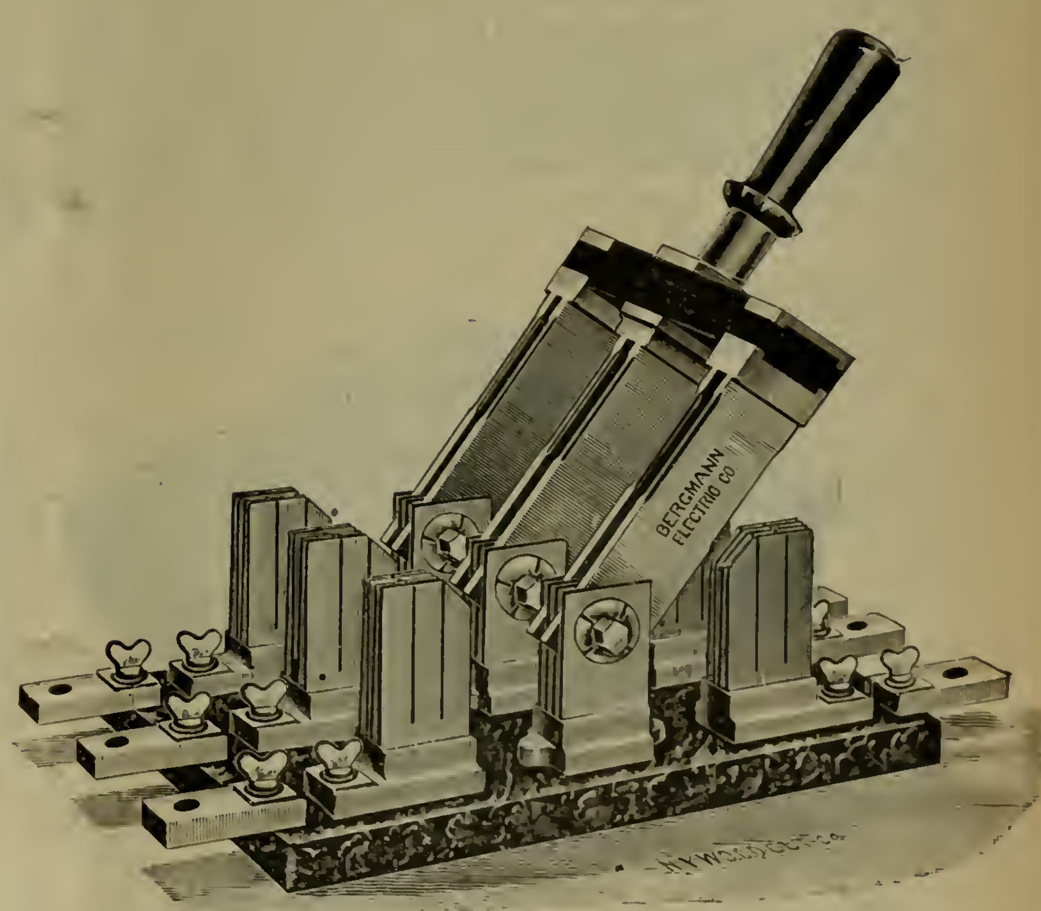
New York, N. Y.—J. G. White & Co. has been incorporated by J. G. White, George H. Walbridge, and Hugh H. Harrison ; to manufacture electric dynamos and other appliances. Capital stock, $100,000.











Removable Fuse Holder—Double Pole.

Removable Fuse Holder—Single Pole.

Two-Wire Double Break, Double Throw Switch.

hree Wire Double Throw, Single Break Switch.

Three-Wire Single Throw, Single Break Switch.

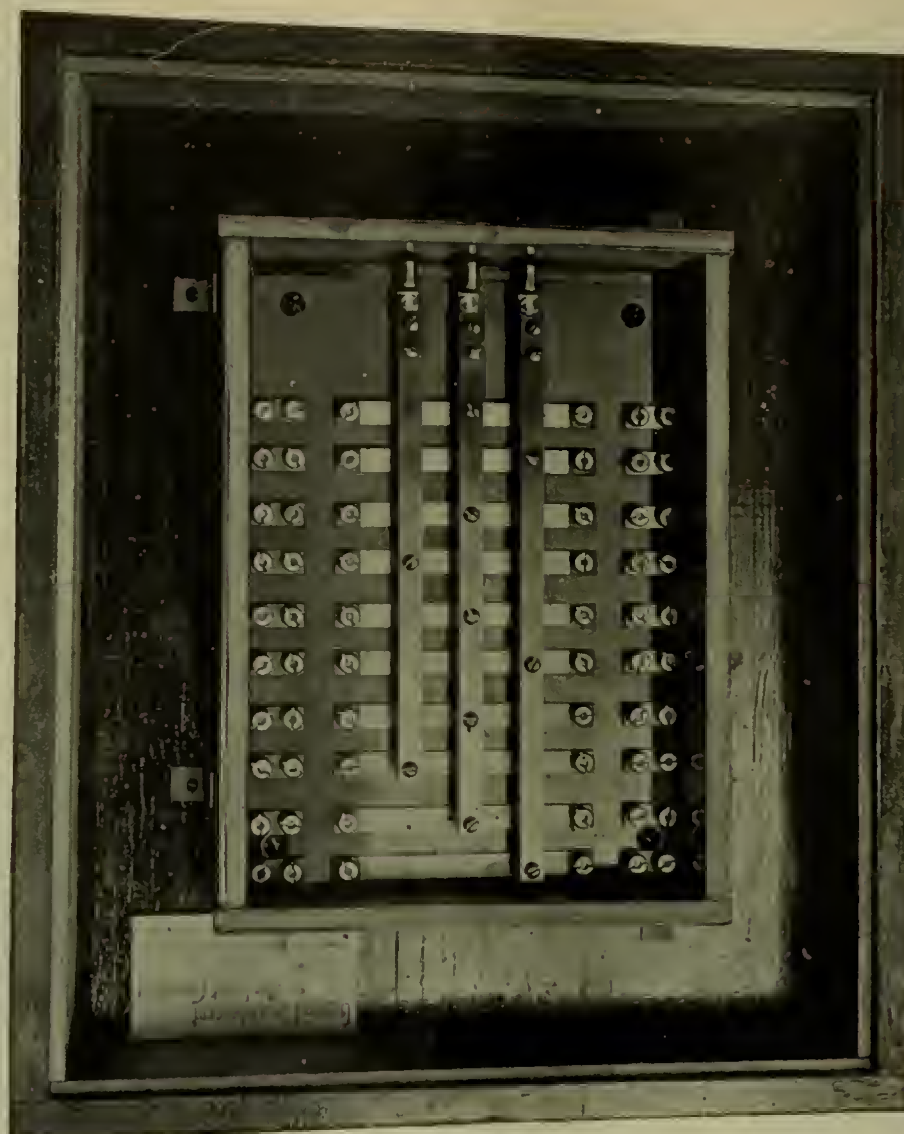
(Manufactured by the General Incandescent Arc Light Co.)

STORING ELECTRICITY.

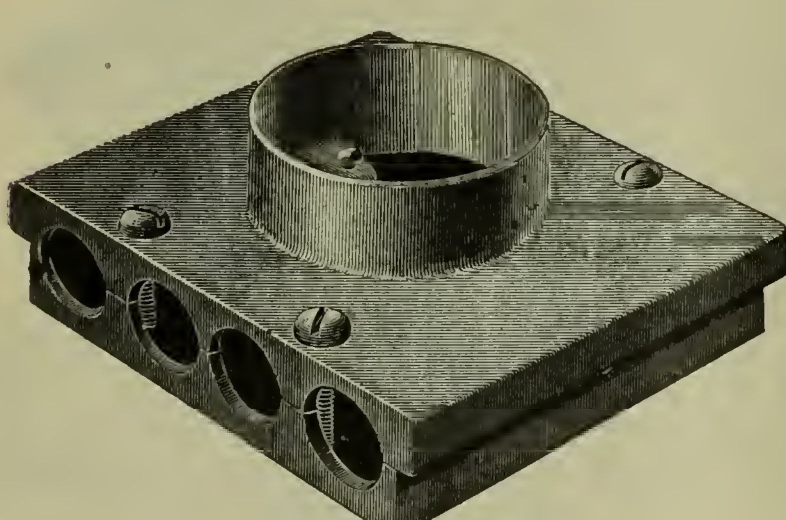
The very interesting account of the introduction of the largest electrical accumulator in this country into the Hartford electrical system which appeared in The Times on Saturday by no means exhausted the subject. Indeed, only the main facts and figures of what is being done by the Hartford Electric Light Company was there presented. That the company has felt justified in investing $100,000 in an accumulator plant proves not only that the storage of electricity for commercial purposes has passed beyond its experimental stage, but suggests a number of questions in regard to the part which electricity is to play in the development of this city in the future.

That the money thus invested has been more wisely used than if it had been applied to the building at this time of another dam on the Farmington River cannot be doubted. But that the second dam will be built before many years shall pass is equally certain. What has been accomplished now is to increase the utilization of the present power by storing up the electricity, which can be generated from midnight until the beginning of the heavy load on the following afternoon. Thus the maximum of power at the command of the company during a period of five hours is brought up to 3,000 horse-power. When the time shall come for adding the water power still available and the creation of still greater accumulator capacity, this power can be doubled without a further increase of steam power. And, as we have said, not many years are likely to elapse before this maximum of 6,000 horse-power shall be attained.

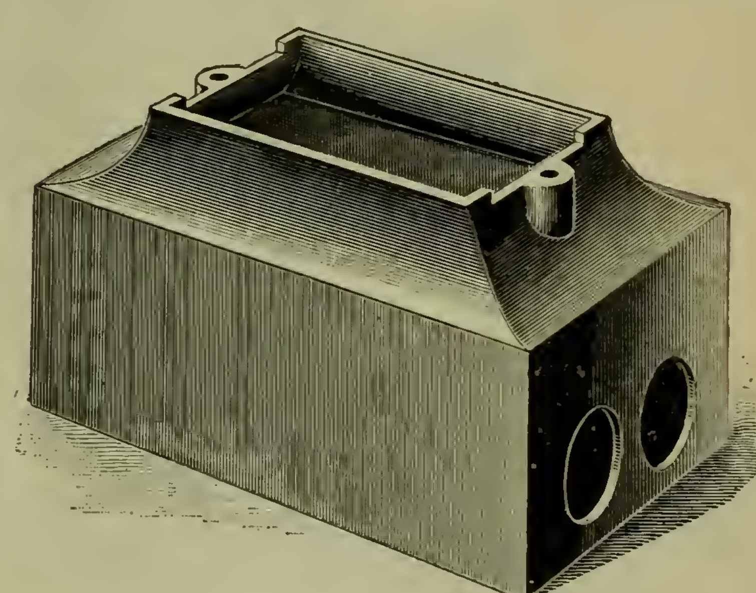
The fact that such an amount of power is at hand must have a marked influence upon the growth of Hartford. Plentiful power produced under the most favorable conditions will mean cheap power for consumers, and such a condition is conducive to the multiplication of small industries. Thus it would be entirely feasible for the electric light company to undertake to meet within a reason-



Panel Board with 3-Wire Bus-Bars and 2-Wire Branch Circuits (for Link Fuses).



Special Outlet Box for Standard Edison Receptacles.



Outlet Box.

able period a demand for 1,000 or 2,000 horse-power for manufacturing purposes. It seems to us that it would be eminently wise for local capitalists to begin the construction of suitable buildings for light manufacturing adjacent to the railroad lines entering the city for which the power might be obtained from the Hartford Electric Light Company. This would avoid the necessity for any investment in boilers or engines. Any person desiring to start a manufacturing business should be able to find well-lighted quarters ready for him, in which he could have a motor of any horse-power that he might require, from one to fifty. Such arrangements would be most favorable for the starting of new industries, and it would only be necessary for the existence of such facilities to be well advertised in order to bring the industries here.

There is sure also to be a great increase in the use of electricity for lighting. Although Hartford now has a larger number of incandescent lights in use than any other city in the country, in proportion to its total population, the extension of electric lighting in private residences is certain to increase very largely in the near future. We shall not be surprised if the number of incandescent lights goes up from 26,000 to 50,000 in five years. There is evidently a great future for electrical service in Hartford and it is fortunate for the city that its electric light and power system is in such enterprising and progressive hands.—Hartford Times.

APPLICATION OF HYPERBOLIC ANALYSIS TO THE DISCHARGE OF A CONDENSER.*

BY ALEXANDER MACFARLANE.

In recent years the theory of the discharge of an electric condenser has played a very important part in the advance of electrical science; for it served as the starting point of the experiments of Feddersen, Paalzow, Helmholz, Lodge, Hertz, and many others, which culminated in the demonstration of the existence and properties of electromagnetic waves. The theory of the discharge was first given by Lord Kelvin, then Professor William Thomson, in a paper on "Transient Electric Currents" published in the June number of the *Philosophical Magazine* for 1853. The application to the phenomenon of the principle of the conservation of energy leads to the differential equation

$$\frac{d^2 q}{d t^2} + \frac{R}{L}\frac{d q}{d t} + \frac{1}{L C} q = 0 \qquad (1)$$

where R denotes the resistance and L the inductance of the circuit, and C the capacity of the condenser which is practically the capacity of the whole circuit. If $q = A e^{mt}$ be assumed as the solution of the equation, then m must be such that

$$A e^{mt}\left(m^2 + \frac{R}{L} m + \frac{1}{L C}\right) = 0$$

which reduces to

$$m^2 + 2 a m + b = 0 \qquad (2)$$

where for brevity a is written for $\frac{R}{2 L}$ and b for $\frac{1}{L C}$.

According to the theory of the quadratic equation, there are two general cases separated by a transition case. If a^2 is greater than b; there are two real values of m, namely

$$-a + \sqrt{a^2 - b} \text{ and } -a - \sqrt{a^2 - b}.$$

If a^2 is less than b, there are two imaginary values of m, namely,

$$-a + \sqrt{-1}\sqrt{b - a^2} \text{ and } -a - \sqrt{-1}\sqrt{b - a^2}.$$

The transition or separating case is where $a^2 = b$; then there is only one value for m, namely, what is common to the two general values.

The following are the solutions which are usually given of the differential equation. In the case of real roots

$$q = c_1 e^{-(a - \sqrt{a^2 - b}) t} + c_2 e^{-(a + \sqrt{a^2 - b}) t}; \qquad (3)$$

in the case of imaginary roots,

$$q = c_1 e^{-(a - \sqrt{-1}\sqrt{b - a^2})t} + c_2 e^{-(a + \sqrt{-1}\sqrt{b - a^2}) t}; \qquad (4)$$

and in the transition case

$$q = e^{-at}(c_1 + c_2 t). \qquad (5)$$

In the imaginary case, the apparently impossible solution is reduced to the form

$$q = A e^{-at} \sin [\sqrt{(b - a^2)}\, t + \varphi] \qquad (6)$$

which shows that the change in the condenser at any time is given by a sine wave of period $\frac{2\pi}{\sqrt{b - a^2}}$ and of amplitude which diminishes geometrically at the rate a.

As the limiting case separates the two complementary regions of the real and the imaginary, we expect that the real solution is also capable of reduction to a form analogous to (6) and exhibiting the function with equal clearness. We also expect the transition solution to be evident from the two general solutions; but when they are in the above forms, the transition is not evident. We observe that in the former general case the roots are treated as simple algebraic quantities, while in the latter general case they are treated as complex quantities. A complex quantity consists of two components, one of which is real and the other imaginary. If there is any thorough going analogy, it must be possible to treat the real roots also as a species of complex quantity.

A complex quantity $a + b\sqrt{-1}$ can be reduced to the form $r(\cos\theta + \sqrt{-1}\sin\theta)$; for $r = \sqrt{a^2 + b^2}$, $\cos\theta = \frac{a}{\sqrt{a^2 + b^2}}$, $\sin\theta = \frac{b}{\sqrt{a^2 + b^2}}$. If we enquire into the geometrical meaning of the $\sqrt{-1}$ here appearing, we shall find that it means a quadrant of turning round the axis perpendicular to the plane of reference. Let β denote that axis, then β^θ denotes an angle of θ radians round the axis β, and

$$\beta^\theta = \cos\theta + \sin\theta\, \beta^{\frac{\pi}{2}}.$$

Hence the ordinary complex quantities can be expressed in the form

$$r\beta^\theta = r(\cos\theta + \sin\theta\, \beta^{\frac{\pi}{2}}),$$

and they are simply coaxial quaternions, the axis being commonly left unspecified, as it is the same for all.

Let $s\beta^\varphi$ denote another complex quantity, than $r\beta^\theta \times s\beta^\varphi = rs\beta^{\theta+\varphi}$

$$= rs[\cos\theta\cos\varphi - \sin\theta\sin\varphi + (\cos\varphi\sin\theta + \cos\theta\sin\varphi\beta^{\frac{\pi}{2}}].$$

Here the product is formed according to the theorem for the cosine and the sine of the sum of two circular angles. Now the circular trigonometry has its complete counterpart in the hyperbolic trigonometry; consequently we expect to find a hyperbolic complex number. This subject was investigated at length in "Papers on Space Analysis,"† which I published 1891 to 1894. In this paper I propose to show that by treating the real

* A paper presented at the Annual Meeting of the American Institute of Electrical Engineers, New York, May 18, 1897.

† "The Imaginary of Algebra." *Proc.* A. A. A. S, vol. —, p. 50. Fundamental Theorems of Analysis, p. 23. Definitions of the Trigonometric Functions, p. 30. Principles of Elliptic and Hyperbolic Analysis, p. 17.

root as a hyperbolic complex quantity, equation (3) can be reduced in precisely the same way as equation (3).

(To be continued.)

Alleged Infringement of Paper Cable Patents.—The National Conduit & Cable Company, of New York City, has begun an action against the New York & New Jersey Telephone Company, which will be tried in the United States Circuit Court in Brooklyn next August. The plaintiff alleges that the defendant has infringed on its patents, covering the manufacture of paper insulated cable. The National Conduit & Cable Company, over a year ago, bought out the Norwich Insulated Wire Company, and secured thereby the title to certain letters-patent of the United States, giving to it the sole right for the use of insulated wire with spirally wound and lapping strips of paper composed of pure vegetable fibre. This paper is applied with a waterproof adhesive substance, consisting of a thin solution of India rubber. This form of cable is very extensively used in cable work, and it is stated that there is at the present time about $15,000,000 worth of this kind of cable now in use in this country. It is alleged that the Bell Telephone Company, which has adopted the paper-covered cable in nearly every city where its instruments are used, has itself made the patented cable. This, it is claimed by the National Company, is an infringement of the latter's patents.

REPAIRS OF ARMATURE, COMMUTATOR AND FIELD.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The dynamo is composed of three important parts, which must receive careful attention each day or they will be apt to cease operating and destroy the utility of the machine. The armature, commutator and field of a dynamo are the three essential parts which develop peculiarities that sometimes cause the engineer considerable trouble.

The armature is subject to grounds and short circuits which may be local and general, serious or of little consequence, depending upon the style of winding.

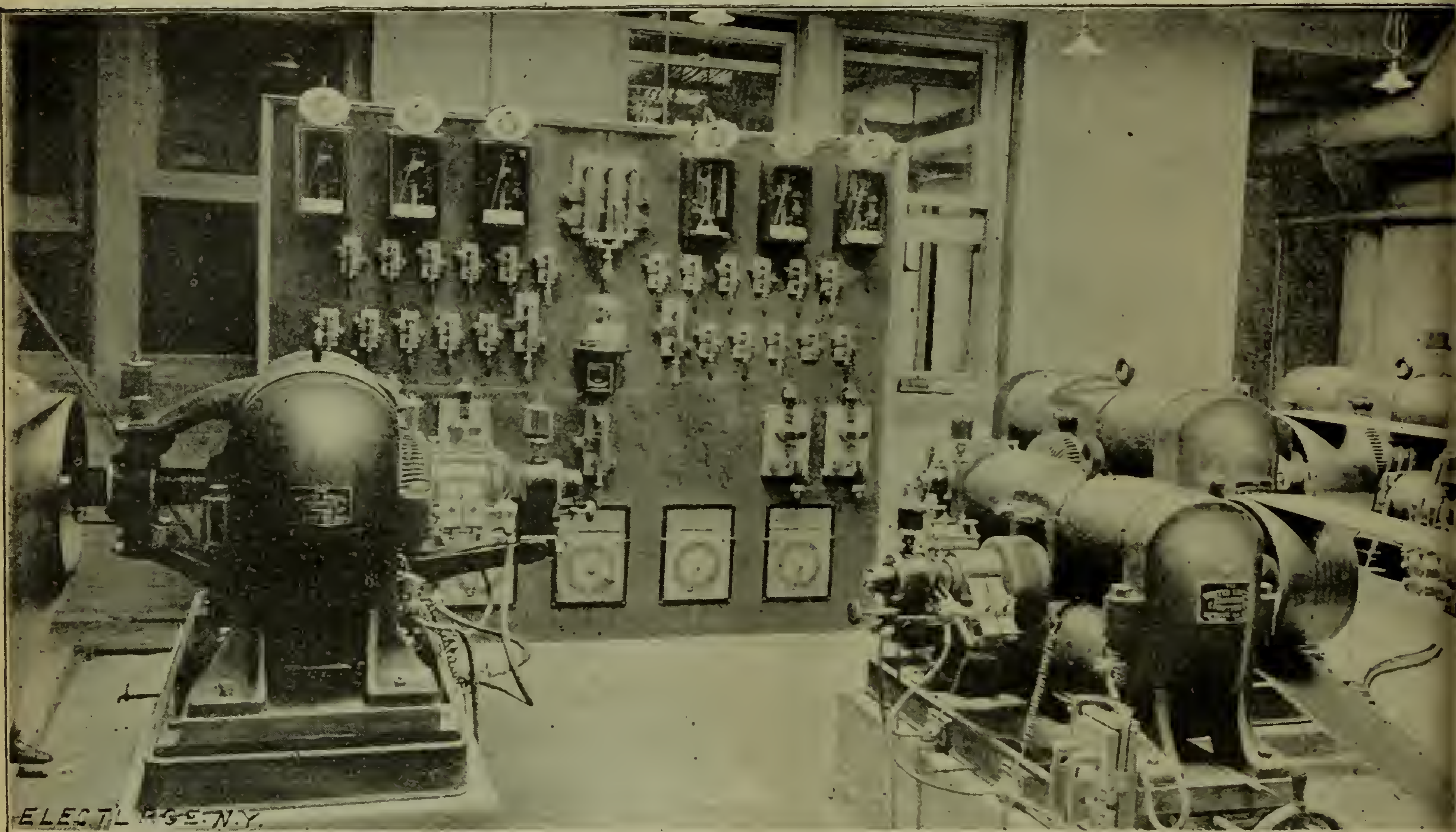
The commutator likewise may be loosely put together, have bad insulation or be slowly ground into a shape like a door-knob, due to the pressure of a grinding brush and a choice collection of injurious sparks.

The field may likewise demonstrate its inability to perform its functions on account of a scorching it may have sustained, or the fact that it is reversed or is otherwise injured.

The repairs of an armature naturally constitute an important department of electrical engineering. Grounds and short circuits make themselves perceptible in ways that can be discovered by testing. A ground, it may be understood, is due to the leakage of current through the insulation, to a great degree, or the touching of the wire against the framework or any metallic part of the machine. A ground may occur in one coil, several coils associated together or apart from each other, or it may be felt throughout the entire armature. If the ground is in a single coil, that coil will have to be removed if its presence interferes with the operation of the machine. A dynamo will run successfully for years, even though grounded, without any difficulties whatsoever; but it is in a sense tempting Providence, because a ground on the other side will constitute a short circuit.

There are such things in armatures as insulation grounds due to moisture getting inside, or caused by an alcoholic dampness, due to the fact that the armature has not been well baked. Short circuits, of course, either melt the wire entirely or so burn the insulation that it becomes a charred and blackened mass. If the armature is of the Gramme type, a coil can be very easily replaced,

(Continued on page 58.)



A Fully Equipbed Isolated Plant. (See Last Issue Model Plants.)

The Electrical Age.

ESTABLISHED 1883.

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NEW YORK, JULY 24, 1897.

CONTENTS.

THE HYGIENIC BENEFITS OF ELECTRICITY.

The times are not ripe in New York for the statement that the use of electricity has obliterated disease, encouraged health, and among the poor the practice of visiting health resorts, because of the fact that this great city carries its passengers by means of an immense cable system. There are other great cities which differ in this respect from our own, one of which, London, has many electric systems branching out to various suburban localities. Our next door neighbor, Brooklyn, is an example of the extent to which electric roads can be developed so that those that desire can for a nominal fee be carried from their homes to the cool, refreshing breath of the sea. If we were to discuss the influence and direct effect of the application of electricity in various ways upon the millions clustered together in large cities we would be surprised to realize that the rate of mortality has actually been lessened and that as a mere accessory to modern civilization its benefits are immeasurably greater than have ever been conceived. In the slums of large cities now brightly lit by the electric light crime has been practically eradicated. In these same centres, that are like a blot upon a city's fair face, disease is suppressed by the fact that five or ten cents carries its little ones miles away to the free, pure air of the country. We might rise to the middle class, whose homes are far away from the scene of their daily labors, and realize what a boon it is to those who earn a fair livelihood to invest it away from the crowded heart of the city. Suburban homes have been the means of adding a tremendous amount of happiness to the toiling masses of large cities, and they owe their homes and the cheapness with which they get to them to the trolley car. We, at present, hear the cry for rapid transit; but think how much better off we are than our grandfathers, whose only vehicles of propulsion were two muscular legs, or even our fathers, whose means of getting to distant points of the city was that of the slowly moving horse-car. We can well believe that as an aid to health, growth and actual prosperity, our cities have no better friend to thank than the trolley car; no kinder agent to be grateful to than electricity.

ELECTRICITY ON THE PENNSYLVANIA RAILROAD.

It would not seem to be a curious sight to any but the managers of the Pennsylvania Railroad if the great trains of cars now hurried along by panting engines were carried to their various destinations by electric locomotives. The time is not far off when this will be so. It has been estimated by a writer on the subject that sixteen per cent. of the cost of operating a road is saved by the use of electricity. The figures given show that one hundred and thirty-six thousand horse-power is utilized by the Pennsylvania Railroad, with an addition of twenty-five per cent. extra during the rush seasons. The total horse-power would then be over two hundred and thirty thousand. As this is required in the track, about four hundred thousand would be necessary in the power stations. It is proposed to divide the road up into forty-five-mile lengths, each length provided with a power-house of six thousand horse-power. These plants would cost about $38,000,000.00, and the total equipment, including motors, $44,000,000.00. The operation of this system would require an expenditure of $3,000,000.00. The present expense of operation with steam being $5,000,000.00. At this rate of saving, the gain by this change of power would be so considerable that as a piece of skilful financiering we wonder why this large and independent corporation has not carefully investigated estimates upon the subject.

The London Times thinks that as drivers of automobiles gain experience and become able to keep their machines thoroughly in hand, risks of collision will be practically eliminated, except that even then there must be learners and that the nature of learners is to spoil a certain portion of raw material. Apart from this, the safety of street traffic would probably be increased if it could be conducted by motors alone without the occasional interference of horseflesh as a disturbing element. It is quite within the limits of possibility that such a condition may be reached in time, but for the next few years, presumably, we must make up our minds to a combination of the two modes of traction and to some amount of friction between them in consequence—friction which, in the words of Stephenson, will often be very awkward for the horse and sometimes for his driver. But the great gain of the new vehicles will arise from the tirelessness of the propelling agency and from the facilities this will give for going as far as the driver may desire and as fast as the current regulations allow. If it should be found possible to introduce motor cars as a means of military transport, some of the greatest difficulties of warfare will be at once superseded and removed.

In American cities, the symmetry of the streets and orderly plan of laying them out render them much better adapted for the use of horseless carriages than the narrow, crooked streets of the Old World, with their congested traffic.

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THOS. EWING MOORE,
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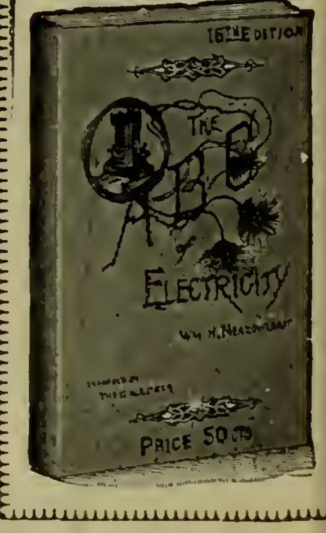


A Most Important Work of General Interest.

The X Ray; or, Photography of the Invisible and its Value in Surgery. By WILLIAM J. MORTON, M. D. Written in collaboration with EDWIN W. HAMMER. 1 volume, 12mo, cloth and silver, 75 cents; paper, 50 cents.

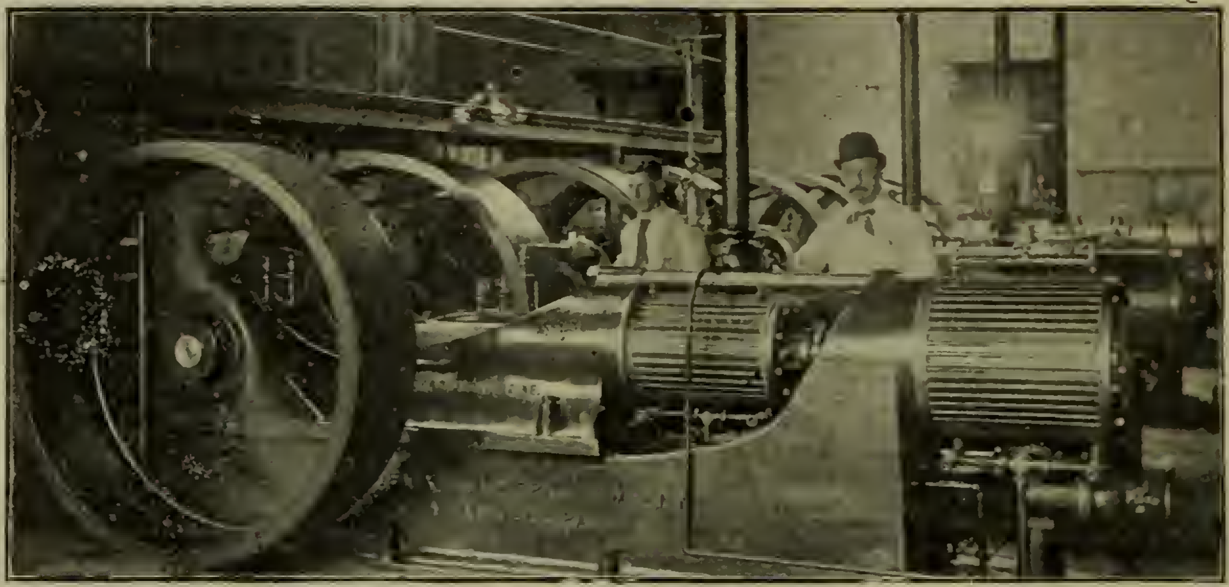
Everyone has been waiting for this work to give full information of Professor Röntgen's marvellous discovery. The work explains in clear and simple style how these extraordinary pictures are taken through solids. Full description is given of the apparatus used, and the text is profusely illustrated with half-tone illustrations giving fac-simile copies of the pictures taken from the negatives of the author. The subjects are varied.

MAILED FREE ON RECEIPT OF PRICE, THE ELECTRICAL AGE PUB. CO., N. Y.

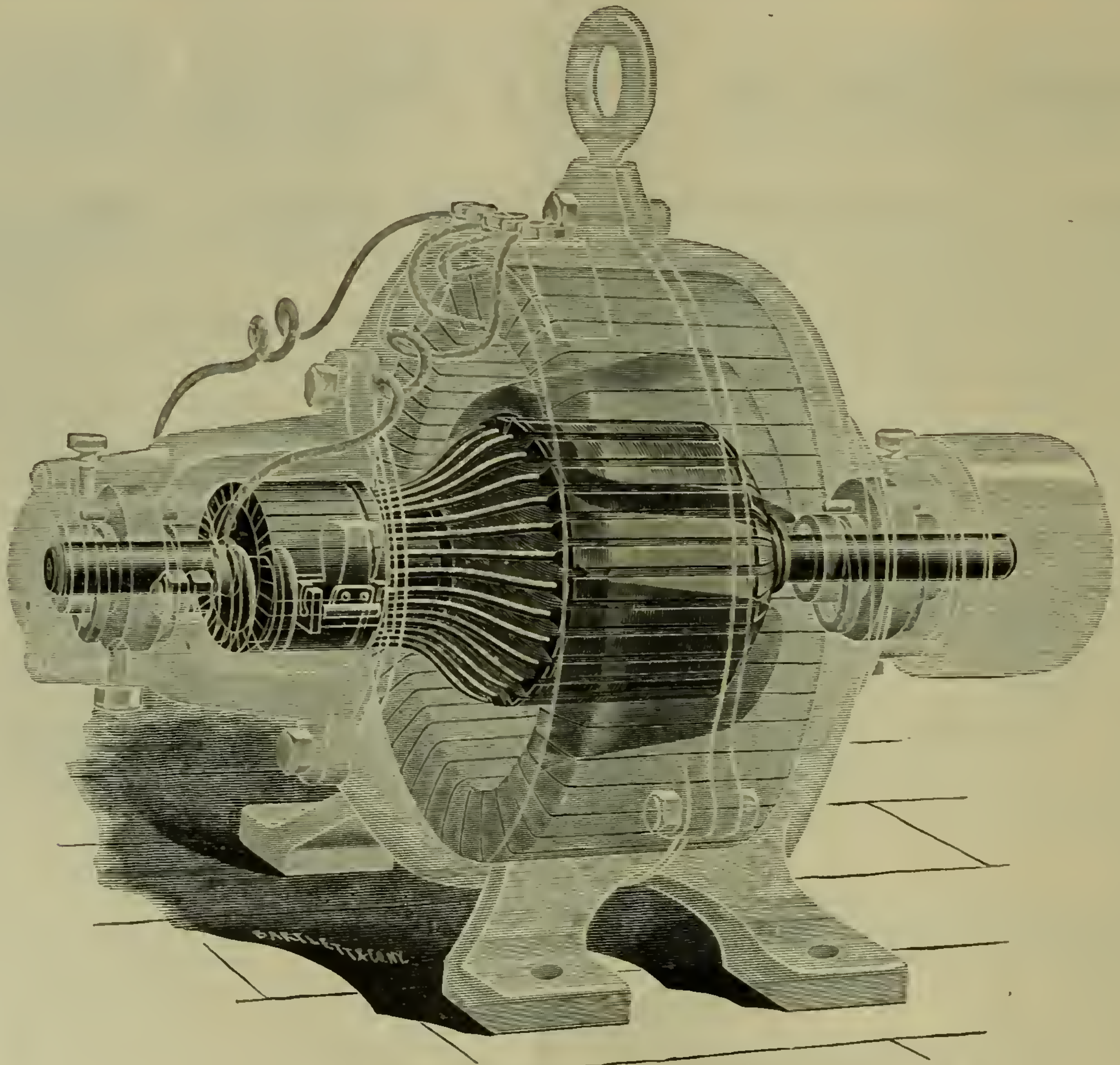
but if a drum armature it will be a difficult matter to repair a coil without disturbing the others unless it be on the outside.

The Eickemeyer Motor Company built a machine the armature of which was wound with detachable coils. This made it a very simple matter to remove a coil or coils that became injured. The only way in which a Siemen's armature can be repaired of the ordinary type is to strip off all the coils until that one is reached which is either burnt, grounded or otherwise affected. By using ventilated winding, such as that adopted by the Schuyler Company in the construction of their arc light dynamos, many of these troubles disappear, and the overheating of any given coil does not exert any evil influence upon its neighbors by transmitting heat to them and injuring them likewise. The repair of a coil is carried on in the same way as if it were to be rewound. A test is first made for the ground, if it occurred at any specific point. That portion is taped and the coil completed. The two ends of the coil are then tested for continuity of the metal and then tested for grounds; one end of the coil with the armature core and then the other end likewise. The tinning of these terminals that set into the commutator segments is effected if possible without the aid of acids, although if great care is taken to prevent the acid from saturating the insulation it may be used without danger.

Toothed armatures sometimes heat very severely; it is worth while mentioning here that this heat is not always due to the winding, because an armature of this description may be tested by the fingers and it will be discovered that the iron is hotter than the conductors. This is due to a poor design of the teeth of the armature, and the engineer's only remedy, which we would not advise him to attempt, is to bore out the fields a little larger.



A High Speed Station Plant.



Details of the Standard Lundell Dynamo, Showing Armature, Commutator, Field Etc.

The commutator, as we have mentioned, may have a grinding brush. It may spark; it may be filled with poor mica, and the mica, if good, may be oil-soaked. It is a difficult matter to repair a commutator except to turn it down. The sparking may be due to a bad position of the brushes, which the engineer can attempt to remedy. The grounded or oil-soaked mica can have its evil effects removed by carefully baking the commutator, thus drying up the oil and removing that as a source of trouble. But if the mica is causing a ground that cannot be attributed to the oil, the segments will have to be tested in pairs until the ground has been located and the mica causing the trouble removed. Commutators must never be cleaned with emery paper, but fine sandpaper should be used.

If a commutator becomes very hot while running, it is due to the fact that the segments are too small for the current passing. This may occur at the beginning or after the machine has been in use for many years; the commutator in the meantime becoming thinner and thinner at every turning. The only remedy for this is a new commutator. Frequently the use of carbon brushes of insufficient capacity will cause a leaking of the commutator by generating heat within themselves due to the current and friction and transmitting it to the commutator segment. The field is very easily repaired. It may be burnt out, reversed, lack ventilation and therefore heat, have broken connections or become affected by moisture, in addition to the short circuits and grounds that generally affect windings, whether of armatures or fields.

A burnt-out field indicates itself by a peculiar aroma of scorching cotton and shellac. If this occurs to one of the inner layers it will not be perceptible, but a heavy ground will result, and the smell of burning insulation will be an additional proof. If the field is reversed, the proper connections can be very easily made, and if it heats to any unusual extent without actually burning, the coil has been poorly designed; its radiating surface is insufficient, and one of the best remedies is to interpose a resistance in its circuit so as to decrease the current flowing through it, and speed the armature up a little higher by the use of a smaller pulley, to keep the voltage the same as before. If the coil is merely grounded, and any anticipation of danger is felt by the engineer, the ground may be discovered between the terminals of the coil and the framework of the machine. In a new machine it may be likewise due to moist shellac; or if the coil is wound upon a metal sleeve, it probably exists in the innermost layer, and had better be left alone. It is always best for the engineer to test for his fields by holding some iron object firmly in his fingers and bringing it to either pole or poles of the machine, or the polarity can be directly ascertained by means of a compass.

MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AT GREENACRE, MAINE.

Probably one of the best known names connected with the advancement in a practical sense of electrical engineering is that of Moses G. Farmer. This able and natural scientist in the earlier days of our science carried out the principles of the dynamo and put them to a practical application by building a successful generator of electricity. His work in the field of electric lighting was unique, and will always give him a place of honor and appreciation among electricians. The American Institute of Electrical Engineers, of which Moses G. Farmer was an honorary member, will meet at Elliot, the week beginning July 26, on which occasion it will hold its annual meeting. Accommodations can be obtained at the Greenacre Inn. Very fine hotels are located at Portsmouth and Newcastle to which those that desire can go by rail, carriage or launch, this last churning its way up the Piscataqua River. The Greenacre movement is one which has for its object a higher cultivation of the public. At this spot one can spend the day in long siestas, agreeably interrupted by opportunities for mental development that few reasonable beings would care to miss. Many lecturers of pronounced standing will be ready to discourse on various subjects. A new circle of life has been created here which comprises within its scope much that is too often neglected in the hurry and rush of life. With such Utopian surroundings, peace and education, agreeably commingled, there is no doubt that those participating in this movement will leave Greenacre with feelings of keen regret. The speakers, whose work at Greenacre will be impressed upon the minds of many auditors, will be such men as Prof. Joseph Le Conte, of the University of California; Prof. Amos E. Dolbear, of Turft's College; Prof. Edward S. Morse, of the Peabody Institute, Salem, Mass.; Doctor Lester F. Ward, of the Smithsonian Institution, of Washington, D. C.; Doctor John Fiske, the eminent historian and philosopher; Judge William C. Robinson, dean of the Catholic University, Washington, D. C.; the Hon. Carroll M. Wright, U. S. Commissioner of Labor, the Hon. Neal Dow; the Rev. Dr. Edward Everett Hale; the Rev. William R. Alger. Doctor E. D. Meade, of the New England Magazine; Mr Frank B. Sanborn, of Concord, Mass.; Doctor L. Dickerman, the Egyptologist; Mrs. Mary A. Livermore; Mr. F. Edwin Elwell, the sculptor, and others of equal fame. Many whose services will be unique, such as lecturers from India, Swâmi, the Vioekânanda, the Swâmi Sâradânanda and Mr. Jehangier D. Cola, of the Parsi community in Bombay. The lecture course will be carried out through the months of July and August, finishing the second of September. The subjects will be Peace and Arbitration, Business Ideals, Education, Evolution; Invention; particularly such as relates to the science of Electricity; Sociology, Psychology, Comparative Religion, etc. Miss Farmer's intention is to commemorate the fiftieth anniversary of her father's earliest labors in electrical work, the application of electricity to traction. It was the purpose of Mr. Farmer to develop that which has now crystallized through the efforts of his daughter. This is an excellent opportunity for American electricians as well as those from foreign lands to meet and enjoy themselves in this ideal manner.

THE NATIONAL ELECTRICAL CODE.*

The long-desired uniformity in the Code of Rules for Electrical Installations would seem to have now become an accomplished fact, as the new edition of the Rules of the National Board of Fire Underwriters, as recommended by the Underwriters' National Electric Association, which is just from the press, is identical with that which has received the unanimous approval of the code committee of the National Conference on Standard Electrical Rules, who have referred it to the various delegates in the conference, with recommendation that they report it to their respective organizations for adoption or approval.

It has been thought advisable that in presenting these rules to the public, they be accompanied by a sketch of the manner in which this uniformity of rules has been brought about, and this article has been prepared jointly by the c de committee of the National Conference and the committee on press of the Underwriters' National Electric Association, in order to show the various stages through which these rules have passed, and the successful work of the National Conference in securing harmony among the divers interests which they affect.

As the adoption of a uniform set of rules for the safe installation of electric light and power apparatus, by the electrical, insurance and allied interests, marks a distinct epoch in the history of rule-making in this country, it seems a proper time to give a brief outline of the evolution of electrical rules from the crude beginnings of fifteen or sixteen years ago up to the present time, when

*This sketch has been prepared by the Code Committee of the National Conference on Standard Rules and the Committee on Press of the Underwriters' National Electric Association.

the rules in force are as nearly perfect as the combined experience of interested parties has been able to make them.

After a large amount of correspondence, inquiry, and consultation of records, the following data has been collected.

It seems that to the New York Board of Fire Underwriters belongs the credit of the first printed requirements in relation to electric lighting. On Oct. 19, 1881, a circular was issued by that Board containing the following resolution :—

Resolved, That the Committee on Police and Origin of Fires are hereby directed to notify the owners and occupants of all buildings in which uncovered electric light wires, or in which arc lights with open bottoms or without globes, are found; that the wires must be covered, and the lamps altered to conform to the rules of this Board within ten days from date of notice and request that the lights shall not be used until the alterations are made ; and in case the alterations are not made within said time, the Committee are hereby directed to notify the members of the Board of said failure, and the companies insuring said property are hereby recommended to give notice to the owners and occupants of such buildings that unless the request is complied with, and the alterations made within a reasonable time, that the insurance on said property will be canceled."

The Boston Manufacturers Mutual Fire Ins. Co. comes in one day later, with a circular dated Oct. 20, 1881, calling attention to the same hazards from arc lighting.

Under date of Jan. 12, 1882, the New York Board issued a very brief circular containing a few rules for the installation of electric lights ; and in January, February and March of the same year, the Boston Manfg. Mutual Fire Ins. Co. issued circulars on this subject, in which the elements of later developments are shown by the classification of the requirements under the headings of Dyamo Machines, Wires, Arc Lamps and Incandescent Lamps.

On May 19, 1882, the National Board of Fire Underwriters adopted the standard requirements of the New York Board for the installation of electric lights, and in the same month the Boston Board of Fire Underwriters isued a circular containing similar rules.

On August 1, 1885, the New England Insurance Exchange issued rules covering both arc and incandescent systems. Previous to that time they had used the rules of the Boston Board, issued in 1882. The rules of the New England Insurance Exchange were perhaps the most complete that had yet been put in print, and in a report of the Electric Light committee of that body, it is stated that in the arrangement of these rules they were "largely aided by some of the leading electric light people."

At a meeting of the National Electric Light Association in Baltimore, in 1885, a representative of the Boston Board, and also of the Boston Manufacturing Mutual Fire Insurance Co. were present ; and while there was considerable talk and discussion on the matter of rules, nothing was carried to an issue. In the following summer a joint conference of certain insurance representatives and members of the National Electric Light Association insurance committee formulated rules, which were later presented to the National Electric Light Association, but were not adopted. The rules resulting from this conference were promulgated simultaneously by the Boston Fire Underwriters' Union and New England Insurance Exchange, under date of May 15, 1889, and these rules, it may be said, were the first which fairly deserve to be called comprehensive, as the rules of other insurance boards, as late as January, 1890, were still very brief and incomplete.

In February, April, July and August, 1890, quite complete rules were issued by the Philadelphia Underwriters' Association, Underwriters' Association of New York State, and the Pacific Insurance Union, and jointly by the Boston Fire Underwriters' Union, Boston Manufacturing Mutual Fire Insurance Co., and the Electric Mutual Insurance Co.

In August, 1890, at the Cape May meeting of the National Electric Light Association, a joint conference between members of the association and insurance representatives was held, which agreed on a large number of points, which were reported to the National Electric Light Association, and a conference committee, consisting of representatives from the insurance and electrical interests, was formed under the name of the National Electro-Insurance Bureau.

In September, 1890, the New England Insurance Exchange prepared, in conjunction with a committee from the New England Electric Exchange, a set of rules which met with the hearty approval of the Electric Exchange, and on Nov. 18, 1891, the New York Board of Fire Underwriters also issued a set of rules.

In September, 1891, the National Electric Light Association adopted the code of rules prepared by the National Electro-Insurance Bureau, which were the first published by that association ; but as there was no special effort on the part of that association or the Electro-Insurance Bureau to secure the general adoption of the rules, they were adopted by only three or four insurance boards, covering a small portion of the United States ; and some of these boards in publishing the rules made changes to suit themselves, basing their rules on those adopted by the National Electric Light Association at their 1891 meeting. Most of the insurance boards continued to use the rules which had so recently been sent out by them, as they had no pressure brought to bear upon them in the interest of uniformity.

In the early part of the year 1892 the Secretary of the New England Insurance Exchange, in the interests of uniformity of rules, corresponded with the Electrical Inspectors of the various underwriters' organizations in the eastern part of the United States, suggesting that a meeting be held in New York City in August. This idea seemed to meet with favorable consideration, and on August 18 representatives of the underwriters' boards, covering the New England, Middle, South Atlantic and Gulf States, met in New York, and taking as a basis the rules which had been adopted by the National Electric Light Association, they carefully considered them, section by section, in order to make such changes as the experience of the insurance inspectors indicated to be necessary in the interests of the insurance companies.

(To be continued.)

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

Chicago, July 17, 1897.

(Q.)—EFFICIENCY OF CABLE AND TROLLEY.

Electrical Age Pub. Co.

Dear Sirs.—Taking advantage of your Inquiry Column, I beg leave to inquire into the gain in efficiency of a trolley over a cable road. The Chicago street-cars were once operated by cable, but an entire change has occurred, which is in certain respects surprising to me, as no evidence of bad operation was perceptible in the cable system either to myself or others of a mechanical engineering turn of mind. If the cable is less convenient than the trolley instead of being less efficient I should like to know. By answering this you will greatly oblige,

Yours respectfully,

John Moreland.

(A.)—The cable and the trolley each have found their place. The trolley is in general more efficient by twenty per cent. than the cable. The Chicago cable system had an efficiency of only twenty per cent. in total, whereas the trolley has an efficiency of at least thirty-five and possibly forty per cent. A city having within its limits very hilly ground would not by using trolley compete very favorably with cable. It is in this respect that the cable is superior, and many facts and figures can be brought forward to make this point clear.

On long and level stretches of ground the trolley is the better from an economical and practical standpoint. The more undulating the ground the less favorable in certain respects it becomes, although the sum of conditions collectively would determine the best system, better than any abstract decision.

(Q.)—CONSTANT SPEED MOTORS.

Albany, July 20, 1897.

Electrical Age.

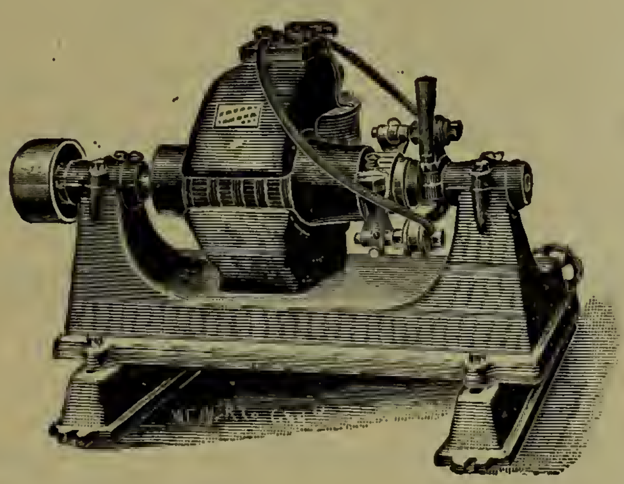
Dear Sirs.—Can the speed of a motor be kept constant for all changes of load, or is it necessary to approximate within a certain percentage and call that a constant speed? I would also like to know the different methods of regulating for constant speed and get some inkling of their practicability. Yours respectfully,

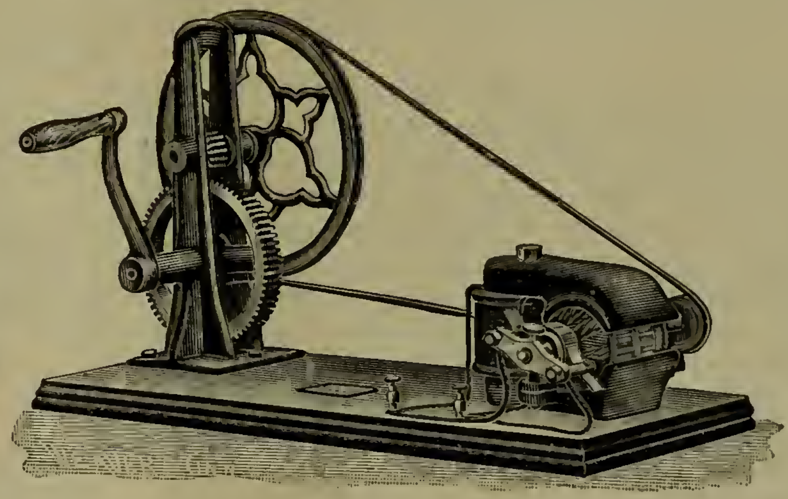
J. F. Collins.

A PERFECTED DYNAMO.

The Elbridge Electrical Mfg. Co., of Elbridge, N. Y., manufacture direct-current dynamos and motors that have in every case fulfilled their functions with perfect satisfaction. Located at Elbridge, the above concern have every facility for the perfect fitting, winding and general construction of electrical apparatus. The time and care they devote to the design of their machines, not only in outward form but inward construction, have made their apparatus successful from every standpoint. The soft iron laminated core of the armatures, the use of wrought iron cores in the fields a commutator that will stand heavy wear, and perfectly fitting bearings, insure efficiency and smooth running. In the illustration two of the products of their factory are represented—one a hand dynamo for experimental use, the other a dynamo for electric lighting. A motor of similar appearance to this last is manufactured by them.

On all machines designed by the above company the latest improvements are to be found. With each dynamo they furnish a book of "pointers," free of charge, which gives answers to all questions consumers or engineers are apt to ask.





Elbridge Dynamos.

(A.)—The speed of a motor is kept very nearly constant. Certain slight changes caused by a variation of the load are inevitable, otherwise the speed is practically uniform.

The methods of regulating a motor (a shunt motor) for constant speed were those that affected the field. A shunt motor increases in speed when its field is weakened and decreases in speed when it is strengthened. By using a differential winding, similar to the series coil of a compound wound dynamo, the field is varied. This is automatically performed and was for a time apparently successful. Today it is a method that may almost be considered obsolete except in special cases.

(Q.)—WHY A MAGNET BLOWS OUT A SPARK.

Newark, July 21, 1897.

Electrical Age.

Dear Editor.—Being a novice I hope my ignorance will be excused, but I will brave criticism by asking why it is that a magnet blows out a spark or rather an electric arc? I have tried the experiment many times with the same result. Yours sincerely,

A Subscriber.

(A.)—An electric arc betrays the path of the current. It produces lines of force because magnetic energy is always associated with the flow of a current. A magnet simply affects the arc as if it were another magnet. It repels or attracts it. This principle is greatly used in practical electrical engineering.

RECENT PROGRESS IN ARC LIGHTING.

(Continued from page 43.)

Owing to the traverse from side to side of the arc between the square-ended carbons, the direction in which light is emitted from the arc most effectively is undergoing continual and very great changes, so that the intensity of light in any given direction may, in a few seconds, vary several hundred per cent., and with a perfectly clear glass inclosing globe this variation would not only be quite noticeable, but in many cases intolerable. The diffusive power of the glass, however, is such in the case of the opal coating, that the travelling of the arc is, in large measure, compensated, and the general effect is that of a very steady, uniform light. Were it not for the diffusive power, the color of light, as well as the intensity, would change greatly; as when the arc happened to be on the side of the carbons, away from the observer, the light would then be in greater proportion from the purple or violet arc flame, and less from the glowing ends of the carbons themselves.

The carbons to be used in an "inclosed arc" should be of the very highest grade as to purity, not too hard or dense, as straight as possible, uniform in diameter and circular in section, and should be obtained of as near a standard diameter as possible, so as to avoid the necessity for adjusting the caps of the inner globes to the size of the carbons. It is necessary that the caps should fit pretty closely around the carbons to avoid leak and consequent reduction of life. Leaks of air into the inner globe must be carefully avoided, if any reliance is to be placed upon a lamp for a given run without recarboning. During the run the upper part of the inner arc-inclosing globe is coated slowly with a deposit, nearly white in color when the carbons are free from iron, and consisting of what little mineral matter has been left in the carbons. Fortunately, the hot uprising currents from the arc deposit considerable of this on the cap above and return to the arc to be reheated and again circulated at a little above the level of the arc itself, and, as the lower carbon consumption gradually causes the arc to descend, the light of the arc continually reaches portions of the glass wall which have been but slightly obscured by the deposits from prior burning. In general, the deposit which forms on the inner globe can be wiped off or dusted off at the time of recarboning. Carelessness in this particular may easily result in a large proportion of the light of the arc being lost, and, what is perhaps worse, the radiant heat and light of the arc being unable to escape, goes to overheat the glass of the inner globe, either melting or deforming it so as to produce leaks, cracking it directly or burning the deposits into its surface. After this they can only be removed by such agents as hydrofluoric acid applied to the surface.

The mechanism of an inclosed arc lamp to be run singly in branches from 110-volt circuits is naturally very simple. Since the lamp regulates entirely by variations of current on its circuit, a simple series magnet suffices. No cut-out other than a fuse in the lamp branch is needed.

The switch is a plain open-circuiting switch. A choking resistance is mounted on the lamp or elsewhere in the branch, the drop over which is about thirty volts. The upper carbon or its holding rod is acted on by a simple positive clutch. There is required, however, even in such a lamp. so apparently simple in itself, great care in proportioning the parts and their relative actions, to secure the best results. If the constructor fails in any detail, the behavior of the lamp soon tells the story—the current is interrupted frequently; the voltage around the arc varies greatly; the current, as well as the light of the lamp, varies.

In the use of "inclosed arcs" instead of "open arcs," one does not escape from the necessity of using in the branch with the lamp a choking resistance. A constant-potential circuit of forty-five volts will not supply current to arc lamps demanding forty-five volts at the terminals and approximately the same at the arc. By the use of resistance in circuit, however, and sufficient additional potential, the current, otherwise "unstable," becomes "stable," and the arc stable. It is possible, indeed, with especially sensitive lamp mechanism, to replace a part of the resistance needed by inductance, and thus save some energy. The "inclosed arc" also demands a sacrifice of energy in resistance, for a circuit of eighty volts constant potential will not run eighty-volt arcs.

For the purpose of discovering the minimum drop of potential required to exist over a dead resistance in circuit with arcs on constant-potential mains, the writer instituted and had tabulated a series of tests in which the resistance in circuit with arc lamps was gradually cut down along with the line voltage, while the current and voltage of the arcs were maintained the same. A set of tests was made with two Thomson '93 lamps in series, using at one time plain National carbons, and at another a cored upper of one-half-inch diameter, and solid lower carbon of one-half inch diameter. Also a set of tests was carried out with eighty-volt inclosed arc lamps adjusted for currents of different amount at different times. During each test the line voltage was lowered and resistance cut out until instability of arc and current resulted, while up to that time the current and voltage of the arc were kept the same during the particular test.

The general result of these tests was as follows:

Two '93 Arc Lamps in Series, with Variable Resistance:

One-half inch National carbons.

With 45 volts at each arc and a current of 9.6 amperes in the lamp branch, line voltage could not be reduced below 110 volts. This would give a drop of 20 volts over resistance and lamp magnets.

With 45 volts at arcs and 7.9 amperes, the limit was reached at 108 volts on the line.

With 46 volts at arcs and 6 amperes, the limit was reached at 108 volts on the line.

Two '93 Arc Lamps in Series, with Variable Resistance:

Carbons, ½-inch cored upper; ½-inch solid lower.

With 46 volts at arcs and 15 amperes current, the limit was 106 volts on line.

With 46 volts and 12 amperes, the limit was 104 volts on line.

With 46 volts and 9.4 amperes, the limit was 108 volts on line.

With 45 volts and 7.3 amperes, the limit was 104 volts on line.

With 42 volts at arcs and six amperes, the limit was 98 volts on line.

Test of 80-Volt Inclosed Arc Lamp, with Variable Resistance in its Circuit.

Solid upper and lower $\frac{7}{16}$-inch "Electra" carbons.

With 75 volts at arc and seven amperes, the limit of line voltage was 88 to 90.

With 74 volts at arc and six amperes, the limit of line voltage was 92 to 94.

With 75 to 76 volts at arc and five amperes, the limit of line voltage was 92 to 94.

With 78 volts and four amperes, the limit of line voltage was 98 to 100.

With 76 volts and 3.2 amperes, the limit of line voltage was 100. (Carbons, ⅜-inch "Electra.")

(To be continued.)

THE INDUCTION FACTOR; A NEW BASIS OF DYNAMO CALCULATION AND CLASSIFICATION.

By Professor Chas. A. Carus-Wilson,
Montreal, Can.

(Continued from page 47.)

Section II.

If for t we put T, where T is the force at the rim of a pulley of diameter d, equation (2) can be written

$$T = \frac{1}{\pi d} M\ C\ 10^7 \text{ dynes} \qquad (5)$$

where d is expressed in centimetres, T in terms of C. G. S. unit of force and C in amperes. If, now, the circumference of the pulley be 10^7 centimetres, *i. e.*, if $\pi d = 10^7$ centimetres, we can express the force of the dynamo thus:

$$T = M\ C \text{ dynes} \qquad (6)$$

The force of a dynamo may thus be defined as a force of M C dynes at the rim of a pulley 10^7 centimetres in circumference. We may call M C the *force factor* of the dynamo.

Since M is the induced volts divided by the revolutions per second, it follows that $C\ M = \frac{C\ e}{n}$; but C e is the rate of doing mechanical work; *i. e.*, the work done per second measured in watts, hence C M is the work done per revolution of the motor at any speed. If, then, we are given C and M, we can find the work per second, *i. e.*, the rate of working, or the power, by simply multiplying the product C M by the revolutions per second.

Example 3. If the induction factor of a dynamo is five, and the maximum current one hundred amperes, C M = 500, and the rate of working at twenty-five revolutions per second is seen at once to be 12.5 kilowatts.

Many manufacturing firms have used the ratio of the watts to the revolutions per second as a basis of comparison of dynamos without perceiving its true significance, and have called this ratio the mass factor.

The fact seems to have been overlooked that the ratio of the induced volts to the revolutions per second is a constant, so long as the useful lines per pole remain unaltered, being in fact what we have termed the induction factor.

While the force factor and the so-called mass factor are one and the same thing, the latter is expressed in a way involving the idea of power and, consequently, of speed, while the former indicates the real nature of this ratio, showing that it is quite independent of speed, and, therefore, not a power unit at all, much less a mass unit, but a force unit.

Example 4. A four-pole railway generator, with the armature parallel connected (giving $P=1$), has 440 conductors on the armature, with 16.1×10^6 lines per pole; the induction factor is seventy-seven, and the force factor for 600 amperes is $77\times600=46.2$ kilodynes; the output at 450 revolutions per minute is $46.2\times7.5=346$ kilowatts; the dynamo is a General Electric Company's M. P. 4, 300 multipolar railway generator.

Example 5. A ten-pole generator, armature parallel connected with 1,440 conductors and 28.6×10^6 lines per pole, will have an induction factor of 412.

The force factor for 1,500 amperes is $412\times1{,}500=618$ kilodynes, and the output at eighty revolutions per minute is 825 kilowatts. The dynamo is a Westinghouse ten-pole railway generator.

Section III.

Use of the Induction Factor in Dynamo Calculation.

The induction factor forms a connecting link between the calculation for and the construction of a motor, and since it is the true basis of the dynamical action of the motor, it can be made the subject of calculation and enter into equations of any complexity.

Example 6. We have to design a motor that will draw a car at thirteen miles an hour, with a tractive effort of 680 pounds on thirty-three inch wheels, with gear ratio 4.78 on a 500-volt line, the resistance of the motor being 1.3 ohms. If the mechanical efficiency is eighty-five per cent. the total tractive effort T must be 800 pounds.

If E be the tension of the line, d the wheel diameter, v the gear ratio, S the speed in miles per hour, R the resistance of the motor, the induction factor is given by the following equation :

$$M=\frac{E\,d}{11.2\,v\,s}\left\{1\ \sqrt{\left(1-\frac{8\,R\,T\,S}{E^2}\right)}\right\} \qquad (7)$$

Inserting the given values in this equation, we find M to be 41.7. We also see from the equation

$$T\,d=2.82\,v\,M\,C \qquad (8)$$

that the current, when running with the given load, will be forty-seven amperes.

So that the motor must have an induction factor of 41.7 and carry safely 47 amperes; *i. e.*, the force factor must be 1,960 dynes.

The induction factor may be made up in any way that is most convenient. If there are 720 conductors on the armature, and four poles, the armature, being series-connected, giving $p=2$, we see from equation 3 that we must have 2.89×10^6 lines per pole. Further, if the motor is series-wound, it must have the specified induction factor for forty-seven amperes in the field winding.

Equation 7 may be written in the form

$$M=7.85\,\frac{E\,d}{v\,s}\left\{1+\sqrt{\left(1-\frac{R\,T\,s}{11\,E^2}\right)}\right\} \qquad (9)$$

where *s* is the velocity measured in feet per second, and d is the diameter of the rope drum of a crane or elevator.

Example 7. We have to design a motor for an elevator where the unbalanced weight to be raised is 2,000 pounds, the velocity 200 feet per minute, the tension of the line 125 volts, the gear ratio seventy-five, the friction equal to 1,400 pounds at the rim of the rope drum, which is thirty-six inches diameter, and the resistance of the motor 0.05 ohm; inserting these values in the equation, we find the induction factor to be 4.45, and the running current 130 amperes; the force factor is therefore 578 dynes. If $p=1$, and $A=200$, there must be 2.22×10^6 lines per pole. Since the pull at the rim of the rope drum is 3,400 pounds, when running at 200 feet per second, this motor would develop about twenty horse-power; and if the elevator had to act always at this speed, it would be sufficient to describe the motor as a twenty horse-power motor; but this would give no information as to the ability of the motor to accelerate, since, at the moment of starting, the horse-power is nothing.

(To be Continued.)

The first large underground work in St. Louis is now under way, and the Standard Underground Cable Company of Pittsburgh, New York, Chicago and St. Louis has recently secured from the Bell Telephone Co, of Missouri, and the Kinlock Telephone Co. (both of St. Louis) two of the largest contracts ever let in this country (and probably in the world) for telephone cables; these two orders comprising all the underground cables in St. Louis yet contracted for, and constituting the complete cable equipment for both telephone companies.

Both contracts were secured in the face of the most severe competition, and the well-known excellence of the telephone cables manufactured by the Standard Underground Cable Co. largely influenced the placing of the order with them, as the prices were exceedingly close.

To fill these contracts there will be required more than 650,000 feet of cable, which in turn requires 100,000,000 feet of No. 19 B. & S. G. copper wire, and 2,000,000 pounds of lead. To meet this extraordinary demand, the manufacturing facilities of the Cable Company in the paper-covering department have recently been doubled, which places them in a position to not only handle this enormous volume of business rapidly and easily, but at the same time to fill without any delay the large and constantly increasing orders for telephone cables, electric light and power cables, rubber-insulated wire, etc., which are being daily entered.

Considerably more than one-half of this cable will be installed by the Cable Company, they having contracted to turn the cable system of the Kinlock Co. over to that company complete and ready for service.

A large force of expert workmen will be employed for nearly a year in this work, under the direct supervision of the St. Louis office.

The Automobile Club of Paris proposes holding in July next a race for heavy vehicles. At the time of the Paris-Marseilles race, a good deal of comment was made as to the advantages of speed in connection with the cause of automobilism, some critics maintaining that it mattered little whether a horseless carriage was fast or not, but that a reasonable rate of speed, combined with strength, was all that was required.

The Automobile Club de France, with a view of developing all branches of automobilism, proposes to hold races with the minimum of ten persons to a carriage and to consider a person equivalent to 100 kilograms (220.46 pounds), baggage included. It is to be hoped that American horseless carriages will be fully represented and that those interested will take note of this announcement.

POSSIBLE CONTRACTS.

Burnham, Me.—An electric plant may be constructed on the new dam on Sebasticook River.

Chester, Pa.—J. L. Glenn, Chairman Board of Public Works Commissioners, may be addressed concerning furnishing machinery, and constructing an electric-light plant.

Rome, N. Y.—Steps are being taken to have a trolley line between Rome and Utica, a distance of 15 miles.

Mechanicsville, N. Y. — Newton T. Bryan, Village Clerk, may give information concerning lighting public streets and places with electricity.

Richmond, Va.—Jas. C. Robertson and others have applied for franchise to build and operate an electric line in Manchester, and to connect same with this city.

Norfolk, Va.—T. E. Steed, Clerk of Committee on Lights, may be addressed concerning lighting of city with electricity for a term of three years.

Atlanta, Ga.—The Atlantic Electric Railway Co.'s lines will be extended further into the suburbs.

Kansas City, Mo.—Joseph Heim and others are interested in building an electric-railroad line on Fifth street and vicinity. A franchise will probably be asked to build this road.

Greenwood, S. C.—T. F. Riley desires to buy electric-light plant for hotel purposes.

Philadelphia, Pa.—An electric-light plant is to be installed in the school building corner Henry, Oliver and Catherine streets.

Brewton, Fla.—Address the mayor concerning establishment of electric-light plant.

Crowley, La.—The mayor may be addressed for information concerning establishment of electric light plant to cost $20,000 to $30,000.

Breckenridge, Minn.—An electric-light plant will be established and the village will be bonded for $4,500 to put in same.

NEW CORPORATIONS.

Albany, N. Y.—The Hudson River Power Transmission Co. has been incorporated with a capital stock of $750,000.

St. Louis, Mo.—The Western Electrical Supply Co., with a capital stock of $25,000, has been granted permission to do business in Texas.

Saratoga, N. Y.—The Saratoga Northern Railway Co. has been incorporated by E. A. McAurice and others to construct an electric railway from Saratoga to Mt. McGregor. Capital stock, $1,000,000.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued January 26, 1897.

575,699. Electro-mechanical movement. E. D. Chaplin, Cambridge, and H. G. Halloran, Boston, Mass. Filed March 21, 1896.

575,733. System for Electric Signaling. W. McC. Ramsey, Allegheny, Pa. Filed August 9, 1894.

575,767. Apparatus for Determining Electrical Resistances Containing E. M. Fs. C. Frolich, Charlottenburg, Germany. Filed May 11, 1895.

575,772. Rontgen Ray Tube. E. Thomson, Swampscott, Mass. Filed August 21, 1896.

575,777. Electric Meter. W. C. Fish, Lynn, Mass. Filed October 16, 1896.

575,782. Rail Support. W. B. Potter, Schenectady, N. Y. Filed August 25, 1896.

575,785. Closed Conduit Electrical Railway. E. W. Rice, Jr. Filed October 31, 1896.

575,805. Electrical Signal System. F. Freeman, New York, and R. E. Slater, Montrose, N. Y. Filed May 25, 1896.

575,830. Printing Telegraph. O. L. Kleber, Pittsburgh, Pa. Filed July 18, 1895.

575,869. Telephone Transmitter. R. S. Barnum, Chicago, Ill. Filed June 1, 1896.

575,887. Microphone. P. Hardegen, Berlin, Germany. Filed May 28, 1896.

575,896. Telephonic Transmitter. M. Kotyra, London, Eng. Filed Nov. 17, 1896.

575,908. Switch and Signal Apparatus. J. G. Schreuder, Edgewood Park, Pa. Filed September 21, 1895.

575,918. Brush Carrier for Dynamo-Electric Machines. S. S. Wheeler, New York, N. Y. Filed May 26, 1896.

575,952. Insulator. F. Hoover, Paducah, Ky. Filed May 19, 1896.

576,040. Fuse Holder. W. W. Dean, St. Louis, Mo. Filed September 19, 1896.

576,053. Electric Appliance for Horses. L. A. Gray, Arlington, Md. Filed October 29, 1896.

The Electrical Age.

VOL. XX., No. 5. NEW YORK, JULY 31, 1897. WHOLE No. 533

Fig. 1.

MOORE VACUUM-TUBE LIGHTING.

The interest attached to experiments in vacuum-tube lighting has received a further stimulation due to added improvements in that system made by Mr. D. MacFarlan Moore. It is a curious thing to realize that in no department of science has the staid reasoner allowed himself more liberty than in discussing the phenomenon of light. Many of the weirdest and strangest theories have been promulgated to account for its various manifestations. It has been the cause of untold theoretical controversies that were neither flesh, fish nor fowl. The discovery of X rays cleared the air and started a series of examinations into the nature and peculiarities of light that had some basis in science and practice. Scientific men realized that but little could be gained by an extension of continued arguments and that the great army of false opinions could only be swept aside by effective experiments. When it was deemed feasible to operate in the new field of lighting of homes by phosphorence, the report that much successful work had already been accomplished, was hailed with delight. The mere suggestion that heatless light would become a modern convenience seemed hardly credible to the scientific world, yet to judge from what has been done by Mr. Moore, such is the case, and the perfection of apparatus for this purpose has been carried to a state of serviceability and excellence. Vacuum-tube lighting as an experiment is an entirely different thing from vacuum-tube lighting for commercial purposes. It must be without failure in actual operation and reliable to a degree that invites competition. In this respect but little is to be feared, as all conditions and circumstances have been effective in directing the trend of this work to a practical issue. The demands of a customer for a clear and steady light that is cheap and readily controlled have been appreciated, and it seems that the light he is destined to enjoy will far surpass his most sanguine expectations.

When Mr. D. McFarlan Moore, after a long period of study, came to the conclusion several years ago that the solution of the vacuum-tube lighting problem lay in breaking an inductive circuit in a vacuum he almost immediately decided that it could be done most advantageously by the use of a rotary motion—not a vibratory motion.

But he also realized that mechanically a vibratory motion was far easier to construct in a vacuum than a rotary one and that the vibratory motion in the form of his vacuum vibrators would have a large field of usefulness, and since immediate results were very much desired, he decided to demonstrate the feasibility and practicability of the vacuum break by means of the vibrator, and he therefore perfected it first. But he has now also well nigh perfected his rotator. The apparatus used last year by Mr. Moore in lighting the hall of the A. I. E. E.—the first hall in the world to be so lighted—also in lighting the stage on the occasion of his lecture before the N. E. L. A., and finally his exhibit at the Electrical Show during May, '96, at the Grand Central Palace, which attracted far more attention than any other exhibit, being witnessed by 85,000 people—consisted of three large wooden boxes, each four feet six inches long, fourteen inches wide and ten inches deep, which contained nine vibrators each. But Fig. I. shows the enormous advance that has beenmade; it is an exceptionally beautiful piece of scientific apparatus—the finished rotator which was used to light the hall of the Moore laboratory during the evenings of his last exhibit on May 27, '97. It was the first time in history that 75 people sat (25 stood) in a room 11½ feet by 34 under the perfectly-steady rays of vacuum tubes for two and a half hours and were there photographed. Fig. II. shows a corner of the hall and gives one the proper idea as to the diminutiveness of the rotator. A single line of tube seven feet six inches by two inches (not double as at Institute) were hung near the junction of the ceiling and wall, about the place usually occupied by a picture moulding. By way of diversion Mr. Moore entertained his visitors by showing them a number of intensely interesting experiments, such as the most realistic lightning flash ever produced. The gigantic candlestick, lighted solely by induction, is shown in the illustration. But even these illustrations are not fully up to date—so rapid are the advances—because already Mr. Moore says it will not be long before he will give an exhibit which will far eclipse anything ever seen heretofore—in fact, it will be vacuum-tube lighting in such a condition that it will be ready for commercial competition with incandescence —and a new era will have begun, one looked for for several centuries — viz., light without heat (commercially speaking).

Fig. 2.

THE NATIONAL ELECTRICAL CODE.

(Continned from page 60.)

The interest in this effort for uniformity of rules, so far as the insurance companies were concerned, was so great that it was decided to hold a meeting in New York in December of the same year, and to invite the inspectors of all the insurance boards in the United States and Canada to be present. The rules, as revised at the first meeting, were put in print; copies were sent with the call for the meeting to be held on December 6; and it was also voted that a committee take into consideration the matter of permanent organization. The response to the invitation to this meeting was very favorable, and representatives were present from underwriters' organizations which covered practically the whole of the United States and a large part of Canada. A permanent organization was effected, and an Electrical Committee appointed, consisting of electricians in the employ of the insurance interests, whose duties were to be the care of the rules, the making of tests, and the giving of information and advice to members of the association. The proof of rules prepared at the August meeting was again carefully gone over and revised, and the members present pledged themselves to use their influence to have their associations adopt these rules.

Proofs of the rules were sent to various prominent electrical interests, with a request that they examine them and submit any suggestions which they might desire to make. The committee received a report from the officers of the Edison Electric Illuminating Company, of New York City, in which it was stated that these rules in general were far in advance of any heretofore published, so far as they were aware, either here or abroad.

These rules were isued under date of March 20, 1893, and were almost immediately adopted by the following fire underwriters' organizations:—

National Board of Fire Underwriters.
New England Insurance Exchange.
New Hampshire Board of Fire Underwriters.
Boston Board of Fire Underwriters.
Suburban Underwriters' Association.
Underwriters' Association of N. Y. State.
Philadelphia Fire Underwriters' Association.
Underwriters' Association of the Middle Department.
Pacific Insurance Union.
Western Union.
Association of Fire Underwriters for Arkansas.
Chicago Fire Underwriters' Association.
Cleveland Board of Underwriters.
Underwriters' Association of Cincinnati.
Detroit Board of Underwriters.

So that, with the exception of New York City and the South Atlantic and Gulf States, very general uniformity of insurance rules was secured in less than one year after the first meeting of the insurance inspectors.

The next meeting of the Underwriters' National Electric

Association was held in Chicago, on August 17, 1893, and an adjourned meeting was held in Boston, on September 5. The rules were again gone over carefully, section by section, revised and amended. The general subject of the rules was divided into classes, and each member of the electrical committee assigned to some particular subject as his special field.

At the Washington meeting of the National Electric Light Association, beginning February 27, 1894, a revised edition of the rules of the association was presented by the Commitee on Safe Wiring, and adopted.

Under date of June 15, 1894, the Underwriters' National Electric Association issued a bulletin advising that the

New York Board of Fire Underwriters, covering New York City,
Buffalo Association of Fire Underwriters,
Michigan Inspection Bureau,
Southeastern Tariff Association,
Milwaukee Board of Fire Underwriters,
Memphis Board of Underwriters,

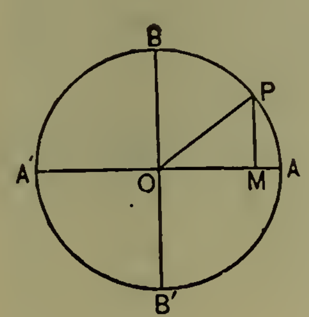


FIG. I

had adopted the rules of the association, and in August, 1894, the Associated Factory Mutual Fire Insurance Companies also adopted the rules, with a few modifications, so that in less than two years, so far as the insurance rules were concerned, uniformity had been secured; and at the meeting of the association held December, 1894, on account of the fact that certain boards had issued some slight amendments and additions supplementary to the rules, thus, to a certain extent, destroying the uniformity which had been secured, it was voted that the secretary correspond with the various associations, asking them to have their rules printed only by the National Board of Fire Underwriters, and to make no changes in, or additions to, these rules, except as promulgated through the National Board on recommendation of the electrical committee of the Underwriters' National Electric Association.

In the meantime a bureau for the testing of devices and materials and for the dissemination of information had been established at Chicago, in charge of a member of the electrical committee, and quarterly reports were issued containing brief accounts of fires in all parts of the country due to electricity; also, bulletins were issued from time to time containing reports of tests of wires, devices and materials.

(To be Continued.)

APPLICATION OF HYPERBOLIC ANALYSIS TO THE DISCHARGE OF A CONDENSER.*

BY ALEXANDER MACFARLANE.

The exponential expression for a circular angle x is $e^{\sqrt{-1}x}$, which expressed definitely is $e^{x} \beta^{\frac{1}{2}}$. By applying the exponential theorem, we obtain a series which breaks up into two parts, namely,

$$1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} +,$$

and
$$\sqrt{-1}\left\{x - \frac{x^3}{3!} + \frac{x^5}{5!} - \right\},$$

of which the former is the series for cos x and the latter the series for sin x. Now because the terms of the sine series are all affected by the sign $\sqrt{-1}$, they do not add directly to the other terms, but are geometrically compounded as forming a perpendicular component to the terms of the cosine series. We enquire for the analogous exponential expression for a hyperbolic angle x. Algebra furnishes none. It is not e^x, for

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} +$$

and here there is no ground for breaking up the series into two components; all the terms are real, and so add directly. For the same reason, it cannot be e^{-x}. But

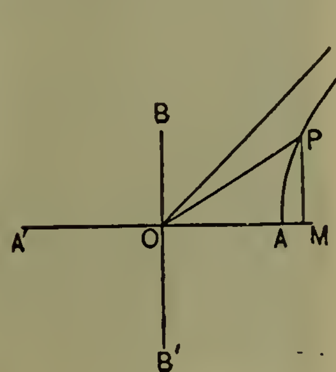


FIG. 2.

we know that

$$\cosh x = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} +,$$

$$\text{and } \sinh x = x + \frac{x^3}{3!} + \frac{x^5}{5!} + ;$$

there must therefore be some proper way of expressing the sum by an exponential function.

Before proceeding further, let us consider what is meant by a hyperbolic angle.

In Fig. 2, let A P be an arc of an equilateral hyperbola, O A and O B the equal semi-axes. The radius O P is derived from the semi-axis O A by a hyperbolic versor which has a magnitude x and an axis through O perpendicular to the plane. Now x is not the ratio of the arc A P to either the radius vector O P or the semi-axis O A; but the ratio of twice the area of the sector A O P to the square on O A. In the circle, Fig. 1, the ratio of twice the area of the sector A O P to the square on O A is equal to that of the arc A P to the semi-axis O A; the symbol x may denote either. But in the hyperbolic counterpart it is the ratio of the areas which must be taken. If x denotes the ratio of twice the area of the hyperbolic sector A O P to the square on O A, then as a matter of truth, not mere definition, cosh x, by which is meant the ratio of O M to O A, is equal to

$$1 + \frac{x^2}{2!} + \frac{x^4}{4!} + ;$$

and sinh x, by which is meant the ratio of M P to O A, is equal to

$$x + \frac{x^3}{2!} + \frac{x^5}{5!} +$$

We observe that O M and O A have the same direction, while M P is at right angles to O A; hence we conclude

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* A paper presented at the Annual Meeting of the American Institute of Electrical Engineers, New York, May 18, 1897.

that the second series is really at right angles to the first. But instead if $\cos^2 x + \sin^2 x = 1$, we have $\cosh^2 x - \sinh^2 x = 1$; the fact that it is the difference not the sum of the squares which is equal to 1 attaches a scalar $\sqrt{-1}$ before the sinh series. We conclude that the proper expression for the hyperbolic versor is

$$\cosh x + \sqrt{-1} \sinh x \, \beta^{1}_{2}{}^{1};$$

and that the exponential expression is $e^{\sqrt{-1}\, x\, \beta^{1}_{2}{}^{1}}$. For brevity we will denote $\beta^{1}_{2}{}^{1}$ by i. Thus e^{ix} denotes a circular angle, and $e^{\sqrt{-1}\, ix}$ a hyperbolic angle.

The process by which equation (4) is usually reduced to equation (6) is highly obscure to the student. We shall state it in a form such that it will apply to the analogous hyperbolic case. For brevity let n denote the square root of the difference of a^2 and b; in the hyperbolic case n is less than a. Equation (4) may then be written

$$q = e^{-at}\left(c_1 e^{int} + c_2 e^{-int}\right)$$

The arbitrary constants c_1 and c_2 are circular complex quantities; they are not perfectly arbitrary, but are connected in such a way that they involve only two independent quantities. Their magnitudes are equal and their angles supplementary. Hence we can write:

$$c_1 = c\,(\cos\varphi + i \sin\varphi),$$
$$c_2 = c\,(-\cos\varphi + i \sin\varphi);$$

then:

$$q = 2\,c\,e^{-at}\left(\cos\varphi \frac{e^{int} - e^{-int}}{2} + i \sin\varphi \frac{e^{int} + e^{-int}}{2}\right)$$

$$= i\,2\,c\,e^{-at}\left(\cos\varphi \sin nt + \sin\varphi \cos nt\right)$$

$$= i\,2\,c\,e^{-at} \sin (nt + \varphi).$$

The i is dropped, $2c$ is written A, and thus equation (6) is obtained.

The assumptions usually made in reducing are

$c_2 = c\,(\cos\varphi + i \sin\varphi)$ and $c_2 = c\,(\cos\varphi - i \sin\varphi)$

Fig. 1—Power Statian, Farrel Foundry Machine Co., Ansonia, Conn.

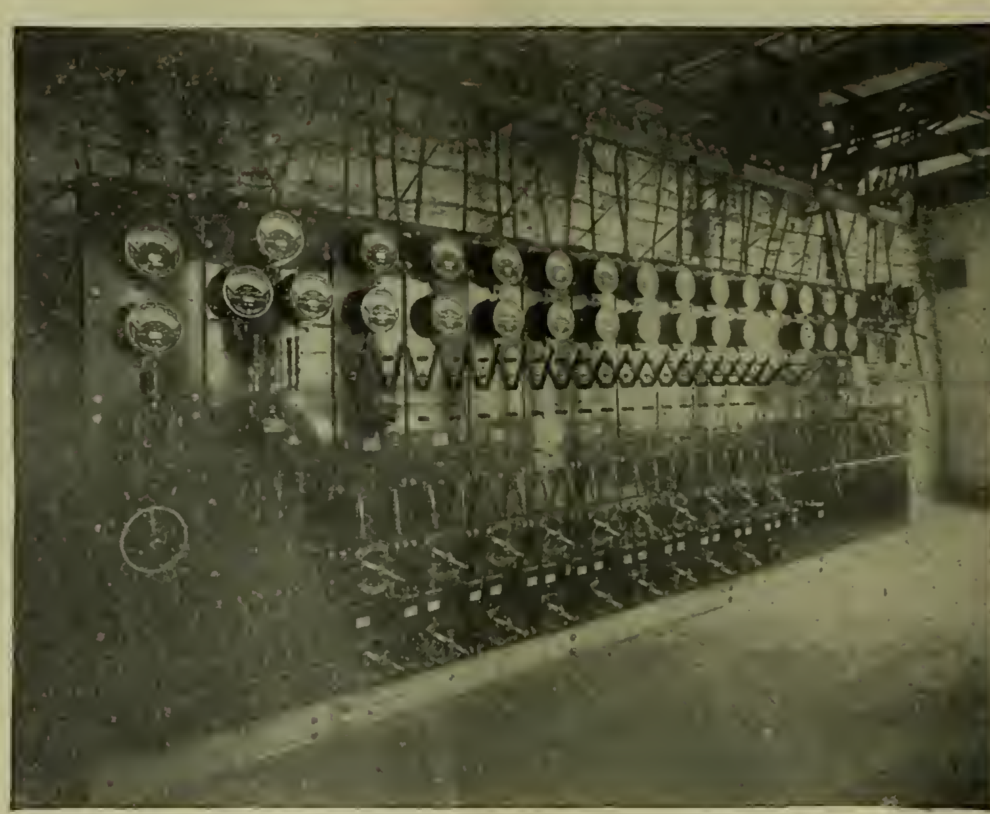


Fig. 2—Switchboard in Power Station, Farrel Foundry Machine Co., Ansonia, Conn.

which is equivalent to making the angles conjugate. The solution then is

$$q = 2\,c\,e^{-at}\cos\,(\,nt + \varphi)$$

which is the horizontal instead of the vertical projection. The analogous investigation shows that the former is the correct assumption for the initial conditions of the discharge.

(To be continued.)

THE USE OF MOTORS IN SHOPS.

The use of motors for driving the machinery in shops seems to be making particular headway in the iron and machinery industries. Each day almost brings news of some important installation of the electrical drive in shops of this character, and it is only a few months ago since the most important iron working establishment in Pennsylvania, that at Homestead, was equipped with electric motors. The result of their use is general satisfaction from the superintendent downwards, as well as marked economy compared with methods previously employed.

An interesting example of electric drive in a heavy machinery works is that found in the shops of the Farrel Foundry and Machine Co. at Ansonia, Conn., the electricity being taken from water-driven generators located nearly three miles away.

Previous to the development of the water-power, the generating plant of the Farrel Foundry and Machine Co. consisted of two 75-K. W., six-pole, 275-revolution, 500-volt dynamos directly coupled to 100-H. P. Ames engines and one four-pole, 65-K. W., 220-volt generator driven by belt. The latter still furnishes current to three travelling cranes; the former, during a short space of time only during the year, drives the different motors scattered throughout the shops. This plant was purchased before the Derby Gas Co. arranged with the Farrel Foundry and Machine Co. to supply it with current from its power station at the Housatonic Dam, where it utilizes the excess water flowing over the dam. The Derby Co., having two four-pole, 200-K. W., 550-volt machines, and being thus in a position to supply power, made a favorable arrangement with the Farrel Company.

Both dynamos being direct-current machines, and the length of the transmission nearly three miles, they are coupled in series to secure the necessary pressure, and deliver current at the brushes at 1,100 volts. At the switchboard at Ansonia the pressure is 1,000 volts. The distribution is carried out on the Edison three-wire system, and as half the motors in the works are connected to each side of the system, the working pressure of each motor is 500 volts.

In the engine room at Ansonia is a switchboard of the panel type, arranged not only for the complete control of the motor plant operated from Derby, but also for the isolated plant of the Farrel Co. The two 75-K. W. generators in the Farrel Works are used for about two months only in the year, the current from the Housatonic Dam being used for the other ten months. The first two panels control the two 75-K. W. generators; the third is an "Outside Supply" panel, and then come ten panels each controlling two motors. Each panel carries two motor automatic-starting rheostats, with magnetic cut-out; four single-pole double-throw switches, so connected that any motor may be thrown on either side of the three-wire system. An ammeter is in circuit with each motor. The last panel but one on the left is the feeder panel for the three travelling cranes, while the last panel is the generator panel for the 65-K. W. 220-volt generator supplying current to the cranes.

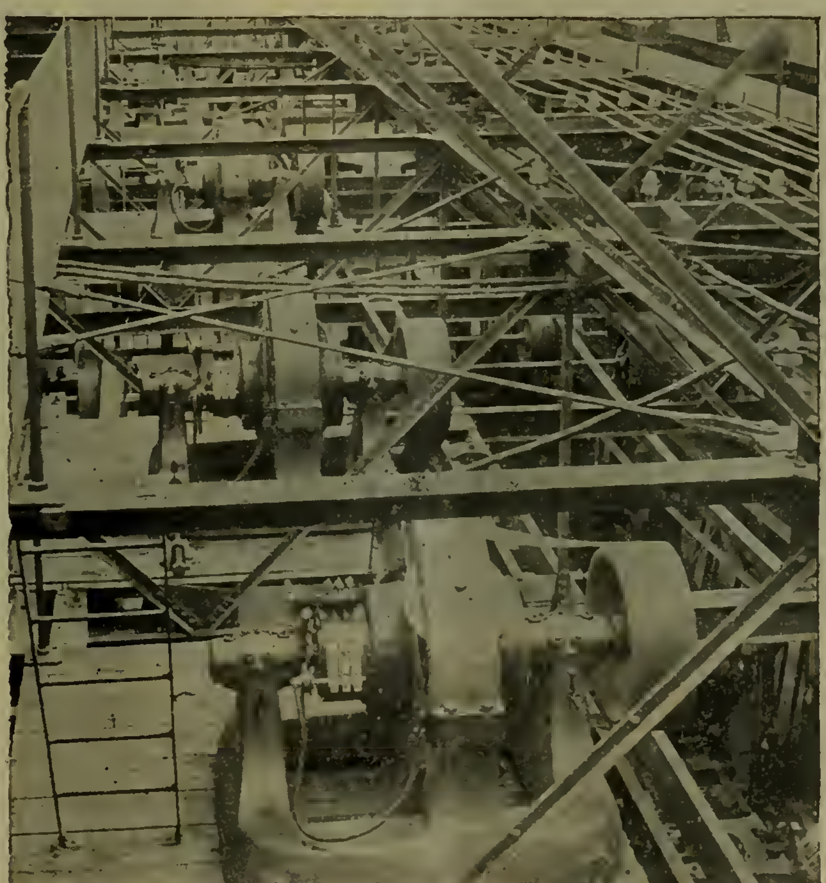


Fig. 3—Six 500-Volt Moters attached to Roof Girders in Shop.

The motor equipment consists in all of nineteen motors of the following horse-power and speed:

Three . . .	35-H. P. . .	525 revolutions.
Five	10-H. P. . .	325 "
Eleven . . .	15-H. P. . .	312 "

They are all of the four-pole type, and for the most part are located directly over the floor of the shop on platforms suspended from the roof girders. From these the belts are taken to the shafting below, whence the various machines are driven. The illustration shows six motors set on platforms in the new machine shop. They range in capacity from ten to thirty-five horse-power. Directly beneath them is the path of one of the travelling cranes. Other motors are attached to the wall, and a few are on the main floor near the walls.

The machinery manufactured by the Farrel Foundry and Machine Co. is of a peculiarly heavy type, and the machines driven by the motors are of various characters and sizes, subjected to sudden, heavy and fluctuating loads, yet according to the officers of the Farrel Company the plant, running since October, 1895, has not only given complete satisfaction, but no repairs either to generators or motors have been found necessary during the eighteen months in which the system of electrical drive has been in operation. The heavy ore and rock crushers made by the Farrel Company are used in all parts of the world, while their mills and heavy calendar rolls are found in nearly every rubber mill in the United States.

The economy induced by the introduction of the electric motors is perhaps best illustrated by the result obtained in the roll shop. This was previously run by a 250-H. P. Buckeye engine, usually loaded to its full capacity. The same rolling machinery as well as a variety of other machinery is now driven by motors taking a total power of from 125 H. P. to 150 H. P.

The 65-kilowatt, 250-volt generator supplies, as stated above, the current to operate three travelling cranes and several jib cranes. The machine is also subjected to very wide fluctuations of load, sometimes extremely severe. Under service of this character the ordinary generator might be expected to give some dissatisfaction, yet it operates without the least sparking and without necessity of changing the brushes under any change of load.

The entire electrical plant was furnished by the General Electrical Company of Schenectady.

NORTHWESTERN ELECTRICAL ASSOCIATION.

The Fifth Semi-annual Convention of the Northwestern Electrical Association was held at La Crosse, Wis., on Wednesday and Thursday, July 21, 22, 1897.

Programme.

Wednesday.—Morning Session.

Convene 10 o'clock—Roll-call—Reading of Minutes—President's Address—Reports of Officers—Reports of Committees—Elections to Membership—Unfinished Business—New Business.

Afternoon Session.

Convene two o'clock.

Paper—"Utilization of Exhaust Steam," by Geo. L. Thayer, Iowa.

Paper—"220-Volt Lamps," by Prof. G. D. Shepardson. Minnesota.

Five P. M.—Trolley Party through city and environs.

Eight P. M.—Complimentary Concert at Germania Hall.

Thursday.—Morning Session.

Convene ten o'clock.

Paper—"Evolution of the Incandescent Arc Lamp," by O. M. Rau, Wisconsin.

Paper—"Use of Oil in Transformers," by Prof. R. B. Owens, Nebraska.

Afternoon Session.

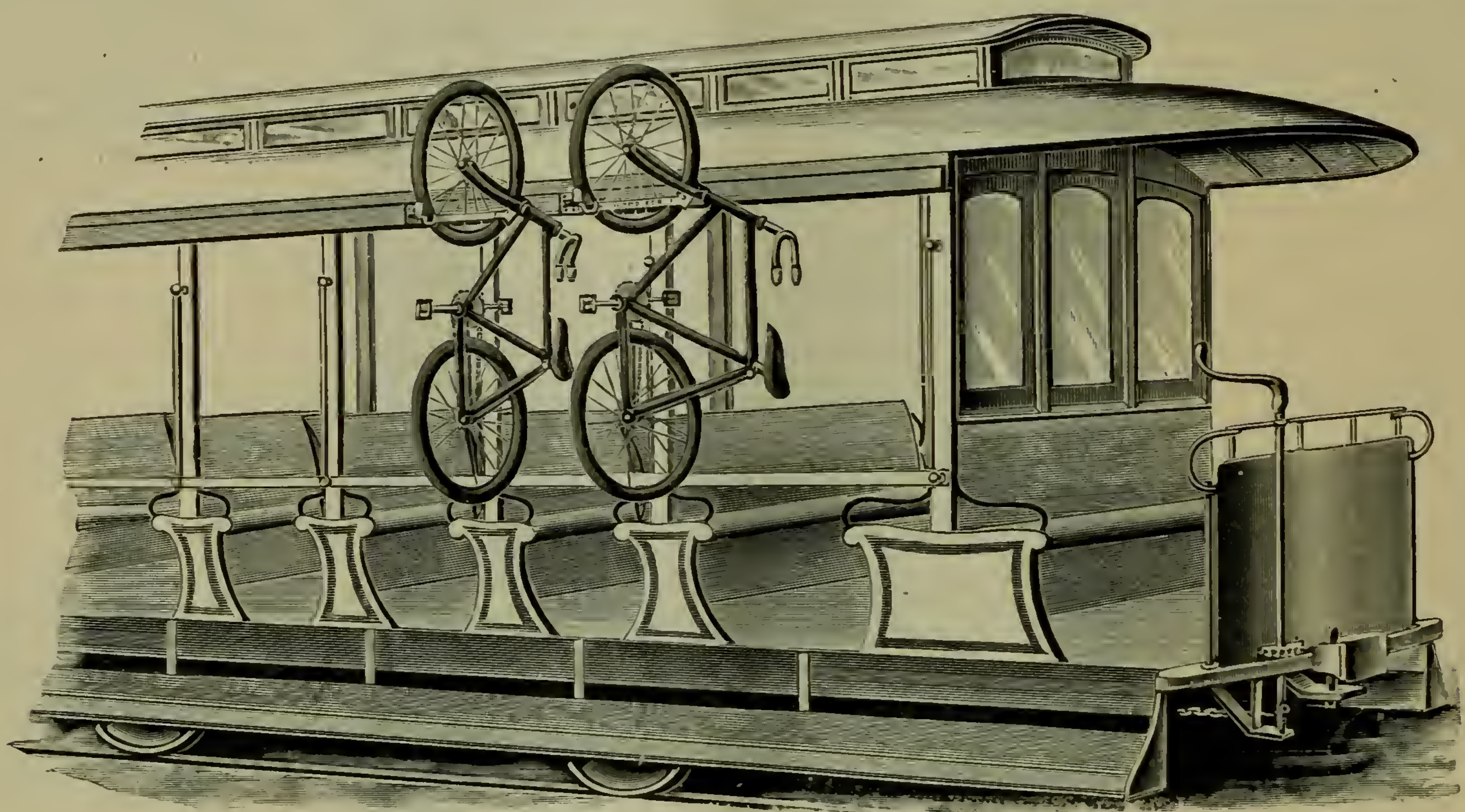
Convene two o'clock.

Paper—"Meter Tests," by Prof. D. C. Jackson, Wisconsin.

Paper—"Practical Specifications for Engineering Materials," by John C. McMynn, Illinois.

5 P. M.—Excursion on the Mississippi in steam launches.

6.30 P. M.—Picnic Lunch on Minnesota shore.



Shows Manner of Placing Bicycles on Closed Cars, or Closed Side of Open Cars.

TROLLEY CARS AND BICYCLES.

A great deal of morality would be preserved if it were possible for bicyclists to secure transportation for their wheels on trolley cars without danger either to the wheel or to themselves, and without arousing in the breast of his fellow passenger an uncontrollable desire to sweep him off the face of the earth. A device has been invented which will be a great aid to trolley car corporations and bicyclists in this respect. The wheel can be carried safely on the outside of the car and the owner, without infringing in any way upon the rights of his fellow men, can travel with comfort and security. Bicycles suffer more wear and tear within city limits than they do outside. The car tracks and cobble-stones are in league against them, and the same can only be avoided by a device such as that illustrated. It is sold by the Champion Bicycle Hanger Company, 457 Broadway, New York city, and may be applied to the side or ends of cars, the wall of a room or the end of a hallway. This arrangement holds the bicycle away from the floor in a position which enables it to be easily handled for cleaning and repairing. It does not injure the wheel in any way, occupies very little space and, when not in use, folds up against the wall. The hanger seen in the illustration swings on a pivot, and can be moved in either direction, making it very convenient and ready for use without any mechanical gymnastics being gone through.

(Continued on page 74.)

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NEW YORK, JULY 31, 1897.

CONTENTS.

THE TROLLEY IS FREE.

A great row has been going on in electrical circles, the chief combatants being the Walker Company, of Cleveland, and the General Electric Company, of Schenectady. The matter at issue was that regarding the exclusive right to an overhead trolley conductor. On July 22 of this year, the United States Circuit Court of Appeals made it possible for the builders and operators of electric cars to run the same without paying tribute to the General Electric Company. The original patent was obtained by Van Depoele, an electrical engineer of considerable reputation. It fell into the hands of the Thomson-Houston Electric Company. By the mutual consent of the Westinghouse and Edison General Electric Companies the trolley patent became if not their common property, at least, was put at the disposal of either of them. The Walker Company kept things pretty hot fighting the syndicate and spending money ad libitum to bring about a rapid issue. The General Electric Company was represented by F. P. Fish and F. H. Betts. The Walker Company's lawyers in co-operation of those of the Hoosic Railway Company were Messrs. Mitchell, Bartlett and Brownell, and Witter and Kenyon. The case was argued on behalf of the Walker Company by C. E. Mitchell. This is a great gain to all trolley roads and those connected with the equipment of the same. It relieves the tension that has previously existed between two powerful concerns and practically removes a great cause of dispute which had previously existed. The patents owned by Van Depoele were filed in the Patent Office, March 12, 1887, and control the rights to a suspended conductor conveying a working current and a contact device carried by the car and employed for the taking-off of the same. The later patent obtained by him "states that in a still earlier application for a patent the patentee had shown and described a contact device consisting of a grooved roller mounted upon a spring and sustained thereby a short distance above the roof of the car." The earlier patent consisted of thirty-five claims, the later of sixteen. The substance of the earlier patent related to "combinations between the conductor switches and the travelling contact." The other patent, the later one, referred "particularly to combinations between the travelling contact and the suspended conductor." The practical identity of these two patents is in many respects evident and the final conclusion reached seemed to have been the result of unbiassed and deliberate thought. Now that this great civil battle is at an end, a greater impetus than ever will be given to manufacturers and investors to place their money in remunerative channels and pursue the even tenor of their way in peace and quietness.

DARK LIGHT.

Light passing through opaque substances and the phenomena connected with the same has been investigated by M. Gustave Le Bon. The published results of his work indicate that the red and infra-red rays of sunlight penetrate heavy metal plates to such an extent that sensitized plates are affected after a long exposure. These results are very remarkable because of the fact that the light retains characteristics which one would expect to find missing in such a case, that is, the passage of the rays through opaque substances. He has tried to establish a relationship or connection between light and electricity, but his efforts have been unsuccessful and his remarks are fanciful and unscientific in this respect. The dark light spoken of in this case, the X rays of Roentgen and the peculiar Hertzian waves with which Signor Marconi is at present experimenting, are tied together by the unbreakable bonds of nature. They are the same but differ in minor respects, yet this difference is sufficient to cause so great a distinction that the layman and semi-scientist would probably identify them without hesitation. A great deal of commercial interest has begun to attach itself to the study of dark light and projected light waves. It may be that in the future, except in cases where vast quantities of power are to be transmitted, a great deal of energy will be sent and received without the aid of conductors and without any dependence being placed upon our present system of metallic conduction.

LONDON TO AMERICAN COMPANIES.

London, June 27.—According to the Daily Mail, the English firms are indignant that the contracts for the traction plant of the London Central Railway, which is to be an underground electric line, amounting in value to hundreds of thousands of pounds, have been given to Americans.

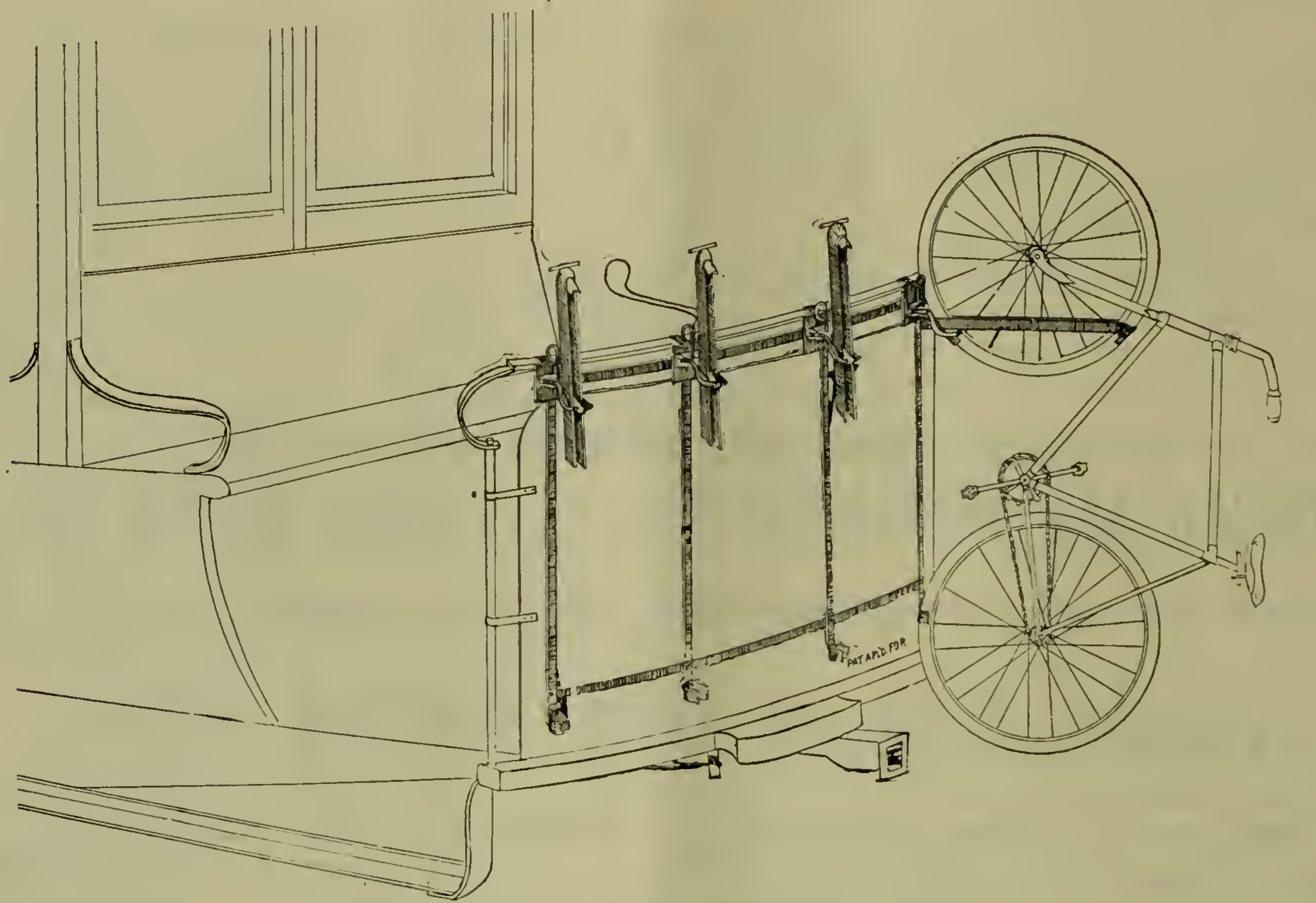
The secretary of the company explains that the contracts for carriage, locomotives and machinery were given to American firms on the advice of the electrical experts, who represent that the greater use of electrical traction in the United States has brought its manufacture to a higher degree of perfection, and made it far less expensive than in England.

In the House of Commons today Lord George Hamilton, Secretary of State for India, in reply to a question why the East India Railway, owned by the Government, had purchased 7,708 tons of rails from the Maryland Steel Company of Baltimore, said that the lowest British bid was £8,675 higher than the American.

This device is constructed with a cast-iron back shaped in a peculiar manner, so as to hold the loop in a firm, rigid position, and is tested to stand a strain of 125 pounds. The loop is made from one-eighth by one inch Norway iron, and has free play in the loop prongs to fold up. When folded it extends only four inches from the dashboard, and when open extends twenty-six inches. On the loop holder and on the end of loop are iron shoes shaped to fit and protect the tire from injury. There is a wire riveted to the rear support running up six inches and alongside of tire, and passes to the rear and then down over the other side, which holds the wheel firmly in the loop. All parts coming in contact with the enamel are covered by rubber. Can be used on both front and rear dashboards, also on side of cars.

Suppose now that we had to reduce the time of starting by one-half; *i. e.*, to start up in one second. One way of stating the case would be to say that we needed a "more powerful motor"; but so long as the frictional resistances and the final speed are to remain the same, the maximum horse-power of the motor remains constant, so that we do not need more power, but more force; *i. e.*, we require a motor with a higher force factor.

We cannot alter M so long as the final speed is specified, so we must double the accelerating current, making the total current at the start 174 amperes. The motor would then be described as having an induction factor of 4.45, with an armature capable of carrying 174 amperes safely; *i. e.*, the motor must have a force factor of 775 dynes.



Shows Manner of Placing Bicycle on End of Car.

THE INDUCTION FACTOR; A NEW BASIS OF DYNAMO CALCULATION AND CLASSIFICATION.

(Continued from page 63.)

Section IV.

The current reqnired for any given acceleration is given by the equation

$$a = 405 \times 10^{-4} \times \frac{v\ M}{d\ W} \times C_a \qquad (10)$$

where C_a is the current requ.red (over and above the frictional or running current) to produce an acceleration of a feet per second in a mass of W tons.

Example 8. We have to start up the elevator car of Example 7 in two seconds; *i. e.*, to get up a speed of 200 feet per minute in two seconds; *a* is then 1.67, and if we suppose the total mass to be moved to be five tons the required current is twenty-two amperes, making a total current, at the start, of 152 amperes. The motor must therefore have a force factor of 676 dynes in order that it may start up in the given time.

If the distance from floor to floor were twelve feet, two seconds would thus be occupied in getting up speed, during which time the car would travel 3.3 feet, and the rest of the distance, 8.7 feet, would be covered in 2.6 seconds at 200 feet per minute, making a total time of 4.6 seconds for the whole distance. Nearly half the time is thus occupied in accelerating.

Example 9. Take the case of the street railway motor of Example 6, with induction factor 41.7 and force factor 1,960 dynes.

The total available tractive effort was 800 pounds; allowing eighty-five per cent. mechanical efficiency left us with 680 pounds for useful effort. (The well known G. E. 800 street railway motor, made by the General Electric Company, has 800 pounds available for useful effort with forty amperes.)

If the track resistance for a car weighing ten tons be 200 pounds, this will leave us 580 pounds per motor, if there are two motors, for grades and starting, or we may say that of the maximum permissible current of forty-seven amperes, thirteen are used in overcoming gear and track friction, and thirty-four are available for grades or starting.

Now, 580 pounds are equivalent to a grade of five per cent. for a ten-ton car, so that the motor would run a car of this weight at the given speed—thirteen miles an hour—up a grade of five per cent. Taking 680 pounds as the useful effort at this rate, the useful watts can be written (to within one-half per cent. of accuracy) as 2 S T or 17.7 kilowatts or 23.7 horse-power. This is the maximum rate of working.

These motors, however, will not be able to start the car on this grade. They can run the car when once started, but if it should happen to stop on the grade, they cannot get it started again, since the whole available current is used up in track friction and on the grade. We must draw more current from the line if we are to start up on the grade.

Equation 10 tells us that we can make the acceleration at the start anything we please, by increasing the current above that required for the grade and for friction. Let us find how much current would be required to start up in twenty seconds on a five per cent. grade.

The final speed of thirteen miles an hour is equivalent to 19.1 feet per second; if we have to make up this speed in twenty seconds, the acceleration must be 1.91 feet per second, assuming uniform acceleration throughout. Inserting this value in Equation 10, remembering that each motor has to accelerate half the car, we find the required current to be twenty amperes, so that the total current from the line at the start would be sixty-seven amperes; namely, thirteen for friction, thirty-four for the grade and twenty for accelerating. The distance traveled in getting up speed would be about sixty-three yards.

The motors then would have to be capable of carrying sixty-seven amperes, and the force factor must be 2,790 dynes.

Section V.

When the tractive effort, the speed, the tension of the line and the resistance of the motor are given, we can write

$$\frac{M\,v}{d} = \frac{E}{11.2\,S}\left\{1 + \sqrt{\left(1 - \frac{8\,R\,T\,S}{E^2}\right)}\right\} \qquad (11)$$

In designing a motor equipment to fulfil certain conditions, we must be able to distinguish between the part played by each of the quantities, M, v and d, in obtaining the desired result.

Example 10. A train and locomotive on the Baltimore & Ohio Railroad weigh 780 tons, and have to mount a grade of 0.8 per cent at 10.7 miles per hour. The frictional resistance of the track is nine pounds per ton, reckoning at this rate both train and locomotive. The tension of the line is 625 volts. Four gearless motors are used, permanently connected in series, each having an internal resistance of 0.0209 ohm.

Each motor thus has to move 195 tons on a tension of 156.2 volts. The draw-bar pull per motor for the grade is 3,490 pounds; for friction 1,755 pounds; allowing ninety-five per cent mechanical efficiency, we get 5,500 pounds as the required tractive effort per motor; inserting this value together with those for E, R and S, in Equation 11, we find the value of $\frac{M}{d}$ to be 2.32, v being unity.

It appears then that whatever size of driving wheel we employ, the induction factor must be 2.32 times the diameter; and that so long as this ratio is maintained, the locomotive will haul the train up the grade at the required rate. For instance, if we take wheels four feet in diameter, the induction factor must be 111. If d is five feet six inches, M must be 153. The current at full speed is 850 amperes from Equation 8, and is unaltered by increasing or decreasing the ratio of M to d, so that we should take d as small as possible, consistent with leaving a clearance for the motor and its attachments. The actual values of M and d for the motors in use on the Baltimore line are M = 144, d = 62 inches.

When running at full speed each of these motors would be doing work at the rate of 158 horse-power, so that the horse-power of the locomotive would be 632. The current from the line would be 850 amperes, as obtained from Equation 8. This current will not, however, start the train on the grade. We have to find then how much current is required to do this.

If the start is to be effected in forty seconds, since the final speed is 10.7 miles an hour, or 15.7 feet per second, the acceleration must be 0.393 foot per second. Inserting this value in Equation 10, remembering that W is 195, and $\frac{M}{d}$ is 2.32, we find the current required for acceleration to be 810 amperes, making a total current at the start of 1,660 amperes, or a force factor of 239 kilodynes. This agrees with the results obtained in starting a train of the given weight under the given conditions. (See Mr. Lee H. Parker's paper on the "Electric Locomotives Used on the Baltimore Line," published in the Street Railroad Journal for March 1896.)

(To be continued.)

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—METHOD OF REFINING GOLD BY ELECTRICITY.

San Francisco, July 20, 1897.

Electrical Age.

Dear Sirs: Having had considerable acquaintance with mining work, both gold and copper, I thought it possible to apply electricity to gold quartz for the purpose of refining it, that is, getting the gold out without crushing the rock. Any dry process of getting at the gold would be a fortune to its discoverer, as there are thousands of tons of quartz having the faintest traces of gold that it would not pay to touch except on a large scale. I believe that electricity will, in some way, be used for gold mining in the near future and hope that any possibilities in that direction will be pointed out by your valuable Inquiry Column to me.

Yours respectfully,
Carlos Gordon.

(A.)—The only method of obtaining gold electrically is by that employed in the Anaconda and other large copper mines, and even then the gold is obtained as a by-product as well as silver. No suggestion can at present be given that would serve to enlighten you on the subject. We appreciate the value of a dry process of getting at the gold, but see no way of accomplishing it.

(Q.)—RESUSCITATING THOSE SHOCKED TO INSENSIBILITY.

Niagara City, July 25, 1897.

Electrical Age Pub. Co.

Dear Sirs: The city I live in is a living centre of electric wires carrying power to all points in the vicinity. The danger arising therefrom I have often seriously considered and wondered what would be the quickest and easiest remedy to apply in attempting to resuscitate those shocked to insensibility. The chances of death or shock occurring are not alarmingly great, but I am of the opinion that it would be a nice thing to know what to do in case of emergency, and how the speediest relief could be given to any unfortunate.

Yours faithfully,
A. Blanchard.

(A.)—To resuscitate those struck down by a heavy pressure consult Cushing's "Standard Wiring for Electric Light and Power." In this book a method is given of restoring animation that is simple and effective:

Take the body for the circuit.

Loosen the clothing and begin artificial respiration.

Hold the tongue forward when the chest is expanded.

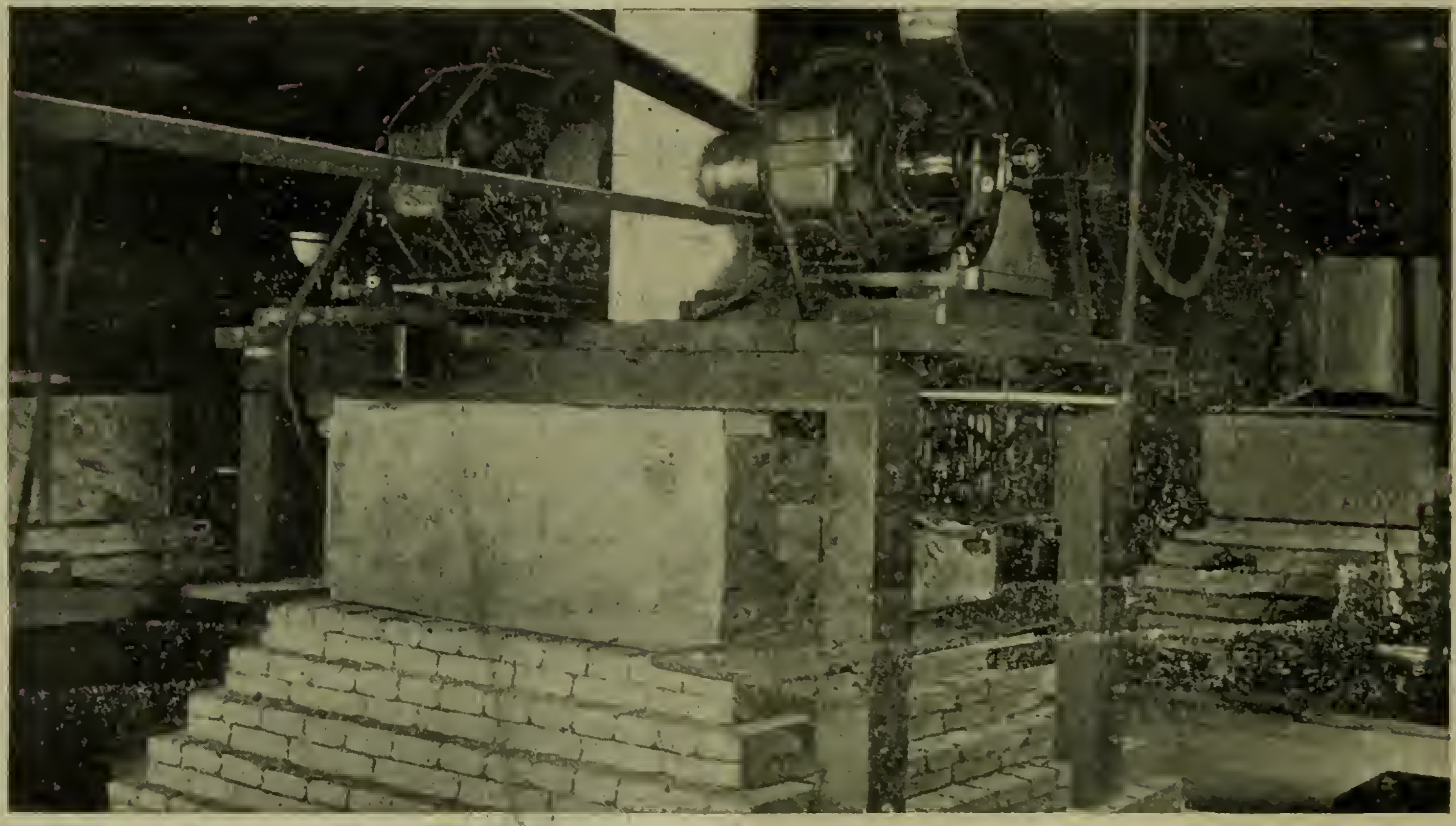
Excitation of reflex action by affecting the splincter muscle of the lower bowel.

The La Borde method of compressing and expanding the lungs, moving the tongue forward and backward to simulate natural action and friction to restore circulation and animation, is about similar to the above in its general features. The method employed to revive a person from the dangers of asphyxiation and drowning is identical to this, and can be duplicated in every respect.

A TYPICAL AMERICAN MACHINE SHOP.

The Garvin Machine Company of New York is one of the greatest concerns in its line and represents with its present improvements what may be looked upon as a typical American machine shop, equipped in every respect with all that is required for the rapid execution of orders and the fulfilment of large contracts.

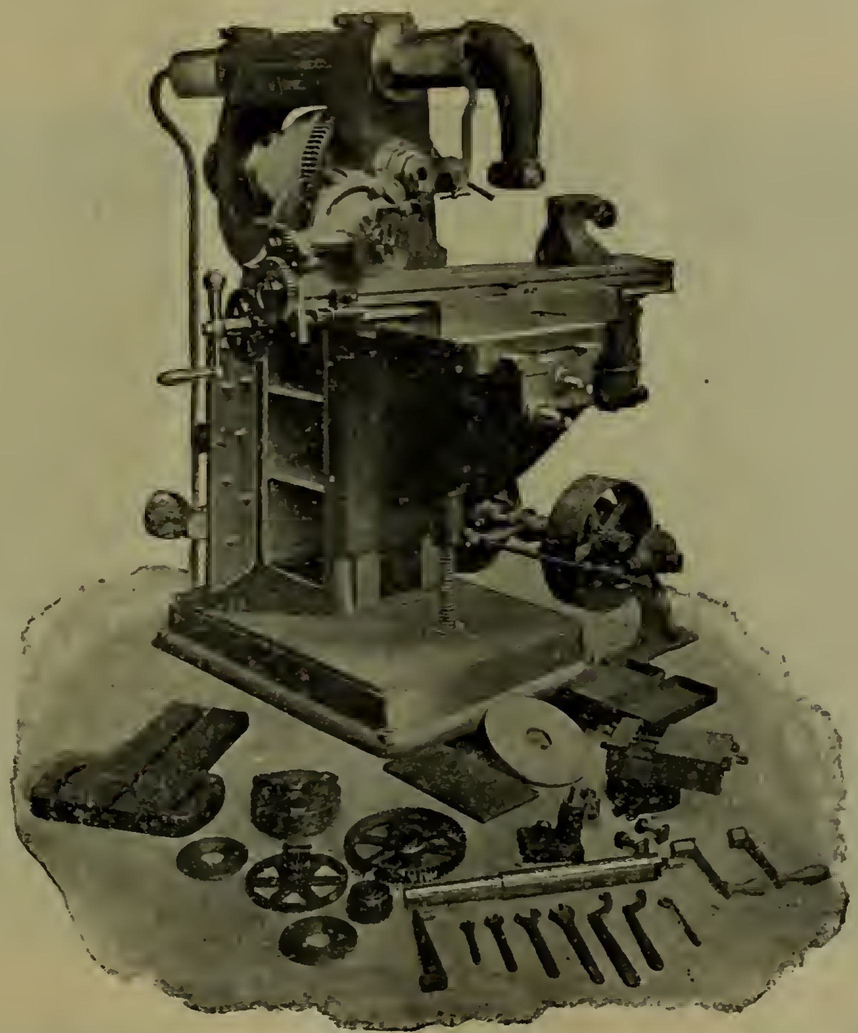
Garvin Machine Company.


Electric Drive on Foundation. Garvin Machine Co.

Tallassee, Ala. — The Mutual Light and Power Co., of Montgomery, Ala., and the Tallassee Falls Manufacturing Co. have completed an agreement by which the 3,000 horse-power used at Tallassee Falls will be converted into electricity and wired to Montgomery.

In 1896 the building in which their work was done was unfortunately burnt to the gronnd, but in spite of this setback and inconvenience the business of the firm was continued, and what had seemed a great misfortune turned out to be in many respects a blessing. A new building was erected which arose, Phœnix-like, from the flames of the old, though not erected upon exactly the same site. The Garvin Machine Company was established in 1862 and incorporated in 1889. The fire to which reference has been made wrought great havoc with the drawings, tools, patterns, etc., of the concern and put those in charge to a great deal of inconvenience and hard labor to bring things to their present condition of smoothness and easy running. We can say that this would have been impossible had it not been for their thirty-five years of past experience, which, added to their appreciation of the value of modern improvements and methods in machine practice, tended to elevate this new shop far above the plane of the older.

The present equipment is as we have noted, thoroughly modern, and all the facilities that can be brought to bear have been made use of in the fittings of their new shop for the purpose of turning out the best of work in the shortest time. The system employed by this concern does not belong to that commonly called piece work or contract work, and in this respect they are wise, for they pay the best of help and receive fair prices for their labor. The property is owned by the Trinity Corporation, and the building, an illustration of which is presented to the reader's notice, is supplied with current received from a plant owned by the above corporation. Crocker-Wheel-



No. 3 Universal Milling Machine. Made by the Garvin Machine Co.

Show Room. Garvin Machine Co.

er motors, as shown in illustration, are used on each floor for driving the main shafts.

The fire, which occurred on March 6 of last year, sent the Garvin Company into this new building, which is fitted with every convenience of an electrical and mechanical nature. There are two large freight elevators, one passenger elevator, electrical power and light, a telephone tools and the other labor-saving devices and special bicycle machinery. The amount of work they do, special and general, is so extensive that it would be impossible in this limited space to do full justice to it, and the reader is therefore referred to their illustrated catalogue and price list. The location of the present shop is at the corner of Spring and Varick streets, New York city.

Switchboard. Garvin Machine Co.

system of twenty-six stations and a system of call bells that rings every department into intimate communication, The building is fireproof, and the possibility of fire has therefore been reduced to a minimum. The cuts of the general offices, show rooms, telephone system, switchboard, electric drive, etc., will give the reader an idea of

Nickel-Plating Department. Garvin Machine Co.

the manner in which the details of this installation have been attended to.

In order to make it convenient for those with whom they transact business, they have divided their shop up into sections, one containing the general machinery and

They also have a store in Philadelphia, at No. 51 North Seventh street.

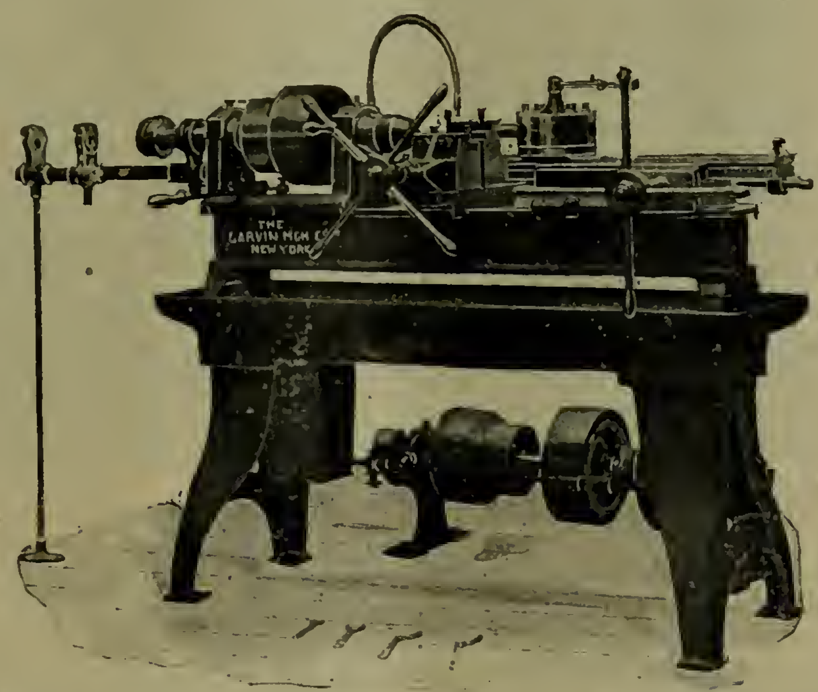
WILL PAY NO MORE ROYALTY.

Trolley companies will no longer pay a royalty of $100 a car to the General Electric Company for using the pole and wheel connecting with the overhead wire. This is the effect of a decision handed down yesterday by the United States Circuit Court of Appeals for this district.

The case has been in litigation for a long time, the jugments heretofore having been invariably in favor of the General Electric Company, which claimed to have a patent on "a travelling contact for electric railways."

The patent was known as the Van Depoele patent, and has been used by its owners as practically prohibiting the use of any trolley, because it was claimed to cover broadly the idea of the under-contact trolley on an overhead wire. The only thing the trolley owners could do was to pay to the syndicate, made up of the General Electric and the Westinghouse companies which had purchased the Van Depoele patent, a royalty for the idea of the contact now in general use.

The royalty charged was $100 per car. The decision affects favorably all the trolley railways in the country.—Press.



No. 12½ Screw Machine, Fitted with Forming Cross Slide. Made by the Garvin Machine Co.

Garvin Machine Co. Telephone System Central Station.

A. K. WARREN & COMPANY CONSOLIDATED WITH THE ELECTRICAL MAINTENANCE CO.

The concern of A. K. Warren & Company, 451-453 Greenwich street, New York, and the Electrical Maintenance Company, of 50 Broadway, have consolidated and called themselves the American Electrical and Maintenance Company. A very large and reliable concern has developed from this coalescence of interests with representatives in Baltimore, Philadelphia and Boston. The two concerns thus represented as one occupy a broad and comprehensive department of the engineering business; repairs, emergency work, maintenance by contract, wiring supplies and an insurance of all losses to the proprietor due to faults or defects in his electrical apparatus represent a large part of it. Both of these concerns were doing very well at the time of consolidation, but it seems that very often in cases where each firm gets along individually in a satisfactory manner a curious mathematical law develops itself. Their success will develop according to the square; that is, two firms will get along in conjunction four times as well. With this expectation we wish this new company every success that honesty, integrity and perseverance will insure.

ANNOUNCEMENT.

New York, July 1, 1897.

We beg to announce that we have formed a copartnership under the firm-name of J. C. Dolph & Co. for the purpose of dealing in Electrical and Street Railway Specialties.

Yours very respectfully,

J. C. Dolph.
F. E. Triacca.

Address 126 Liberty St.
Tel. 1005 Cortlandt.

Mr. A. C. Jahl is selling for G. Humbrock the large stock of receptacles and sockets held by the Electrical Engineering & Supply Company, which he is willing to dispose of at greatly reduced prices. He has also bought a large stock of knife switches which will be sold at very low prices. Mr. Humbrock is buyer for some of the largest consumers in the United States, which includes central stations, electric railway companies, supply houses and isolated plants.

The Holtzer-Cabot Electric Company have as their New York manager David Chalmers, 112 Liberty street, New York. They have been given the eastern agency for Cutler-Hammer motor starters and circuit breakers. The Wagner Electric Manufacturing Company of St. Louis, A. H. Mustard, New York manager, 26 Cortlandt street, report an excellent demand for their new single-phase motors from one and one-half to ten horse-power.

Mr. C. D. Taylor, of Cleveland & Taylor, the well-known firm of electrical contractors, No. 5 Dey street, New York, can be seen once more by his friends at his desk as usual. Mr. Taylor has run the gauntlet of pain and suffering. He was laid up with some latent trouble in his knee-joint about a year ago which developed to such an extent and so seriously threatened his entire limb that amputation of the leg above the knee was considered necessary. At present, however, he is looking quite well and is ready for all that the world will throw in his way. The firm of Cleveland & Taylor have installed some of the finest plants in this city, among which may be noted the Treasury Building in Wall street. This concern has secured a permanent reputation, due to the high quality of their work in wiring and installing electric-light plants. The trade were very much grieved to hear of Mr. Taylor's misfortune, but we feel sure that their appreciation of the concern of which he is a member has not diminished and that it will assume a practical form this fall season as it did in the past.

F. M. HAWKINS, who has had charge of the New York office of the Electric Engineering & Supply Co., of Syracuse, N. Y., for the past four years, has taken the agency for Pass & Seymour' selectrical specialties and the Crouse-Hinds Electric Co., makers of knife switches, switchboards, panelboards, etc. He has offices and store room at Nos. 39–41 Cortlandt street, where he will carry a complete stock of supplies.

Brenham, Tex.—The Brenham Compress Oil & Manufacturing Co. contemplates increasing its electric-light plant. Will probably want 3,000-light outfit, and may want estimates on same.

Brunswick, Ga.—The Southern Telephone & Telegraph Co. has received franchise from the City Council for the establishment of an exchange in Brunswick.

Pulaski, Va.—The Pulaski Electric Co. recently organized, will apply for city franchise, and if same is granted, will erect a plant.

TELEPHONE NOTES.

McComb, Miss.—W. M. White and J. W. Johnson, of Whitestown, Miss., will establish a telephone system in McComb City.

NEW CORPORATIONS.

Columbia, S. C.—The People's Electric Light Co. has been incorporated with a capital stock of $100,000.

Hempstead, N. Y.—The Suburban Electric Light Co. has been incorporated by Frank M. Frary, F. H. Crowin and O. M. Chace; with capital stock of $25,000.

Toccoa, Ga.—The Southern Industrial and Colonization Society has been granted a charter for electric light plants.

Jacksonville, Tex.—J. B. Roberts has been granted franchise for the establishment of an electric-light plant.

Lansingburgh, N. Y.—The Beacon Electric Light Co. has decided to increase its capital stock from $75,000 to $100,000. The company will also add new machinery.

MR. L. E. FRORUP, of Schiff-Jordan Co., 232 Greenwich street, has returned from a well-earned vacation in Europe of business and pleasure. He is in town, ready for a big fall business. The high tariff does not affect him.

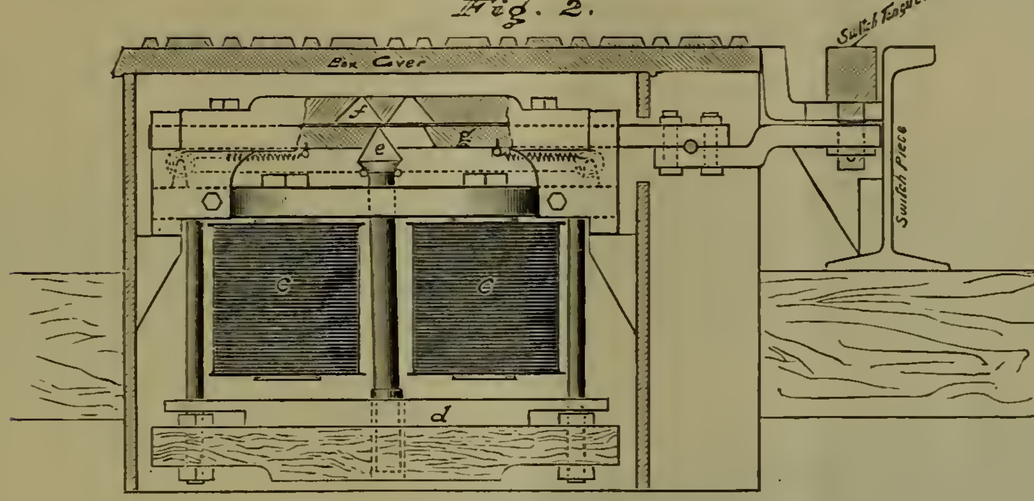
Prof. Albert Lloyd Colsten of Oahu College, Hawaii, tells in the June number of the *The Home Magazine* why the Hawaiians want to be annexed to the United States, and in view of the facts that he sets forth, there seems to be little doubt that they should have what they want.

The Electrical Age.

VOL. XX., No. 6 NEW YORK, AUGUST 7, 1897. WHOLE NO. 534

Surface View of Automatic Electric Switch. New York Switch & Crossing Co.

Fig. 2.



Section through Switch Box, at A-B.

Section of Automatic Electric Switch,

AN AUTOMATIC ELECTRIC SWITCH.

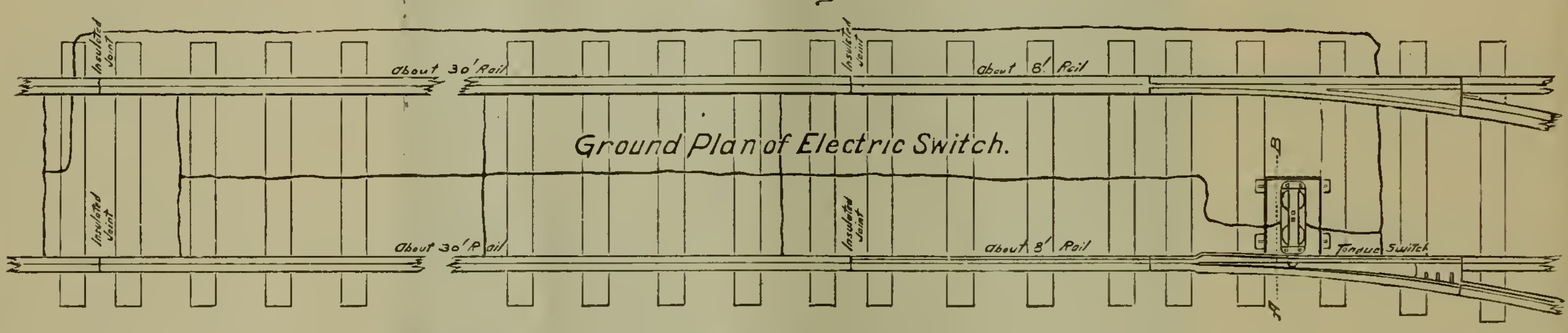
The greatest imaginable boon to street car companies is comprised in a reliable automatic electric switch. Since the trolley car has become a fixed feature of city life, and the improvement of the entire system has been aimed at from every standpoint, managers have sought far and wide for a simple, practical and easily operating device with which to control the switches so frequently met with on the route in every crowded city. The necessity of having something that would fulfil its functions unhesitatingly and which would not interfere with the general equipment of either roadbed or car was duly appreciated. The past history of street cars, and even steam railroading, will give the reader an idea of the amount of experimenting carried on with this object in view. It will likewise indicate the drift of the work and the great number that failed to achieve any satisfactory results. The difficulties are not great, yet the requirements are absolute, and any deviation from them would mean costly experimenting by that company hazarding a change, even though the change mentioned from an engineering standpoint contained the least elements of chance. Any man's judgment would therefore draw him to the conclusion that an automatic electric switch must be modelled on lines which make its actions absolutely positive, its mechanism readily controlled and its durable nature an established fact. Perhaps a series of limitations as rigidly enforced as these must be, would in the reader's mind prevent the average inventor from touching upon this well-defined field of work, but strange to say it has not. Many ingenious arrangements have appeared and lived their ephemeral life without being regarded as either useful or essential according to the prescribed form. Their number is legion, which counts radical changes in the system, roadbed, tracks and cars, as necessary for this purpose. But from this great collection of possible schemes and impossible methods a valuable lesson can be learned and much experience gained.

The New York Switch & Crossing Company, of Fifteenth and Madison streets, Hoboken, N. J., were the first to place upon the market an automatic electric switch combining within itself all the elements of simplicity, effectiveness and cheapness which must be present in order to recommend it from both a scientific and practical point of view.

This switch, illustrations of which are given, is controlled from the car by the motorman. Each car exercises a special jurisdiction over it independently and with equal surety. The approaching car automatically energizes the electromagnet seen in sketch of sectional view, which pulls its armature up and throws the switch-tongue over. In case the switch is already on, the motorman opens the circuit by shutting off the current and the car moves freely without delay. A section of the track is insulated beyond the switch; when the car rests upon it complete control of the switch is effected by the motorman simply opening or closing the circuit. In case of accident, the switch still retains its customary features as an ordinary switch; if the road is blocked it can be moved by a prodding bar. The construction of the device—its cast-iron casing, as illustrated—makes it impervious to wet, yet to make assurance doubly sure it is connected directly with the sewer, to rid it of any moisture that may possibly enter.

This switch is called the "dividend saver, labor saver," etc., by its manufacturers, and every word they say in its favor is strongly supported by outside testimonials. The expense of a day and night man to operate the ordinary switch is not less than $1,000.00 per annum, over three times the cost of one automatic electric switch completely installed.

Fig. 1.



Connections of Switch and Rail.

switches in constant operation, all working perfectly since they were installed. The following communication may be interesting as showing the appreciation of capable judges regarding this automatic switch :

W. C. Wood, Esq.,
Pres. New York Switch & Crossing Company,
Hoboken, N. J.

Dear Sir: Replying to inquiry about your electric automatic switch would say, we have had a switch in operation for the past six months at a point where about seven hundred cars pass over it daily. It has given us satisfaction ; that is why I now write you an order for another, to be placed at a similar location.

Yours, very truly,
Brooklyn & Newtown City Railway Co.
Per John H. Partridge, Pres't.

Factory of the New York Switch & Crossing Company. Showing Curve of the North Hudson County Railway Using the Automatic Electric Switch.

The North Hudson County Railway Company of Hoboken, N. J., have seven of these switches in use, and the Brooklyn Heights City Railroad Company of Brooklyn, N. Y., employ an equal number. The Brooklyn City & Newtown Railway Company, of Brooklyn, have three

Mr. W. H. Starr, General Manager of the North Hudson County Railway Company, Hoboken, N. J., speaks very highly of the electric automatic switch. The value of this switch in practically completing and improving a trolley road to such a point of high excellence that little else is left to be imagined, much less desired, is evident to the reader of this article. The appreciation of railroad managers has become so strikingly manifest that, in the near future, it is highly probable that no street railway equipment will be considered complete without electric automatic switches.

APPLICATION OF HYPERBOLIC ANALYSIS TO THE DISCHARGE OF A CONDENSER.

BY ALEXANDER MACFARLANE.

(Continued from page 69.)

In the case of the hyperbolic roots

$$q = e^{-at}\left(c_1 e^{\sqrt{-1}\, i\, nt} + c_2 e^{-\sqrt{-1}\, i\, nt}\right).$$

Let

$$c_1 = c\,(\cosh\varphi + \sqrt{-1}\, i \sinh\varphi),$$

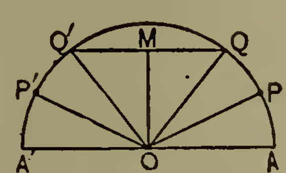


FIG. 3.

and

$$c_2 = c\,(-\cosh\varphi + \sqrt{-1}\, i \sinh\varphi);$$

then

$$q = \sqrt{-1}\, i\, c\, e^{-at}\left(\cosh\varphi \frac{e^{\sqrt{-1}\, i\, nt} - e^{-\sqrt{-1}\, i\, nt}}{2} + \sinh\varphi \frac{e^{\sqrt{-1}\, i\, nt} + e^{-\sqrt{-1}\, i\, nt}}{2}\right)$$

$$= \sqrt{-1}\, i\, 2\, c\, e^{-at} \sinh(nt + \varphi),$$

and by dropping $\sqrt{-1}\, i$ and writing A for $2\,c$,

$$q = A\, e^{-at} \sinh(nt + \varphi).$$

Were conjugate hyperbolic angles taken for the arbi-

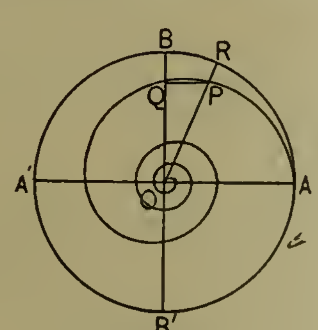


FIG. 5.

trary constants, the horizontal projection would be obtained, involving $\cosh(nt + \varphi)$ in which case the initial current could not be zero. Either projection satisfies the differential equation, but it is only the former which satisfies the initial condition that there is no current at the beginning.

The meaning of these solutions is illustrated by Figs. 3 and 4.

Fig. 3 represents the circular case. O P multiplied by c represents c_1, and O P¹ multiplied by c represents c_2; O Q multiplied by $c\,e^{-at}$ represents the first circular solution and O Q¹ multiplied by the same quantity represents the supplementary circular solution. The multiples of O Q and O Q¹ are compounded, their resultant being $2\,c\,e^{-at}$ of O M which represents $\sin(nt + \varphi)$.

In the hyperbolic case (Fig. 4), O P multiplied by c represents c_1, and O P¹ multiplied by c represents c_2; O Q multiplied by $c\,e^{-at}$ represents the first hyperbolic solution, and O Q¹ multiplied by the same ratio represents the supplementary hyperbolic solution. The multiples of O Q and O Q¹ are compounded, their resultant being $2\,c\,e^{-at}$ of O M, which represents the sine of the hyperbolic angle $nt + \varphi$.

By differentiation we deduce the solution for the current; let it be denoted by I. As $I = \dfrac{dq}{dt}$

$$I = -A\,e^{-at}\,[a \sinh(nt + \varphi) - n \cosh(nt + \varphi)]$$

$$= -A\sqrt{a^2 - n^2}\; e^{-at}\left\{\frac{a}{\sqrt{a^2 - n^2}} \sinh(nt + \varphi) - \frac{n}{\sqrt{a^2 - n^2}} \cosh(nt + \varphi)\right\}$$

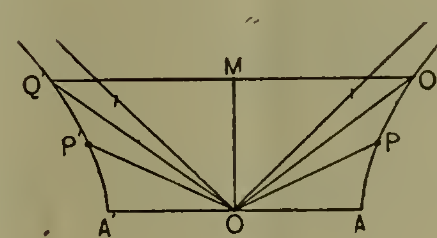


FIG. 4.

$$= -A\sqrt{a^2 - n^2}\; e^{-at} \sinh\left(nt + \varphi - \tanh^{-1}\frac{n}{a}\right)$$

Thus the charge is in advance of the current by the hyperbolic angle whose tangent is $\dfrac{n}{a}$, which is the hyperbolic angle at which both q and I have their maximum value. The same proposition applies, *mutatis mutandis*, to the oscillating discharge.

Writers on this subject call $\dfrac{1}{a}$ the time constant for an exponential discharge, and $\dfrac{1}{-a + \sqrt{a^2 - b}}$ and

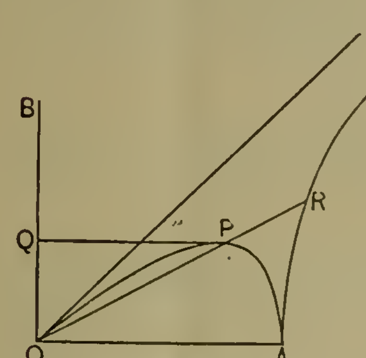


FIG. 6.

$\dfrac{1}{-a - \sqrt{a^2 - b}}$ the time constants for the non-oscillating discharge. But from the above presentation of the subject it is evident that $\sqrt{a^2 - b}$ is the analogue of $\sqrt{b - a^2}$ in the circular case. There it means the angular velocity of the auxiliary circular motion; so here it means the angular velocity of the auxiliary equilateral-hyperbolic motion. In the oscillating case $\dfrac{2\pi}{\sqrt{b - a^2}}$ gives the period; in the non-oscillating case $\dfrac{2\pi}{\sqrt{a^2 - b}}$

gives the hyperbolic period. By the hyperbolic period is meant the time occupied by the radius-vector of the equilateral hyperbola of unit semi-axis to sweep out twice the area of the circle of unit radius. This definition of *period* applies to the circular case also.

The function $A \sin (n t + \varphi)$ represents the vertical projection of a uniform circular motion of amplitude A, angular velocity n, and epoch φ. Similarly the function $A e^{-at} \sin (n t + \varphi)$ represents (Fig. 5) the vertical projection of the circular spiral motion of the point P having angular velocity n, epoch φ and logarithmically decreasing amplitude $A e^{-at}$. In the same manner the function $A e^{-at} \sinh (n t + \varphi)$ represents (Fig. 6), the vertical projection of the hyperbolic spiral motion of the point P having hyperbolic angular velocity n, epoch the hyperbolic angle φ, and amplitude $A e^{-at}$. It will be observed that this spiral is convergent, for n is less than a.

By putting in the conditions that $I = 0$ and $q = Q$ when $t = 0$, we obtain

$$\varphi = \tanh^{-1} \frac{n}{a} \quad \text{and} \quad A = Q \frac{\sqrt{a^2 - n^2}}{n}$$

consequently

$$q = Q \frac{\sqrt{a^2 - n^2}}{n} e^{-at} \sinh \left(nt + \tanh^{-1} \frac{n}{a} \right)$$

and

$$I = -Q \frac{a^2 - n^2}{n} e^{-at} \sinh n t.$$

These curves have a maximum value when the angle is $\tanh^{-1} \frac{n}{a}$; hence when $t = 0$ and $t = \frac{1}{n} \tanh^{-1} \frac{n}{a}$ respectively. They have a point of contrary flexure, when the angle is $2 \tanh^{-1} \frac{n}{a}$; hence when $t = \frac{1}{n} \tanh^{-1} \frac{n}{a}$ and $t = \frac{n}{2} \tanh^{-1} \frac{n}{a}$ respectively. The properties of either curve are given by the general equation

$$\frac{d^m q}{d t^m} = (-1)^m Q \frac{\sqrt{(a^2 - n^2)^{m+1}}}{n} e^{-at} \sinh \left\{ n t - (m - 1) \tanh^{-1} \frac{n}{a} \right\}$$

corresponding to

$$\frac{d^m q}{d t^m} = (-1)^m Q \frac{\sqrt{(a^2 + n^2)^{m+1}}}{n} e^{-at} \sin \left\{ n t - (m - 1) \tan^{-1} \frac{n}{a} \right\}$$

in the oscillating case.

The nature of the curves for the charge and the current in the non-oscillating case has not been plain to some electricians of high authority. It the first volume of his work, "Alternating Current Transformers," page 379, Professor Fleming represents the current graphically by an exponential curve, which is far from representing the current correctly. In the first volume of his "Lecons sur l'Electricite," page 256, Professor Gerard represents the charge by an exponential curve which has no maximum at the beginning; and the same representation is given by Professors Jackson in appendix C of their "Alternating Currents." The curves are correctly represented graphically by Doctors Bedell and Crehore in their "Alternating Currents," and by Professor Webster in his "Theory of Electricity and Magnetism."

(To be Continued.)

THE NATIONAL ELECTRIC CODE.

(Continued from page 67.)

The object for which this association was started, that is, the securing of uniformity of rules to be enforced by insurance inspectors, having been practically accomplished, and the results of the work of the committee having apparently proven themselves to be proper and satisfactory, the committee felt that they were now in a position to invite general criticisms from all those engaged in the electrical business. Their rules had been adopted by practically nearly all of the underwriters' organizations, forty of which were using rules printed from the same type; they had been incorporated in the ordinances of fifteen or twenty cities, and had received the hearty approval of representatives of many of the most prominent manufacturers and central-station men. Early in October, 1895, the committee sent out a circular letter, with blanks, practically broadcast, inviting any suggestions for changes or additions in the present rules. Many such suggestions were sent in, and at the December, 1895, meeting they received careful consideration. At this meeting the discussions and votes were not confined to members of the electrical committee, but the full privileges of both discussion and voting were extended to all present, and there were representatives at this meeting from several municipal inspection departments, who took active part in the matters before the committee.

There was still a feeling, however, that the electrical interests did not have as full an opportunity to express themselves on these rules as they were entitled to, and under date of October 15, 1895, a communication was sent to various associations on behalf of the National Electric Light Association and their Committee on Standard Rules, containing resolutions adopted by that committee in September of that year, suggesting a joint conference composed of delegates from the following associations:—

American Institute of Electrical Engineers,
American Street Railway Association,
National Board of Fire Underwriters,
American Institute of Architects,
International Fire Chiefs Association,
American Bell Telephone Co.,
Western Union Telegraph Co.,
Postal Telegraph Co.,
General Electric Co.,
Westinghouse Electric & Manufacturing Co.,
National Electric Light Association,

who should "undertake the codification, promulgation and enforcement of one standard set of rules, which shall meet as fully as possible the conditions that now exist, and be acceptable to all electrical, insurance and allied interests."

Later the Underwriters' National Electric Association, the American Society of Mechanical Engineers and the Factory Mutual Fire Insurance Companies were invited to send delegates, and certain others were invited as complimentary delegates.

From this meeting the National Conference on Standard Electrical Rules was organized in New York on March 18 and 19, 1896, and the voting delegates were limited to those from the

American Institute of Architects,
American Society of Mechanical Engineers,
American Institute of Electrical Engineers,
American Street Railway Association,
Factory Mutual Fire Insurance Companies,
National Association of Fire Engineers,
National Board of Fire Underwriters,
National Electric Light Association,
Underwriters' National Electric Association.

A Committee on Code was appointed, to whom was assigned the task of amending and codifying the standard electrical rules. A pamphlet had been prepared, embracing the various codes, printed in parallel columns. These were carefully discussed, and it was decided that the rules promulgated by the Underwriters' National Electric Association were the most feasible ones to take as a basis. The results of the consideration by the Conference were referred to the Code Committee, and that committee met in New York, in October, 1896, and prepared a number of suggestions for changes and additions in the underwriter's rules. These were referred to the Underwriters' National Electric Association, through the representative of the National Board of Fire Underwriters. At the annual meeting of the electrical committee on December 8, 1896, the suggestions from the code committee of the Conference, together with other suggestions from various sources, were considered, and on December 11 several members of the electrical committee met with the code committee of the conference, and a report was made, showing that nearly all of the Conference suggestions had been adopted, and giving the reasons why those which were rejected did not meet with approval.

At the meeting of the electrical committee of the Underwriters' National Electric Association a sub-committee was appointed to recodify the rules, as the changes in the electrical industry had made obsolete the classification of 1892, and it was difficult to incorporate amendments and additions under the proper heading. The committee was instructed to make this re-codification, so far as possible, without changing the rules themselves, and to submit the results of their work to the electrical committee for approval. This work of re-codification was duly undertaken, but proved to be a work of considerable magnitude, which will account for the delay of some six months in issuing the rules, as the results of the re-codification were to be submitted in proof to the electrical committee of the Underwriters' National Electric Association for approval, and were also submitted to the code committee of the National Conference, and meetings of that committee with the re-codification committee were held in New York in May and in Boston in June. The rules as re-codified had already been adopted by the Underwriters' National Electric Association and the National Board of Fire Underwriters, and the code committee of the National Conference passed the following resolution:—

"Resolved, That each delegate who attended the National Conference on Standard Electrical Rules be sent a copy of the Standard Electrical Code, stating that said code had met with the approval of the Code Committee of the National Conference and the Code Committee of the Underwriters' National Association, and stating the belief of our committee that there was no necessity for calling the conference together as a body again, entailing, as it would, a very considerable sacrifice of time and money, and requesting their immediate reply if they acquiesce in this recommendation, and approve of the report submitted by the committee, and by the president, secretary and treasurer of the Conference itself. In the event of their objecting, and desiring that the conference as a body be called together as a body to receive the committee's report, answer is to be made within ten days, or their opinion is to be considered as favorable, and the Code and reports published through the press by the Code Committee, and each delegate represented at the Conference requested to bring same formally before his association for approval."

(To be continued.)

Group of Ancient Clam Eaters Who Trust in Providence.—R. I.

AMERICAN ELECTRICAL WORKS' NINETEENTH ANNUAL CLAMBAKE.

Those who deal in metaphors are never clams; yet clams have been an inspiration to the poet and a source of delicious reverie to the prosaic. To speak of clams is to deal in metaphor, to associate its bivalvular existence with sights, scenes and sounds that ravish the memory. The great clam dinner to be given on the 21st of August by Eugene F. Phillips, president of the American Electrical Works, of Providence, R. I., to the members of the electrical fraternity, is a function in honor of which all things of foreign importance must be thrust aside.

Lunch begins at 11.30, the bake at 2 P.M. The Pomham Club will be the seat of these festivities, and its location is beyond criticism. Cool, refreshing breezes haunt this famous spot, and a surrounding of shrubbery adds a picturesqueness to the scene that charms the eye. Mr. Phillips' hospitality is of the most pronounced type, and the great clambake of the 21st will be a worthy successor to those of the past.

USE OF THE INDUCTION FACTOR IN DYNAMO CLASSIFICATION.

(Continued from page 75.)

Section VI.

Example 11. Two generators run at the same speed and have the same kilowatt output. A is a generator giving ninety-six amperes at 125 volts, whilst B gives 9.6 amperes at 1,250 volts. These two dynamos differ radically, but the difference is one that their classification by kilowatt output fails to recognize. They differ dynamically, as can be seen by passing the same current through both, when the one machine will give ten times the torque of the other. This experiment can be made when the machines are standing still, so that the difference does not depend upon that of their induced volts when they are both running at the same speed, but, rather, the difference of volts depends upon the dynamical difference that exists whether they are standing still or whether they are running.

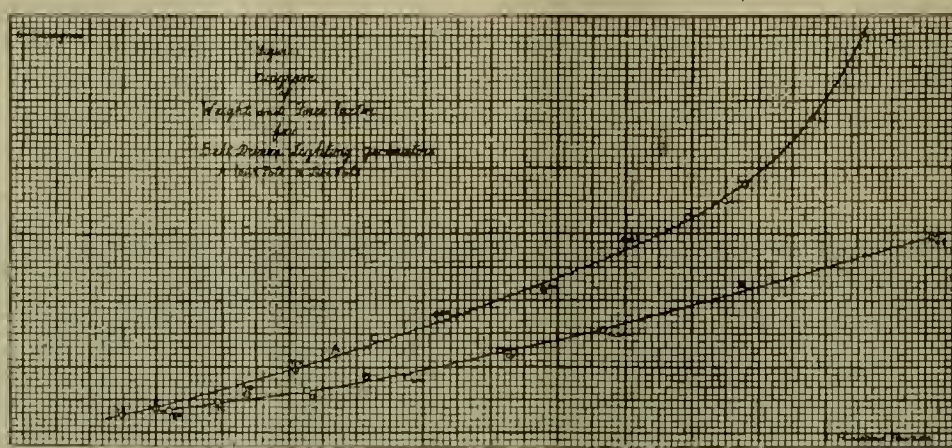


Fig. 1.

The induction factors of these machines can be found thus:

The low-tension machine has 200 conductors on the armature, and 2.5×10^6 lines per pole, p being unity, so we have

$$M = 200 \times 2.5 \times 10^6 \times 10^{-8} = 5$$

The high-tension machine has 3,760 conductors and 1.33×10^6 lines per pole, p being unity, so that the induction factor is given by

$$M = 3,760 \times 1.33 \times 10^6 \times 10^{-8} = 50$$

A comparison of the induction factors indicates the real difference between these two machines. If they are to run as generators at equal speeds and give the same kilowatt output, the current delivered by one will be ten times that delivered by the other. If they are to run as motors at the same speed with the same horse-power output, one must run on a line tension ten times that of the other.

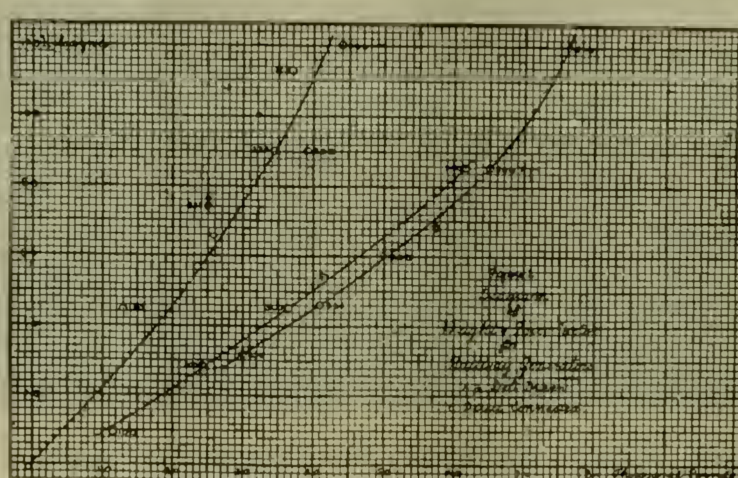


Fig. 2.

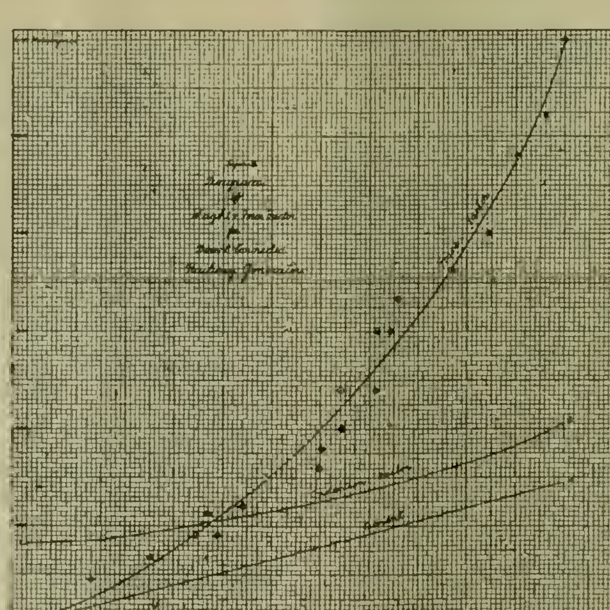


Fig. 3.

(Continued on page 88.)

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CONTENTS.

ONE HUNDRED AND FIFTY THOUSAND HORSE-POWER.

A new era in the history of engineering has begun, one in which the great sources of power that have wended their way for countless ages to the deep sea will be bridled in their hasty march and sent palpitating with invisible force to do service for the human race. At the suggestion of practical scientists water-power has become an important factor in the industrial world. There is no longer any doubt as to its utility, and far-sighted, shrewd and able intellects have seen in its use a source of great wealth to themselves and of untold advantage to their fellow-men. Many colossal schemes have been originated for various purposes, yet among the most unique may be classed that which has for its object the utilization and distribution of one hundred and fifty thousand horse-power. At Massena, on the St. Lawrence river, it is proposed to erect turbines, generators and a great power station from which will radiate lines stretching miles away carrying the pent-up energy to factory and home. The originators of this enterprise are found in the firm of Stewart & Company, No. 40 Wall street, New York City, the present proprietors of the St. Lawrence Power Company, of Massena, N. Y. It is understood that a vast amount of capital will be put in circulation for the furtherance and successful completion of this gigantic plant, the cost of which erection will range from $3,000,000 to $6,000,000. This company has been in London selling bonds to the extent of $3,000,000, its original capitalization being $6,000,000. William C. Lane is president; S. H. Gardyne Stewart, vice-president; Carlton H. Reeve, secretary, and William C. Cox, treasurer. John Bogart will have management of the engineering and construction, with Messrs. Kincald, Waller and Manville of London to act in the capacity of consulting engineers. The vast size of this plant and the fact that it is at present the greatest that has ever been contemplated with the serious intention of completion has been a matter of surprise and wonder to all engineers. At least fifteen five-thousand horse-power generators made by the Westinghouse Electric & Manufacturing Company, of Pittsburgh, will be used, and fifteen or more five-thousand horse-power turbines of the Stillwell-Pierce and Smith-Vail design. This place is unique as the site for a power station. The N. Y. Central and Grand Trunk Railways converge and unite at this point and the Vermont Central is but six miles away. It is presumed that this great flood of energy will so build up Massena and the surrounding districts that they will in a very short time be classed among the greatest of manufacturing districts. The power-house in which the generators and turbines will be placed is to be erected near the Grass River, from which they hope to obtain before two years have passed at least seventy-five thousand horse-power. The water-power secured will be due to a canal reaching from the St. Lawrence above the rapids that bridges the river near Massena to the valley of the Grass River. At this point a head of over forty feet is obtained, and power sufficient to satisfy the expectations of the engineers in charge. This canal will have dimensions as follows: it will be two hundred and twenty-five feet wide and twenty-five feet deep; the water flowing through it re-entering the St. Lawrence River a short distance below the rapids. The reader has perhaps already realized that the great power set in motion and sent pulsating through huge cables to distant points represents potentially enormous interests. The control of power is the control of wealth, and there is no better gold mine, no clearer example of the modern purse of Fortunatus than a great stream whose force is turned to use in this manner. The utilization of water-power is but the beginning of a great cycle of dependent interests. The philosophic mind will realize the truth of this at once and appreciate the social, industrial and even political value of a great enterprise of this nature. The original idea when crystallized throws into operation the productive mechanism of many large concerns. Turbine manufacturers and manufacturers of electrical generators and the accessories required to complete their installations are called upon to deliver their goods. The architect and builder assume their places, and large bodies of men are engaged to lay the wires and complete this undertaking. Then we turn over the next page in the history of this plant and see the representatives of various industries appear for the purpose of deciding upon a permanent location there—a location where power is cheap and money may be saved. Then the trolley lines spring up and the lighting and power lines string out, and along their route we find great clusters of houses and factories which, knitting themselves closer and closer together, may ultimately become a huge centre of industry and a monument to enterprise and engineeriug success.

Detroit, Mich.—The Fuller & Curtis Co. has been incorporated, with Frank E. Kirby, president; Neil McMillan, vice-president; Cameron D. Waterman, secretary; Rodolphus Fuller, general manager and Wm. H. Curtis, superintendent; to manufacture the Fuller dynamo and other electrical apparatus, and the Curtis heaters and ventilating appliances.

Kansas City, Kans.—The Kansas City and Leavenworth Traction Co. has been incorporated by F. D. Hutchings, James F. Getty, C. F. Hutchings, W. F. Street; to build and operate an electric line between Kansas City and Leavenworth. Capital stock, $250,000.

Example 12. The motors in use on the Liverpool Overhead Railway and on the City and South London Railway are rated at about the same horse-power, but on actual test the Liverpool motor can pull over two of the South London motors when equal current is passing in all three.

The motors on the Liverpool Railway were designed to run in parallel two motors to each car, while those on the South London Railway were designed to run permanently in series, two motors also to each car.

If the tension of the line, the speed and the draw-bar pull were the same in the two cases, the induction factor of the Liverpool motors must be twice that of the South London motors; the values were actually 120 and 60 for 100 amperes in the series winding in each case, the force factor being twelve and six kilodynes, respectively, for this current. Hence, each of the Liverpool motors must give twice the draw-bar pull of one of the South London motors for the same current, provided the wheel diameter is the same in both cases. The wheels on the Liverpool cars have a diameter of thirty-three inches, while those on the South London cars are twenty-seven inches diameter; so that the respective draw-bar pulls for one hundred amperes would be (taking the values of M as given above), for the South London motors, 630 pounds, and for the Liverpool motors, 1,030 pounds.

We must not infer from what has been said that the Liverpool equipment is necessarily more efficient than the South London equipment when running at full speed, because, although for equal speed and draw-bar pull the current per motor in the former would be half that in the latter, yet since the South London motors are in series, the current from the line is the same.

Section VII.

If we take the weights and the force factors of a number of dynamos belonging to the same type and plot them on rectangular axes, we obtain a series of points lying on a curve.

In Figure 1 this curve has been plotted for two types of dynamos manufactured by the General Electric Company; Type A is a four-pole and Type B a two-pole, belt-driven lighting generator. The vertical ordinates give the force factor in kilodynes, and the horizontal ordinates give the weights in pounds.

The curves afford a convenient way of comparing the two types. The well-known fact that the four-pole machines give a greater output for equal weight than the two-pole machines is clearly shown. The numbers against each point show the rated kilowatt output. All the dynamos in this diagram are wound for 125 volts. Equal force factors and equal speeds give equal kilowatt output.

The force factor corresponding to any weight may be made up in a great number of different ways, by taking different values of M and C.

For instance, taking a force factor of 2 kilodynes, we may have machines of equal weight with the following differences :

C.	M.	MC	Revolutions per minute for 125 volts.	Kilowatts
200	10	2,000	750	25
250	8	2,000	940	31
340	5·9	2,000	1,270	42
400	5	2,000	1,500	50

There is thus a considerable range of output for a machine of given weight, according to the speed at which it is to run. For this reason we may find machines of the same type giving equal output, but of different weights, the heavier machine running slower than it need do, if it occupied its normal position on the force curve.

Thus a dynamo of this type, giving 340 amperes at 125 volts at 1,270, will weigh 3,550 pounds, and have a force factor of two kilodynes. A dynamo of the same type, weighing 4,750 pounds, has a force factor of three, and, if required to give 340 amperes at 125 volts, must have an induction factor of 8.83 and run at 850.

Figure 2 gives the curves of force factor and weight for different types of railway generators. A and C are made by the General Electric Company, the former belt-driven, the latter direct-connected. B is made by the Walker Manufacturing Company, and is belt-driven; the numbers opposite to each machine indicate the rated kilowatt output, all at 550 volts.

Figure 3 gives the force factor curve for the complete line of direct-connected railway generators made by the General Electric Company. The particulars of the machines are given in the table. All these dynamos are wound for 550 volts.

TABLE.

DIRECT-CONNECTED RAILWAY GENERATORS.

Poles.	No. in Diagram.	Rated kilowatt output	C.	R. P. M.	M	M. C. kilod	Weight 1,000 lbs
10A.	1	500	910	125	264	240	64.0
10B.	2	..	....	75	440	364	87.1
10B.	3	...	...	90	367	334	76 0
10B.	4	...	....	100	330	300	71.3
10B.	0	800	1,450	80	412	600	110.0
10B.	5	...	....	120	275	400	94 4
10C.	6	...	....	100	330	480	100.9
8A.	7	400	725	80	412	300	74 2
8A.	8	...	....	120	275	200	64.3
8A.	9	...	....	100	330	240	71.4
6A.	10	150	270	200	165	44.5	13.1
6A.	11	225	410	200	165	67.5	25.1
6A.	12	. .	...	150	220	90.0	34.3
6A.	13	...	....	120	275	113	37.0
6A.	14	300	545	200	165	90.0	39.1
6A.	15	...	...	150	220	120	43.9
6A	16	...	....	100	330	180	60.4
6B.	17	400	725	150	220	160	59.7

The vertical ordinates of the force curve represent the product of the induction factor M and the current C. If both these quantities increased uniformly with the weight, the force curve would be a straight line. The bending up of the curve indicates that either or both of these quantities does not increase uniformly with the weight.

If we plot the induction factors corresponding to each machine as vertical ordinates, the points thus obtained should lie on or above a curve giving the smallest induction factor for a machine of any weight; *i. e.*, indicating the highest speed at which a machine of that weight may be run. The points may lie above this curve, since a dynamo of any weight can be run at a speed lower than the limiting speed, but the points should not lie below this curve. By dividing the force factor for any weight by the corresponding induction factor, we obtain a third curve which gives the variation of the current with the weight.

In Figure 3 the curve *a b* has been drawn on the assumption that the current curve *od* is a straight line. It is probable that it is not quite straight, but it would seem that the weight varies very nearly as the current. The induction factors are plotted vertically on a scale of one

NOTE.—The form of this curve was first noticed by Mr. E. Wilson, in a paper recently read before the Institution of Electrical Engineers in London; the force factor is there spoken of as the mass factor.

inch equal to one hundred of M and the currents on a scale of one inch equal to 500 amperes.

As an illustration of the use of the curve, let us find the lightest dynamo of this type that will give 500 kilowatts at 550 volts.

The current is 910 amperes, and the weight, consequently 69,000 pounds. The corresponding induction factor is 270, so that the machine must run at 122 revolutions per minute.

If we look at the list of dynamos in the table, we shall see that the lightest dynamo of this output, actually made, weighs 64,000 pounds, and runs at 125 revolutions per minute, being thus a little lighter than that indicated by the theory.

Note—The limits of this paper do not permit me to insert the proofs of the equations it contains. These will, however, be found in full in the work on Electro-Dynamics, which I am now preparing, and which will shortly be published by Messrs. Longmans, Green & Co., London and New York.

Factory of Triumph Electric Company.

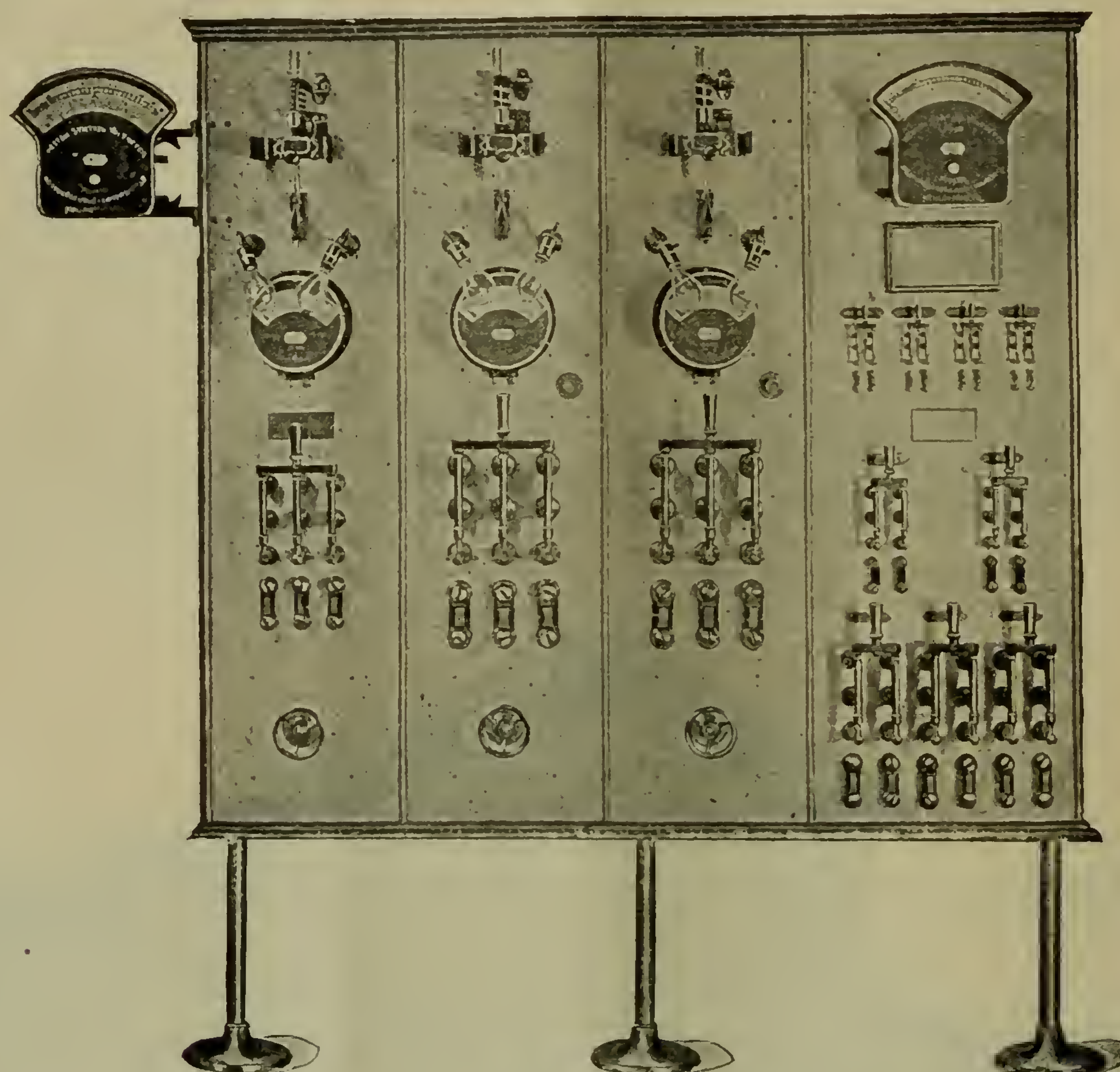
ARE THE ELECTRIC RAILROADS RESPONSIBLE FOR PIPES DESTROYED BY ELECTROLYSIS?

The gas and water companies of this city have been put to a great deal of expense aud loss in replacing pipes destroyed by the trolley currents. These pipes look as if they had been eatenaway by acids. The men who control the trolleys are interested in the water and gas corporations so that up to the present there has no litigation over the damage done. However, the responsibility of the trolley roads for pipes destroyed by their currents bids fair to be judicially determined. The water-service pipe leading from the street main to the new Odd Fellows Hall has been eaten by electrolysis and destroyed so that a new service pipe is necessary. Workmen tore up the street today and removed the old pipe which was very badly corroded, although only in use a short time. One of the trustees of the lodge who owns the bnilding, said to a News reporter: "We shall send the bill for the new service pipe and cost of putting it in to the trolley company. If they refuse to pay it we shall institute a suit and ascertain if these corporations can destroy private property withou paying for it." The outcome of the matter will be awaited with great interest, as the question is one which concerns every property owner on streets where trolley cars are laid—Paterson Evening News.

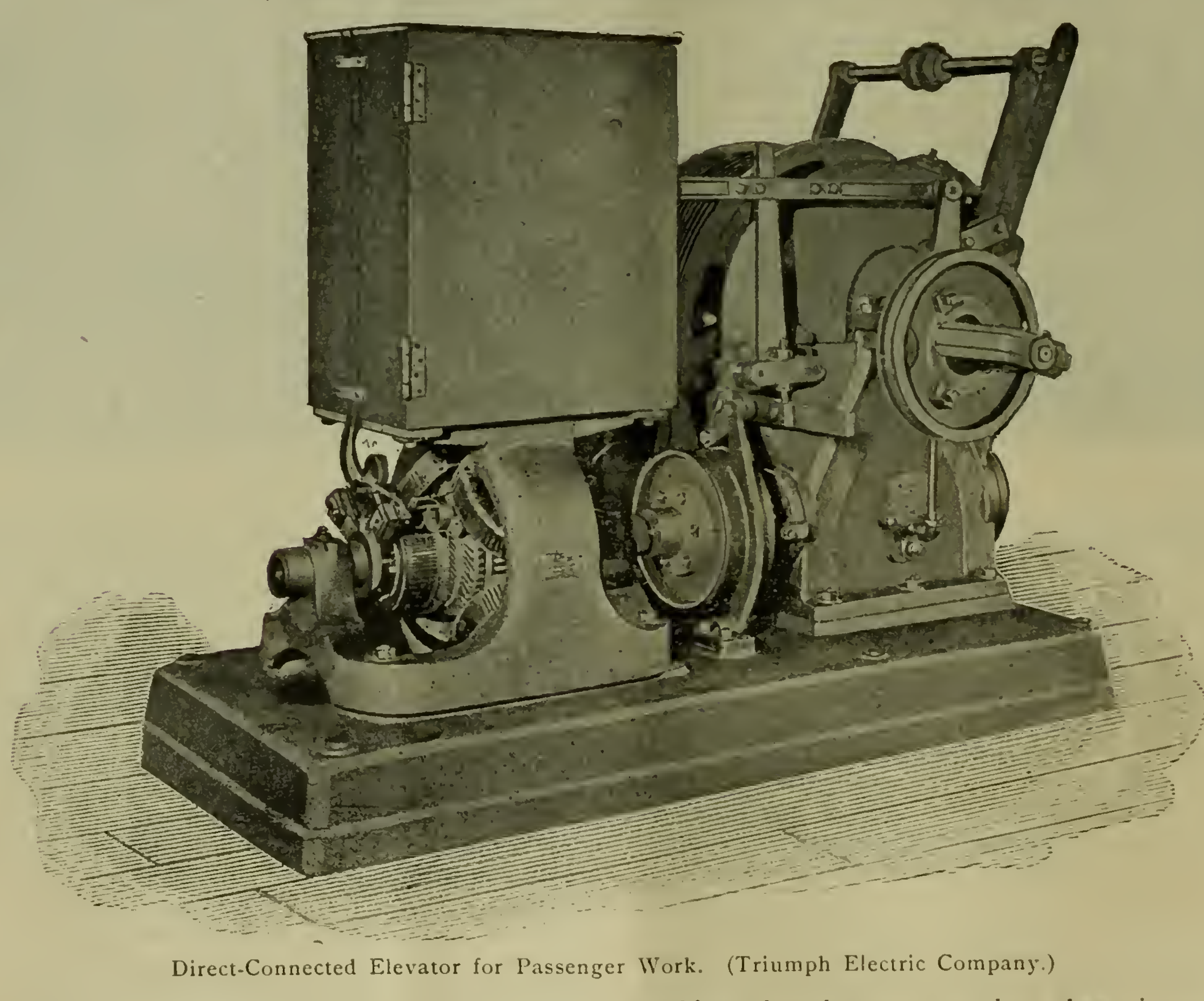
IMPROVED ELECTRICAL MACHINERY.

During the last five years improvements in electrical machinery have far excelled the expectations of those who had dealings with manufacturers or were engaged in that particular field of work themselves. The mediocre machine of today, whether dynamo, motor or special apparatus, is superior to the improved type that appeared six or seven years ago. It is therefore evident that the better and best class of apparatus produced by manufacturers is superior in a high degree to any turned out at a time that approaches closely to the present. It is practically impossible to sell poorly designed or poorly constructed electrical machinery with any expectation of continuing in business. The public has become educated and expects that the money it lays out shall bring to it its real equivalent.

The Triumph Electric Company of Cincinnati, O., have stuck to the conclusion that it is better to turn out strong, well made and reliable apparatus which will bring in a fair figure than cheap, poorly constructed and unreliable machinery that will bring a low figure, and enable the seller thereof to compete, for a while, with success. It has been realized by experienced business men that those concerns selling the greatest amount of apparatus are not always the most successful concerns, the most lasting or the ones best able to secure hearty recommendations from the consumer. Yet it frequently happens that a company whose object is well defined and whose purpose is that of constructing weil-made machinery will possibly sell but little in the beginning, but as the merits of its manufactured goods become better known, they gradually obtain prominence, popularity and large sales.



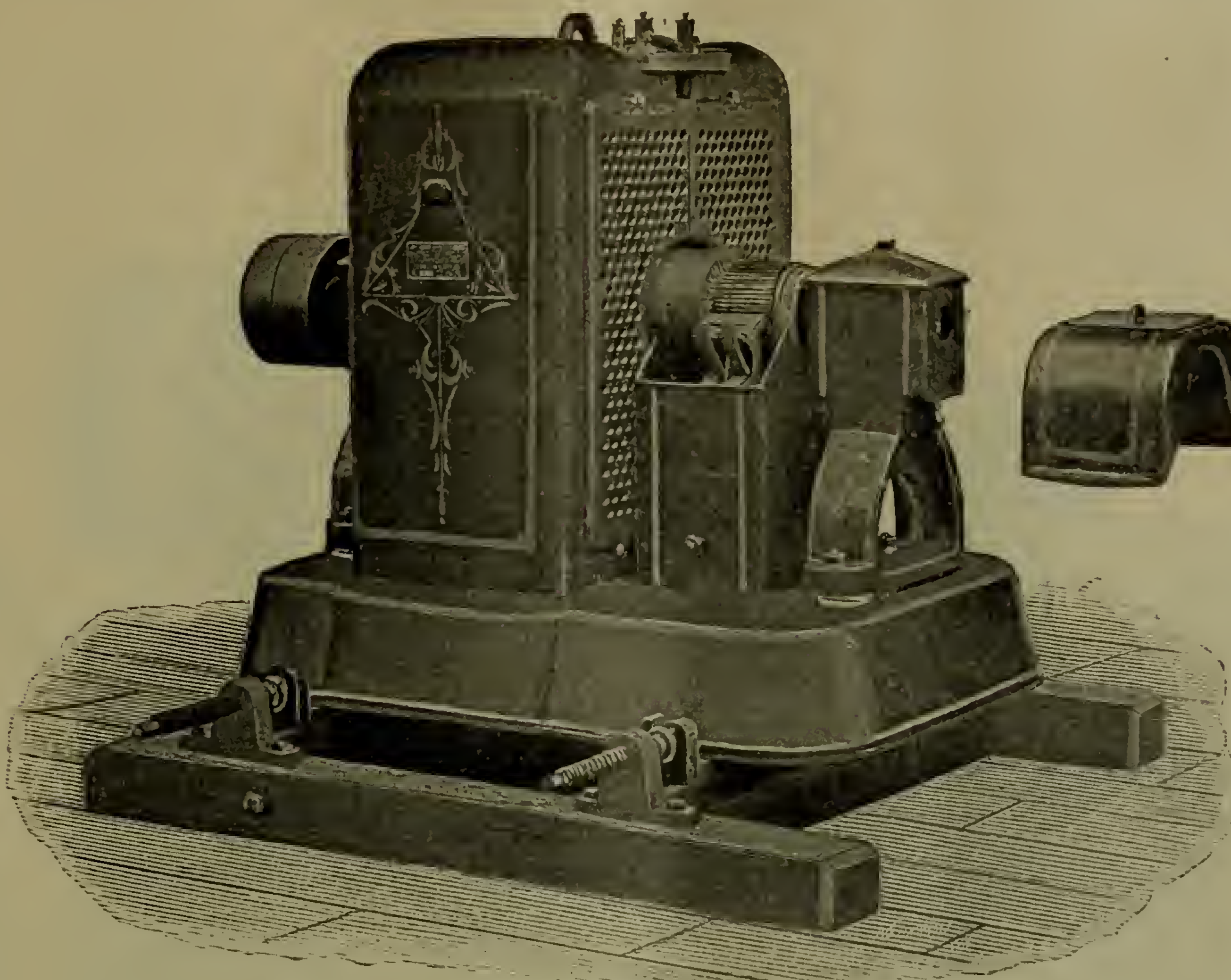
Switchboard, Plant of the Columbus State Hospital. (Triumph Electric Company.)



Direct-Connected Elevator for Passenger Work. (Triumph Electric Company.)

The Triumph Electric Company have secured what we may call a popular trade based entirely upon the superior quality of their goods, their attention to details in the design and construction of the same and their desire to give a customer the real equivalent of his money. They have sales offices in over twenty-five large cities, covering the entire area of the United States. Many of the machines that they turn out have been in use eonstantly since installed and have served the purpose for which they were intended in a most satisfactory manner. They manufacture street-railway generators which embody the elements of simplicity, easy and quick repair and a capacity that enables them to stand considerable overloading without injury.

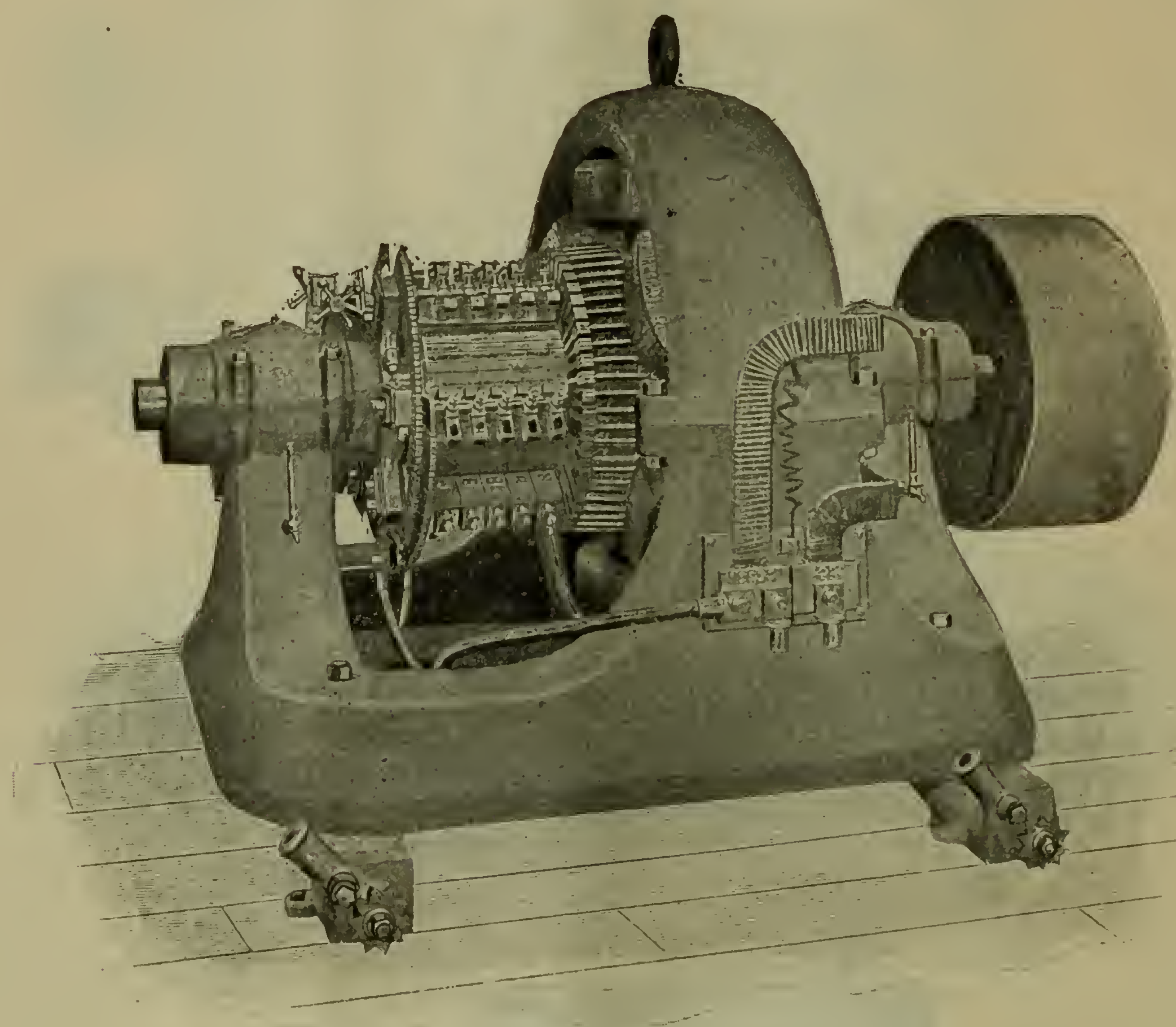
The direct-connected or engine type plant consists of a generator and engine mounted together running without vibration or tremor, earning its title to superiority by the fact that the dynamo runs without heat, sparking or noise of any description, its bearings self-oiling and its capacity sufficient to make it stand additional work be-



Bi-Polar Ironclad. (Triumph Electric Co.)

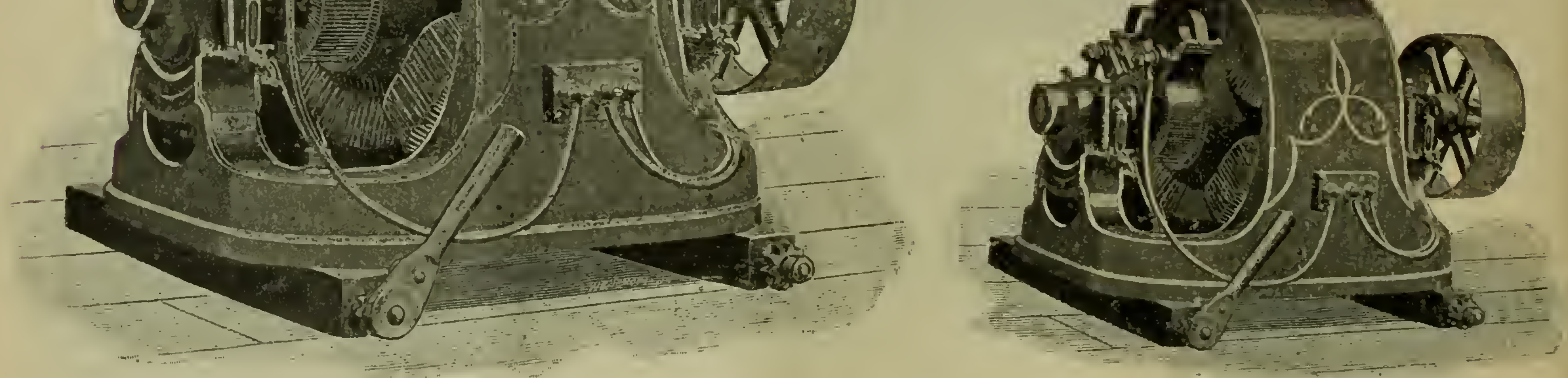
Commutator. Bar-Wound Armature. Body of Armature. (Triumph Elec. Co.)

yond its rating without injury; the engine to which it is connected running smoothly and noiselessly with every evidence of economy and mechanical efficiency. The power generators are undoubtedly model types of ma-



100 K. W. Generator at The J. A. Fay & Egan Co., Cincinnati, O. (Triumph Electric Co.)

chines used in many of the largest cities of the United States, always earning an excellent reputation on account of their simple construction, easy running, sparklessness and high efficiency.



Power Transmission. (Triumph Electric Co.)

Marine plants have been installed by this company which have given great satisfaction, occupying very little space and running practically without attention. It can be realized that high speed and low speed dynamos vary greatly in weight, the higher speed being, for equal power, the lightest ; the lower speed, the heavier. The wear and tear of a high speed machine is naturally greater than that of a slow speed, and the slow speed has therefore come into general use on account of its wearing qualities and the greater absence of possible injury and de erioration of its most important parts.

The framework of the Triumph dynamo is soft, close-grained cast iron. The pole-pieces, composed of laminated wrought iron, that is, sheet iron incorporated into the fields. It is supplied with phosphor-bronze bearings of the ball and socket type, which are self-aligning. Sizes greater than twenty K. W. have their pedestals cast to the base, the smaller sizes possessing detachable ones. Motors are manufactured by this concern for the transmission of power or its utilization at any point of the line.

For shop work there are but few that can stand on an equal footing with them, their substantial construction, economical operation and simplicity being great features in their favor.

The armature and commutator of either dynamo or motor is carefully constructed, the armature being slotted and well insulated in every respect. No bands are used to bind the conductors and the conductors pass each other in such a way that an air-gap is always between them. The armature does not heat and is so carefully designed that the commutator to which it is connected, runs sparklessly.

Their substantially constructed commutator, insulated in the best manner possible, is, beyond doubt, a most noticeable feature of the machine. For elevator service, either for passenger or freight work, their outfits are without doubt unquestionably faultless, and the sense of security felt by those using the same has never been destroyed by any failure in their apparatus. Bi-polar motors are manufactured by them, and switchboards for plants of almost any description. The many orders that have come piling in have kept them very busy.

They represent a type of the straightforward, energetic and progressive concern which bases all its expectations upon its own inherent power to turn out machinery that is serviceable, reliable and, as far as it can be made so, efficient.

ELECTRICITY ON BOARD OF OCEAN GREYHOUNDS.

The steamship "Bremen," of the North German Lloyd line, which recently made her first transatlantic trip is, perhaps, more fully equipped electrically than any other vessel of the merchant marine in the world. Aside from the usual electric-lighting plant, she has a very complete and most novel power plant, the successful operation of which is now fully conceded.

The first power installations on the steamers of the North German Lloyd were made by the Union Electricitats Gesellschaft, of Berlin, the German ally of the General Electric Co., of Schenectady, N. Y.; on the steamships "Darmstadt" and "Prinz Heinrich;" in these two cases the familiar and noisy donkey engine were superseded by electrically operated winches, and it was the successful operation of these that determined the North German Lloyd to extend the use of electricity to the "Bremen." In this case, however, in lieu of winches, a full equipment of electric cranes was installed. These cranes are sixteen in number, eight on the starboard side of the vessel and eight on the port side. Four of these have a capacity of 3,000 kilograms, or 6,614 pounds, and twelve of 1,500 kilograms, or 3,307 pounds, and have a total swing outboard of 20½ feet.

The power-generating plant is located in the after portion of the engine-room and consists of four dynamos each directly connected to its own engine. Two of these are placed on the starboard side and two on the port side. The dynamos have each a capacity of 75 kilowatts or 100 H. P., and run at a speed of 210 revolutions per minnte, delivering current at a pressure of 105 volts. The output of two dynamos is used for the cranes; one is used for the lighting of the ship, and the fourth dynamo is held in reserve in case of accident or other emergency. The engines are of the triple expansion type and were built by Schichau, of Elbing, near Danzig.

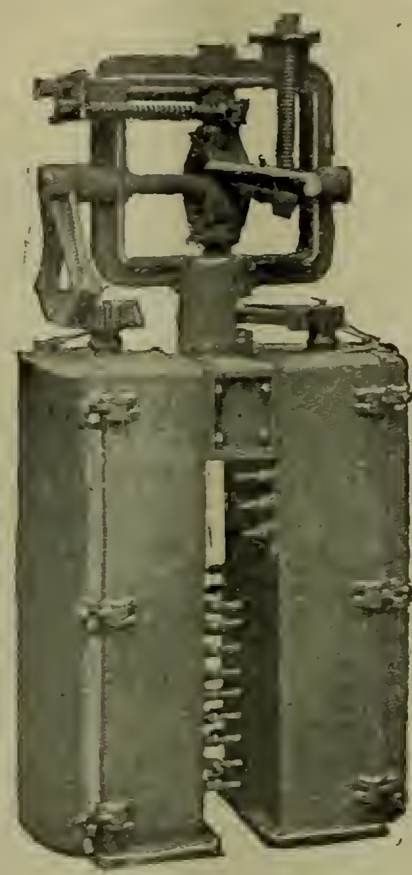
The most notable feature of the electrical equipment is the cranes, the lighting installation conforming to the standard practice. In designing the cranes, the principal requirements specified and obtained were as follows:

The load should be lifted smoothly; the resistance should be so arranged that the various speeds of the motors should be obtained without too apparent and sudden change; the control of the different motions should be instantaneous and positive, these motions to be effected in the smallest possible space; the cranes to be

Aft Deck of "Bremen," Showing Eight Cranes.

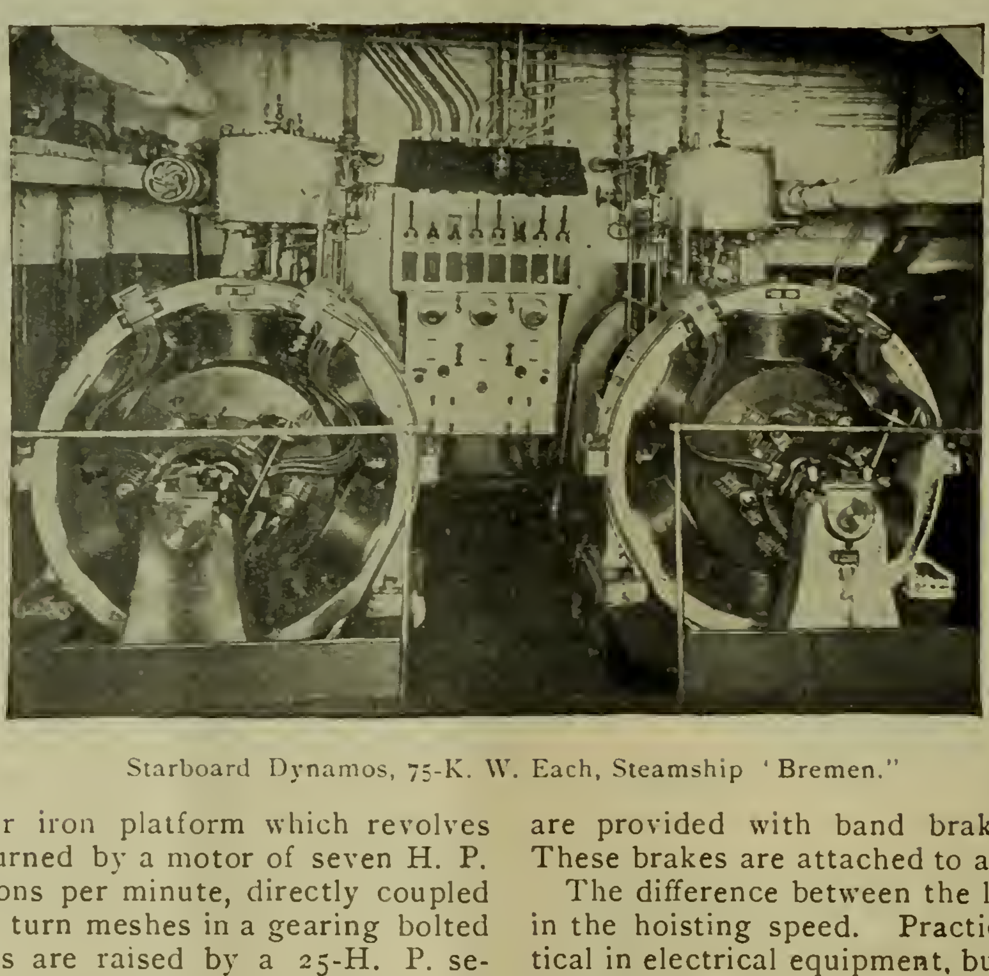
compact and contain the smallest possible number of parts; the controlling mechanism to be of the simplest to suit the class of operator likely to handle them; and the electrical apparatus to be absolutely protected against changes of weather, inroads of dust and sea-water, and to be of such a nature as to withstand rough handling. In addition all conductors were to be carefully protected, and the last consideration, but by no means the least, on a passenger-carrying steamer destined to be constantly loading and unloading, the operation of the cranes was to be noiseless. In conforming to these requirements, the Union Electricitats Gesellschaft has produced what is the latest and a very decided innovation in a ship's equipment.

The cranes, motor and controlling mechanism are mounted upon a circular iron platform which revolves upon a pivot. This is turned by a motor of seven H. P. running at 700 revolutions per minute, directly coupled to a worm gear which in turn meshes in a gearing bolted to the deck. The loads are raised by a 25-H. P. series motor, running at a speed of 900 revolutions, and driving a special worm gear meshing into the gear of the drum. On the gear end of the drum shaft is fitted a winch head.



The Controller, with Universal Gear.

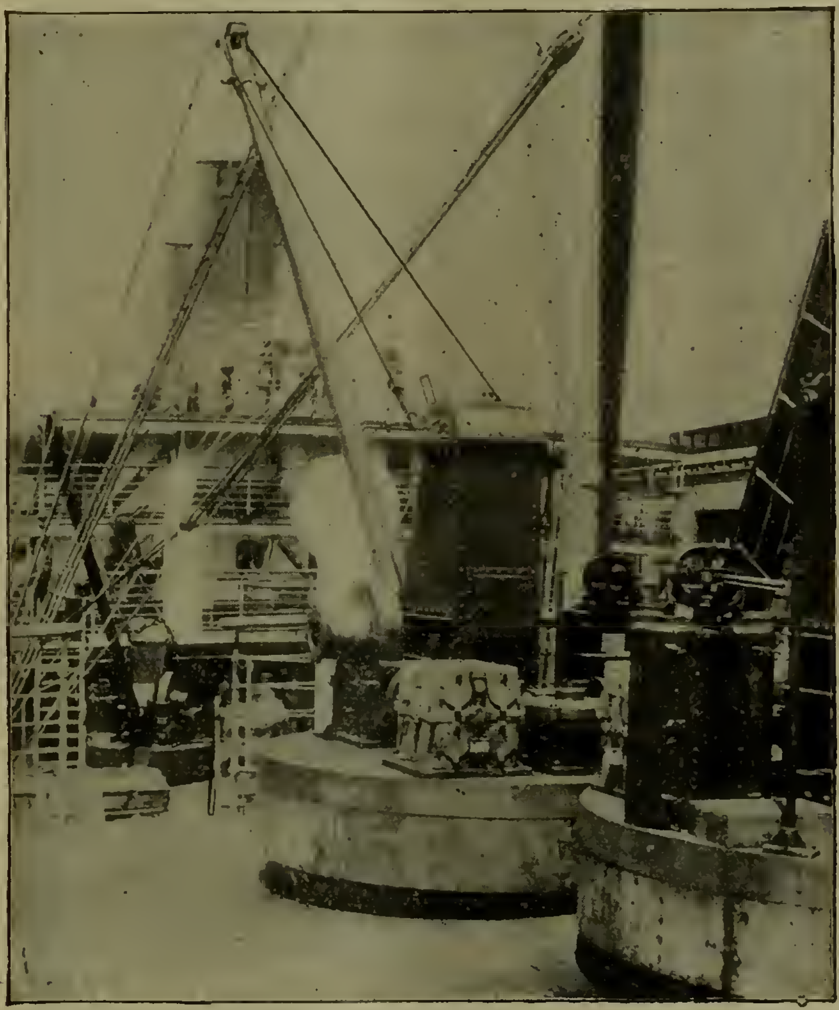
The controllers resemble a double street-car controller about two feet high. They are fitted with magnetic blow-out, any spark being immediately extinguished in a magnetic field. The contact cylinders are operated by a special mechanism actuated by a simple handle or lever, the movements of which correspond to the movements of the load. Raising the handle raises the load; depressing the handle lowers the load, and movement of the crane to the right or left is obtained by corresponding movements at the lever. Raising and swinging movements can be effected simultaneously. So simple are these operations that the dullest stevedore can handle these cranes with ease. Motors and controllers are water-tight and dirt tight, but the cases of both can readily be opened when necessary. To give a more perfect control both motors are provided with band brakes operated by the foot. These brakes are attached to an extension of motor shaft.



Starboard Dynamos, 75-K. W. Each, Steamship 'Bremen."

The difference between the large and small cranes lies in the hoisting speed. Practically both cranes are identical in electrical equipment, but the hoisting speed of the 3,000-kilogram crane at full load—sixty feet per minute is only half that of the 1,500 kilogram crane at full load—120 feet per minute. The movement of the jib of the cranes is 13 feet per second.

The most remarkable feature of the cranes, however, is the absolute noiselessness of their operation. During the visit paid by the writer of this to the vessel the whole eight starboard cranes, four on the aft and four on the forward deck, were engaged in discharging cargo. Had the operation of hoisting and lowering not been witnessed it would have been difficult to detect the fact, had it been necessary to depend upon the ear. It is this feature that will recommend the electrical cranes to shipbuilders, especially those of passenger steamers, in such trades as that of the Mediterranean, where loading and discharging is effected at every port, and great credit is due the North German Lloyd Steamship Co. for first effecting this great innovation.



Cranes Showing Operating Handle.

RECENT PROGRESS IN ARC LIGHTING.

(Continued from page 62.)

The above tests are, doubtless, sufficiently accurate to show the main point very clearly. This is that a certain line voltage as a minimum is absolutely necessary in working arc lamps on constant-potential lines, whether they be open arcs or inclosed arcs. Thus, two forty-five-volt arcs in series, with uncored carbons like the brand known as "National," cannot be safely worked below 110 volts on the line with resistance in series with them. More than 110 volts should, of course, be maintained for safety of the service.

The tests show, also, that with a cored upper carbon, the limit is lowered several volts on the average, and it is known that the voltage of the arcs may be safely reduced somewhat when cored positives are used.

It is also shown that a seventy-five to eighty-volt arc, run upon a constant-potential line, is stable at considerably less line voltage than the open arc. It would appear also, that, with either open or inclosed arcs at ordinary current strengths of from five to ten amperes, the steadying resistance in the branch is required to cause a drop of about fifteen to twenty volts, or waste energy at the rate in watts of fifteen to twenty multiplied by the amperes of current used in the lamp.

What the development of the art would have been if the voltage of our incandescent circuits was, as originally set, say, ninety volts, instead of 110, is a subject for meditation.

With inclosed arcs on continuous-current circuits, as with open arcs on similar circuits, the chief source of light is the positive crater, and the downward emission is, of course, favorable to their use in illumination. This tendency to throw light downward is, in the inclosed arc, modified by the diffusive action of the inner globe, which tends to scatter the light received by it in all directions —upward, downward and horizontally.

The running of single alternating-current arc lamps on constant-potential circuits is facilitated by the ease with which, by a transformer or compensator, the potential required for the lamp may be obtained. It was natural that, when arc lamps came to be used on constant-potential, continuous-current circuits, a demand for lamps which would work upon alternating circuits fed by transformer secondaries should arise. While in the direct-current systems the potential was definite and practically could not be adapted to the lamp, in the alternating-current case transformation was easy, as by the simple device of a compensator the line voltage could be raised or lowered to suit that demanded by the lamp. An arc-lamp compensator is simply a laminated core bearing a coil divided into sections with connections carried out between the sections. If the self-induction of the coil is proportioned for the secondary circuit voltage in a transformer system, as for 110 volts at the ends of the coil, circuits of thirty volts may be obtained by taking three-elevenths of the turns as a secondary; that is, by connections which include between them any turns of the coil which equal three-elevenths of the total, or which give thirty volts. Moreover, several connections of the kind may be made to the same coil anywhere between its ends, provided that the wire included between the two connections for one lamp circuit is sufficient to give the requisite voltage. Further, the sections of wire thus chosen may overlap each other, and portions of the compensator coil thus appear to be doing double or treble duty. Whether the current be furnished direct from the secondary of a transformer or through compensators, the lines led to the lamps are of constant-potential character, and the lamps have to be adapted thereto.

An alternating arc is peculiar, and different from the continuous-current arc in a nuumber of important particulars. The fact that the arc is extinguished between successive alternations at the zero points of the current wave, and at a rate equal to double the periodicity, results in the musical sound of the arc, which may become a source of annoyance. The same cause gives rise to difficulty in starting the arcs without having them chatter, for until the carbons get strongly heated the arc is not re-established after extinguishment with the carbons separated. With cold carbons, the carbons must touch each other after an extinguishment at the zeros. Hence, the carbons must be separated very slowly, while a large current flows so as to strongly heat their ends, or a higher potential than that to be used in running the lamp after starting must be applied at first. Another way is to employ a resistance or, better, a reactive coil in circuit with the arc lamp, so as to change the character of the potential at the lamp terminals, which then becomes less than that of a constant potential and, in fact, begins to approach, in a measure, constant-current supply. But in the use of a resistance or reactance in circuit with the lamp, it is, of course, necessary to increase the potential of the line accordingly, so as to give the proper potential to the arc; while both expedients involve a loss of energy. It is found not to be practicable to run alternating-arc lamps on circuits much below forty cycles; the common rates of sixty and 125 are well adapted to the case.

The efficiency of the alternating arc as a source of light has been shown by Prof. A. E. Blondel, in a recent paper, to be quite variable. It depends on the length of arc used with the particular carbons employed, and on the diameter of the carbons, as with continuous current. It also depends on the form of the wave of the alternating current. It was found that, with a rectangular wave alternating current, such as may be produced by reversing a continuous current by a commutator, the light given out was as seventy-nine to fifty-nine in the case of sine-wave currents. This should follow from the fact that the extinctions, as Blondel pointed out, were instantaneous in the first case, and lasted for about one-quarter of an alternation in the case of the sine wave.

(To be continued.)

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.) TELEGRAPHING WITHOUT WIRES.

San Francisco, July 28, 1897.

Electrical Age.

Dear Sirs: We are very much interested in this section of the country in the subject of telegraphy without wires. As a reader who has closely followed the subject matter of your journal for many years I beg leave to inquire into this subject more closely. Do you think the system practical; that is, applicable to the transmission of messages from here to New York? Is the expense very great in operating, and is there any danger attended with it?

Hoping that this will not be considered unworthy of consideration I remain, Very respectfully,

J. LIVINGSTONE.

(A) Wireless telegraphy has proved itself a success so far. The only limits that can be reached in transmitting messages is that due to a limit in power. The possibility of signalling between New York and San Francisco without wires is not doubtful. The expense of communicating in this manner cannot be fairly estimated at present, but there is every indication that the new telegraphy will be given a fair and careful trial.

(Q) ELECTRICALLY WELDED RAILS.

Boston, Aug. 1, 1897.

Electrical Age Publishing Co.

Dear Editor: The trolley roads in our city are continually subjected to repairs due to the deterioration of the bonding employed. Whether this be due to the rain, dirt, etc., that works its way into the tracks I cannot say. The only remedy that seems to be of any value is that of welding the rails together, and in this regard I am unable to do more than inquire of you as to the real efficacy of such a cure. Whether it affects a road to its injury or benefit locally or in general? Respectfully,

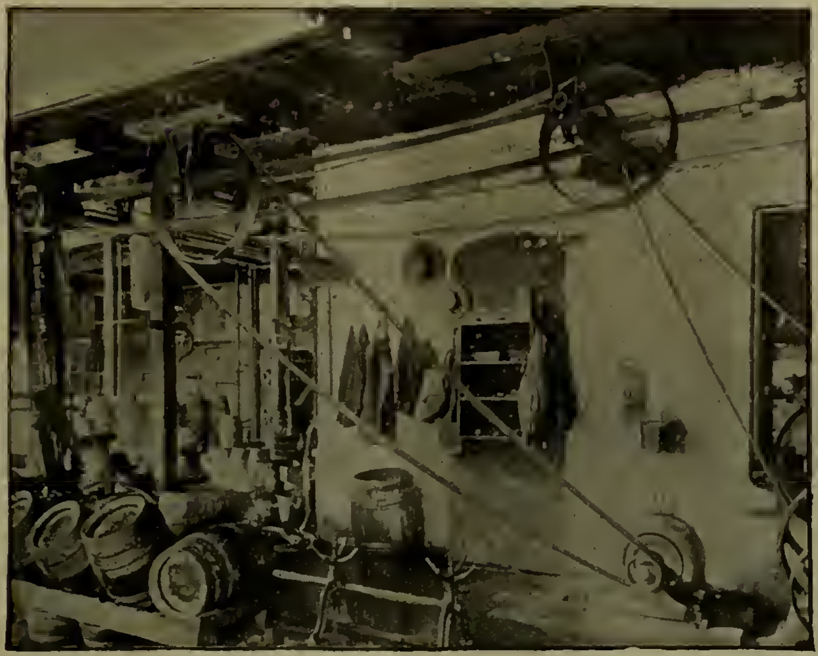
A. N.

(A) The welding of tracks has been tried in Brooklyn with doubtful success. The expense of welding is high, and when performed it interferes with the ready repair or replacement of the track. The expansion and contraction are also somewhat injurious to the road and prevent railway men from considering it with favor. As far as the continuity of the rail is concerned, nothing is lacking electrically to make it beyond doubt superior to bonding in any shape or form.

Ashland, Ohio.—The New London and Loudonville Electric Railroad Co. has been organized by H. A. Thomas, H. A. Mykrantz, J. R. Swartz, G. F. Shelley, S. J. McCready, Bert Hank and E. J. Best.

The Electrical Age.

Vol. XX—No. 7 NEW YORK, AUGUST 14, 1897 Whole No. 535



10-H. P. G. R. Induction Motor in Keg-Washing Department.

Buffalo Brewing Company's Brewery.

THE MOTOR AN AID TO HOME INDUSTRIES.

The electrification of Sacramento is proceeding apace since the introduction of the current generated at Folsom, twenty-four miles away, demonstrated the cheapness of electrical power when compared with steam power. Electricity is now used in Sacramento to drive machinery of all kinds, and is entering largely into what may be called the household life of the city. One of the most important motor installations is that driving the machinery in the shops of the Southern Pacific Railway Co. At about the time this was effected the Buffalo Brewing Company of Sacramento substituted motors for the steam engines upon which it had previously been dependent for power with gratifying results.

This brewery is one of the largest on the Pacific coast. Its present motor equipment consists of one 5-H.P.; one 10-H.P.; one 20-H.P. and two 30-H.P. motors. They are all of the General Electric Company's three-phase induction type, without brushes, collector rings or moving contacts, and run almost without attention beyond an occasional oiling. They are driven by 200-volt current supplied from the 1,000-volt circuit running from the sub-station a distance of two miles, the pressure being transformed down at the brewery.

The smallest motor is used in the bottle-washing house; that of 10-H.P. in the keg-washing department. The three others are used to operate the blowers, the malting house and the machine shops. The large ammonia pumps in the brewery will also shortly be driven by electric motors.

The printing presses of Day & Joy, in Sacramento, are also driven by motor. In this case the motor is of similar type to those in the brewery, but of 10 H.-P. capacity. It was one of the first in the city to take current of the long distance transmission. On the day of its installation, the 8 H.-P. engine formerly used was draped in crape. Its usefulness had departed, with its noise, heat and discomfort. The motor now drives one four-roller Huber cylinder press, one Cottrell press and two job presses, and although it has been in use a number of months has not involved the firm in a cent for repairs.

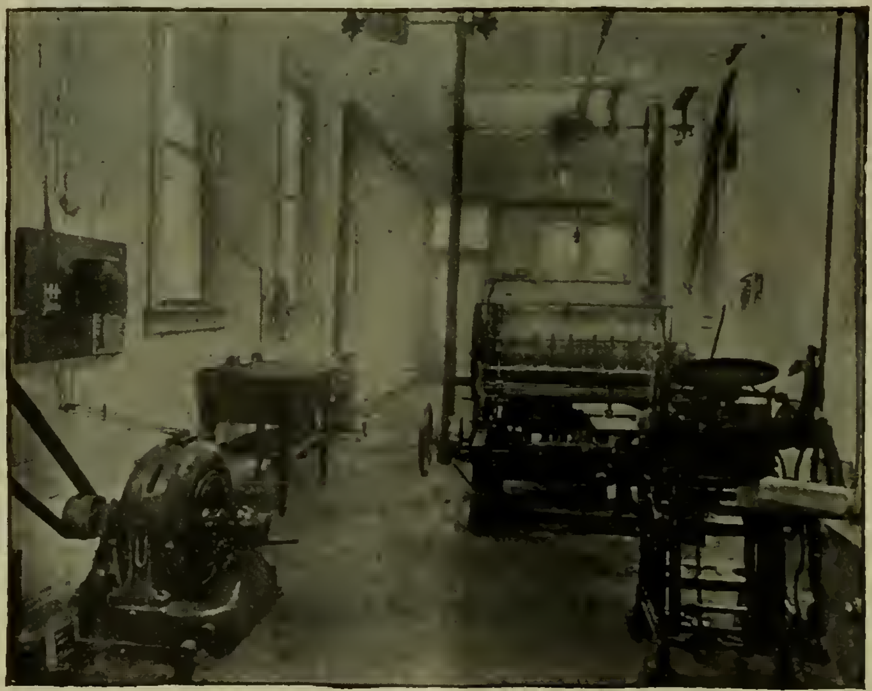
In installing the Buffalo Brewing Company motors the question of the probable economy of the change was naturally uppermost. Would it pay to dispense with the steam and trust to the motors? The guarantee finally given was that electricity would show a saving of forty per cent. After the motors had been running for some time a series of tests were made, with the result that the saving, instead of forty per cent., was shown to be actually a little over fifty per cent. Results almost similar have been obtained in other installations in Sacramento. It is hardly a matter of surprise that with such showings to do missionary work, the use of electricity is rapidly extending in that city.

5 H. P. G. E. Induction Motor in Bottle-Washing House,

AMERICAN MACHINES IN GERMANY.

It seems that the enormous development of German industry during the last few years is about to benefit the machine-making industry of the United States. It has just been announced that the German Ammunition and Small Arms Factory (Deutsche Munitions und Waffenfabrik), at Berlin, has given an order to an American firm (the Cleveland Machine Screw Company, Cleveland, Ohio), for nearly $120,000 worth of machines for making steel balls for bicycles. This article used to be made almost exclusively in Germany, at Schweinfurt, in this consular district (Bamberg), and exported to the United States in small quantities. The export of this article amounted to $20,877.43 during the last four quarters. The manufacturers at Schweinfurt had hitherto been considered to have a sort of monopoly, *i. e.*, to be the sole possessors of patents for the manufacture of such balls. It came, therefore, as a surprise to those connected with this trade in Germany that the requisite machines (in German, "Fraesmaschienen") were also being manufactured in the United States, and even exported thence to Germany.

What phenomenal development this steel-ball industry has experienced is shown by the fact that an English syndicate offered $1,000,000 for a Schweinfurt factory (Deutsche Gusstahl Kugelfabrik), which is devoted exclusively to the manufacture of these balls and which was made a joint stock company twelve months ago with a capital of only $150,000. The same concern produced, after the first year, a balance sheet showing net profits amounting to about $87,000—and this with a capital of $150,000.



10-H. P. G. E. Induction Motor in the Printing Establishment of Day & Joy.

Quite a number of ball factories have sprung up in this district during the last few months, one of which is situated in this city. If these have only been partially started, it is because it is impossible to procure the necessary machinery, for many of the large machine-building works in Germany are fully engaged for more than ten months ahead and do not take an order without stipulating delivery within a year. This circumstance ought to be turned to more profitable account than hitherto by our engineering works in the United States. American makers of machinery fit for export ought—after having taken out the necessary patents and thus protected their articles against imitation as much as possible—to look about in Germany, either personally or by efficient representatives. Catalogues printed in English, such as are received by consular officers, are of little value in Germany.

In conclusion, attention may be called to the fact that the firm which is constructing the electric street railway in this city has lately been awarded the contracts for building the tramways at Liegnitz (Silesia) and Fiume (Austria). The firm works with the patents of an American establishment (the Walker Electric Company, Cleveland, Ohio), and obtains the electric machinery from this American firm only.

Louis Stern,
Commercial Agent.

THE STANDARD UNDERGROUND CABLE CO.

Electrical Age Pub. Co.,
New York City.

Gentlemen: In relation to the articles recently published in your paper, which claim the exclusive monopoly of paper-insulated cables and wires, we are sending the attached notice and guarantee to our customers. If you would kindly notice this fact in your next issue in such words as you may prefer, we would be very much obliged.

Very respectfully,
Standard Underground Cable Co.

"Our attention has been called to the somewhat extravagant pretensions put out by interested parties, wherein claim is made, in substance or effect, of an exclusive patented monopoly of paper-insulated electric cables and wires. We have been manufacturing and selling wires and cables of that kind for many years, and under advice of counsel we have no doubt whatever as to our right to do so. We therefore advise you that as regards any such wires and cables which you may purchase from us, we will be prepared at any and all times, at our own charge and expense, to defend any suit or suits brought against you for infringement of the patent referred to, we to be promptly notified of such suit or suits, and to be allowed an opportunity to make defence therein."

Lansdale, Pa.—An electric light plant will be established.

THE TRANSITION FROM STEAM TO ELECTRICITY ON CHICAGO ROADS.

On May the eighth, 1895, the Suburban Railroad Company sprang into being with the object in view of constructing, fully equipping and operating lines that brought into close relationship suburban towns in the neighbor-

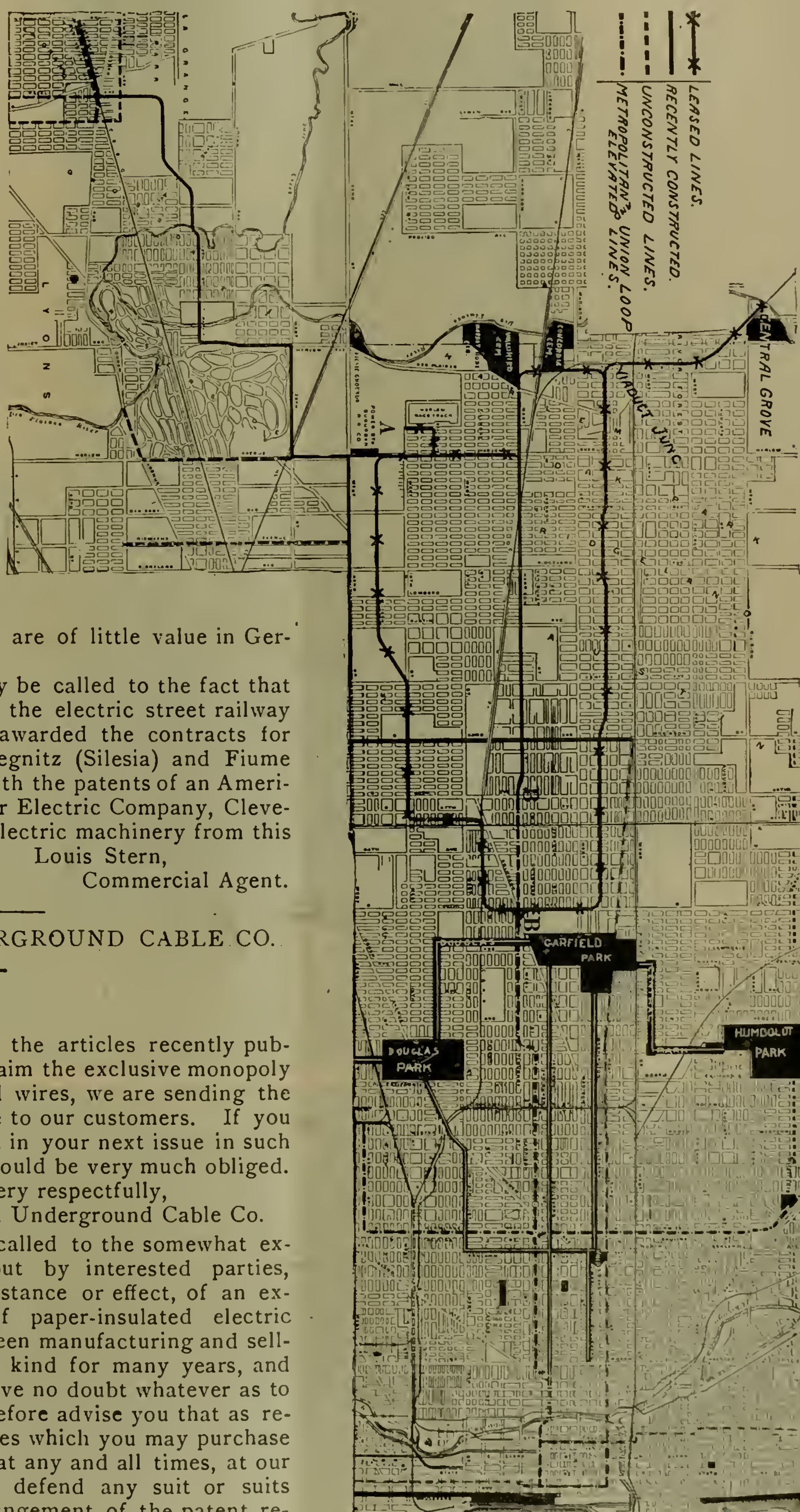


Fig. 2. Map of the Suburban Railroad Company's System.

hood of Chicago, notably the southwest and west, with the metropolitan elevated roads. The Harlem and Southwestern divisions of the Chicago and Northern Pacific Railroad, which includes nine miles of double track and

5.75 miles of single track and 1.7 miles of the main line of the Wisconsin Central Railroad, was turned over for a fifty years' lease to the Suburban Railroad Company; Naugle, Holcomb & Company undertook to transform all leased lines into trolley systems, or at least to have them operated by electricity. In fact, the entire equipment

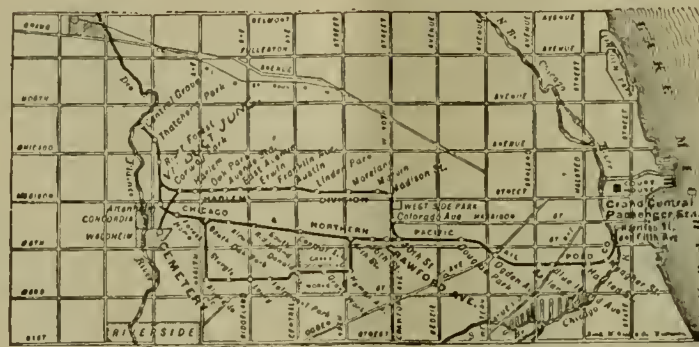


Fig. 1. Main Line, Harlem and S. W. Division, C. & N. P. Railway.

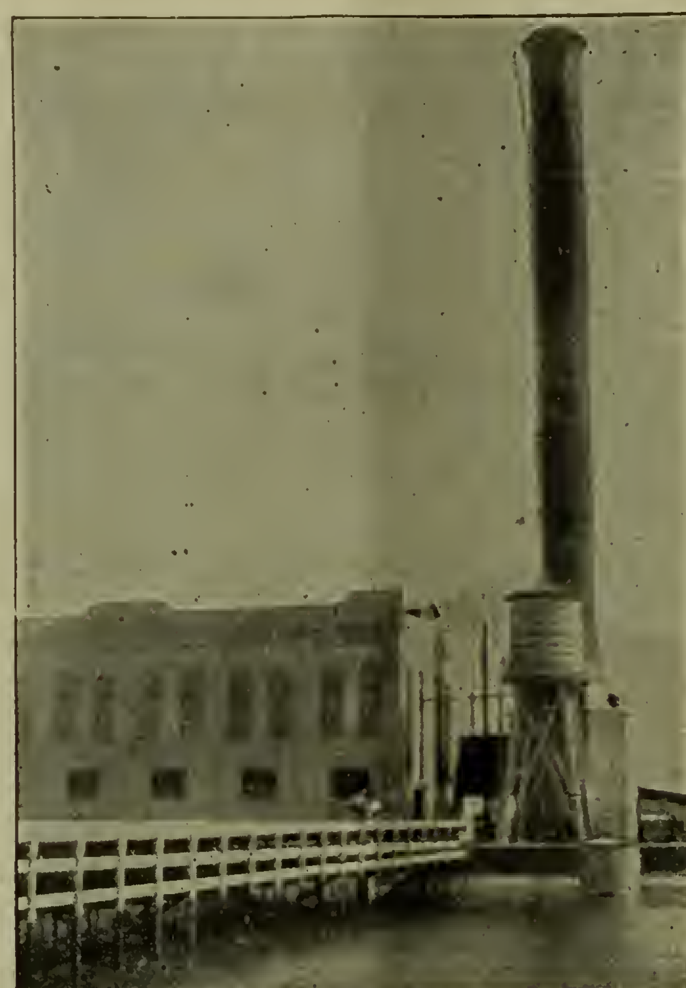


Fig. 4. Power House and Cooling Reservoir.

the 1.7 miles line of the main line track run between two points called Central Grove and Viaduct Junction.

The Suburban Railroad Company made a contract with with electrical apparatus was looked forward to. A great deal of work has already been completed in connection with these leased lines.

Fig. 3. Motor Car and Trailer, Suburban Railroad, Equipped with Walker Co. Apparatus.

the firm of Naugle, Holcomb & Company, which allowed this last concern to utilize the Chicago & Northern Pacific Company's lines by steam. The date from which these arrangements began was December 3, 1896. The firm of

The illustrations in this article give the reader an idea of the scope of the work. Figure 1 represents the branches of the Chicago & Northern Pacific, which can be traced by following the heavy lines. Figure 2 shows the entire system as at present equipped. Wherever the figure X appears the reader may understand to be leased lines. The others, the newly constructed ones.

of thirty miles an hour, although it is not expected that a higher average than twenty miles an hour will be obtained. During the day, when the rush is on, a ten

Fig. 5. Water Cooling Table.

The towns that will be reached by the Suburban Railroad Company's lines comprise a population of about 175,000. The trains used will be able to run at the speed

minute service will be carried out by means of trains which consist of a motor and one trailer.

A rather gruesome practice will be carried out by this

Fig. 6. No. 25 Walker Co. Railway Motor, 200 H. P.

Motor Car Equipped with Walker Co. Motors, Drawing Six Loaded Trail Cars.

company, which will strike the eastern mind very curiously, and that is the running of funeral trains to three cemeteries. The conditions in Chicago are somewhat different from those further east. The respect for the dead is such that pretty nearly 7,000 people make it their object to reach these places on Sunday. Many points of interest lie along the line of travel. There is every expectation that it will build up strongly and rapidly.

This new track, to which reference has already been made, is built of seven-inch, seventy-pound W rails (Shanghai) in sixty foot lengths, spliced with four bolts, splice bars and bonded with double 0000 Chicago bonds. The base of the rail is five and one-half inches wide. Cedar ties are used on tangents and oak ties on curves, with service tie-plates eight and one-half by three and one-quarter inches. It was impossible to use a third rail system on account of the road being on the public highway. The trolley wire used is of a number 00 size. The feeders are of 350,000 and 500,000 circular mils. Washburn & Moen wire was used. The Ohio Brass Company supplied the insulators, ears, etc.

The car equipment, built by the Pullman Company, is exceedingly fine. It consists of fourteen motor cars and ten trailers, each car being forty-two feet and one-half in length aud thirty-two of actual body. Closed vestibules have been built at each end of the motor cars. McGuire, No. 26, trucks are used with thirty-three inch wheels; five foot six inch wheel base, and the distance between truck's centre being twenty-three feet. Two 50-horse power Walker motors supply the power to each car, one on each truck, on the back and rear axles. A controller of the series parallel, Walker type K, is used; likewise hand and air brakes, supplied by the Christensen Engineering Company of Milwaukee. The Gold hot water system warms the cars. The seating capacity of these cars is forty-eight, although when crowded they will hold one hundred. In addition, those sitting down can by pressing a button give word to the motorman. Figure 3 shows a complete equipment with Walker apparatus of two of these trains.

Figure 4 shows the power-house, the brick building 96×108 feet. It contains three sets of Sterling water-tube boilers of two hundred and fifty horse-power apiece, with Meisner stokers and two Greene tandem compound condensing engnes, constructed by the Providence Steam Engine Company of Providence, R. I. Of these two, one of 560-H. P. is connected direct to a 400-K. W. Walker generator having a 60,000 pound fly-wheel. The generator produces 650 volts; the smaller dynamo is 240 K. W. capacity, connected to an engine of proper size.

Figure 5 illustrates the water-cooling table, the leaves of which have a fall of 14 inches and are 182 feet long. This reduces the loss of water down to a very small amount.

The other illustrations are practically self-descriptive, figures 7 and 8 referring directly to the installation just described. A cut of the number 25 Walker Company Railway motor of 200 horse-power is seen in figure 6.

The responsibility of this entire equipment of the leased lines fell upon the shoulders of George Weston, who acted in the capacity of superintendent and engineer and as manager of the construction department of Naugle, Holcomb & Company. Mr. W. H. Holcomb, Jr., aided him in the capacity as assistant superintendent, in addition to Mr. I. B. Walker, the electrical engineer. The mechanical engineer in charge of the power-house and car-barn work was Chas. H. Chapman, the track construction being in the hands of Mr. C. E. Thomas. The entire equipment of the cars and the generators was made by the Walker Company of Cleveland, O.

The Suburban Railroad Company of Chicago will make a prodigious success of their woik, and this transition from steam to electricity can only be hailed as a forerunner of some tremendous changes in the near future.

Fig. 8. Motor Car, Equipped with Walker Co. Motors, Drawing Loaded Freight Train.

A FEW ELECTRICAL DON'TS.

Don't try to revolutionize the electrical business by cutting prices. You can't.

Don't expect to get all the jobs you figure on and get mad if you don't.

Don't expect to make a living on a ten per cent. margin of profit. You can't.

Don't abuse your competitor because he underbid you; he may lose money and yet do as good work as you.

Don't bid low, do poor work and employ boys to even up. You can't.

Don't educate the embryo electrician, and then try to kill him off as soon as he is able to work.

Don't fail to keep your credit good; you must get a fair price for your work or you can't.

Don't give your work away; what is worth doing is worth getting paid for; and above all employ good workmen.

Don't with a big D think you are the whole push. There are others.

Watch the "don'ts" if you wish to succeed.

Donaldsonville. La.—Paul Leach, mayor, can be addressed concerning erection of electric light plant.

The Electrical Age.

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CONTENTS.

TELEPHONING UNDER THE SEA.

It has been the ambition of many able engineers to overcome the difficulties of ocean telephony and thereby earn for themselves immortal fame. Some of the best minds in the world have turned their attention to this subject with the hope of achieving success. The problem as it stands at present is one that is clearly defined. There is a retardation experienced by a signal passing through a conductor buried under water. This retardation is due to a peculiar electrical condition that necessitates our filling the conductor, so to speak, with electricity, that is, charging it, before the other end is able to deliver a message. A cable which stretches for miles and miles along the ocean's bed, lying in an abyss five miles deep, and which conveys intelligence to points separated by the span of a continent, must be constructed to perform its functions with dispatch and surety. There is no need of speaking of the commercial benefit that would be immediately derived from a means of communication that is so direct as to allow of actual speech. We are interested in all that relates to experiments bearing upon this great problem.

To eradicate static effects from a cable its active conductors must be either surrounded by a substance that annihilates this troublesome influence, be widely separated from each other, or given a spiral twist, from which will be created an inductance neutralizing the capacity of the cable.

Mr. W. H. Preece, of England, read a paper before the British Association in which he described a form of telephone cable that acted as a healthy stimulant to those following out the above subject. The Telegraph Construction & Maintenance Company designed a cable, the conductors of which were separated from each other by a considerable air-space. This cable was constructed under the supervision of its designers, Mr. Willoughby Smith and Mr. W. P. Granville. Four separate conductors composed the cable, an air-space separating them, a section of their cable showing the conductors with a cross-like vacancy between them.

To every eight inches of the cable there is one turn of wire, and the air-space in its interior is divided by walls into separate compartments. We have in this particular form of cable a crystallization of two principles. The first, the use of air as a dielectric, so far as practical conditions will allow, and a turn or twist to the conductors that tends to neutralize the distributed capacity of the cable by a distributed inductance. Two knots' length were laid between the Isle of Wight and the Hampshire coast, and the inductive capacity per knot with the wire submerged amounted to .098 micro-farads.

To illustrate the success attained an alternating current of considerable strength was sent through one pair of the conductors, and it was found that telephony through the other pair could be carried on without any difficulty. The cable, which may be the germ of what will be used for transatlantic communications in the future, is mechanically deficient, but there is a hope that from this beginning will spring a series of improvements that will lead us with happy expectation to the great and final issue.

IMPORTED CARBONS AND THE MANUFACTURERS' OPPORTUNITY-

The high duty imposed upon imported arc carbons should serve as an incentive to American manufacturers to enter actively into the field of competition and make carbons whose qualities and service will equal the best of foreign products. At present the rate is ninety cents per hundred, and the duty on pencil carbons alone is equal to the price of good domestic carbons. There is no lack of proper ingredients to be found in the United States, neither is there any reason to suppose that our skill is one whit inferior as manufacturers to that of our friends across the water. Why, then, is no effort made by American manufacturers to produce hard, fine-grained and pure carbons? This question might best be answered by saying, they have made the attempt, but remained content to turn out an inferior grade, because they could not get a fair price for their goods. In the use of enclosed and alternating-arc lamps, the employment of hard, fine-grained carbons is imperative. Every day the demand for imported carbons is increasing. Before the present rate of ninety cents per hundred was demanded, the old duty of thirty cents, ad valorem, made their introduction an easy matter in American markets. They became a necessity, and it is evident that they will continue so, for the high duty cannot debar their use until an equally good, domestic carbon is manufactured here. There is not a carbon manufacturer in this country that will not, on reading this article, believe it to be in his power to ultimately compete with as fine a grade of carbon as the Nuremburg or Hardmuth. If American persistence and resolution cannot do this, we must then acknowledge that our facilities are incomplete. We can make everything required for an electric-light plant, but we cannot make good carbons. Let the carbon manufacturers answer this.

Cincinnati, O.—Mrs. Elizabeth Zinn, of Clifton, has purchased the plant on Eggleston avenue and Sixth sts., Cincinnati, and it will be at once remodelled and made into a power plant for manufacturing concerns, which will be furnished with heat, light and power.

The London Times, in an editorial, predicts that enough has been done to show that motor cars, either in their present form or with such improvement as experience may suggest or ingenuity devise, are destined to play a great part in the future transportation of people and merchandise. As far as extensive use is concerned, the question is, of course, mainly one of economy, and its practical decision will turn upon the relative expenses of fuel to fodder or upon the rate of the deterioration of a machine with that of an animal. It is highly probable that motor cars will be brought largely into use before there has been time or opportunity to train an adequate number of drivers; if so, we must be prepared for a considerable catalogue of collisions and other accidents, many of which, from the very nature of the agencies concerned in producing them, are likely to be of a very serious character. With every form of petroleum motor, the dangers of fire are superadded to those of collision, and it would be a proper precaution to require that great pains should be taken in all such vehicles to protect the reservoir from injury.

RECENT PROGRESS IN ARC LIGHTING.

(Continued from page 96.)

The distribution of light from an alternating-current arc with vertical carbons, owing to the fact that the chief light source—the positive crater—is on the upper and lower carbon alternately, is both downward and upward. The upward radiation, except in rooms with white walls or ceilings, or with the lamps provided with shades or globes of a strong diffusing power, would be lost except for the employment of deflectors or reflectors immediately above the arc, which catch a fair proportion of the rays and send them downward. The lamp in this case is made focusing, so that the arc will always be kept burning but a short distance below the reflector plate, which is made with a heat-resisting, white enameled surface.

A moment's consideration will show that under no circumstances can an alternating arc give out as much light for a given expenditure of energy as does a continuous-current arc for the same expenditure. The light comes mainly from the positive crater, whose temperature and consequent luminosity is limited by the vaporizing point of carbon. The positive crater from which the current passes to the arc is much larger and much hotter than the negaive spot on the opposite carbon receiving current. If, now, there is a rapid interchange or reversal of current and dead points or zeros between the reversals at each alternation, the positive crater has to form anew upon a surface which, while negative, was, on the average, far below crater temperature, having cooled during the time it was negative, and during the zero or period of extinguishment. It results from this that the average temperature of the light-emitting surface of carbon in an alternating arc is below that of the vaporization temperature of carbon, and the emission of light consequently lessened. It is known that the light emitted from a hot surface as temperature rises, increases far more rapidly than the temperature or total radiation.

The shape of the wave of current has a great iufluence on the conditions of temperature just pointed out, and the rectangular wave must necessarily approach in its efficiency more nearly that of continuous currents than a peaked wave with longer zeros.

The use of single arcs across alternating constant-potential mains requires only that the lamp mechanism be operated by variations of the current passing the arc. Hence, an electro-magnet in series is used to lift and feed the carbons, or sometimes the expansion of a high-resistance wire, traversed by the lamp current, has been applied for the same purpose, as in the "Kester" lamp. The electro-magnet is open to the objection that its action is so instantaneous as to provoke chattering at starting, requiring a carefully adjusted check, or dash-pot, to prevent such action, and the magnet armature, or core, may also, unless very carefully arranged, produce by its inevitable vibrations a harsh note audible some distance away. Add this to the hum of the arc itself, and it is easy to see that such a lamp may become intolerable indoors in a quiet room. In the use of a hot wire the objection of chattering at the start is overcome without difficulty, and the wire is noiseless in its action; but it demands that considerable energy be wasted in it, and hitherto the temperature at which the wire must be run to secure sensitiveness of feed or rapid heating and cooling, following variations of current, has been such as to endanger its permanence or cause it to oxidize. If the arc requires twenty-eight to thirty volts, and the regulating five to seven volts, it is easy to see that a considerable sacrifice has been made for the result attained, particularly as in the use of hot wire over-feeding is liable to take place. The writer obtained, a considerable time ago, a much better result by using the hot-wire principle, but variably shunting it by a set of contacts controlled by a small electro-magnet in series relation, which addition imparted greatly increased sensitiveness, while the slow start given by the hot wire was still secured.

It is well known that in practice an alternating-current arc often starts readily with new carbons, the trouble of chattering appearing when a new arc is to be started with carbons which had before been heated or used. This difference is owing to the fact that in the latter case the high temperature of the arc had driven out the gases and volatile materials which, as present in the ends of the new carbons, facilitate the formation of flame or lower the resistance of the arc at starting. By dipping the ends of the used carbons in a solution of some salt for a moment, the required volatile matter may be furnished to them so that they will start as readily as the new carbons.

The arc in the ordinary alternating-current arc lamp appears to be stable, even when the connection is made across constant potential mains without resistance or reactance in the branch as a check upon the current. Therefore, nearly all the energy may be thus delivered to the arc itself without deduction. This fact tends to neutralize the lower efficiency of light production in the alternating arc, since the continuous-current arc on constant potentials involves a dead-resistance loss. Any comparison then, must, for practical purposes, consider the total energy used in the branch in which the lamp exists, and the light produced or emitted in directions permitting utilization.

While the alternating arc, run from constant potentials, is feasible, the difficulty of chattering and large variations of current at starting results from the arrangement, and any sudden fall of potential may cause a momentary extinguishment. Particularly is this the case when the arc is of the "inclosed," long-burning type. In such case, on account of the greater length of the arc, it is peculiarly sensitive to influences which would affect but slightly the ordinary open-air arc. With the open-air arc a comprehensive set of tests made under the writer's supervision disclosed the fact that various makes of carbon gave widely different results. It was found that the length of arc or separation of the carbons for a given potential was under equivalent conditions, quite variable, and the curious fact was noted that with some makes of carbon the variation of arc length with variations in the potential of the circuit supplying the lamp were much less than with certain other makes. Some gave excessive variations of arc length with moderate variations of potential at the arc, while others gave only moderate variations of arc length for considerable variation of potentials at the arc. Of course, the latter are far the most desirable carbons for practical use. The results in each case were plotted as a curve, and comparison and superposition of the curves showed the superiority of one or another brand. The curves showed also the arc length for each kind of carbons for a given potential across the arc, which it was important to know in selecting carbons best adapted for alternating-current work. The carbon which gave the longest arc at the lowest potential, and one which did not vary its length as much or more than that obtained with other carbons for certain variations of potential, would practically be preferred, other things being equal. It is too early to predict what part the "inclosed" alternating arc may play in the future art of arc lighting, but it probably will find a considerable application.

(To be continued.)

We want prices on a 400-light, incandescent dynamo and switchboard and all apparatus, wires, etc., to light the town of Elkin; say 100 to 150 16-c. p. street lights and 30–35 stores and residences. Please state to your advertisers our wants.

Elkin Manufacturing Co., T. J. Lillard, Treasurer,
Elkin, Surrey Co., N. C.

Sterling, Kas.—The Sterling Telephone Co. has been incorporated by Melvin E. Richardson, Herbert K. Lindsey, John Anderson, Gustaf A. Anderson and Frank A. Lindquist. Capital stock, $5,000.

Ashland, Ky.—The Lawrence Telephone Co. has been incorporated by D. G. Putnam, D. L. Leffingwell and E. C. Means. Capital stock, $12,000.

Toccoa, Ga.—The Toccoa Cotton Mill, W. A. Matheson, president, will put in an electric light plant.

THE WAGNER ELECTRIC MANUFACTURING COMPANY.

For general excellence of design and detail finish the direct current motors and generators turned out by the Wagner Electric Manufacturing Company, of St. Louis, Mo., will hold their own against the best in the land. It is a difficult thing for either the consumer, accustomed to buying electrical apparatus, or the layman, that knows nothing at all about it, to be able to distinguish between a really good machine and one which appears to be all right on account of its paint and polish. While it is impossible to instruct either the consumer or ordinary layman in the techniques of dynamo design, it is possible to point out to them the best points of a good machine and then trust to their common sense and powers of observation in any future case.

Fig. 12. Twenty K. W. Armature.

The magnetic circuit is the first thing that attracts our attention, because if it is insufficient in dimensions or departs from the simple rules of continuity in any way, a distorted field will result, which will be an endless cause of trouble to those entrusted with the care and operation of this machine.

View Showing Frame Construction. (Walker Elec. Mfg. Co.)

The Wagner dynamo or generator betrays a frame construction that is magnetically correct, with proportions and cross sections that can never affect the operation of the machine. Cast steel pole-pieces are used and their faces enlarged so that the arc of embrace of each will invite sparklessness and good commutation.

The armature of this machine or of any other, in fact, manufactured by the above company, is substantially made, the core being built up of laminæ to form a slotted body, upon which the wire is wound. Very little waste segments, with mica insulation between, and has never been known to run with a loose bar, grounds, or evince the signs of any other possible defect.

A rear-end view of 15 K. W. Generator. (Wagner Elec. Mfg. Co.)

Front view of 15 K. W. Generator. (Wagner Elec. Mfg. Co.)

results from the style of winding indicated in the sketch, and this reduction of idle wire is a point that no engineer will fail to see the excellence and utility of.

The commutator is carefully built up of finely fitted

The shunt field coils are detachable and co-operate with a series coil, which gives the machine the power of close regulation.

Self-oiling bearings, that are likewise self-aligning, constitute an additional mechanical feature in the design of the Wagner generator.

The brushes and brushholders are solidly built so that the tightening of any part of it will not allow of further motion but holds the carbon brushes, that are employed, securely fixed, free from tremor or vibration, and collecting current from the commutator, without sparks or noise.

It might be well to mention that the frames of Wagner generators are composed of a very high grade of iron, which, in conjunction with the cast-steel pole-pieces, makes the magnetic circuit highly permeable to the magnetic influence.

The apparatus installed by the Wagner Electric Manufacturing Company runs as well after years of service, according to the numerous testimonials they have received, as it did when the armature was first started. It is a great satisfaction to this concern to know that their machinery is held in high esteem by all that have had experience with it and the most conservative contractor will say that it performs its work with the least possible attention and the greatest economy.

The New York office is at No. 711 Havemeyer Building, and is in charge of Mr. A. H. Mustard, an able agent and manager.

Cast Steel Pole Piece.

Standard Shunt Field Coil.

Bi-Polar Self-Aligning Bearing.

A Series Coil.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q) DETERIORATION OF INSULATION.

New York, Aug. 10, 1897.

Electrical Age Publishing Co.

Dear Sirs : The rapidity with which grounds develop in a newly-wired building is something extraordinary. I have paid careful attention to the matter and from a long experience, and from a series of far reaching tests, came to the conclusion that a change occurs in the insulation of so gradual a nature, in some cases, as to take a long time to develop, but otherwise suddenly occurring, without any preliminaries, as though the insulation underwent a rapid deterioration. Any information of a general or specific character bearing upon the subject will be thankfully received by, Yours respectfully,

J. L. Sanger.

(A) The wiring of a newly-constructed building is apt to betray signs of decay which will disappear after it has thoroughly dried.

It is a well-known fact that insulation fails unless of the best possible character, and particularly so after being exposed to moisture or dampness, if of an inferior quality. It is impossible to consider tape, or any rubber compound, without realizing that in the course of time, especially under the influence of heat, it will dry up, crumble, and become absorbent. The conduit in which it is laid will protect it for a long time, possibly many years, until the building is condemned ; but, if the wire is at all exposed, faults will occur and remain. A well-wired building should be free from grounds at the start if the conduit and insulation used are of good quality. In spite of all precautions, at the fixtures and cut-outs may often be found a ready source of trouble that can be traced and removed.

Q.—USE OF PRIMARY BATTERIES.

Eaton, August 9, 1897.

Electrical Age.

Dear Sirs : For house lighting, is there anything that will compete with gas outside of primary batteries ? Can you suggest any means of lighting a house with a few lights, say six, that will not be more expensive than primary batteries ? If primary batteries are used, which is more expensive, a gravity or bluestone cell or an acid battery ? Your answer is awaited by,

Yours respectfully,

A. G. Long.

(A.)—A thermo-electric generator using gas is cheaper than a battery. If batteries are employed, acid cells are the best to use; the immense number of bluestone batteries otherwise required would be a great source of expense and bother.

(Q) KEROSENE ENGINE FOR ELECTRIC LIGHTING.

Stamford, Conn., Aug. 2, 1897.

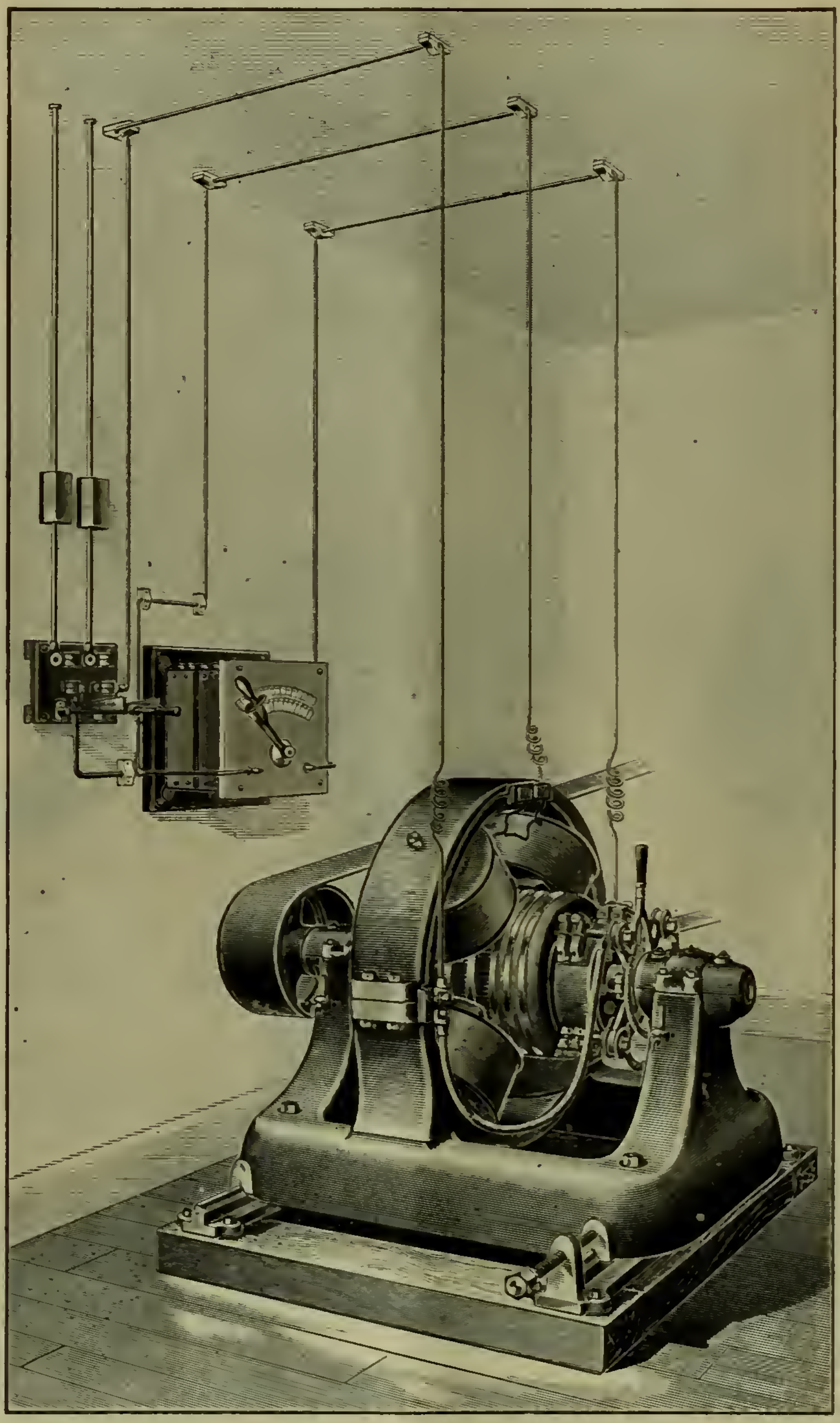
Electrical Age Publishing Co.

Dear Sirs : Can a kerosene engine be used to drive a dynamo without smell, expense and noise that would make it objectionable for a 50-light plant? What substitute can you suggest for the above in a case where gas is unobtainable and expense is a matter of careful consideration? Also, what engine is recommended for the purpose which will run steadily, or, if this is impossible, how many and what sized accumulators will be needed to supply a full candle-power for ten hours!

A Subscriber.

(A) A kerosene engine can be used to drive a dynamo without any of the symptoms mentioned appearing in a violent form. Gasoline engines are becoming popular for electric lighting. A kerosene or gasolene engine will not be expensive fuel consumers. L. J. Wing & Co., of 109 Liberty street, New York, sell a good electric light engine run by gasolene.

it strictly up to date, in revising it every year, has given us an authority on safe wiring, and one that if followed carefully by the engineer and wireman will prevent any misunderstanding with insurance inspectors throughout the country. Mr. Cushing has been exclusively identified with insurance interests in an electrical engineering capacity for a number of years and has given the subject of safe installation of electrical apparatus and wiring his entire attention. The present edition of "Standard Wiring" consists of 5,000 copies, and being the fifth edition of that number we have no doubt that a vast amount of good has been accomplished towards standardizing the methods of installing and wiring electrical apparatus throughout the United States.



An Improved Installation in Every Detail and Wiring Connections, for Shunt-wound Four-Pole Motor, Designed Especially for "Standard Wiring" by the General Electric Co., from the Author's Specifications.

A VALUABLE HAND-BOOK.

There is probably no hand-book on the subject of wiring which has met with such universal favor among engineers, central-station managers and contractors, as "Standard Wiring" for Electric Light and Power, by H. C. Cushing, Jr., Electrical Inspector for the Fire Underwriters' Tariff Association of New York. Before coming to New York to accept his present position, Mr. Cushing was the electrician for the Boston Board of Fire Underwriters, and in that capacity he conceived the idea of not only compiling a valuable and practical book of tables but also embodied in this little book every requirement for the safe installation of apparatus and wiring from the Fire Underwriters' standpoint, and by keeping

The book not only treats in a brief, practical and simple manner, the recognized safe methods for inside wiring, but contains almost all the necessary information for outside work, such as pole-line installation, transformers, lightning arresters and roof structures, with all the necessary data as to dimensions, weights of various sizes of wires between poles and many points of information and ready reference for the central-station manager. Mr. Cushing has confined himself mostly to practical and complete tables for ascertaining almost all the necessary information for even large and complicated lighting or power installations without having to use pencil, paper and complicated formulæ. For special cases, however, the book contains a collection of the most simple formulæ and rules, requiring no knowledge of any but the simplest arithmetic. The practicability of the book is shown by the following sample table, and the explanation and examples accompanying it, and the sample illustration which shows the proper and safe way of installing a motor. The book is full of just such complete tables and illustrations, and therefore commends itself to all practical construction men.

The following examples, which are worked out, will show the method of using the wiring table given on page 48:

1. What size of wire should we use to run 50 16-candle power lamps, of 110 volts, a distance of 150 feet to the centre of distribution with the loss of 2 volts? First multiply the amperes, which will be 29 (50 16-c. p. 110-v. lamps take 29 amperes, see table on page 71), by the distance, 150 feet, which will equal 4350 ampere feet. Then refer to the columns headed "Actual Volts Lost," and as we are to have only a loss of two volts look down the column headed 2 until you come to the nearest corresponding number to 4350 and we find that 4920 is the best number to use. Put your pencil on the number 4,920 and follow that horizontal column to the left until you come to the vertical column headed "Size B. & S." and you will find that a No. 3 B. & S. size will be the proper size to use in this case.

2. What size wire should we use to carry current for a motor that requires 30 amperes and 220 volts and is situated 200 feet from the distributing pole, the "drop" in volts not to exceed 2 per cent.? First multiply 30 amperes by 200 feet, as we did in the first example, and we get 6000 ampere feet. Now look at the upper left-hand corner of the table and you will see a vertical column headed "Volts." Go down this column uutil you come to 220 and follow the horizontal column to the right until you come to the figure 1.8, which is the nearest we can come to a 2 per cent. loss without a greater loss or "drop." Place your pencil on the figure 1.8 and follow down the vertical column of figures until you come to the nearest corresponding figure to 6000, which we find to be 6200. Then with your pencil on this figure follow the horizontal column to the left and we find that a No. 5 B. & S. wire is a proper size to use for the above conditions.

3. Supposing we have occasion to inspect a piece of wiring, and find a dynamo operating 50 16-c. p. 110-volt lamps at a distance of 150 feet, and our wire gauge shows that the wire in use is a No. 12 B. & S. At what loss, or "drop" are these lamps being operated? First multiply the amperes, which will be 29 (50 16-c. p. 110-v. lamps take 29 amperes, see table on page 71), by the distance, 150 feet, and we get 4350 ampere feet. As we find in use a No. 12 B. & S. wire we look for the vertical column headed "Size B. & S." and follow it down until we come to 12. With our pencil on the figure 12 we travel along the horizontal line to the right until we come to the nearest corresponding number to 4350, which we find to be 4575. Then starting at this number we travel up the vertical column and we find a loss of 15 actual volts, or at a 12 per cent. loss, which would greatly reduce the candle-power or brilliancy of his lamps.

WIRING TABLE FOR LIGHT AND POWER CIRCUITS.

Multiply current in amperes by single distance and refer to the nearest corresponding number under column of Actual Volts Lost, to find size of wire.

Volts.	Percentage of Loss.																
2000	1.7	1.5	1.4	1.2	1.1	1.0	0.75	0.5	0.45	0.4	0.35	0.3	0.25	0.2	0.15	0.1	0.05
1000	3.4	2.9	2.7	2.4	2.2	2.0	1.5	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0 1
500	6.5	5.7	5.2	4.8	4.3	3.9	2.9	2.0	1.8	1.6	1.4	1.2	1.0	0.8	0.6	0.4	0.2
220	13.7	12.0	11.0	10.3	9.3	8.3	6.5	4.4	3.9	3.5	3.1	2.7	2.2	1.8	1.4	0.9	0.45
110	—	—	20.0	18.5	17.0	15.4	12.0	8.4	7.6	6.8	6.0	5.2	4.4	3.5	2.7	1.8	0.9
52	—	—	—	—	—	—	22.4	16.1	14.7	13.3	11.8	10.3	8.8	7.1	5.5	3.7	1.9

*Carrying Capacity Amperes.	Size B. & S.	Actual Volts Lost. 35	30	27.5	25	22.5	20	15	10	9	8	7	6	5	4	3	2	1
300	0000	345800	296400	271700	247000	222300	197600	148200	98800	88920	79040	69160	59280	49400	39520	29640	19760	9880
245	000	274400	235200	215600	196000	176400	156800	117600	78400	70560	62720	54880	47040	39200	31360	23520	15680	7840
215	00	217525	186450	170912	155375	139837	124300	93225	62150	55935	49720	43505	37290	31075	24860	18645	12430	6215
190	0	172550	147900	135575	123250	110925	98600	73950	49300	44370	39440	34510	29580	24650	19720	14790	9860	4930
160	1	136850	117300	107525	97750	87975	78200	58650	39100	35190	31280	27370	23460	19550	15640	11730	7820	3910
135	2	108500	93000	85250	77500	69750	62000	46500	31000	27900	24800	21700	18600	15500	12400	9300	6200	3100
115	3	86100	73800	67650	61500	55350	49200	36900	24600	22140	19680	17220	14760	12300	9840	7380	4920	2460
100	4	68250	58500	53625	48750	43875	39000	29250	19500	17550	15600	13650	11700	9750	7800	5850	3900	1950
90	5	54250	46500	42625	38750	34875	31000	23250	15500	13950	12400	10850	9300	7750	6200	4650	3100	1550
80	6	43050	36900	33825	30750	27675	24600	18450	12300	11070	9840	8610	7380	6150	4920	3690	2460	1230
60	8	26985	23130	21202	19275	17347	15420	11565	7710	6939	6168	5397	4626	3855	3084	2313	1542	771
40	10	16975	14550	13337	12125	10912	9700	7275	4850	4365	3880	3395	2910	2425	1940	1455	970	485
30	12	10675	9150	8388	7625	6862	6100	4575	3050	2745	2440	2135	1830	1525	1220	915	610	305
22	14	6720	5760	5280	4800	4320	3840	2880	1920	1728	1536	1344	1152	960	768	576	384	192
15	16	4235	3630	3328	3025	2723	2420	1815	1210	1089	968	847	726	605	484	363	242	121

NOTE.—In case a larger loss than any given in the table is required, proceed as follows:—Divide the ampere feet by 10 and then refer to column of Actual Volts Lost divided by 10, from which we find the size wire as before. For explanation of above table see examples worked out on page 49.

APPLICATION OF HYPERBOLIC ANALYSIS TO THE DISCHARGE OF A CONDENSER.

BY ALEXANDER MACFARLANE.

(Concluded from page 69.)

We deduce the solution for the transition case by means of the principle that in form it must agree with what is common to the two general solutions. Now for the hyperbolic case

$$q = A e^{-at} \left\{ n t + \varphi + \frac{(n t + \varphi)^3}{3\,!} + \right\},$$

and for the circular case

$$q = A e^{-at} \left\{ n t + \varphi - \frac{(n t + \varphi)^3}{3\,!} + \right\};$$

hence for the transition case

$$q = A e^{-at} (\varphi + n t).$$

As $A \varphi$ is represented by a length and $A n$ by a linear velocity, let them be denoted by the constants $2c$ and $2v$. Then $q = 2 e^{-at} (c + v t)$.

In the case of the horizontal projections the only common part is the first term of the series, namely 1; hence b denoting an arbitrary length, we have $2 e^{-at} b$ for that projection Hence the primary form of the solution of the differential equation in the transition case is

$$q = e^{-at} \{ [b + i (c + v t)] + [- b + i (c + v t)] \}.$$

This is represented in Fig. 7, which is the transition between Figs. 3 and 4. O P represents $b + i\,c$, and O P[1] represents $-b + i\,c$; O Q represents $b + i\,(c + v\,t)$ and O Q[1] represents $-b + i\,(c + v\,t)$; O M represents half of the resultant of O Q and O Q[1].

By putting in the conditions that $I = 0$ and $q = Q$ when $t = 0$, we obtain

$$q = Q\,e^{-at}\,(a\,t + 1)$$

$$\text{and } I = -\,Q\,e^{-at}\,a^2\,t.$$

The general differential coefficient is

$$\frac{d^m q}{d\,t^m} = (-1)^m\,Q\,e^{-at}\,a^m \left\{ at - (m - 1) \right\}.$$

Hence q is a maximum when $t = o$, and has a point of contrary flexure when $t = \frac{1}{a}$; and I has a maximum when $t = \frac{1}{a}$ and a point of contrary flexure when $t = \frac{2}{a}$. Thus we see that 1 takes the place of $\tan^{-1}\frac{n}{a}$ or $\tanh^{-1}\frac{n}{a}$, and that a takes the place of n.

Fig. 8 is the transition between Figs. 5 and 6. The point R describes a uniform motion along the straight line; O P is O R diminished at a uniform geometrical rate, O Q is the vertical projection of O P. The path of P is perpendicular to O A at the point O, whereas in the hyperbolic case it makes an angle of 45°.

If attention is restricted to real roots, it is difficult to see why the transition solution is not of the form $q = Ae^{-at}$, nor is the matter made very clear in treatises on Differential Equations.

The preceding investigation throws new light on the theory of the quadratic equation. The current theory may be stated as follows: A quadratic equation has either two real roots or two imaginary roots, the separating case being when the roots are equal. According to the results of the preceding investigation, the theory should be stated as follows: So far as real roots are concerned, a quadratic equation has either two such roots or else none, the separating case being where they are equal. The two general cases are the real and the impossible. As regards complex roots, a quadratic equation has either two conjugate hyperbolic roots or else two conjugate circular roots, the separating case being where they are straight-line. Consider the quadratic equation $x^2 + 2\,ax + b = 0$. If a^2 is greater than b, the roots are hyperbolic, and

$$x_1 = -\,a + \sqrt{-1}\,i\,\sqrt{a^2 - b}$$

$$x_2 = -\,a - \sqrt{-1}\,i\,\sqrt{a^2 - b}$$

If we substitute either root in the equation, we shall find, just as in the case of the circular roots, that the terms which do not involve i cancel one another, and likewise the terms which do involve i. The equation is doubly satisfied by the independent vanishing of the two parts.

The preceding investigation has an important bearing on the theory of the complex quantity, a theory which lies at the foundation of algebraic analysis. The eminent mathematician Cayley maintained that the complex quantity $a + ib$ is the most general magnitude considered by algebra, and that were it fully investigated the science would become *totus teres atque rotundus.* The current doctrine among mathematicians is thus stated in a recent able work on alternating currents, where from the nature of the subject the circular complex quantity is a fundamental idea:

"Within the range of algebra no further extension of the system of numbers is necessary or possible, and the most general number is $a + ib$, where a and b can be integers or fractions, positive or negative, rational or irrational." †Let the question be limited to the algebra of the plane although that is in truth an arbitrary restriction, for spherical trigonometrical analysis is as much algebra as is plane trigonometrical analysis. The preceding investigation shows that the ordinary complex quantity is only one-half of the whole subject of plane algebra; for parallel with the circular complex quantity we have a hyperbolic complex quantity, and for every theorem about the former there is an analogous theorem about the latter. If the one is within the domain of algebra, so is the other. Here we have another instance of the danger involved in predicating *impossible*.

† Steinmetz, Alternating Current Phenomena, p. 405.

$$x_1 = -\,a + \sqrt{-1}\,i\,\sqrt{a^2 - b}$$

$$x_2 = -\,a - \sqrt{-1}\,i\,\sqrt{a^2 - b}$$

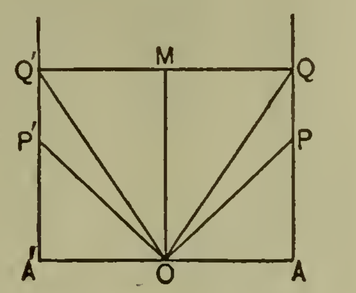


Fig. 7.

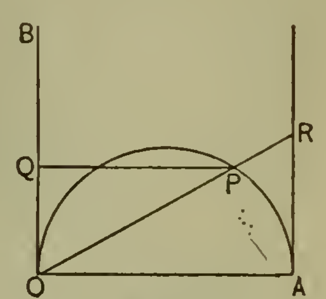


Fig. 8.

THE NATIONAL ELECTRICAL CODE.

(Concluded from page 85.)

The rules of the National Board of Fire Underwriters are now printed with the following note:

"The National Electrical Code, as it is here presented, is the result of the united efforts of the various Electrical, Insurance, Architectural and allied interests, which have, through the National Conference on Standard Electrical Rules, composed of delegates from the following associations, unanimously voted to recommend them to their respective associations, for approval or adoption.

"American Institute of Architects.
"American Institute of American Engineers.
"American Society of Mechanical Engineers.
"American Street Railway Association.
"Factory Mutual Fire Insurance Companies.
"National Association of Fire Engineers.
"National Board of Fire Underwriters.
"National Electric Light Association.
"Underwriters' National Electric Association.

"And as soon as meetings of these associations are held and action taken, the fact will be noted."

These rules received the approval of the National Electric Light Association at its meeting at Niagara Falls, held June 8th of the present year, and will, undoubtedly, receive the approval of the other associations represented in the National Conference; so that now for the first time a "National Electrical Code" is issued, stamped with the approval not only of the insurance interests, but also of the national societies of electrical, architectural and allied interests.

From the foregoing sketch it is evident that the underwriters have from the beginning availed themselves of the advice and suggestions of the electric interests. The 1885 edition of the New England Insurance Exchange rules was prepared with the "aid of some of the leading electric light people." Insurance representatives were present at the Baltimore meeting of the National Electric Light Association in 1885, and while that association took no action on the rules which came from this and later meetings, they were recognized and adopted by the Boston Board and New England Insurance Exchange in 1889. The rules of the New England Insurance Exchange issued in 1890 were submitted to and approved by the New England Electric Exchange, and when the Underwriters' National Electric Association was organized in 1892, it took as a basis of its rules those which had been formulated in 1891 for the National Electric Light Association by the Electro-Insurance Bureau. The rules prepared by the Underwriters' National Electric Association were submitted to and received the hearty approval of, representative electrical experts. The insurance interests, however, have always felt that it was their province to settle what should be the electrical equipment of risks which they insured. This course has always been pursued in England, where the Phœnix Fire Office Rules are practically the only ones recognized, and it is a position which can be well defended, and must be admitted to be entirely reasonable. It is equally true that the underwriters should not be arbitrary and overbearing, and should make their rules as favorable to the electrical interests as the overcoming of the fire hazard will permit; and we believe that the facts show that this course has been generally maintained.

The principal reason why harmonious relations between the electrical and insurance interests in the matter of uniform rules has not sooner been reached is, we believe, because there was no organization through which the electrical, architectural and allied interests could be reached until the National Conference on Standard Electrical Rules was formed. For the same reason uniformity of rules in the various insurance boards was not accomplished until the formation of the Underwriters' National Electric Association, an organization through which the various boards could be reached, and in which they had a voice. Just as soon as this association was formed, uniformity of rules, so far as the insurance interests were concerned, became an accomplished fact, and just as soon as an organization of the other interests was formed, *complete* uniformity of rules was secured.

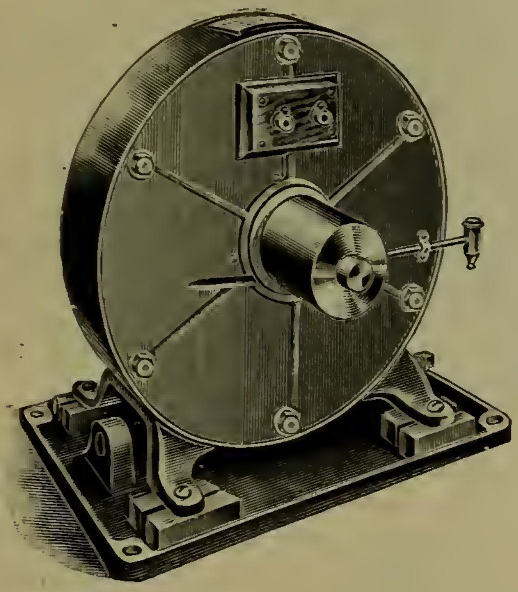
In the joint meetings between the code committee of the National Conference and the electrical committee of the Underwriters' National Electric Association the utmost harmony has prevailed, and suggestions from either have been most courteously considered by the other. If the Underwriters' National Electric Association had not been formed for the purpose of uniting the many independent underwriters organizations, and had it not been for their ready and cheerful co-operation, it is probable that the National Conference could not have brought about the result for which they were working. The efforts of the members of the code committee of the National Conference to secure harmony and uniformity are most certainly appreciated, not only by the electrical but by the insurance interests as well.

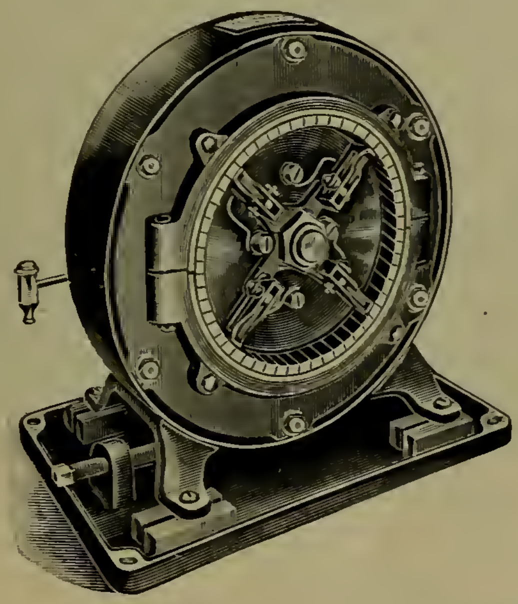
As matters now stand the Conference has accomplished its work, and has adjourned. The organization remains, and the work that it has done stands as a precedent, so that, should occasion ever again demand, the machinery could be easily put into motion.

It is recognized that from time to time changes in the rules will have to be made to meet the natural growth in electrical lines; it is, however, felt that considering the very satisfactory results now secured, and the slight changes needed in all probability for several years to come, that the Underwriters' National Electric Association is the most available body to charge with this work of revision, for the immediate present.

To keep the Conference in commission to do this work is rather difficult, as it requires more time and attention from men otherwise very busy, than the needs seem to warrant.

It is the purpose of the Underwriters' Association to give in the future, as it has endeavored to do in the past, the fullest hearing on all criticisms, and the members of the National Conference will be fully welcomed and with full privileges of voting at the Underwriters' meetings, thus giving the very largest liberty and breadth to the make-up of the Underwriters' Association.





Imperial Electric Company.

NEW IRONCLAD SLOW-SPEED MOTOR.

The Imperial Electric Company, 140 Washington street, New York, have recently placed upon the market a slow-speed multipolar motor for direct connection to individual tools such as lathes, planers, printing presses, power presses, organs, pumps, sewing machines, etc., thus obviating the use of step-down pulleys and unnecessary shafting.

The usual method in designing motors is reversed in this case, inasmuch as the armature is stationary and the field revolving. The armature is built up of very soft iron disks, slotted to receive the winding, and when completely wound and connected makes a practically indestructible armature.

There are several advantages gained by having the armature and field thus constructed. First, since the fields of a motor are always much heavier than the armature, the centrifugal force, due to the revolving of the field, enables it to take up any sudden change of load without diminution in speed and making it more efficient electrically, it taking less free current to overcome the losses. Likewise, the armature being stationary, it is a very simple matter to more thoroughly insulate for high potentials and, as there is no centrifugal force on the part of the armature, no binding wires are necessary.

The motor is absolutely ironclad and dust-proof, and will not be damaged by rough handling. There is an entire absence of sparking under wide variations of load, which result is obtained by making a strong field in the air gap ; also a uniform gap with a uniform armature winding, thereby eliminating the back currents which are so liable to flow through the different circuits of a multipolar machine.

The temperature rise in the armature does not exceed 35 degrees C. after a continuous run of ten hours with 25 per cent. overload.

We herewith give a table of the smallest machines that the company build, the larger sizes being in the course of construction :

H. P.	Speed.	Weight.	Floor Space.	Efficiency.
¼	350	90	9 in. by 16 in.	65 per ct.
½	600	100	9 " " 16 "	67 "
¾	600	100	9 " " 16 "	69.5 "
1	550	150	12 " " 18 "	71 "
1½	550	155	12 " " 18 "	73 "
2	475	220	14 " " 18 "	77 "

POSSIBLE CONTRACTS.

Portsmouth, Va.—The Portsmouth Street Railway Co. has been granted permission to build a trolley line in the city.

Colorado Springs. Col.—An electric road is to be constructed to connect with the Cripple Creek gold camp.

Mazeppa, Minn.—An electric light plant is to be run in connection with Rust & Mason's flouring mill at Forest Mills.

Madison, Fla.—Wm. S. Jordan, chairman of Electric Light Committee, may be addressed concerning erection of proposed electric light plant.

Scranton, Miss.—The Mayor may be addressed concerning water and electric light plants.

TELEPHONE NOTES.

Hagerstown, Md.—R. B. Hazlett, of Norfolk, Va., has been granted a franchise for the construction and operation of a long-distance telephone system, to cost $30,000.

Trenton, N. J.—The Standard Telephone and Telegraph Co. have filed a certificate with the Secretary of State surrendering its local franchise.

Covington, Ohio.—The Covington Telephone Co. has been granted permission to string wires and operate a new telephone system between this city and Newport.

NEW CORPORATIONS.

Kansas City, Mo —The South Side Electric Light & Power Co. has been incorporated by Henry Pfeffer, L. A. Schueffer and G. C. Hale. Capital stock, $30,000.

Charlestown, W. Va.—The Hays Construction Co. has been incorporated by F. J. Hays, J. K. Hays, O. B. Loose, C. H. Loose, and F. J. Clary; for the purpose of constructing railroads, telegraph and telephone lines, etc. Capital stock, $100,000.

New York, N. Y.—The Valley Vital Carbon Brush Co. has been incorporated by Darius A. LeValley, John V. Clarke, Edward J. Lewis, J. Ralph Hartnett and William J. Creed; to manufacture commutator brushes and electrical devices. Capital stock, $25 000.

New York, N. Y.—United States Electrical Supply Co. has been incorporated by William J. Clarke, T. Channon Press, and Charles P. Sheridan; to manufacture electrical supplies and erect electrical plants. Capital stock, $10,000.

Kankakee, Ill.—The Kankakee, Wilmington and Morris Electric Railway Co. has been incorporated by Frank B. Handwork, Thomas J. Diven, August D. Ehrich, Cyrus L. Bennett, Philip I. Cromwell, Julius L. Lins, and J. A. Henry; to build an electric road to start in Kankakee, run through Wilmington, and thence to Morris. Capital stock, $50,000.

WILLIAM TAYLOR, formerly of the paper "Electricity," has just returned from his trip around the world. He won the prize offered by The Evening Telegram to the one guessing the nearest to McKinley's plurality. Mr. Taylor is manager in New York for the Hart & Hegeman Manufacturing Co. of Hartford, Conn. The New York office of the above company is in the Mail and Express Building. The famous Hart switches require but little introduction to the reader's notice, being one of the best known and best made in this country.

The Electrical Age.

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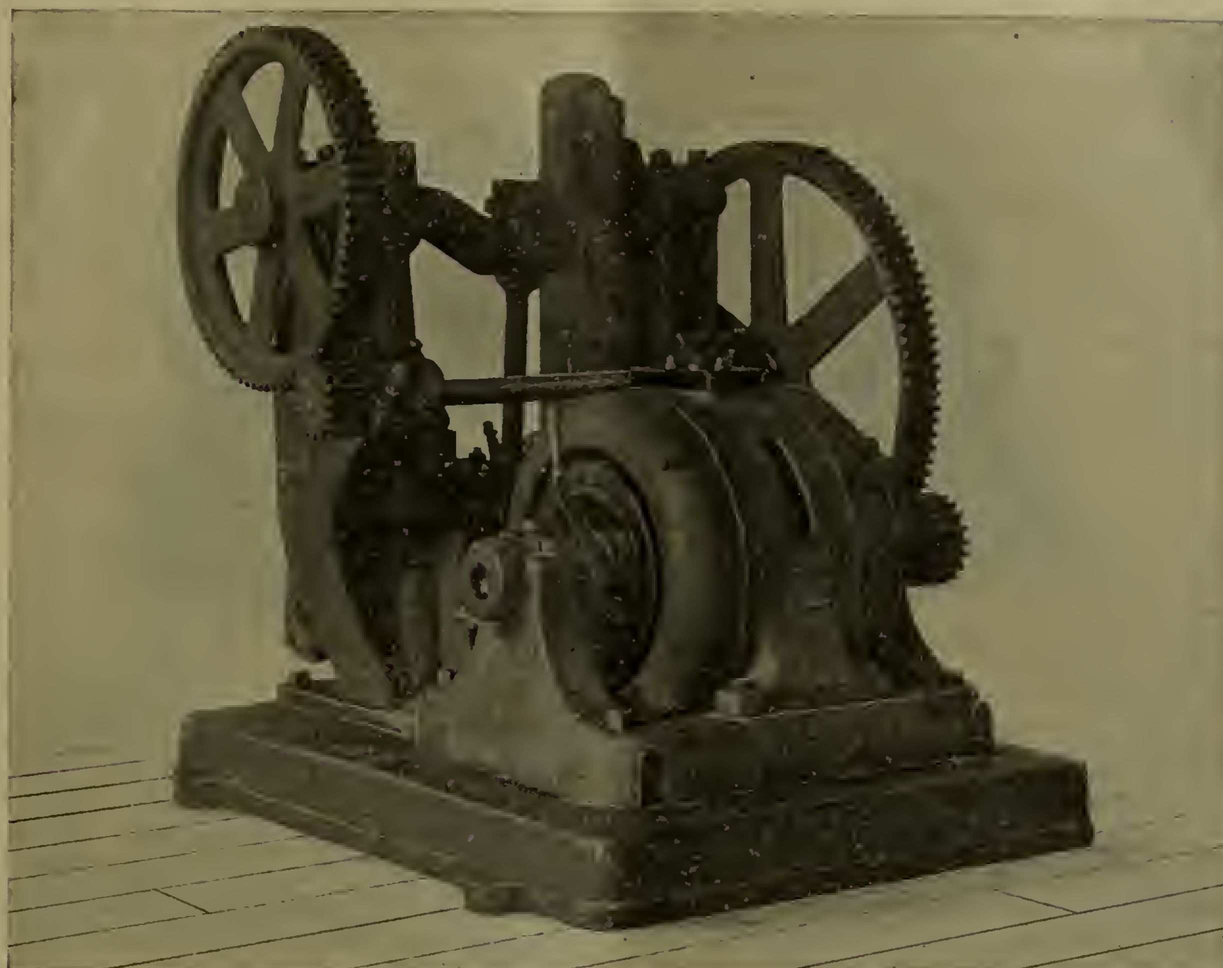


Fig. 4—Three-phase Vertical Triplex Pump Driven by 5 H.-P. Induction Motor.

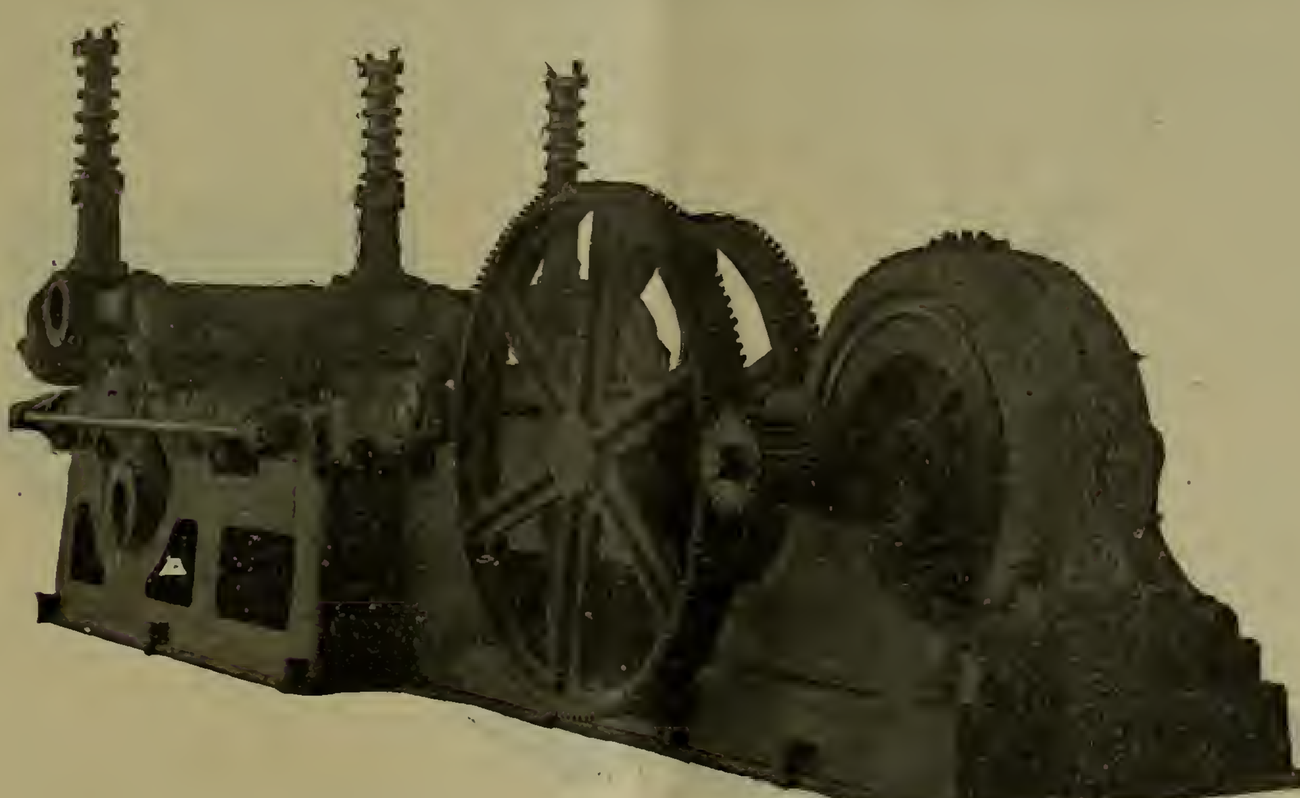


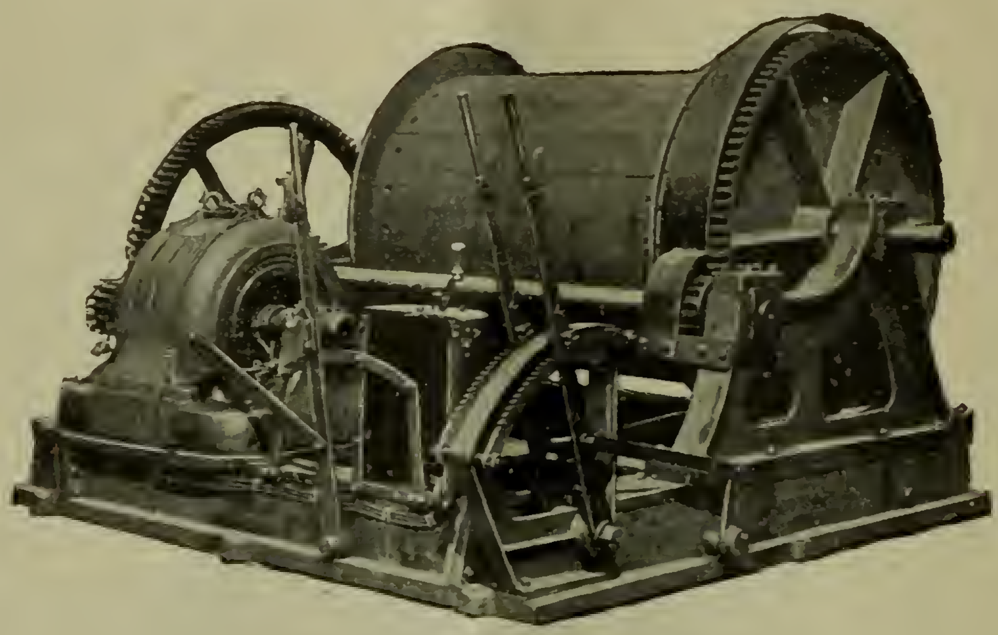
Fig 5—Double-acting Horizontal Triplex Pumd 75 H.-P. Induction Motor.

ELECTRICITY IN THE COAL MINE.

The comparatively recent developments in the manipulation of alternating current electricity have, in broadening the whole field of electrical application, extended the use of the current also in the mining industry and given to the mine operator a system extremely efficient and flexible both in its distribution and adaptation. The alternating current possesses one great advantage, among others, which no other system presents, in the ease with which the voltage may be varied. This is done by means of transformers, and allows the electricity to be transmitted at a high voltage, and consequently cheaply, over long distances, to be transformed down at the point of utilization. It also allows of the use of motors which, equally effective in their performance with direct-current motors, are free from commutators and moving contacts, and consequently from sparking, as well as from other shortcomings.

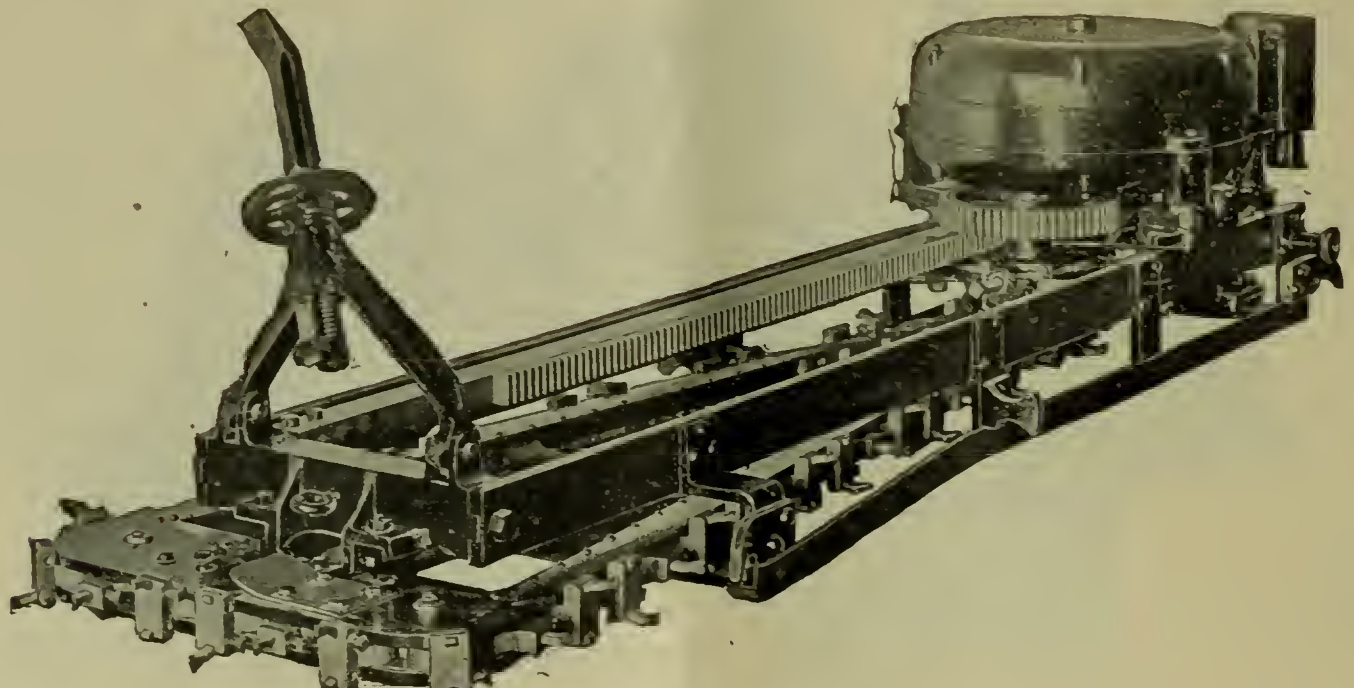
To the mine operator the alternating current system, or rather a modification of it, known as the three-phase system, offers special advantages. Mines many miles apart may be operated by current generated at a single central point, situated where it can be procured and distributed most economically. The electricity, transmitted at a suitable high voltage, on reaching the mine mouth, is reduced in pressure and the wires taken down the shafts carry a low voltage current only. It can then be used not only to drive the mine machinery, but also to light the arc and incandescent lamps on branches from the same main circuits, at even a lower voltage than that used for the machines. In case continuous current is required in lieu of alternating, as for the operation of mine locomotives, the alternating current can be converted into continuous in a rotary converter, and the voltage of the latter current regulated to the necessary pitch for the new use. Furthermore, although three wires are used with the three-phase system, and two with the direct, the cost of the three wires is one-quarter less than that of the two wires, allowing the same loss in transmission and using the same initial voltage.

The development of electric mining machinery to be operated on the three-phase system has been carried forward vigorously by the General Electric Co., and convinced of the advantages of the system, while recognizing the need of propaganda, it equipped a large freight car as a central three-phase station, with boiler, engine, alternator and station equipment complete. This was held ready for installation at the mouth of the mine of any operator desirous of investigating the economy and efficiency of the system. The installation made, station and mine apparatus were left with the operator. He was then placed in a position to watch both generating and operating machinery and judge for himself. This car was never long out of requisition.



30 H.-P. Hoist and Induction Motor.

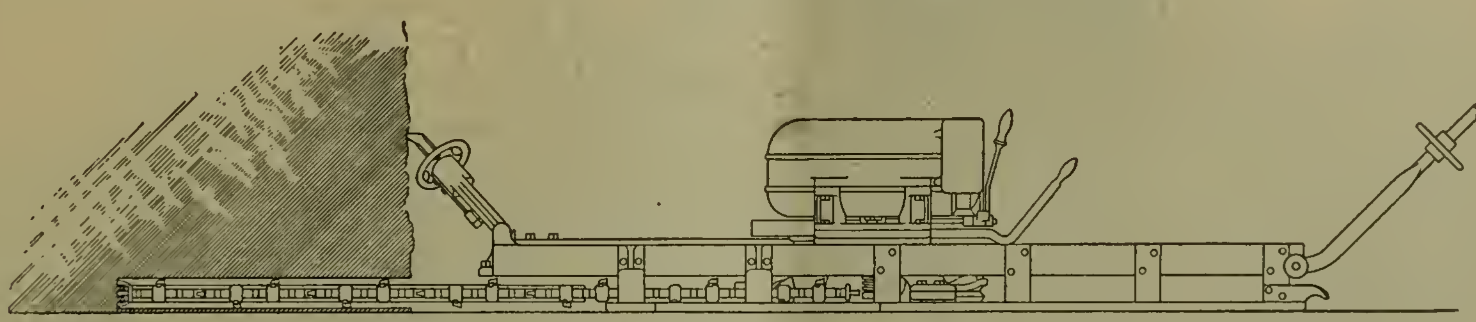
To the cutting of coal by machinery the three-phase system seems peculiarly suited. The chain coal cutter illustrated shows the latest type—a stationary frame and travelling carriage carrying the motor, driving gear, feed gearing and cutting chain. The motor is an induction motor laid on its side. It has neither commutator brushes nor moving contacts, and as it cannot spark can be used in gaseous or dusty mines where a spark might result in a costly disaster. The windings of the motor are stationary coils embedded in metal and protected from injury, and as these coils are separately formed and insulated, they may be readily removed and replaced. The motor is entirely enclosed, and no starting box being necessary complete control is given by a simple enclosed switch. The motor stops work the moment it is overloaded and the machine is thus subjected neither to strain nor breakage. The shaft of the motor is vertical and runs at a low speed, allowing the chain sprocket wheel to be driven by a single reduction spur gear, thus avoiding on the main drive both worn and bevel gears. The feed gearing is driven by a worm at the lower end of the armature shaft. The backward thrust of the feed gearing is taken by a single rack, so located as to compensate largely for the side thrust of the chain as it cuts the coal. Into this rack mash two pinions, one for the forward and one for the backward motion of the carriage. The reverse lever at the back of the machine throws clutches in or out of these gears and is arranged to throw automatically when the end of the cutter travel is reached. A characteristic feature of this cutter is the small amount of gearing employed and reduced number of wearing parts.



Chain Coal Cutter.

The chain is arranged to take three shapes of bits, each form cutting grooves about one and one-half inches deep, separated from the next groove by a ridge of coal which is broken down by the links. The cut is about four inches high by thirty-six inches wide, and the bits, made in the form of an arc of a circle, can be set out as required. This gives a great advantage in sharpening, as no part of the bit except the cutting edge needs redressing and all of the steel may be used up. The chain is built to stand the strain and the vibration of the cutter. The bit links are of tough phosphor-bronze, and the strap links are steel drop forgings of such shape as to bring all the strain directly upon the solid forgings and not on the rivets.

In rooms where the proper clearance can be obtained, this coal cutter can be shifted, or moved from the first position ready for the second cut in an average of two minutes, it being understood that the props are away from the face, the floor reasonably smooth and the face of the coal properly squared. The time of loading and moving the cutter from room to room will average about fifteen minutes, provided the rooms are adjacent. The time required for setting the bits will average ten minutes. The cutter has in favorable coal, where other conditions were rather unfavorable—such as roof, props, track, etc.—been able to average eight cuts or runs, each thirty-six inches wide, per hour, or at the rate of 240 lineal feet per ten-hour shift. The conditions can scarcely be so unfavorable that it will not always be able to average at least four runs per hour.



Method of Operation.

An approximate idea of the number of machines required for any particular mine can be obtained from the following formula, which gives the tonnage output:

$$\frac{(\text{Number of ft. face per 10 hr. shift}) \times \frac{(\text{depth undercut}) \times (\text{height coal})}{27 \text{ cu. ft.}}}{}$$

= Number of tons of mine coal.

To reduce this to lump coal the percentage of fine coal that passes through the screens from pick-mining is ascertained. The percentage of lump from the machine will then be twenty-five per cent. greater than when produced by pick or hand labor. The amount of powder to shoot or break down the coal is also largely decreased. Any coal that would require ordinarily an eighteen inch cartridge to break down, will require, when the same coal is properly undercut with the machines, an eight inch cartridge for the same or a greater amount of coal.

Accompanying the cutter is the electric mining pump, which presents the great advantage of portability, which renders the electric pump superior for mine work to pumps driven by any other method. With an electric pump the pump shaft is free from all machinery. It contains only the conductors and discharge pipes. Indeed, the three-compartment shaft so common in mines, one for pumping and the other for hoisting, can, by the use of the electric pump, be reduced to two, as the discharge pipes and wires which occupy so little space can be placed in one of the hoisting compartments. Furthermore, with an electric pump, deleterious and often disastrous effects inseparable from the use of steam are absent. Moreover, the three-phase pump requires no attention beyond an occasional oiling, and needs no attendant to start or stop it. It can be operated by a switch from the engineer's office at the mine mouth.

There are different types of electric mine pumps, but the three-phase pump presents features of excellence similar to those noted in the coal cutter. Our illustration shows a Knowles four inch by six inch vertical triplex pump, with a capacity of sixty gallons a minute against 300 foot head. It is driven by a sparkless induction motor of five H. P. capacity mounted on the same bed plate as the pump and driving it through a double reduction. The weight of the motor and pump complete is about 2,480 lbs. Another type of three-phase pump is shown. This is a Knowles seven and one-fourth inch by twelve inches double acting horizontal triplex pump, having a capacity of 600 gallons a minute against a head of 200 feet. The motor is also of the sparkless induction type, but of seventy-five H. P. capacity, and the outside dimensions of the combination of motor and pump are nine feet high, six inches wide and twenty-five feet by six inches deep. This mine pump is now in use in Mexico.

This description of three-phase mining machinery would be incomplete without an illustration showing the application of the induction motor to the hoist. In the sketch it is rated at 3300 pounds at 200 feet per minute. The drum is four feet in diameter and five feet between flanges. It is fitted with friction clutch and usual hand brake, and is stopped, started and reversed by a cylindrical switch or controller. The lever at the left of the controller is connected to the resistance switch by a cam, and is used for short-circuiting the resistance in the armature as the motor comes up to speed. The motor is a standard General Electric thirty H. P. motoı, with the denomination of 8-30-900.

Generally speaking, the use of electric mining machinery reduces materially the amount of dead work and, in the case of the cutter, reduces the amount of haulage. These two factors alone result in a decreased cost of mining, and although it is difficult to state the extent of the saving, the practical operator will be able without effort to realize the benefit derivable from the use of electric mining machinery. Beyond those already mentioned the following may be enumerated: Ventilating fans may be placed in any part of the mine and be driven by motors; partitions can be lighted by incandescent lamps; the coal can be hauled by electric locomotives, and all with no greater encumbrance in the mine workings than some small wires strung on porcelain conductors out of sight, almost on the roofs.

BISHOP WIRE will be used in the installation of forty Sprague elevators in London, England. They will carry the people up and down from the Underground Railway. Bishop wire is used in the big Astoria Hotel in which Sprague elevators have been installed. The Crocker-Wheeler Company will use Bishop wire in installing electric ventilators in the same hotel. The reputation this wire has secured is entirely due to its good qualities, insulation and durability being its most prominent characteristics.

*A NEW FORM OF INDUCTION COIL.

BY ELIHU THOMSON.

The induction coil presently to be described, it is believed, constitutes a new type of employing the principle of a "substitute primary" or "secondary primary," which principle has been applied by me in a variety of ways.

The prime object of this coil is to permit the direct connection to circuits of considerable potential for obtaining energy for the production of high potential discharges like those of a Ruhmkorff coil for working Rontgen ray vacuum tubes, and for such like purposes. The object, also, was to avoid the employment of banks of lamps or storage batteries, and to limit the energy consumed to only that amount required to work the coil itself. Furthermore, no larger condensers than those ordinarily used with an induction coil of equal capacity are needed, and no air-blast, while the coil as a whole is still available as an ordinary Ruhmkorff without change in its structure or connections.

To illustrate the principle, reference is made to Fig. 1, where *p n* represent connections to mains at, say, 110 volts difference of potential; I I is an iron wire core around which are wound two coils, one over the other, either of which may, of course, be the primary. The inner coil P in the figure is made the primary, and is wound with many turns of comparatively fine wire. For 110 volts it may have some thousands of turns and be wound with a wire safe for .5 to .75 ampere. The outside wire, S, may be coarse or fine. In the figure it is quite coarse and of relatively few turns, since it is assumed to give low potential and large current. The coil S is so proportioned as to be practically almost short-circuited at intervals by its load at B, which is three cells of storage battery in series, for example. The object is assumed to be that the batteries are charged by transference of energy from coil P to S at low potential in S. The coil S should have ample copper so as to lower its internal resistance as much as possible; the resistance of the cells B should be low; and the average voltage of discharge of S much superior to the counter E. M. F. of B. Two synchronously revolving break-pieces, E, F, which may, in fact, be combined into one, are used; E is for governing the intervals of passage of current in coil P and connection of condenser C across the break or interruption periodically made between one terminal of P by a brush G and a metallic segment on E occupying a considerable arc on its periphery. Brush H connects to main *n*. Back of the main segment on E is a small condenser segment in continuous connection with one side or foil of the condenser, and the other side is connected to the other terminal of P, or that leading direct from line *p*. The contact maker and breaker F has a segment which is in continuous connection with one terminal of battery B to be charged, and which touches a stationary brush J, at or about the time of the break between brush G on the main segment of E. The battery B may have terminals by which it may furnish current while being charged.

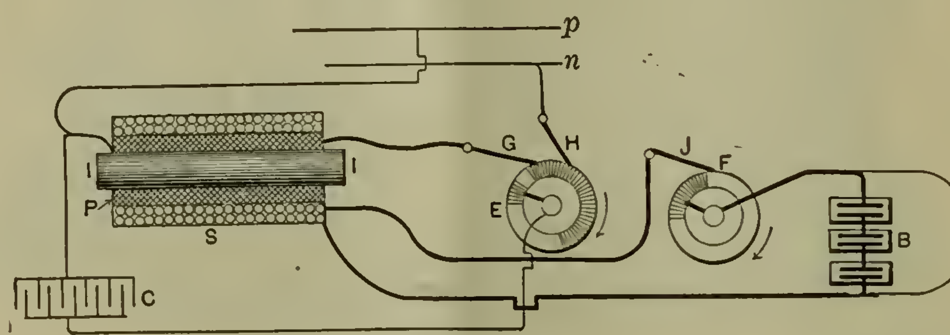


Fig. 1.

Now let the break-wheels E and F be given rapid revolution, say, 10, 20 or 30 per second. The contact of brushes G and H with the main segment of E passes current for a certain considerable fraction of the revolution, at full line potential of 110 volts, through primary P. The current rises gradually during this period, and may at the end attain a value of one ampere, more or less. With slow revolution it would be limited by the resistance of P chiefly, but at rapid rates, the time constant of P acting as a self-induction, determines the ultimate value of current before breaking. Upon the break of brush G with the main segment it touches the condenser segment, which is thereby put across the break, but the circuit of S is also closed by contact of segment on F with brush J. The condenser receives only a small charge on account of the circuit of S having been closed. In fact, the break at G with main segment of E would be nearly sparkless without the condenser C, but what slight self-induction is not wiped out by the mutual induction of the currents in S and P is very easily taken care of.

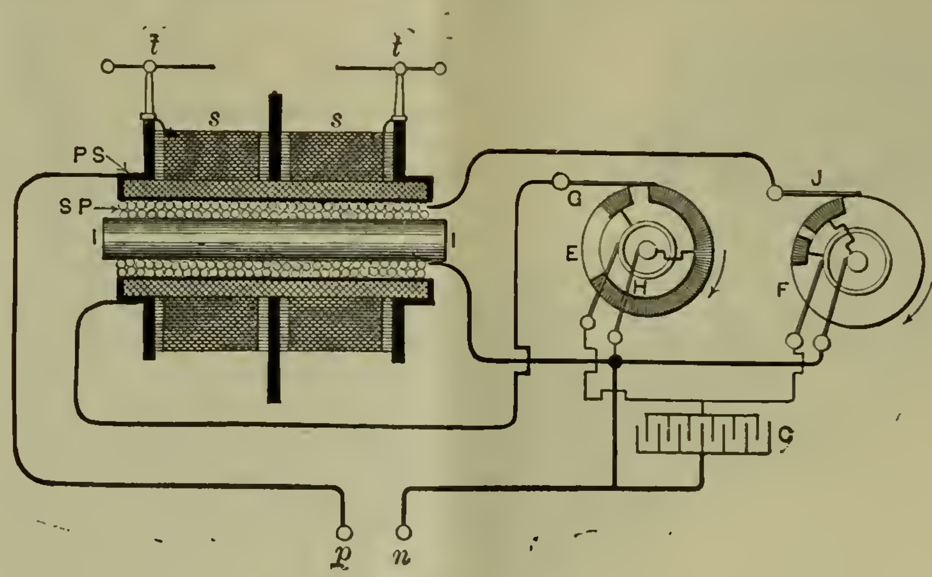


Fig. 2.

The magnetizing of the core I I, or absorption of energy is by P, while delivery of energy is by S acting as if nearly on a closed circuit. This condition, however, does not involve much waste of energy if the ohmic resistance of the circuit of S be low enough. Here, then, is a transfer of energy from one circuit to another, while the cur-

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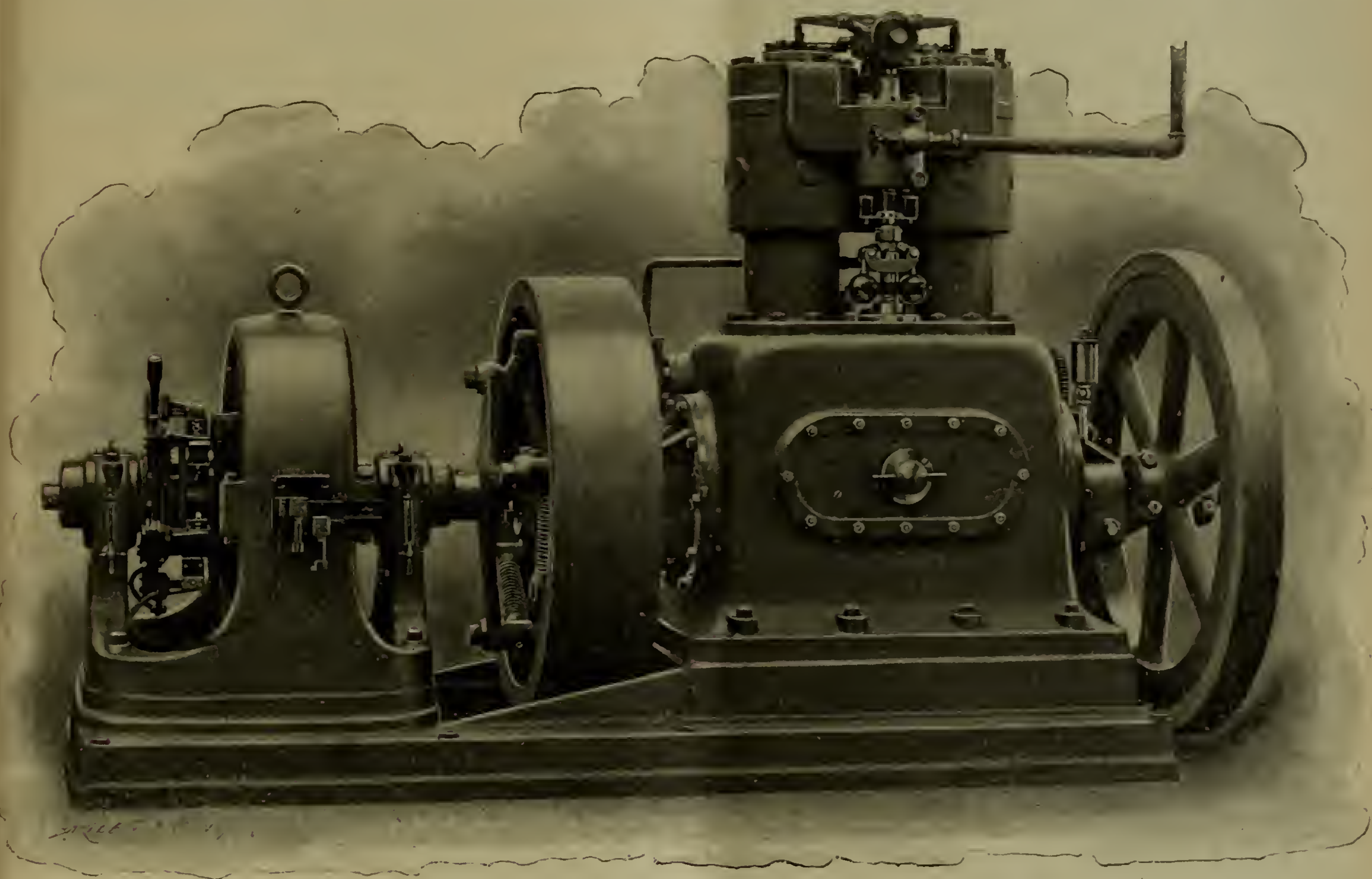
A paper presented at the 14th General Meeting of the American Institute of Electrical Engineers, Eliot, Me., July 26th–28th, 1897.

rents are direct currents in each circuit. To insure this being the case in S, the time of contact of segment on F with brush J must be selected so as not to permit any reversal, *i. e.*, the break of said segment with K must be timed to be made on the cessation of the first impulse or discharge from S. To do this an ammeter, responding to direct currents only, placed in the battery circuit, or in the leads from S, will indicate a maximum direct current when the segment F is of proper extent, and less under other conditions.

With the principles of the above apparatus in mind, it is easy to understand the action of my new form of induction coil, which may be described, briefly, as follows: The iron core I, Fig. 2, of the induction coil, is wound with the ordinary coarse primary coil and terminals provided therefor. Then a coil of intermediate gauge, between the inner primary and the outer secondary is wound. It is to be capable of being connected across a circuit of 110 volts as with coil P, Fig. 1. This coil is the true primary or energy supplying coil, but for convenience and saving of wire I prefer to connect it in as the under portion of the real secondary circuit. It thus becomes useful as a part of the secondary itself and, having several thousand turns, adds a considerable fraction to the total potential of the secondary. The secondary is, as usual, of quite fine wire of many thousands of turns, well insulated throughout.

In Fig. 2 the coarse coil is marked S P, and the intermediate coil P S, while that outside is marked S. The functions of the coils S P and P S are to act as secondaries and primaries alternately. This is, in fact, an essential function of S P, but is only incidental to coil P S, having been connected into the secondary circuit S, whose terminals are at *t t*. The break-wheels E F are like those of Fig. 1, except that in F there is a much shorter main segment and a condenser segment following, as in E. There is no battery in the circuit of S P, but it is put on dead short-circuit at intervals, just at the time P S is broken. Coil P S receives current from line at *p n*, at 100 to 200 volts, or more. On the break of this circuit at brush G the ampere turns, so to speak, are shifted suddenly into circuit of S P, closed on itself by J F. The consequence is that even at slow breaks no spark occurs at the rupture of G E. As soon as the current has been fully established in S P on short-circuit, and after brush Q has got entirely away from all metallic connections on E, the main segment of F breaks the circuit of S P, which is conveying a very heavy current at low potential. The condenser C is put instantly across the break, and the spark flies between terminals *t t*. In this way a coil of the size of a six-inch Ruhmkorff gives a torrent of six-inch sparks, with an average current from a 110-volt line of about one-half an ampere. A simple motor or clock-work may be used to drive the break-wheels E F, which are made of fair diameter to insure accuracy in operation. The best results are only to be obtained when the proportioning of the parts is carefully done, and with a knowledge of the result to be obtained.



Direct-Connected Gas Engine and Dynamo. (Westinghouse Machine Co.)

The discharges are indistinguishable from those of a similar Ruhmkorff. In fact, the coil described might be used with the same condenser C as an ordinary Ruhmkorff coil energized by batteries. In this case the terminals of the coil section P S are disconnected, brush J lifted and battery inserted between brush G and terminal of S P, which goes to J in Fig. 2. The break-wheel, E or F, when run with low potentials may be immersed in water in the usual way to facilitate sharp breaks, but the apparatus has been very successfully run, at full output, dry, or a little heavy oil on the break suffices. Also, the flux of current in S P may be made by a magnet to break its own circuit under water when the current has risen to a predetermined amount. In other words, it may be provided with the usual automatic break, damped or adjusted not to get into tremulous vibration. It will be seen from the above description that a new way of energizing an induction coil, or other transforming apparatus, has been embodied and that it consists in the rapid substitution of secondary and primary functions in coil S P.

GAS ENGINES FOR ELECTRIC LIGHTING.

The ideas of M. Beau de Rochas have been incorporated in the construction and design of the Westinghouse gas engines. The Otto Cycle is the name given to the method, attributed by the Westinghouse Machine Co. to Rochas, which forms the chief basis of their work. A gas engine of effective government will require perfection in certain respects that will add to its general reputation. They are mechanical fitting and simple regulation. The general action of the Westinghouse gas engine is briefly outlined :

The first outward stroke of the piston draws in a charge of gas and air, the return stroke compressing it. This charge of explosive mixture is ignited when the crank passes the centre. The combusted gas escapes at the next stroke ; the cycle of operations being similarly continued. Each four strokes of the piston mean but one explosion, *i. e.*, taking mixture, compressing it, exploding it, and expelling it. There are two strokes to a revolution ; therefore a single cylinder gas engine, as described, has but *one* explosion or *two* revolutions. Regulation and constant speed are unattainable in consequence. The Westinghouse gas engine is *double cylindered;* there is one explosion to each revolution. A steady speed is possible and, is actually obtained. No entire dependence is placed upon the fly-wheel for the preservation of a uniform speed. The gas engine in the illustration compares favorably with the best steam engines for regulation and constant speed. It may be said that the Westinghouse Machine Co. have added greatly to the possibilities of electric lighting by their perfected gas engine. Large electric plants may now be operated with a minimum of attention.

Isolated plants of the above description will become an indispensable accessory to large flats and apartment houses ; a boon to factories and suburban residents.

THE EFFECT OF HEAT ON INSULATING MATERIALS.*

BY PUTNAM A. BATES AND WALTER C. BARNES.

A paper on this subject was presented before the American Institute of Electrical Engineers on May 20, 1896,† by Messrs. Sever, Monell and Perry. In the discussion which followed the results were questioned by several members, and Mr. C. F. Scott cited some investigations of Mr. Skinner, who obtained curves which differed very considerably from those shown in the paper.‡

This left the subject in such an unsatisfactory condition that it was decided to make further tests with the object of reconciling the differences or determining what the real facts are.

In our investigations, more attention has been paid to the actions which take place when one kind of material is subjected to tests while the conditions are varied, rather than a great number of tests on different materials, under the same conditions.

In fact, it has been deemed wise to conduct all the tests on one kind of material, it being safe to conclude from results previously obtained that the action on it would be quite similar to that produced on other samples. Therefore, the ordinary "red fibre" insulating material having the general appearance of thick red paper, has been selected. Its thickness is about .009 inch.

The Apparatus.

This consists of two distinct parts, viz: the device for heating and that for testing the insulation resistance.

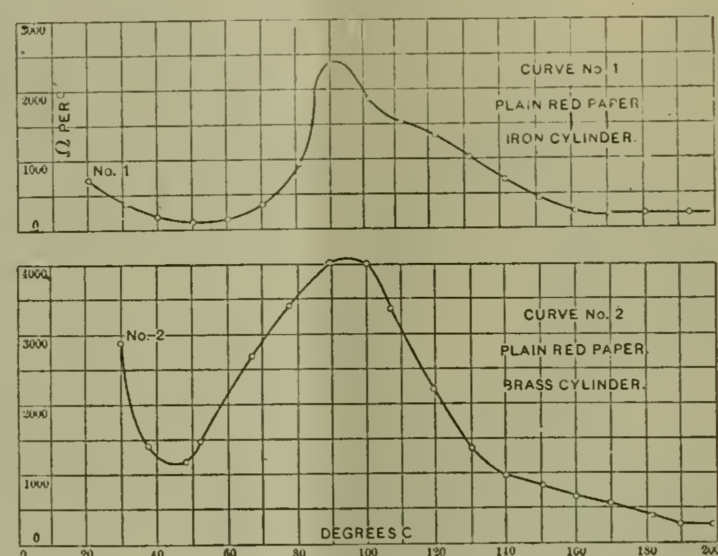


Fig. 1.

The heating apparatus consists of a single electric heater, having a radiating surface of 47 square inches. This is nothing more than six resistance coils tightly packed with asbestos in a short sheet iron cylinder, whose lower end is open. The terminals come from the ends of this set of resistance coils through the bottom of the heater, and are then connected through a suitable switch to a 110-volt circuit. This heater is supported on three porcelain insulators, which rest on a slab of slate one and one-half inches thick and one foot square. The heater takes exactly four amperes of current when all other resistance is cut out of the circuit.

Around the heater is placed an earthenware cylinder one foot high and nine inches in diameter. This provides an excellent method of keeping the heat in, and together with the electric heater secures perfect regulation of temperature. The terminals of this heating circuit are brought directly down and out from the heater through the base slab of slate to the terminals of a 110-volt lighting circuit, and are thus kept entirely separate from any other part of the testing apparatus.

Resting on an asbestos collar and at a height of about two inches above the heater, in the earthenware cylinder, is placed a circular iron plate ⅛-inch thick, which is one terminal of the testing circuit itself and is connected to one binding post of a Thomson high resistance galvanometer; a standard megohm being placed in series between the two.

The insulating material to be tested is wrapped on an iron cylinder three inches in length and having an external diameter of .875 inch, the insulation not quite reaching to the ends of the cylinder. The insulation is then wound with No. 26 B & S bare copper wire. This winding makes the other terminal of the testing circuit, and is

(Concluded on page 120.)

*A paper presented at the Fourteenth General Meeting of the American Institute of Electrical Engineers, Eliot, Me., July 26th-28th, 1897.

† Transactions, vol. xiii, page 223.

‡ Ibid, page 237.

* Transactions, vol. xiii, page 223.

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CONTENTS.

INFLUENCE OF COLD UPON CONDUCTORS.

Perhaps one of the most interesting departments of science is that which treats of heat and cold. The relative meaning of these two is clearly evident to the scientific mind, and although it has been possible for the reader of scientific literature to grasp the idea of an absolute zero it has not been possible to reach even theoretically the highest attainable temperature or to presume in any way that it is limited to a certain number of thousands of degrees. Some famous experiments have been made in France and Germany with exceedingly low temperatures. Alcohol has been reduced to the consistency of a heavy, viscous fluid, hydrogen and oxygen frozen solid and air, under the influence of compression and cold turned into a liquid and solid. It has come under the notice of certain minds that the application of cold to conductors has been effective in reducing their resistances. The limit of temperature reached has always been above absolute zero, although experiments made for that purpose, the securing of an absolute zero, are continually in progress. At absolute zero all conductors would presumably have no resistance, and it is evident that conductors of varying resistance would, when exposed to very low temperatures, gradually converge, more or less rapidly towards a zero point. It has been proposed, in view of the fact that metals lose more and more of their resistance when exposed to very low temperatures, to examine into this subject closely, to see whether it will have any commercial value. Dr. Matthiessen has given an empirical formula, used for the determination of a metal's resistance, with increasing temperature. It might possibly be modified for the purpose of determining the resistance of a metal exposed to a decreasing temperature The general fact to be gleaned from this entire field of investigation is this, the reduced resistance of conductors under the influence of intense cold may enable power companies to prevent the waste of considerable energy, usually dissipated in the form of heat. Possibly one of the best means for doing this is by the aid of liquefied air. The application of an intensely cold fluid, like this, to a metallic conductor, is sufficient to annihilate its resistance. It has been suggested by Elihu Thomson that electricians might find a means of reducing station and transmission losses to a minimum, by surrounding or exposing conductors and transformers to liquefied air. This subject becomes very interesting when it is realized that liquefied air is an excellent insulator, dificnlt to break through without the aid of enormous potentials. The writer states that a transmission plant of eighteen thousand horse-power sustains a loss of from ten to fifteen per cent.; that is, eighteen hundred horse-power and more are dissipated on account of the line having resistance. The suggestion made is that of keeping the conductors supplied with liquid-air coatings. This might be improved upon by having the conductors hollow and pumping the liquid air through them, avoiding the difficulty of applying it outside. From a commercial standpoint, the advantage or disadvantage of such a system can be readily determined. The cost of a plant for the compression and circulation of air must be balanced up against the cost of energy otherwise wasted unless this system is employed.

The application of liquid air to transformers might be exceedingly beneficial; the losses reduced down to nearly zero and their construction carried on without the use of iron, thus avoiding waste of power in conductors and hysteretic and other losses in the iron. Just how far and to what extent an electric system could be improved upon with the aid of liquefied air it is not possible to immediately determine without some data from actual experiments; but certain promising features appear which encourage further investigation and lead us to believe that a saving of thousands of dollars, possibly millions, may be made if liquid air can be cheaply and successfully circulated through the main conductors of our largest electric light, power and transmission plants.

THE SYNCHRONIZING OF WATCHES BY THE MARCONI SYSTEM.

A very unique and original scheme has been advanced by Signor Marconi, the young and illustrious inventor of the new system of wireless telegraphy. There is every likelihood that in the future an individual walking through the streets of a large city will realize that his watch is keeping the best of time, that is, without any attention from himself, is being synchronized and forced to record the proper time with absolute accuracy. At present, a reliable clock in Washington automatically synchronizes other clocks in surrounding cities, but it will not be necessary in the light of this new invention to utilize wires of any description or to depend upon a mechanism which can only affect it through the medium of a metallic conductor. The new system of projecting ether waves through the air to points eight miles distant, will really enclose a large city within a magic circle. Those moving within it carrying watches designed so that the invisible waves will affect them, need never concern themselves about the main-spring, hair-spring, gear wheels, or lack of adjustment in any part, because the rays proceeding from a central source will govern their timepiece and keep it in perfect accord with the original electric chronometer. The office-boy plodding to his temple of sorrow cannot excuse himself by saying the clock was slow. People hurrying to catch a train cannot set their watches ahead but will have to hurry harder than ever, and those departments of the commercial world in which time plays an important part will realize that it passes for all alike, and the word late may, under the influence of this new and valuable training, be stricken from the English language as useless and obsolete.

connected to the other post of the galvanometer. The iron cylinder, upon which the insulation is placed, is then placed upright on the above mentioned iron plate. Thus it will be seen that the insulating material now separates the copper wire winding, as one terminal, from the iron cylinder which is now in contact with the iron plate, as the other terminal. The leading-in connections to these terminals pass through small holes bored in the earthenware cylinder. Glass insulators are used in these holes in order to prevent any current from creeping across from one wire to the other over the surface of the earthenware. Heavy covers of asbestos board are placed over the top of the earthenware cylinder, and this again is entirely covered with a large glass globe.

The potential used in this circuit is 500 volts. A suitable shunt, consisting of one or two turns of bare copper wire wound on each end of the sample of insulation, so situated that they would intercept and shunt past the galvanometer any current tending to leak along the surface of the insulation from the iron cylinder to the winding, that is, from one terminal to the other, is used in order that a deflection of the galvanometer needle will be produced only when a current actually passes through the insulating material under test.

In making the apparatus we have been very particular to eliminate all metals, with the exception of iron and copper, thus avoiding any possibility of the volatilization of zinc, which was one of the points raised in regard to the previous tests.*

This apparatus when complete works admirably, absolutely no difficulty being experienced with either the heating or the testing circuit.

The questions that we have attempted to answer by this investigation are four in number, viz.:—

1st. Does the presence of brass or other metals from which zinc may become volatilized, in the apparatus in which the test is conducted, affect the insulating material or its behavior?

2d. Why should one experimenter obtain an insulation resistance curve for fibre, whose minimum point is at about the same temperature as the maximum point of an insulation curve obtained from similar material by another experimenter?

3d. What effect on fibre insulating material is produced when it is subjected to conditions similar to those likely to occur in dynamo-electric machinery?

4th. What is the action, or actions, that take place when fibre insulating material is repeatedly heated from 20 degrees C. to 200 degrees C.?

Question No. 1 has been approached in the following manner: the resistance of the insulating material at the temperature of the air, or 20 degrees C., being determined, the temperature is gradually raised until 200 degrees is reached, when the test is discontinued. The time taken for this rise was exactly 2½ hours. Resistance measurements are made at frequent intervals, and from these curve No. 1 is plotted. The area of insulation tested being 5.5 square inches thickness = .0095 inch.

The position and shape of this curve agrees very closely with the results obtained by Messrs. Monell and Perry, who in their experiment used a brass cylinder, but a confirmatory test with a brass cylinder was also made in our apparatus. This experiment was deferred until the completion of all other experiments.

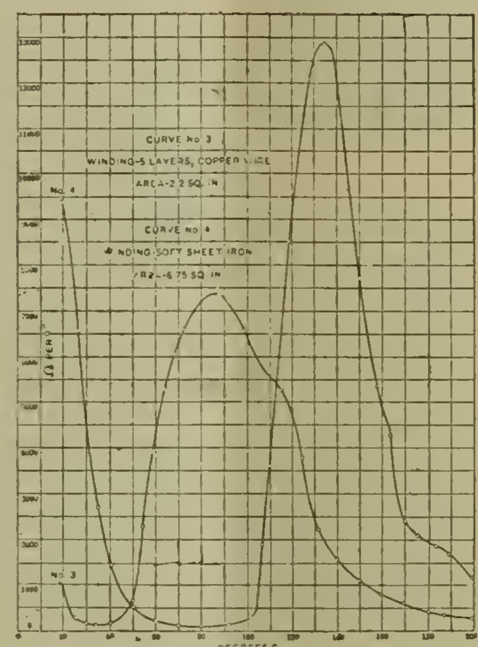


Fig. 2

Curve No. 2 thus obtained from a like sample of insulating material, thickness .0095 inch, area tested = 4.6 square inches, showed that the presence of brass in the apparatus does not affect the shape or position of the curve.

In taking up question No. 2, it is intended to prove, by comparative tests, that the position of the maxima and minima points of the resistance curves depend upon the opportunity of escape given to the moisture originally contained in the specimen.

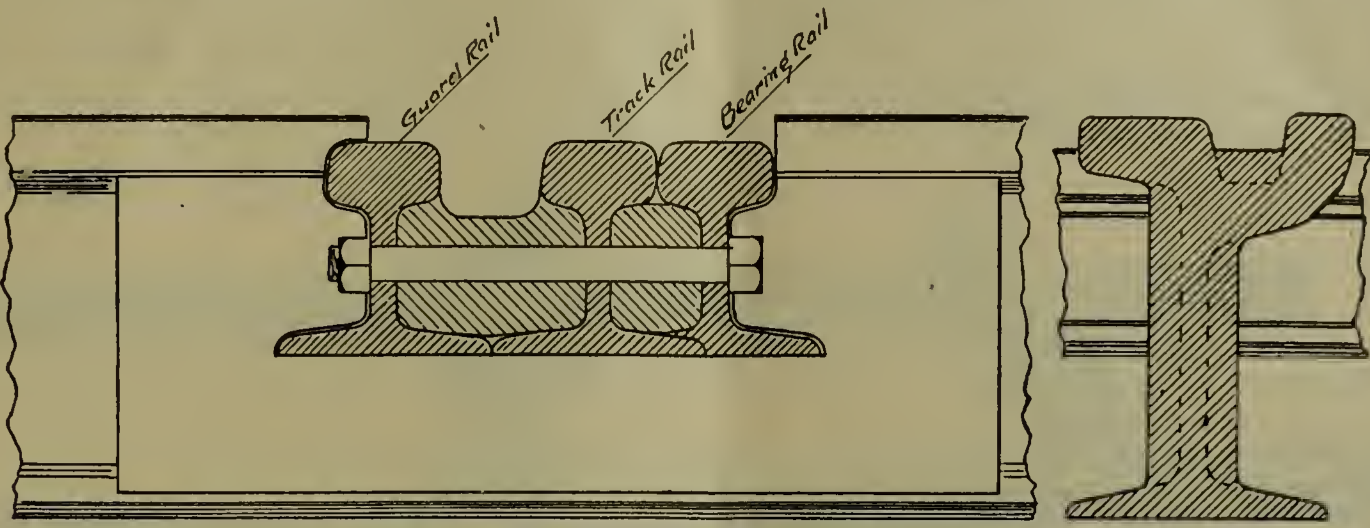
Curve No. 3 shows the results from a test on a sample of plain red fibre, thickness .009 inch, the area of insulation under test being 2.2 square inches. In this case five layers of No. 26 B. & S. bare copper wire were wound closely upon the fibre, the length of winding being only .8 inch.

Curve No. 4 has been obtained from a test on a specimen cut from same sample wrapped with a sheet of thin malleable iron held firmly in place by a number of layers of tightly wound copper wire, thus approaching the conditions under which the experiments cited by Mr. Scott were made. The area covered by this iron wrapping is 6.75 square inches. This test consisted as before in gradually raising the temperature from that of the air to 200 degrees C., the resistance being measured at frequent intervals. The curve obtained under the above conditions is almost identical with that published by Mr. Scott.†

It is clear from these two experiments that the position of the curve may be shifted at pleasure by simply varying the opportunity for the escape of the moisture originally contained in the insulating material. That is to say, if we wind our specimen with wire and only cover a small area, we find that the moisture has a much better chance of escape than if completely covered with an iron wrapping extending over a large area, and that the curve will actually take a position depending upon the rapidity of escape of the moisture. In the case of the wire-wound specimen the moisture escaped not only through the interstices between the wires, but also, and to a much greater degree, from the exposed ends which it reaches through the pores of the material; while with the iron-wrapped specimen the only chance of escape is from the exposed ends. Therefore, the greater the area covered, the longer will be the path traversed by the moisture, and consequently a longer time or higher temperature will be required.

(To be continued.)

This tread or indentation will form about ½-inch deep at times, leaving a projection on the wheel which strikes the arms of the trolley rail and cuts them off. There is one disadvantage in a crossing built the ordinary way due to the creeping of the steam rails, which shove the trolley rails out of alignment sometimes as much as six inches. The sectional view of the steam and electric crossing



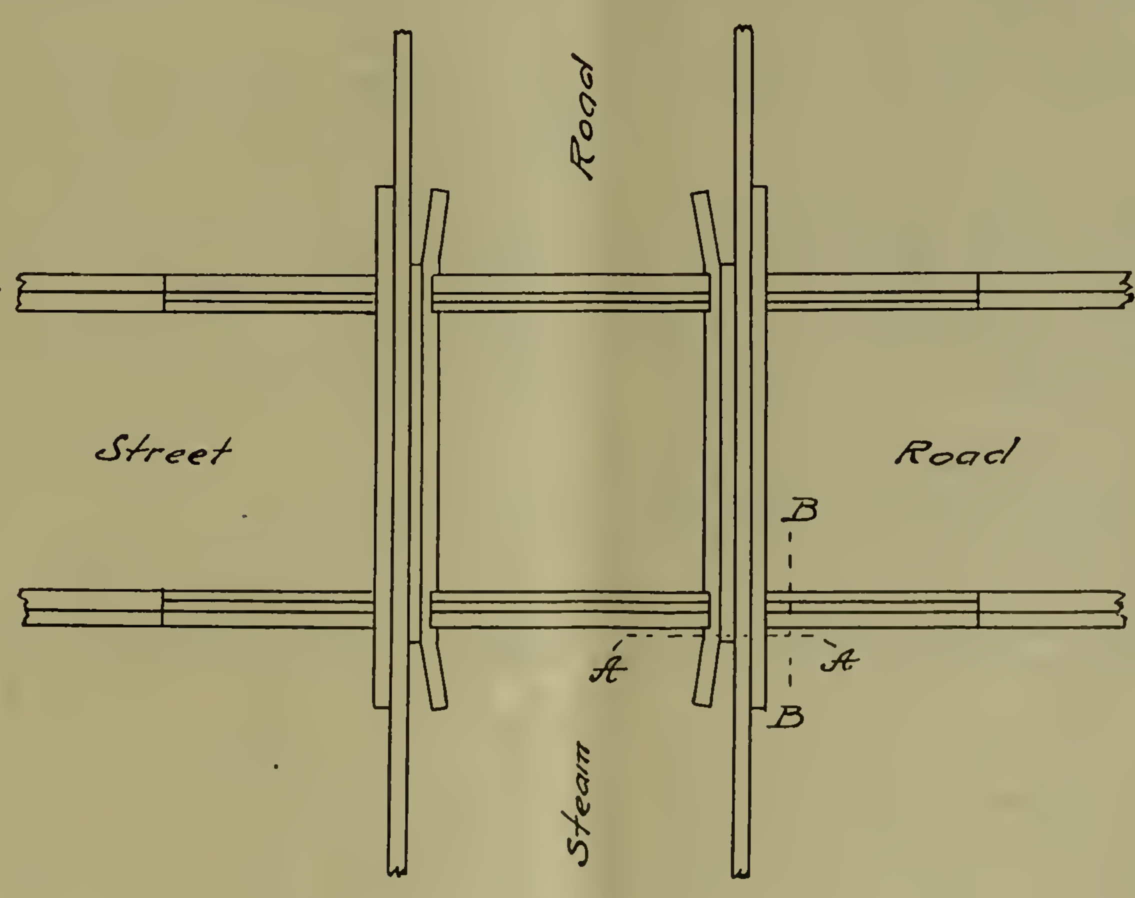
Section Through A.A. — Steam Road Run

Section Thro. B.B. — Street R.R. Run.

UNBROKEN STEAM RAILS FOR ELECTRIC AND STEAM ROAD CROSSING.

The illustration shows a steam and trolley road crossing, nineteen of which have been installed by the New York Switch & Crossing Co. of Hoboken, N. J., for steam and trolley roads this season within a radius of eight miles. The crossing shows auxiliary rails outside of the stock or running rails. These auxiliary rails save the cutting off of the arms of trolley rails by the hammer of the flat edge and worn tread of the locomotive drivers.

shows how to avert the drawing out of line of trolley rails by the draw of the steam rails. The deep nine-inch trolley rail as shown in sectional view is cut out to receive or fit the steam road rail. The steam rail fits into the trolley rails, which are re-enforced to compensate for the cutting out, and allows the steam rail to draw through the trolley rail without putting them out of alignment. This is a very much simpler crossing and has all the advantages of the solidly bolted steam and trolley crossing. It overcomes the drawing out of alignment of the trol-



Plan of Crossing.

Electric and Steam Road Crossing with Steam Rail Unbroken.

This tread or indentation is formed by running in a T rail, as the outside tread of the wheel seldom touches the rail. An indentation is found next to the flange for about three inches towards the outer edge of the tread.

ley rails and is very easily inserted. This crossing can be put in without cutting the steam road rails and does not interfere with the traffic on the steam road. The work can be as quickly done on the trolley as well.

RECENT PROGRESS IN ARC LIGHTING.

(Concluded from page 105.)

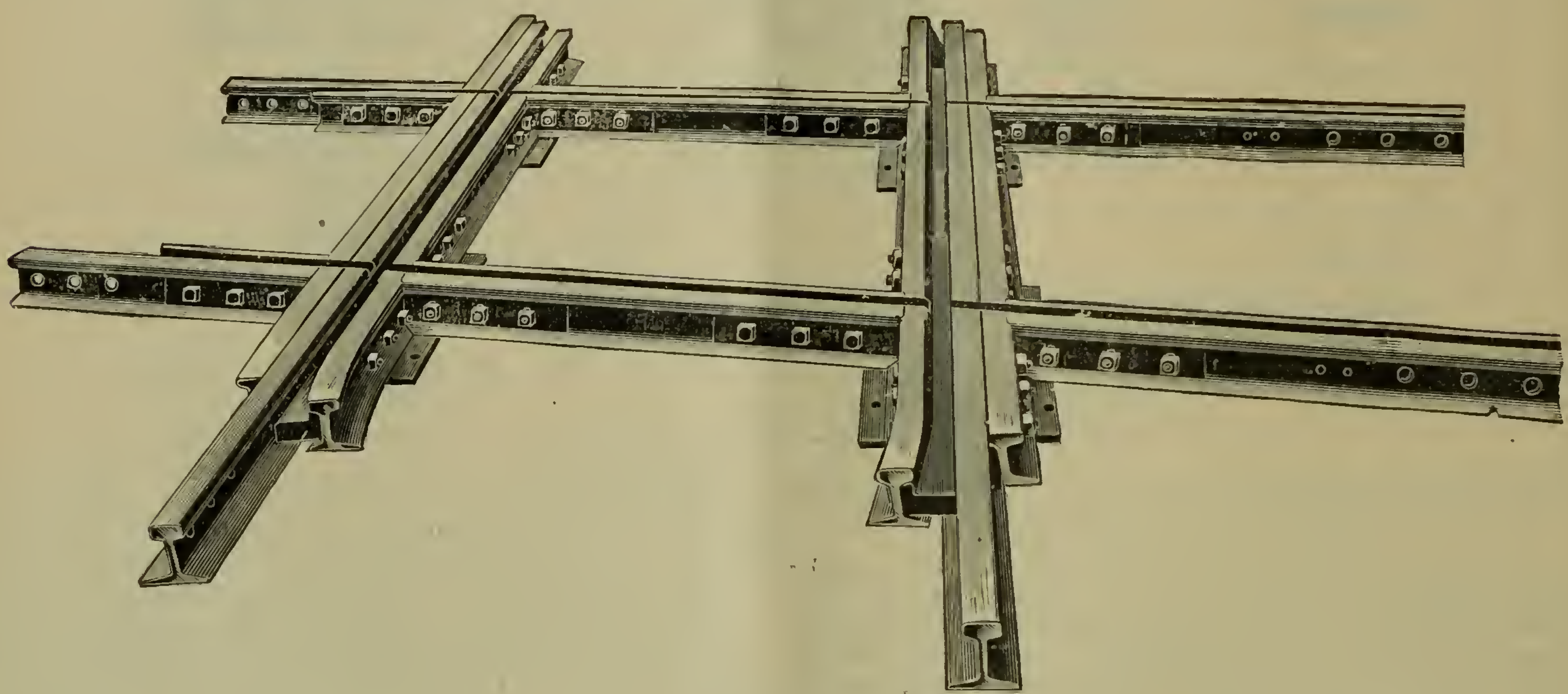
When an alternating arc is run with a considerable dead resistance in series with it, or when a reactance coil is in series, or when it is fed from the secondary of a leakage transformer, taking the whole current thereof, the condition approaches, though in cases only imperfectly, the running of the lamp on approximately constant current. In reality, the condition is intermediate between constant-current and constant-potential working. In such a case the regulation of the lamp may be by a series magnet, or a shunt magnet, or by a combination of both. In fact, there is no real utility in generating a constant current of alternating character for working a single lamp. The utility of the "intermediate" working just alluded to is in the lessened liability to rupture of arc, lessened chattering at starting and avoidance of excessive flux of current if the carbons, by accident, come together. The condition is one decidedly useful in the case of the "inclosed arc" of alternating type, and it is doubtful if such arcs can be run except under conditions like those here called "intermediate." For saving energy a reactance or reactive coil in the lamp circuit is preferable to a dead resistance, and is relatively more effective.

It may be well to add to the present paper, which has grown to unexpected length, a statement concerning the results arrived at by innumerable tests of the different types of arcs and arc lamps under conditions resembling those of practice, with a view of ascertaining their lighting values. These tests have been embodied in comprehensive reports by Mr. Jesse Coates, of the testing department of the General Electric Company, at Lynn, and the tabulated results might easily furnish material for a lengthy discussion. They embody complete series of measurements of candle-power in various directions and curves of the same for each kind of arc or condition of surrounding globe, together with mean spherical and estimated useful illuminating intensities. The methods of measurement cannot be detailed here, but are such as, in the writer's judgment, can be relied upon to give comparative figures. Moreover, the mean of many observations is, in each case, taken for comparison and plotting of curves.

The purpose here shall be to state, in a general way, some of the results obtained.

It is well known that the larger the arc, or the larger the current in it with a normal voltage, the more efficient is the light production. The energy is more effectively converted into luminous waves, so that the watts per candle would naturally be less with a twenty-ampere arc at forty-eight volts than with ten amperes flowing. Measurement shows that where, with continuous current, the same brand of hard carbons is used of diameters varying approximately with the current strength, naked arcs, with ten amperes and forty-eight volts, may take for each mean spherical candle-power 1.2 watts, while arcs of seven amperes and forty-eight volts require 1.4 watts.

The use of a cored upper carbon appears to raise the efficiency to a moderate extent, probably because the arc may be maintained at a voltage somewhat less, as at forty-two or forty-four volts. The use of a clear globe surrounding the arc loses ten to twelve per cent. of the light, while alabaster and opal globes use from forty-five to sixty-five according to their thickness and the specific absorptive power of the glass. Naturally, since an inclosed arc, consuming approximately the same energy in watts at the arc as a ten-ampere open arc, will have a current of only about seven and one-half amperes, the efficiency would be expected to be less. Measurements show, after a run of 102 hours, and per each mean spherical candle-power of a four and three-quarter-ampere, inclosed, continuous-current arc with clear inner and no outer globe (one-half inch carbons), an expenditure of 1.94 watts at the arc. If the energy expended in the lamp branch be taken as the true expenditure, that lost in resistance is added to that of the arc, and the watts per candle increased accordingly. A similar loss is, of course, experienced with naked or open arcs on constant potentials, owing to resistance being used in series. The result given above, or 1.94 watts per candle, is at the end of a long run of 102 hours, but with a clear inner globe. Inclosed arc lamps with clear inner and clear outer globes are not satisfactory, and, in fact, for good results of uniformity and diffusion, a slightly opal inner globe is needed. Those now known as "alabaster" are well suited to the purpose. When these are used, the watts at the arc per mean spherical candle-power will, at the first part of a run, range about two watts, increasing seriously only towards the very end of the run. While it may seem that the watts per candle are higher than might be expected, yet it must be borne in mind that, in all incl sed arcs, the current is relatively small and the potential high for a given expenditure of energy, and this acts in a double way to lower the efficiency, as not only the crater emitting light is smaller, but a large part of the energy goes to sustain the arc flame, which is



(View of Crossing. See page 121.)

long, while, also, the absorption of light by the surrounding glass is not to be neglected. No construction of lamp, regulation or adjustment thereof can get rid of the inherent properties here pointed out. Nevertheless, it is true that the character of the light, both of the open or exposed arc, and of the inclosed arc, is such as to make it very desirable as a substitute for daylight and for many cases of use. The fact that the light is shed mainly downward by continuous-current arcs results virtually in an addition to the efficiency and economy of the light; thus, if the light emitted downward be considered as alone useful, the expenditure per mean useful candle would, with naked arcs, fall to about one-half a watt, and with inclosed arcs, to from one to one and one-half watts at the arc.

With alternating arcs the conditions are different, since the light is sent up and down equally. By a reflector placed above the arc, a considerable fraction of the light which would often be lost upward is sent downward to increase the effectiveness; thus, a sixteen-ampere, twenty-five-volt, naked alternating-current arc used, per mean spherical candle, 1.49 watts, or for mean useful below the horizontal, 1.12 watts, which was reduced to .8 to .9 watt, when a porcelain reflector above the arc was used. For the same causes that necessarily reduce the efficiency of an inclosed continuous-current arc as compared with the uninclosed, the efficiency of an inclosed alternating arc falls below that of the open arc with similar currents. The watts at arc per candle will be found per mean spherical candle, to be, under the best conditions, about two watts, increasing toward the end of the run, owing to obscuration of the inner globe and other causes. No reflector or deflector can be used with much effect with the inclosed arc, so that the mean useful is but little different from the mean spherical candle-power.

The apparent advantage in economy of the continuous-current inclosed arc over that with alternating currents is in large measure neutralized by the fact of the former requiring a dead resistance in circuit to give stability to the current, while the latter can be run without it, or, at most, with a reactive coil which wastes but little energy.

Still it must be confessed at the end that the luminous yield is but little better than that obtained in incandescent lighting. After all, it may be that the whiteness of the light and the daylight effect obtained may be a sufficient reason for the large introduction of inclosed arcs, now that the frequent trimming and attention to the lamp is not needed. Indeed, it may also appear that all the varieties of arc lighting which have grown into importance within the past few years have their own fields of usefulness, and that, therefore, the work spent in developing them has not been labor in vain.

It should be said in conclusion, that the figures given above and expressing the watts per mean spherical candle, while strictly comparative so far as a study of arc lights alone is concerned, might vary somewhat if the object had been to compare arc and incandescent lights, owing to the difference in color of light, though the variation would not in any case be great.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—METALLIC POLES.

Albany, Aug. 16, '97.

Electrical Age.

Dear Sirs: Wooden poles rot so easily I am surprised they are not supplanted by metal ones. It seems to me they are better able to stand the wintry weather, weight of ice and sleet, and strong winds; besides remaining whole in the soil, however damp. Your opinion on this subject would be appreciated by a constant reader.

R. J. Castle.

(A.)—Metal poles are being greatly used every day. They last longer, are stronger and more reliable than wooden poles. If carefully installed may be depended upon in the severest weather. The only objection is the difficulty of climbing them. The following notes may be interesting:

Cedar poles last twenty years.
Chestnut " " ten "
Locust " " thirty "

(Q.)—CLASSES OF MAGNETIC TROUBLES.

Philadelphia, Aug. 17, '97.

Electrical Age.

Dear Sir: The armature of a dynamo is subjected to certain magnetic troubles which I would like you to enumerate and classify for me. I have noticed a dropping of E. M. F. and a shifting of the brushes when the machine becomes loaded, and have been informed that both are caused by a magnetic change in the armature. A few words from the Editor of the Inquiry Column are being awaited by,

Yours respectfully,

J. Robinson.

(A.)—The magnetic field is both warped and reduced. The names of these magnetic deficiencies are:

Cross magnetization,
Back "

Certain turns on the armature twist the field and others reduce its strength.

(Q.)—AURORA BOREALIS.

Montreal, Aug. 5, '97.

Editor Electrical Age.

Dear Sir: The aurora borealis is sometimes seen from our city blazing very brilliantly in the north. Can you give me a general idea of the nature of this phenomenon? Those seeing it for the first time think rays from a search light are being projected to different points of the horizon.

Yours faithfully,

Manuel R. Lucy.

(A.)—A Geissler tube discharge is very similar to an auroral manifestation. An electric discharge occurs between the electrified clouds, or the earth and the clouds; something in the nature of a glow discharge. Certain magnetic conditions affect it and, so far, have not cleared our opinion further than to substantiate the general theory regarding its origin. A similar phenomenon is visible at the South Pole, the aurora australis. Sun spots, magnetic storms and brilliant auroral discharges are to some mere coincidences, but there appears to be a relationship between them that is undeniable.

ELECTRIC METERING FROM THE STATION STANDPOINT.*

BY CARYL D. HASKINS.

It has occurred to me that in presenting a paper to the Institute upon such a subject as that which I have selected, I may appear to have departed too entirely from the technical side of our profession and to have selected a line of argument which would have been more appropriate before a more commercial body. But in my opinion such is not the case, for I find that almost every merit in, or objection to metering apparatus, or in connection with the use of it, is dependent upon some point involving engineering skill.

The general adoption of the electric meter is in itself

* A paper presented at the 14th General Meeting of the American Institute of Electrical Engineers, Eliot, Me., July 27, 1897.

an endorsement of the precise methods which characterize engineering practice. It is, indeed, a well established fact today, well borne out by data from widely separated portions of the country, that the average electric lighting station can do one-third more business with the same station capacity on a meter basis, than it could upon a contract basis, under what were nominally equivalent contract rates, netting at the same time the same revenue per light as formerly. In other words, it is apparently well established that $33\frac{1}{3}$ per cent. represents the average wastefulness of average human nature in connection with the use of light.

In many central stations today I find that, whilst managers are almost universal in favor of an exclusively meter basis, a large proportion are still in ignorance as to what qualities they should seek and what they should avoid in selecting a meter.

In response to an inquiry as to what merits in a meter are necessary to success, a common reply is, accuracy, durability, registration in a simple unit easily comprehended by the customer, and ability to withstand tampering. These points are probably of importance in about the sequence in which they are commonly stated; but they are too sweeping, too entirely generic and too slightly specific to be in any high degree helpful.

Let us, for example, consider the broad question of accuracy. A meter, which will be accurate under commercial conditions from quarter load to full load within $\frac{1}{10}$ of one per cent., or a meter which will start on one per cent. of its rated capacity, are neither of them necessarily either the most accurate or the best for general commercial use. This latter point is one which is frequently raised. The fact that a meter will start on one per cent. of its rated capacity is in reality no sure criterion of the accuracy of that meter, even on light loads. It is not necessarily even good evidence; yet I find that in very many cases this is almost the only test applied to meters at the time of purchase. The percentage of accuracy at light loads is very important, more important, I believe, than is commonly appreciated; but I am perfectly safe in saying, that a meter which will run within five per cent. of zero error on five per cent. of its rated capacity may readily be a much better meter, even though it will not run at all on one per cent. of its rated capacity, than one which will run on one per cent. of its rated capacity but in regard to which no evidence is at hand as to its percentage of accuracy at reasonably low loads.

Ability to start on very light loads is certainly an indication of merit and is important, but it is not nearly as important a point to determine as is the lowest load at which a meter begins to register with fair accuracy. I have inspected a very large number of meters which would start on phenomenally low loads and which would yet fail to give anything like approximate accuracy at reasonably low loads.

In considering the question of accuracy, therefore, the first two steps should be to determine the accuracy of the meter by actual measurements at full and medium load; and also at a reasonably low load; say, for example, five per cent. of the meter's rating.

That low-load accuracy is really of vital importance is well shown by the fact that, with the average 24-hour station, in the neighborhood of 15 per cent. of the total station output goes to feed one and two lamp loads. Yet in the face of this I have seen large installations of meters reported as entirely satisfactory, tested with frequency and care under admirable sytems, but only at full or medium loads, and yet failing to account for more than 50 per cent. of the one and two lamp loads, or in other words, losing to the illuminating company an average of probably $7\frac{1}{2}$ per cent. of the revenue which their measured station output should give them, after deducting for legitimate losses.

Granting that, having determined the actual percentage of accuracy obtainable at light, medium and full loads, a very important and in fact probably the most important evidence as to accuracy has been obtained, there still remains much information of vital importance which should be sought and which should materially influence a decision.

One point which is very commonly neglected, but which is, nevertheless, quite essential, is the ability of a meter to give accurate results for brief periods on overloads. This is a point at which many meters fail, and it is also a point which, odd as it may seem, is intimately related to light-load accuracy. It may be laid down as a rule, that in station operation the smallest meter which will do the work should always be used. Otherwise, however good the meter on light loads, much of the light-load revenue must be lost in the effort to take care of occasional heavy loads. Extremely heavy loads are generally of brief duration, aud on these loads a meter should operate with accuracy and also without injury to itself. This, therefore, should be an early point of investigation in selecting a meter.

On alternating circuits, inductive loads are becoming commoner every day. The wider use of fan motors and other alternating power devices, the rapidly growing popularity of alternating-circuit arc lamps, and the commoner use of inductive dimmers, all render it essential that a meter should be accurate irrespective of the power factor. The company which insists upon charging its patrons for power delivered to fan motors on a basis of volt-amperes is obviously rendering itself unpopular, greatly limiting its business and giving its competitor, or competitors, the best of opportunity for intruding; yet many such companies exist today, and they exist not because they are following a wise policy in their own estimation, but because they are ignorant of what they should look for in the meter which they are using.

Again, there are few electric-light stations today of any considerable size and age which are not operating some smooth core and some tooth core alternating armatures. It is, therefore, important that the meters in service at such stations should be equally accurate on any shape of wave; yet many meters fail in this particular; and seldom, if ever, is the point made a subject for investigation in selecting measuring apparatus.

This same consideration holds good in connection with frequency, and this is a point which it is difficult to overcome in most metering devices; but it is one which should be earnestly sought and which is of importance both to the station and to the consumer.

Even after this long list of points which must be investigated, as contributing to the broad question of accuracy, there are others which also merit consideration, but to a less degree. Such, for example, as barometric conditicns (more especially altitude), temperature and humidity. These all have direct bearing upon the question and all enter into the every-day conditions of central-station practice.

Summing up the question of accuracy we may say, therefore, that the following points should be investigated with care:

Ordinary volt-ampere accuracy;
Accuracy on inductive loads;
Accuracy on varying wave forms;
Accuracy on overload;
Accuracy on varying frequencics;
Influence on accuracy of variations of temperature, barometric conditions and humidity.

The second point, which is commonly given consideration in the selection of a meter, is that of life. This is a question which must depend more upon good judgment than upon any test which can be applied; for it is in reality no test of the enduring qualities of a meter to run it at excessively high speed for a relatively brief time. The life of a meter, in other words, cannot be measured by revolutions, irrespective of the speed of those revolutions; nor can it be determined by the speed at which it rotates alone. (To be continued.)

POSSIBILITIES OF LIQUEFIED AIR.

Prof. Elihu Thompson, in the July Modern Machinery.

The well-known effect of cooling by liquid air or like gases a conducting metal like copper is to almost abolish its resistance. Consequently a conductor so cooled is able to carry very much larger currents with less loss than at ordinary temperatures. This fact has attracted the notice of electricians and physicists for a long time past. It has recently been found that liquid air is one of the most perfect insulators, and that most insulating materials cooled to the temperature of liquid air are greatly improved in insulating qualities. It is known, also, that cooling renders it more difficult to cause a spark to occur between oppositely electrified conductors, the striking distance for a given pressure being diminished. The stability or permanence of liquid air in bulk, even when it is fully open to the ordinary atmosphere or kept at atmospheric pressure, is, of course simply dependent upon the heat insulation provided, and if this could be made perfect the air would never evaporate. Recent methods, such as those of Hampson and Linde, make it possible to obtain large quantities of liquid air by simple means and with moderate expenditure of power. Niagara power is twenty-four-hour power, and as there are but few industries demanding power for the whole day, it must follow that surplus power is either not used or wasted, and that to keep the plant working night and day at full capacity is desirable, even if some of the power only yields a moderate return. Can it not be used in making liquid air? Cannot the excess at certain times of day be put to use in compressing air to be afterward liquefied on the large scale?

It would seem that large tanks of liquid air can be heat insulated very perfectly by layers of air and fibrous material properly placed outside. The evaporated air from the tank could traverse the jacketings in successive order from within outward, so as to help keep down the temperature of the jacketings. A furnace with an internal temperature of 2,000 deg. to 3,000 deg. above the normal temperature of the air is easily insulated by moderate thicknesses of asbestos or other fibrous coating, so that the outside temperature is but slightly above the normal. The temperature difference between liquid air and normal air is, say, one-eighth of that between the interior of the furnace assumed and the normal, so that it ought to be possible to insulate so that but little heat would enter. In most electric long-distance transmission lines a loss on the line of about 10 or 15 per cent. is suffered. With 18,000 horse-power this would mean from 1,000 to 1,500 horse-power lost in resistance of line. If the conductors were immersed in a pipe with liquid air, the loss might fall to not over one or two per cent. perhaps, leaving available a large power for condensing air to supply evaporation. Just how far 1,000 horse-power would go in keeping the conductors supplied with liquid air coatings is a matter requiring data to determine. But if it were not sufficient for the purpose, there is a surplus of power during certain hours to supplement it. But it may be possible that a much higher voltage than is now used (10,000 to 20,000 volts) may be successfully used with conductors cooled and insulated by liquid air. If the potential could be raised to 50,000 volts, either the loss on the conductors for a given power transmitted would fall off as the inverse square of the voltage, or the conductors could be made smaller in the same proportion, or the distance of transmission increased with the same section of conductors as the square of the potential. These are matters worthy of experimental determination.

The limit to the capacity of an electric transformer to transfer energy from its primary to its secondary circuit is found in the heating and loss involved in the copper conductors comprising these circuits, and upon the nearness with which the two circuits may be placed one to the other, which is in turn governed by the insulating material used to separate them. Could the conductors be kept cool by liquid air and thereby their conductivity and insulation greatly increased, the work of transfer in a transformer could be much greater for a given size than it now is, or the loss could be even less than it now is, although but three per cent. is sacrificed in ordinary practice. Transformers in liquid air might be made entirely of copper without iron, and their light-load efficiency become nearly equal to full-load efficiency. A transformer without iron would avoid the loss in the iron, and would permit such a saving in material that changes in design or disposition of the copper could be made to suit the condition of absence of the iron.

We need not touch upon the possibilities of liquid air as a means of energy storage, for they are self-evident enough, since liquid air is virtually compressed air which remains compressed, as it were, even when exposed to atmospheric pressure; that is, addition of heat gives to it pressure and the ability to do work in suitable engines in the usual compressed-air motors. Our object has been to briefly point out what may be termed possibilities in electric engineering, assuming that data favorable to the ideas presented be the outcome of experimentation. It is too early to make any predictions or calculations concerning this subject. It must be confessed that it has a certain fascination. Perfection of heat insulation seems to be the key to the situation. All else seems to depend on that, the main questions being what will it cost in power and machinery to supply the necessary evaporation waste in a system of the kind outlined, and whether the voltage of transmission can be raised in consequence of the new conditions.

DAVID CHALMERS, New York agent for the Holtzer-Cabot Electric Company, with office at 114 Liberty street, reports a flourishing business with every prospect of a heavy fall trade. Mr. Chalmers is well known to the trade, being formerly connected with the A, B, C Electric Company and having had an extensive experience with all manner of electrical goods. The compound-wound dynamos of the Holtzer-Cabot Electric Co. are standards of excellence and fine workmanship. Their automatic motors are installed in all sections of the city. At the Mechanics' Fair, in 1895, the Holtzer-Cabot machines took the palm for design and operation. With so enterprising an agent as Mr. Chalmers the Holtzer-Cabot Electric Co. meet with great success in their sales and installations in this vicinity.

The well-known firm of James Leffel & Co., Springfield, Ohio, U. S. A., have issued a neat, new pamphlet, "D," replete with numerous illustrations and descriptions of the throttling and automatic engines, with portable and stationary boilers, which they are building in a variety of sizes and styles. Copy is sent free to parties interested, on application to the company.

Sumter, S. C.—The Sumter Electric Light Co. contemplates the enlargement of its plant to supply increased demand.

TELEPHONE NOTES.

Westernport, Md.—The Gordon Telephone Co., C. G. and Reginald Fennell, have secured a franchise from the city for telephone system.

Glencoe, Minn.—The Western Minnesota Telephone Co. has been incorporated, to establish telephone connections between the principal towns in the western half of the state. Capital stock, $30,000.

New Orleans, La.—The Louisiana Telephone, Telegraph and Construction Co., incorporated by J. J. Fowler, president, and others, to establish a telephone system, etc. Capital stock, $250,000.

Palestine, Texas.—A long-distance telephone is being organized from Hearne to Palestine, and from there to Tyler.

Lawrenceburg, Tenn.—The Town Clerk may be addressed concerning the construction of an electric light plant.

Fayetteville, N. C.—An electric light plant will be established, and $15,000 worth of bonds will be issued for same.

Battle Creek, Mich.—A movement is on foot to build an electric railroad from Battle Creek to Kalamazoo, by way of Gull Lake.

NEW CORPORATIONS.

Pasadena, Cal.—Smyth Electric Company has been formed by George F. Kernaghan, B. F. Ball, Horace M. Dobbins, R. Eason, David M. Smyth, Joseph E. Smyth, and A. R. Metcalf. Capital stock, $300,000.

Washington, D. C.—The Caracas Electric Heat and Power Co. has been incorporated with a capital stock of $1,000,000, under the laws of New Jersey, to build an electric light plant and an electric railway in Venezuela.

ELECTRICAL and STREET RAILWAY PATENTS

Issued February 2, 1897.

11,588. Electric Meter. J. Harris, Lynn, Mass. App. for re-issue filed October 18, 1895.

576,082. Automatic Switch. J. P. Alexander, Jackson, Tenn. Filed May 29, 1896.

576,095. Battery. W. S. Doe, Brooklyn, N. Y. Filed February 29, 1896.

576,103. Electric Arc Lamp. P. H. Fielding, New York, N. Y. Filed April 23, 1896.

576,129. Electrical Advertising Device. L. Julig, San Francisco, Cal. Filed December 26, 1895.

576,145. Method of and Apparatus for Electric Propulsion. L. H. Nash, South Norfolk, Conn. Filed November 16, 1895.

576,163. Paste Carrying Machine for Electric Accumulators. F. W. Schneider, Triberg, Germany. Filed January 13, 1896.

576,164. Costruction of Cells for Electric Accumulators. F. W. Schneider, Triberg, Germany. Filed May 21, 1896.

576,166. Automatic Block System. J. Shoecraft, Harveyville, Kan. Filed May 7, 1896.

576,177. Electrode for Storage or Other Batteries. T. A. Willard, Norwalk, O. Filed November 7, 1895.

576,178. Battery Plate. T. A. Willard, Cleveland, O. Filed May 4, 1896.

576,201. Automatic Street or Station Indicator and Advertising Medium. M. B. Leece and A. R. Bullock, Cleveland, O. Filed June 2, 1896.

576,202. Rheostat. H. W. Leonard, East Orange, N. J. Filed July 30, 1895.

576,240. Electric Meter. J. R. Tucker and C. C. Hincklet, Aurora, Ill. Filed January 25, 1896.

576,243. Contact Apparatus for Telegraphing. C. Vreede, Rotterdam, Netherlands. Filed January 6, 1896.

576,266 Advertising Device. H. Green, Hartford, Conn. Filed February 8, 1896.

576,267. Advertising Device H. Green, Hartford, Conn. Filed May 2, 1896.

576,268. Contact Box for Depressible Conductor Rails. W. Grunow, Jr., Bridgeport, Conn. Filed May 8, 1896.

576,332. Locking Device for Electric Controllers. G. Valley, Johnstown, Pa. Filed November 10, 1896.

576,333. Electric Controller. G. Valley, Johnstown, Pa. Filed November 10, 1896.

576,342. Electrically Operated Musical Instrument. G. H. Davis, New York, N. Y. Filed March 25, 1896.

576,347. Elcctric Heater. F. A. Johnson, Binghamton, N. Y. Filed February 24, 1896.

576,369. Automatic Electric Cut-Out. C. C. Kritzer, Newaygo, Mich. Filed November 13, 1895.

576,372. Automatic Cut-Out for Magneto Bells. J. Z. Miller, Baltimore, Md. Filed September 23, 1896.

576,375. Spring Jack. W. S. Paca, Baltimore, Md. Filed September 23, 1896.

576,183. Alarm for Electric Circuits. C. B. Sterling, New York, N. Y. Filed June 24, 1895.

576,384. Brake Mechanism and Controller for Electric Cars. W. D. Thomas and L. R. Gignilliat, Savannah, Ga. Filed June 2, 1896.

576,392. Insulator. H. E. Billings, Hartford, Conn. Filed November 21, 1894.

576, 394. Trolley for Electric Cars. G. L. Campbell, Shunk, Pa. Filed March 18, 1896.

576,405. Spiral Trolley Wheel. C. A. Langford, St. Louis, Mo. Filed May 25, 1896.

576,469. Switch Plug. W. S. Paca, Baltimore, Md. Filed September 23, 1896.

576,472. Telephone Signal Transmitter. A. C. Rabes, Medford, Mass. Filed July 25, 1896.

576,475. Electric Arc Lamp. D. A. Shesler, Toledo, O. Filed February 13, 1896.

576,514. Apparatus for Stopping Engines. G. W. Brown, West Newbury, Mass. Filed October 4, 1895.

The Electrical Age.

Vol. XX—No. 9 NEW YORK, AUGUST 28, 1897 Whole No. 537

Removing Snow at Skowhegan, Maine.

SNOW PLOWS.

For a number of years past the street railway world has been brought nearer and nearer to the realization that no well equipped road is complete without an appliance for the removal of snow and ice from its line ; and these conditions are more particularly apparent in the northern and eastern sections of this country, where we have winters of such well-known severity. We illustrate in this issue a number of snow-plows made by the Taunton Locomotive Manufacturing Company of Taunton, Mass., whose long experience in this line of manufacture has enabled them to put on the market what is undeniably the best class of appliances of their kind.

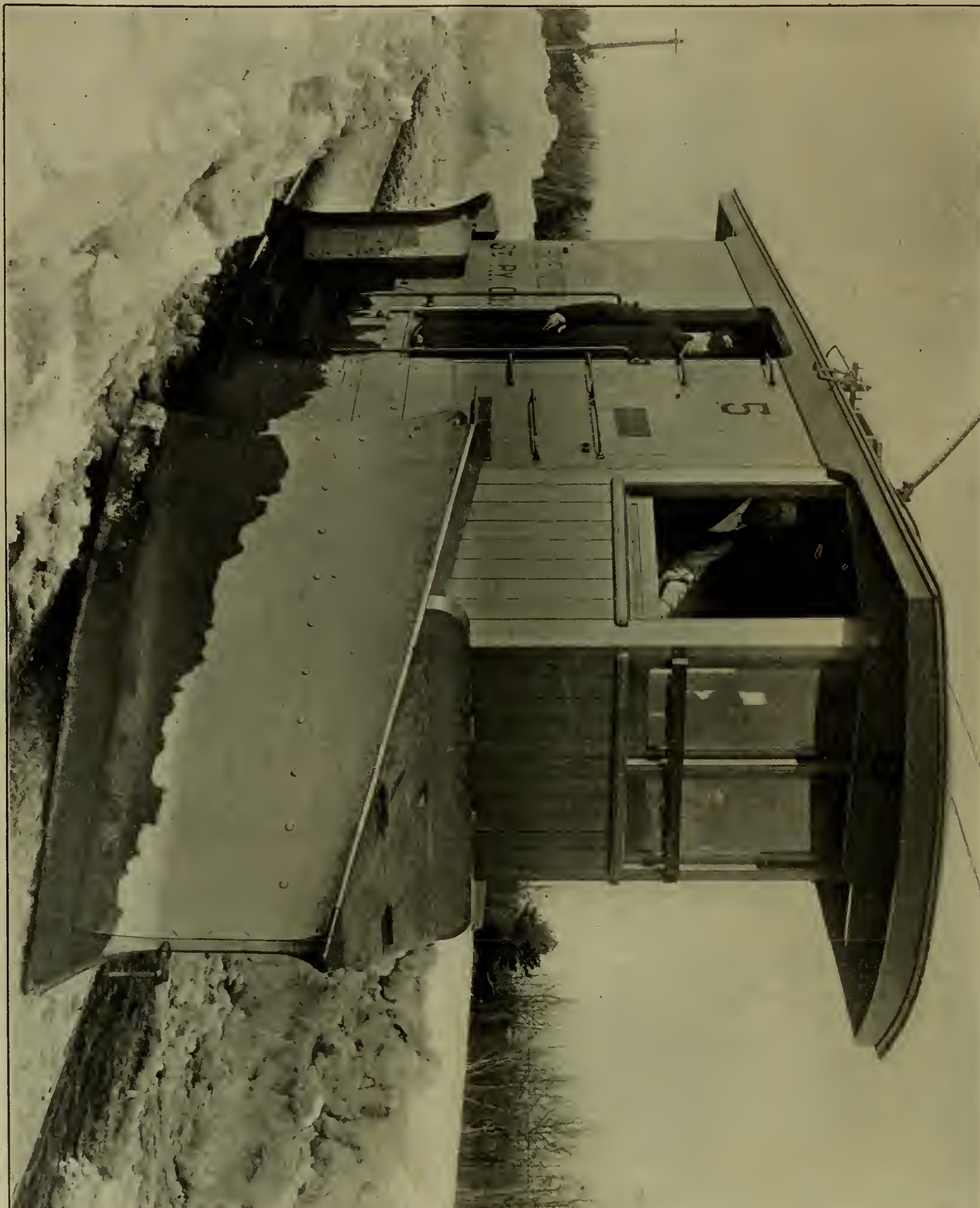
These plows are not thrown together by the rule of thumb, but are carefully and skilfully designed with a view toward fulfilling the end for which they are constructed, with the strictest economy for the user. The great secret of their success lies in the solidity and ruggedness of their construction ; they can take the hardest kind of service with perfect ease, and in this way the cost of repairs is reduced to a minimum. No repairs, excepting those in the course of ordinary operating, such as replacing brake shoes, bearings, etc., being necessary.

The new digger mechanism of the "Standard" plow, shown in Fig. is worthy of special comment. These diggers are so constructed that they may be worked with the foot. The shoes rest diagonally on the rails, and when an obstruction, such as a frog or a loose joint between rails arises, the digger, by means of a stiff spring, is enabled to ride over the obstruction without damage. This experiment has been tried in the yards of the Taunton Works, the obstruction used being two pieces of steel, one inch by two inches by nine inches, placed rigidly between two rails, and the plow being sent, with diggers down, over them at the rate of four miles an hour. The steel projected about two inches above the rails, but there was absolutely no damage done. The springs are stiff enough to enable the diggers to remove all sleet and ice from the rails, but, as explained, they are designed to "give" at an extraordinary obstruction, and override it without injury to themselves or any portion of the plow.

The mechanism for lifting the shares or noses of the plows is simple, strong, and thoroughly effective, a great advantage being given the operator by a counter-weight to balance the weight of the noses or shares, which work independently of each other. The lifting is done by means of a wheel, with a ratchet and pawl on the floor, and as all the working parts are made "easy," the operator only has to put enough power into it to counteract the effect of what little friction there is.

The wing mechanism of the Heavy Nose plow and the

Share plow is under quick and positive control, the wings being opened and folded at will by means of levers suitably placed within the house. On the "Standard" plows the wings are operated by ropes and counter-weights, the coupling of these appliances being *absolutely positive* and entirely under the control of the operator.



Wakefield and Stoneham Heavy Nose Plow.

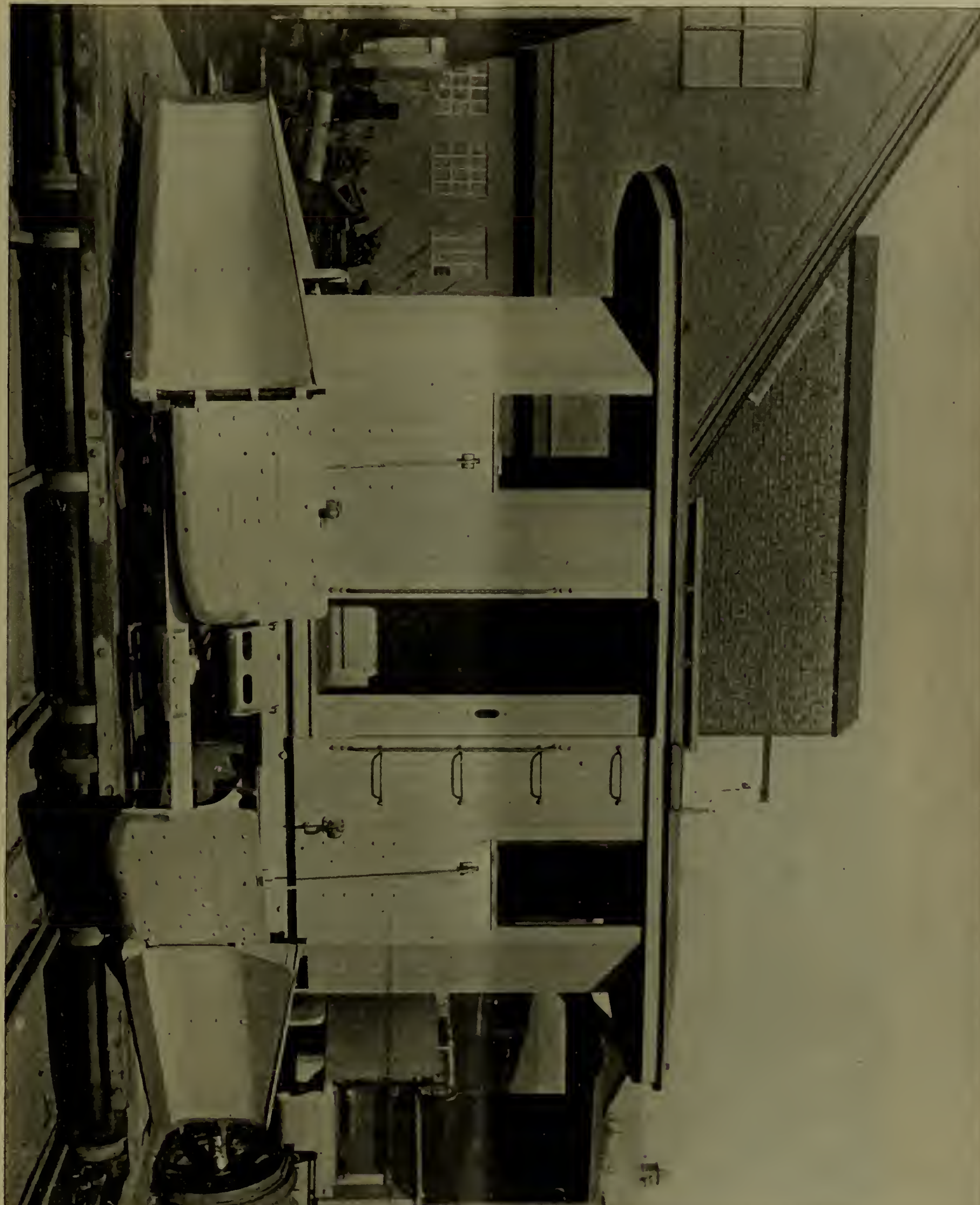
ELECTRIC METERING FROM THE STATION STANDPOINT.

BY CARYL D. HASKINS.

(Continued from Page 124).

Ninety per cent. of all the wear in a meter centres, in the case of motor meters, at the single jewel bearing, which is almost universal. The two chief factors which have influence upon the mere mechanical life are the weight of the moving mechanism and its speed, the variation of the area of the point of contact being, of course, always so small as to be out of the consideration.

A low speed meter is usually the best meter, provided the speed be not carried so very low as to threaten the accuracy of the meter on light loads, by reason of being held up by intermittent friction in the form of dust or a spider. Practice has indicated that low speed is more conducive to long life than is light weight of the moving mechanism, although both are, of course, very important. More important than either, however, is the quality of the material used at the points of friction and the ease with which the friction parts can be renewed. The best of sapphire is barely good enough, and the pivot end must be of correct shape, burnished to the highest degree, and its point must be absolutely concentric with the centre of movement.



The Standard Nose Plow.

More than half of the meter jewels which are destroyed are rendered useless, not by the rotary motion of the shaft, but by reciprocating motion of the shaft, due to vibration. Hence it is very necessary that the jewels should be in some way cushioned, for vibration cannot be always avoided.

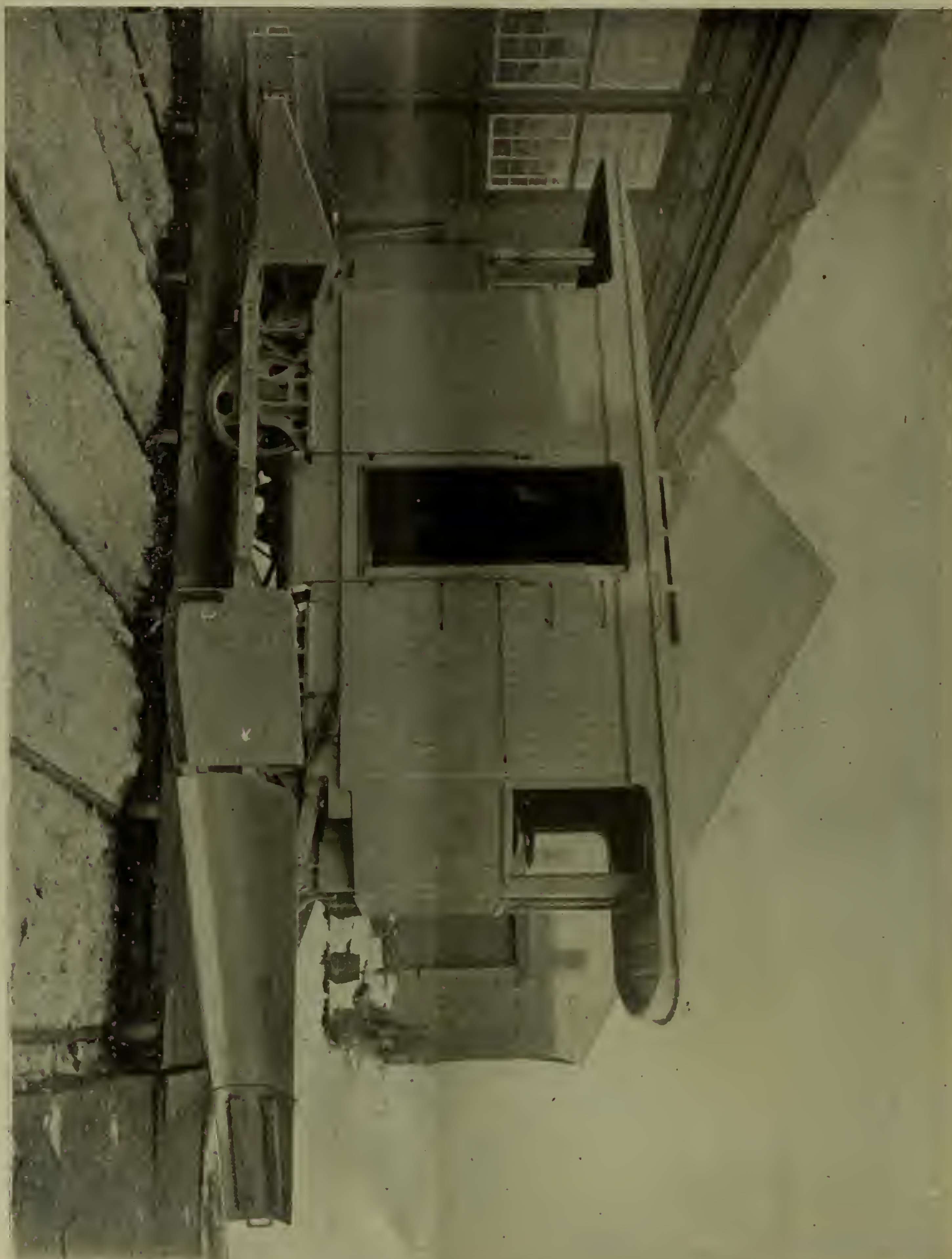
These are all, I admit, mechanical considerations, but they compass much of failure or success in electric metering. The purely electrical features of the meter contribute no grave factor of consideration in connection with the life question, always supposing that the copper is ample and the potential windings are so distributed and so ventilated as to preclude a burnout.

Passing over the central station man's third factor for consideration, that of the best unit of measurement, as one which is practically a closed question, we are brought face to face with his lamentable fourth point, the necessity that the meter should be able to withstand tampering. It is a regrettable fact that this is a consideration which is coming daily into more prominence ; but light has to be sold to all sorts and conditions of people ; and apparently the transgressor against meters is even more common than the transgressor against taxes; and this is a growing evil, largely, perhaps, because of the lax conditions of the laws, which can be invoked to protect the meter owner in many of our states.

The methods which are commonly practiced in tampering with meters can scarcely form any proper part of a technical paper ; but as this paper may go into the hands of some who need the knowledge to guard themselves and their interests, it can do no harm to briefly state the common methods used, not only that they may be guarded against, but also that meters may be selected which lend

Meter covers and bases are drilled, and wires, broom straws and the like inserted. Covers are pried up and healthy colonies of spiders introduced.

Ingenious individuals have even been reported as finding profit in a clever apparatus for injecting fine iron filings into meters by means of a bellows.



A Double-Track Share Plow, Sold to the Union R. R. of New Bedford, Mass.

themselves least readily to such practices. It is not unusual to place large masses of iron above, below or at the side of meters, but this practice is falling somewhat into disrepute among its advocates, since even they have in time discovered that there is a class of meter which it accelerates.

Electromagnets, drawing their energy from the circuits under measurement and used as the iron was formerly used, are now not uncommon, and it is difficult to prove in court deliberate evil intent.

All of these things need to be watched for and guarded against.

The question of installation and care of meters is a wide subject, and in connection with it I shall endeavor to mention only a few salient points, selecting those which are most commonly overlooked or neglected.

The most radical cause of trouble in connection with installation is vibration and the consequent reciprocating motion of the shaft ; for this reason the most solid of foundations should be selected, the neighborhood of moving machinery should be avoided, as should also partitions of light construction in which doors are located. The rhythmic vibration of moving machinery is infinitely more dangerous than occasional heavy shocks.

Meters should be installed as near to the foundation as possible, not as is now quite common, at the top of buildings, where the amplitude of all vibrations is of course much greater.

Locations where great variations of temperature occur are undesirable. For this reason, also, basements are preferable to attics.

A very common error, causing the loss of very many meters annually, by the bnrning out of the potential circuits, occurs in connection with the metering of power delivered to motors. In the effort to save the very trivial amount of energy passing through a potential circuit, it is very common to instal meters on the motor side of the controlling switch. This not only exposes the meter to the full force of the field discharge, but it also results in the eonstant cooling and heating of the potential winding, and the resultant expansion and contraction chafes and weakens the insulation, and also weakens the wire itself at the turns, opening the path for a final breakdown either by a lightning discharge or by a field discharge.

As to care of meters: It is a fallacy to suppose, as many insist upon doing today, that meters should require no care whatever. Almost all meters will continue operative for a very long period without any care whatever; but the cost of a cleaning and testing visit twice annually is trivial as compared with the good results which follow such a system, by reason of the better light load accuracy obtained. It is not, I think, too strong a statement to say that such a system will have an influence for good, amounting to from three to five per cent. on the meter readings annually.

Central station managements have probably given more attention to systematic methods of meter reading than to any other one point contributing to success. The old and faulty plan of reading the dials of a meter at the time of the visit to the meter is fast giving place to the better system, which provides the reader with a fac-simile of the meter dial in blank upon a page of his meter book. This fac-simile is roughly marked in pencil to indicate the position of the hand at the time of the visit. These fac-similes are taken into the office and are all read by one individual who is an expert in meter reading, and who sets down the consumption under the fac-simile on each page. Such a system commonly reduces the errors from about ten per cent. per month, where they not uncommonly stood under the old system, to materially less than one per cent. under the new; for, surprising as it may seem, it is an extremely easy thing to make mistakes in reading meter dials.

In changing from the old and not infrequently popular contract system, a good many central stations in the earlier days made the grave blunder of going on to the new basis during the winter months, with the result that the highest bills of the year reached the customer after a long period of indulgence under the contract system, and the result at times proved temporarily disastrous.

(To be continued.)

NATURAL DRAFT TRANSFORMERS.

Natural Draft Transformer, Closed.

Natural Draft Transformer, Open.

One of the forms which the transformer for use with high voltage currents has taken is shown in the accompanying illustrations of the special "type 11" natural draft type, developed by the General Electric Company, in its long distance transmission work. In transformers of this type the primary coils well taped and bound are insulated from each other by thick layers of felt—in that shown the primary coils are eight in number. Between the coils of the primary and the secondary winding an air space of one-half an inch intervenes. The whole is mounted upon a solid iron foundation and securely braced, and is then covered with a corrugated iron cylinder provided with a ventilating roof.

One of the first transformers of this type has been for the past five months in service where it is necessary to reduce directly from 10,000 volts to 125 volts without intermediate transformers. It is used on the transmission lines of the Redlands Light & Power Company, at Redlands, Cal., to furnish low voltage current at a point some ten miles away from the sub-station secondary lines.

FRED. PEARCE, of 79 John street, the noted manufacturing electrician, has returned from an extended tour of Europe. He visited all the large electric plants in England, France, Germany and Italy.

Madison, Fla.—An electric-light plant is to be established.

ELECTRICAL ENGINEERING IN THE LEHIGH UNIVERSITY.

The opportunities offered to ambitious young men have increased year by year in the colleges and universities of the United States. Since new fields have been opened up in applied science, educational institutions have added to their curriculums a series of new and interesting departments of study. The haze that hung over the technical applications of electricity has been swept aside, its principles laid bare, and development accelerated by the systematic study it has received in our leading universities.

The Lehigh University of South Bethlehem, Pennsylvania, was founded in 1866 by Asa Packer. One of its most favored courses is that in Electrical Engineering, under the direction of Alexander Macfarlane, M. A., D. Sc., L.L. D.

Physical Building.

The instructors and assistants in physics and electrical engineering are J. H. Klinck, M. E.; H. S. Webb, B. S.; S. S. Clark, S. B.; R. B. Williamson, M. E.

Electrical Laboratory.

The course consists of four years' work, embracing mathematics, physics, chemistry, etc., and the principles and applications of electricity.

The electro-technical studies are comprised in the following list: Principles of Electricity and Magnetism,

The Electrical Age.

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CONTENTS.

NERNST.

The discoveries of Volta and Galvani have been further developed up to the present time by a series of able scientists. The theory of the chemical generator or primary battery has, for the past seventy-five years, been more of the nature of an excusable substitute, than one which answered the direct questions of science unfalteringly. The osmotic theory of Nernst was the first which touched to the quick all that related to the origination of a current within a primary battery. It was first advanced by him in 1889 at Goettingen. The general reliability of his theory and its acceptance of the latest facts of physical chemistry, as an integral part of his own far-reaching principles, places his work prominently before the public eye as worthy of the highest commendation.

The theory of current conduction outlined by Helmholtz; of ionization or electrolytic dissociation by Arrhenius, are utilized when necessary to further explanation and throw light upon some original line of investigation. The value of his observations on osmotic pressure and their bearing upon the future of the chemical generator cannot be estimated. The phenomena of electrolysis has received the closest attention in his hands, and it would be well for those desirous of acquainting themselves with this genius to look up his original papers and experiments. There may be a great change in the near future which may so utterly transform the primary cell, that though remembered as the progenitor of the new, it will be seen in scientific collections side by side with other pieces of apparatus valuable only on account of its historical importance and past usefulness.

While it frequently happens that invention anticipates theory, it has been acknowledged by all intelligent men that the original invention can only be moulded to serve the purposes of the hour by a full recognition of the principles which underlie its operation and in subservience to which it is henceforth modelled. The principles advanced by Nernst have been deduced from a series of careful observations and the primary cell reconstructed on the basis of certain suggestions advanced by him and Oswaldt may begin a new life of usefulness.

FAKE SCHEMES.

The causes that depress trade are not always to be individualized as singly acting factors, neither are they to be looked upon as spontaneous outgrowths of a seven years' periodicity. More often they arise from a soil that has languished through overwork or become unproductive on account of its very richness; the seat of healthful progress usurped as it were by fungoid growths inimical alike to the present and the future. Political economists advance their theories and advise the course of industry and commerce. They point to some festering source in the national tissues and apply local remedies, but the great body of the nation beats at fever heat without awakening them to the full sense of an impending crisis. It is not until a convulsion is felt from the North to the South, the East to the West, that our purveyors of prosperity hoist the danger signal of national distress.

Whether it be wheat crops, silver or a failing confidence that becomes the festering sore, let it be known that beyond all these lie other causes, parasitical and decimating, which appear with the smile and smirk of reality but are made of the dissolving substance of fraud and illegitimacy. The century closes with a name for this symptom of degeneracy. It is neither poetic nor prosaic but belongs to the slang phraseology. We hope that "fake" schemes in name and fact will become obsolete before the dawn of another era.

ELECTRIC CARS IN A TWO-THOUSAND FOOT TOWER.

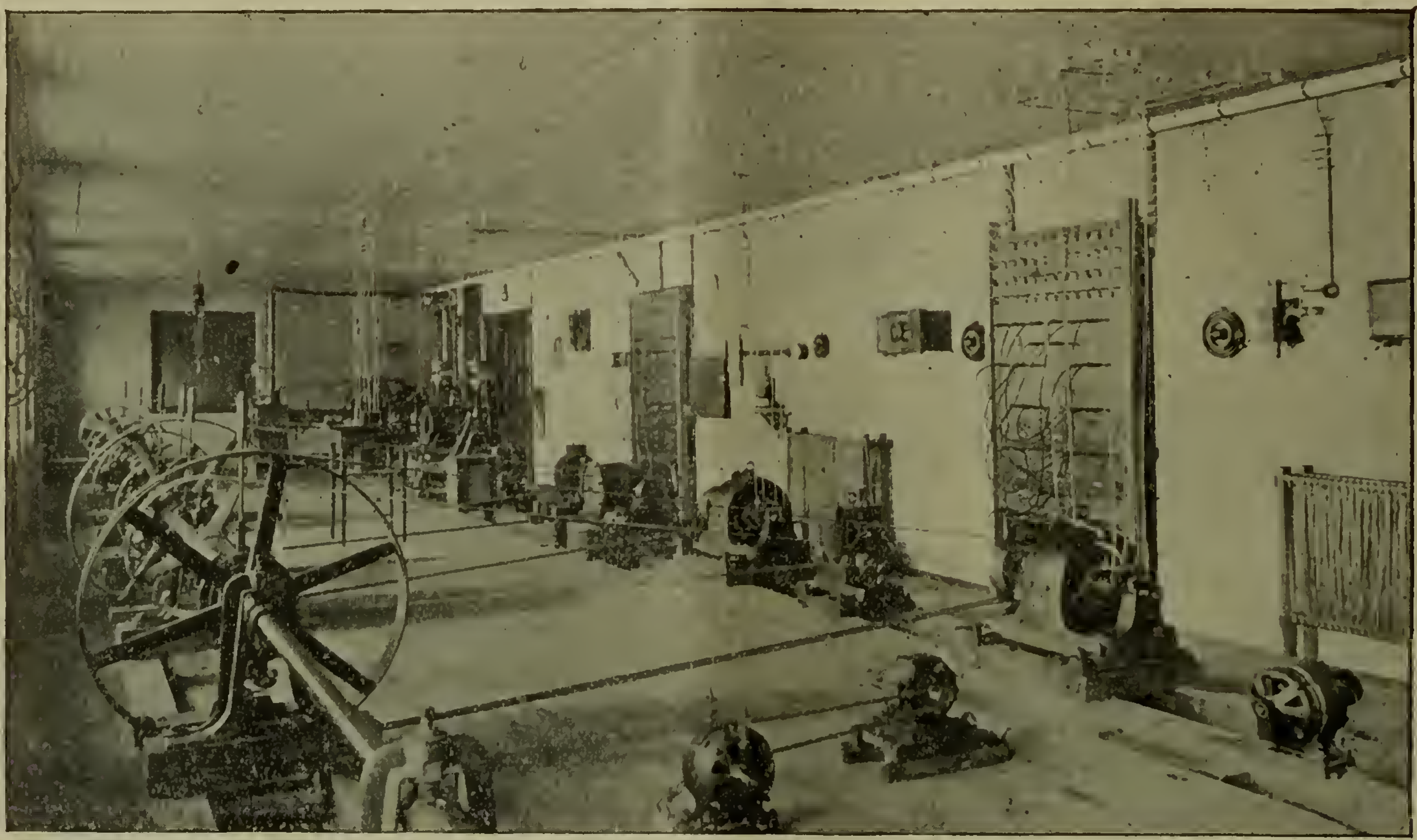
The plan of William J. Frye to erect a tall edifice in commemoration of the union of New York and Brooklyn is novel and interesting. The great Eiffel tower of Paris was nine hundred and eighty-four feet tall, but this scheme takes in a building whose dimensions, upward, will be two thousand nine hundred and forty feet; three hundred feet in diameter to four hundred, being its girth at the base. This structure is interesting to electricians because a proposition to run electric cars in certain portions of it has been made. The cars will ascend spirally, from the fifth floor to the top, covering a distance of two and one-half miles in so doing. From our nineteenth-century standpoint, the tower of Babel is not in it in comparison with this new, novel and prodigious scheme.

Catonsville, Md.—The Catonsville Ice, Light & Power Co. has been incorporated by B. N. Baker, Victor G. Bloede, William H. Gorman, Wesley M. Oler, Conway Robinson, Hanson Robinson and Dr. C. G. W. Macgill; to build on the Patapsco river, near Orange Grove, an electric light plant, to cost about $65,000, equipped with the latest improved machinery. Capital stock, $82,000.

New York, N. Y.—Empire Electrical Traction Co. has been incorporated by William W. Doty, James A. MacKnight, Charles C. Granten, Joseph C. Granten, Charles J. Beckermann, and William Reinhart; to manufacture electrical appliances. Capital stock, $100,000.

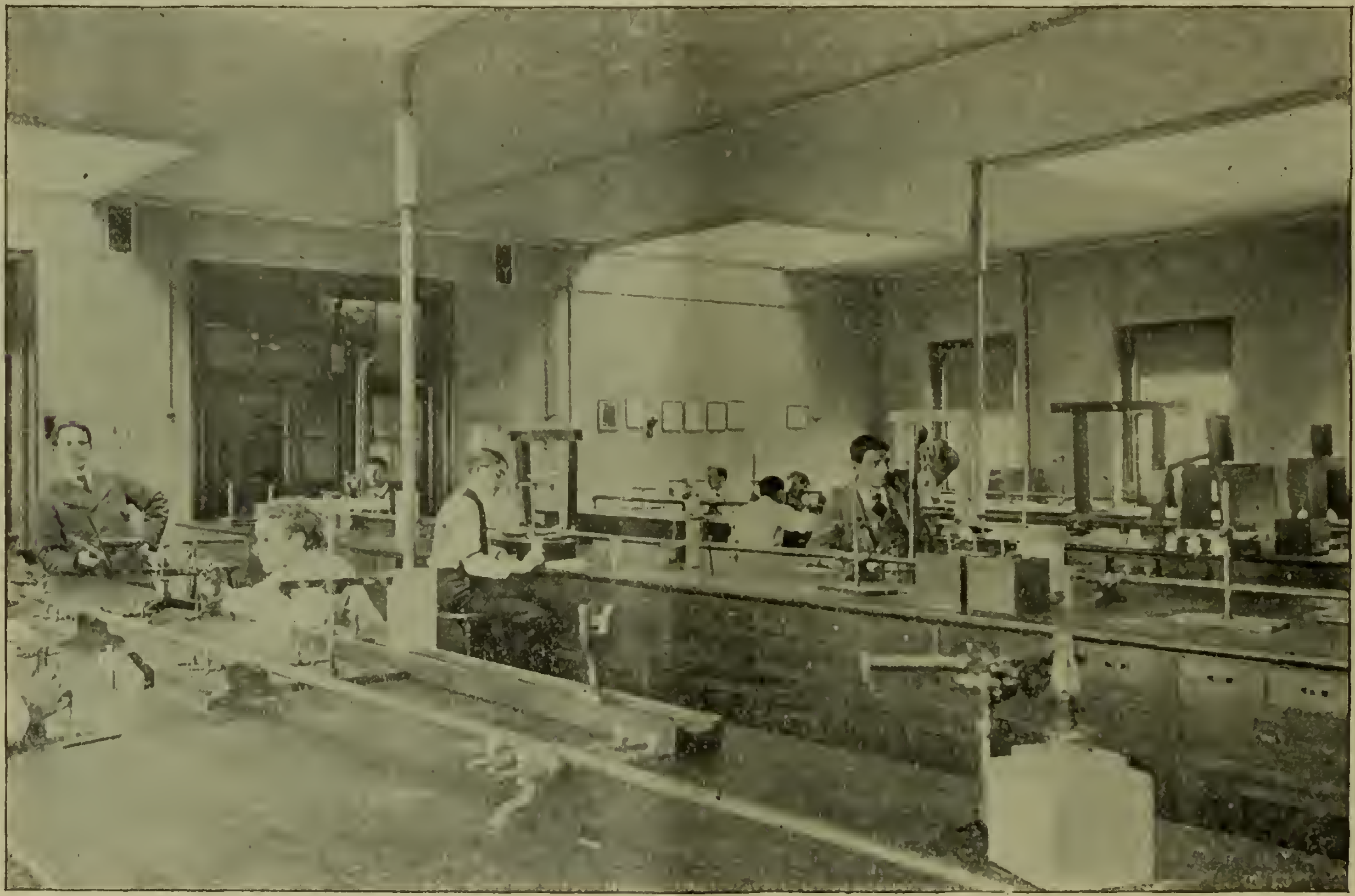
Chattanooga, Tenn.—A telephone line will probably be constructed between Dickson and Charlotte.

Electrical Measurements, Electromagnets, Theory of Dynamo-electric Machinery, Dynamo Laboratory, Dynamo Design and the Technical Applications of Electricity. Illustrations are given of the Physical Building, Mechanics and Heat Laboratory, Dynamo Room and Electrical Laboratory.



Dynamo Room.

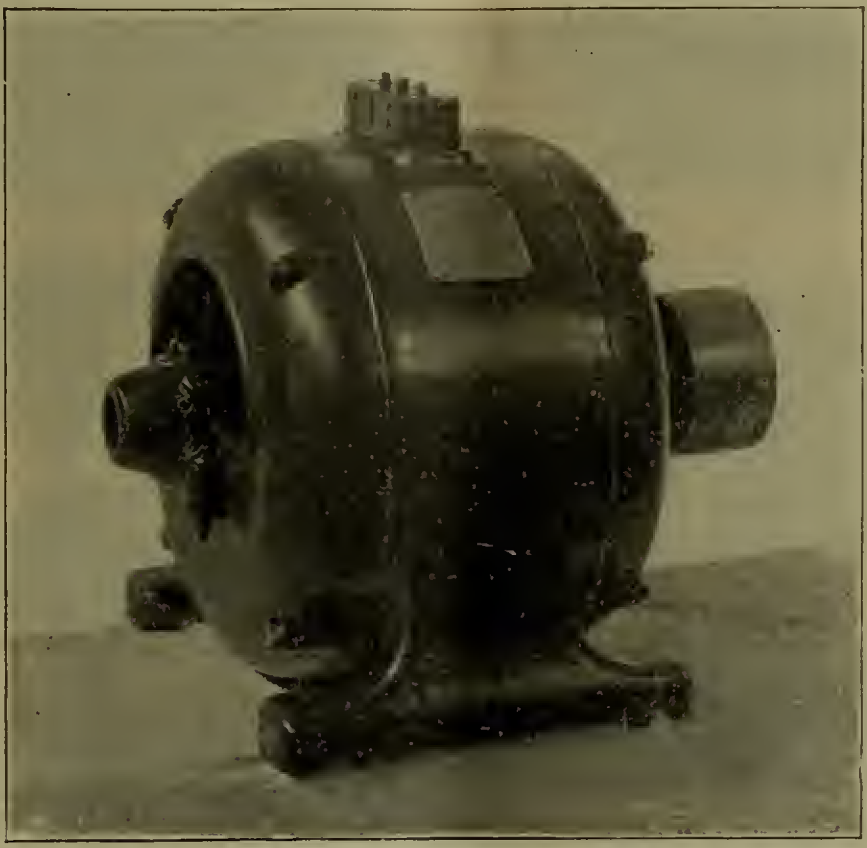
The Physical building is 235 feet long, 44 feet wide and four stories high. Within it are contained the various departments fully equipped for the study of physics and electrical engineering.



Mechanics and Heat Laboratory.

First Floor.—On the west side is the dynamo laboratory, comprising dynamo room, store room, workshop, battery room, computation room, cloak room, etc. The dynamo room is 70 feet long and 20 feet wide. A 50-horse-power straight-line steam engine drives a ground line shaft, to which the several dynamos are connected by belts and clutch pulleys. The electrical plant consists of two Westinghouse rotary transformers, two Edison dynamos, Thomson-Houston arc dynamo, Richter arc dynamo, Wenstrom incandescent dynamo, Westinghouse alternator, two Tesla induction motors, several small motors, ten alternating-current transformers, etc. The laboratory is supplied with ammeters, voltmeters and wattmeters of various types, Kelvin balances, Brackett cradle dynamometer, standards of capacity, etc. The battery room contains an 80-cell chloride accumulator, which supplies current for experimental or testing purposes at times when the engine is not running. By means of switchboards located in the battery and dynamo rooms, current is made available for use in any of the laboratories or lecture rooms throughout the building.

On the east side is the Thesis laboratory, comprising eight separate rooms of uniform size, office, balance room, and constant temperature vault underneath. Each of the separate rooms is furnished with three stone tables resting on foundation piers; one is specially fitted up for arc light photometry; in all the use of iron has been avoided in order to make them suitable for magnetic measurements. The room underneath is similarly furnished, and is specially suitable for accurate measurements of resistance.



Induction Motor.

Second floor.—On the west side are the designing room, blue printing room, offices, reading room and apparatus rooms. The designing room, 56 feet long by 44 feet wide, provides ample accommodation for designing and draughting. It is well lighted and contains the beginnings of an electrical museum. The reading room contains a collection of works of reference, and sets of several electrical journals. On the table will be found the current numbers of the leading electrical journals.

On the east side are the laboratory of electrical measurements, magnetic room, office, comparator room, store room, etc. The electrical laboratory, 60 feet long by 44 feet wide, provides desks with drawers and lockers for eighty students. Like the thesis laboratory below, it is entirely free from iron, the gas and heating pipes being made of brass. Slate shelves fastened to the walls provide suitable support for delicate instruments. A selection of the best books on electrical measurements is kept at hand, and references are given to such of these as treat a particular problem in the best manner. The laboratory is well supplied with sets of the more common instruments, and recently a number of instruments have been added comprising Anthony form of Wheatstone bridge, megohm resistance box, Crompton potentiometer, Ryan electrometer, standard condenser, Weston ammeters and voltmeters, etc. The magnetic room has been fitted up and set apart for measurements of the magnetic qualities of iron and steel.

Third floor.—On the west side are the lecture hall, workshop, recitation room and apparatus rooms; on the east side the lecture room, office, small laboratory, apparatus rooms, workshop and electrolysis room. The lecture hall is 70 feet long, 44 feet wide, and 18 feet high, and has seats for 400. It provides accommodations for examinations, the meetings of several large classes, and University lectures. The lecture room is 40 feet long and of the same width and height as the lecture hall. The benches rise in tiers and provide seats for 140.

Fourth floor.—On the west side are the mechanics and heat laboratory, etc.

Graduate students from the course of electrical engineering are given an opportunity of continuing their studies in the mathematical theory of electricity. Prof. Marfarlane occupies a high position in the scientific world, and those entering this course are honored by his instruction.

POLYPHASE HIGH-FREQUENCY INDUCTION MOTORS.

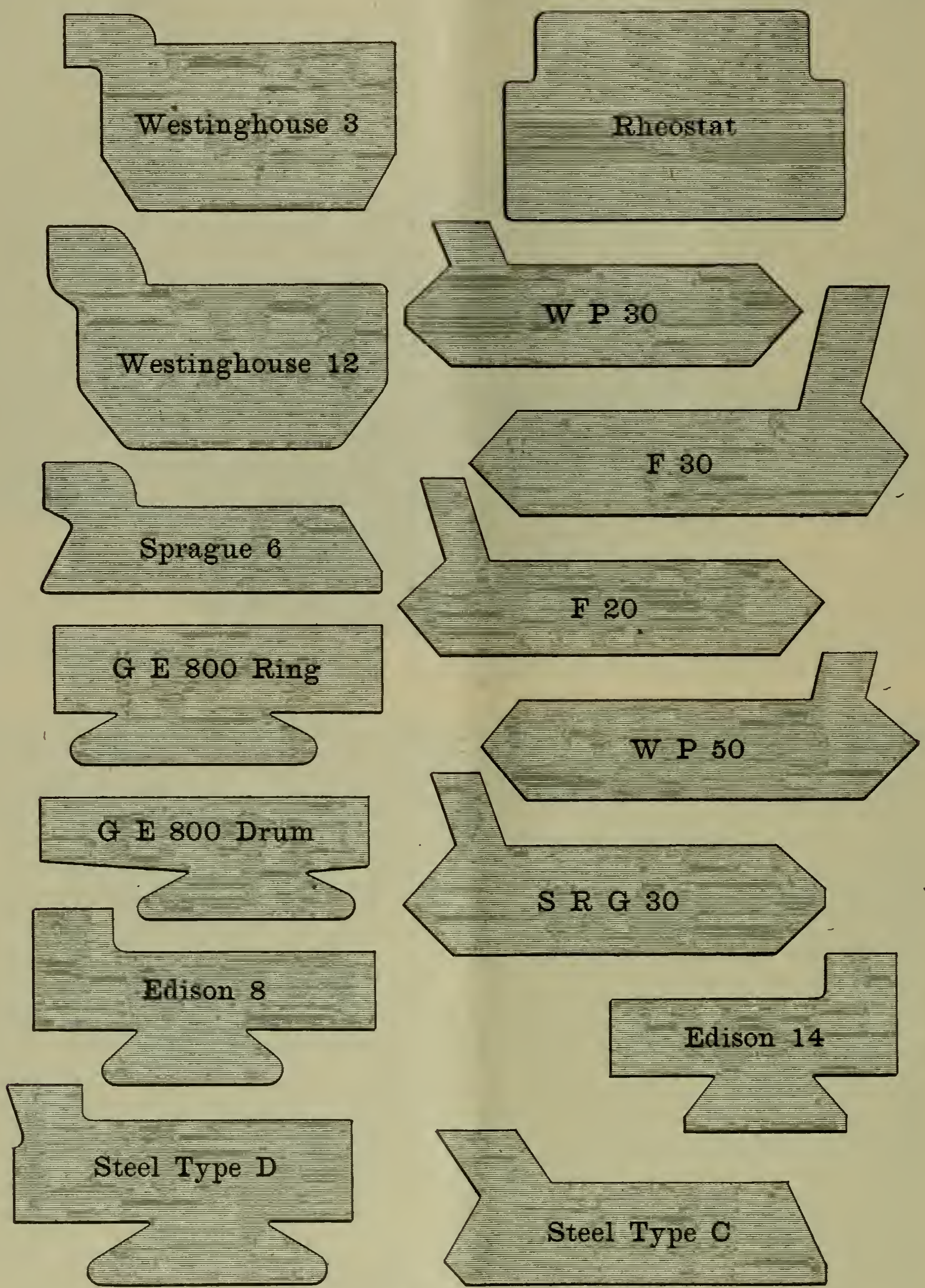
The new single-phase and three-phase high-frequency induction motors of the General Electric Company have been designed to operate from circuits of 125 cycles, and to run at any frequency within ten per cent. greater or less than 125 cycles with corresponding increase or decrease in the speed.

The liability of the high-frequency synchronous motor to be thrown out of step with any fluctuation in the speed of the generator is a disadvantage which does not seem likely to be overcome. If the feeder supplying current to a motor is changed over to another generator—a frequent occurrence in central stations—a fluctuation occurs in the frequency, the high-frequency synchronous motor is thrown out of step and is brought to a stop. This can only be prevented by running the high-frequency generators in parallel or by using high-frequency induction motors, and consideration of this fact has brought the new line of motors into existence.

Two lines of motors have been designed—those for three-phase circuits and those for single-phase. The mechanical structure and electrical features of the standard G. E. 60 cycle induction motors also distinguish these. The armature or induced element, in all sizes larger than five H.-P., has a polar winding and a revolving starting resistance cut out by means of a lever. In the 5 H.-P. size and less the armature either has the polar winding and starting resistance or is built with individually short-circuited coils. While the latter is cheaper, the starting current required is greater and the starting torque less, the efficiency also falling below that of the motor with the variable resistance.

The full load rating is not the heating limit, but is determined by the safe margin allowed for the overload carrying capacity. The rise in temperature above the surrounding atmosphere when run continuously for ten hours at the rated full load is not over 45° centigrade.

The speed, practically constant, does not vary with changes of voltage and cannot exceed the rated speed.



Street Railway Motor Mica Segments.

The field is wound with the conductors in slots, the winding being supported by end shields, which protect them from outside mechanical injury. The self-oiling and self-adjusting bearings are amply large. The oil cannot overflow and no oil can run out at the armature end. The connection board on the motor has no bare terminal connections and no part of the active conductors are exposed.

If speed variation is required on the three-phase motors it can be obtained by the addition of collector rings and brushes and a rheostat in the armature circuit. No speed variation is readily obtainable in the single-phase induction motor.

The starting torque and starting current of the three-phase high frequency motors with resistance in armature are from 25 per cent. to 30 per cent. in excess of the torque and current at rated load. For special cases the motor can be built for a much greater starting torque.

The single-phase motor requires a starting box, starting it with half load torque and about one and a half full load current in the case of the motor with variable resistance. The box consists of a non-inductive resistance and a choking coil, the object being to establish a displaced phase of E.M.F. and produce a starting torque. When the motor is up to speed the box is cut out, and the motor then runs as a simple single-phase motor. This motor can also be started with full load torque and a little over twice full load current, but this necessitates a larger box. The single-phase motor with independently short-circuited coils or fixed resistance in the armature requires about twice this amount of current when starting and gives somewhat less torque.

These induction motors are totally without moving contacts, and are standard for 104 volts. The smaller sizes can be run upside down or sideways fastened against the wall, greatly economizing floor space.

The high-frequency three-phase motors have been designed to meet a demand for power service principally from high frequency monocyclic generators, and may be wound two-phase for use on two-phase circuits of similar frequency.

The single-phase motor meets the demand created for a motor to be operated on the existing high frequency alternating current systems. No alternating current motor for such systems has heretofore been built which has approached the direct current motor in efficiency, regulation, torque and reliability. In this motor, therefore, the General Electric Company gives us a satisfactory high-frequency single-phase alternating current induction motor, guaranteeing it superior to any other motor of similar type.

EAST INDIA MICA.

It is a well established fact that mica is now an absolute necessity to the electrical trade; every practical electrician knows that he cannot do without it.

To have the best and most satisfactory results you must use mica in its native condition, that is, in solid sheet as it is mined, and it is only in this form Mr. A. O. Schoonmaker, 158 William street, New York, sells it to the trade. The mica he sells comes direct from the original sources in India. It is selected stock of guaranteed purity, and no region in the world furnishes a better article for insulating purposes.

It is perfectly free from iron, thus rendering its non-conducting properties of the highest order. It splits even throughout and has a uniform, smooth cleavage.

This mica has been used constantly by many of the largest and most prominent electrical companies in the country, and has given perfect satisfaction.

It is always reliable.

Mr. Schoonmaker keeps on hand a large stock for immediate delivery, of solid sheet mica segments, rings, washers, and uncut sheets of all sizes, for dynamos, motors, conductors, and for all other electrical purposes.

The increased tariff on mica has not affected the price of India mica, except in the two smaller grades, which have been advanced only five cents per pound. Of the stamped segments for railway motors many have been reduced in price.

THE SAFETY COMPANY'S YACHTING-FISHING PARTY.

The beautiful engraved invitations sent out by Mr. Leonard F. Requa, general manager and treasurer of the Safety Insulated Wire & Cable Company, of New York City, notified his numerous friends to enjoy a sail August 18, on Gen. Benjamin M. Whitlock's beautifnl auxiliary steam yacht "Hildegarde." Mr. Whitlock is president of the Safety Company. The eighteenth of August was a most propitious day for a sail and fishing. Many guests were met at the foot of Whitehall street, N. Y. city, at 9:10 A. M. by Messrs. Requa, senior and junior, and also Messrs. Richards, Eckert and Parsons, representatives of the company, who furnished tickets to Bay Ridge, where the guests were transferred in steam launches to the "Hildegarde." General Whitlock was in waiting and gave a hearty greeting to the guests. The steamer then headed for Sandy Hook, at 10:30, loaded with a great variety of palatable goods, and with song, music and mirth the guests went sailing merrily on. Upon reaching Sandy Hook, brand new, white duck overalls were furnished to the guests, great distress being observed in finding overalls to fit the noble form of Mr. Blackall, of Blackall & Baldwin, N. Y. When all were ready, the captain of the fishing fleet, seen in the offing, arrived and took off a party of guests. Then the steam launch and yawl of the "Hildegarde," with Gen. Whitlock at the helm, took off the balance of the fishermen and distributed them among the fishing smacks. Mr. Day, the elocutionary entertainer, and Mr. Ferguson, of the Municipal Electric Light Company, of Brooklyn, were in a party of fishermen. Mr. Day complained that Mr. Ferguson magnetized the fish, they all coming to Mr. Ferguson's line. He was the prize fisherman of the party, having caught the largest number of big blue fish. Many of the guests who did not take a hand in the piscatorial sport, remained on

The Hildegarde.

board the "Hildegarde." Every large electrical industry in the East was represented among the guests, among them being the N. Y. Telephone Company, the N. Y. & N. J. Telephone Company, Western Electric Company, Crocker-Wheeler Electric Company, Edison Ltd. Company of N. Y., General Incandescent Arc Light Company, the Electric Storage Battery Company, of Philadelphia, Manhattan Electric Light Company, Hatzel & Buehler, Zindars & Hunt, Kings County Electric Light Company, Brooklyn Edison Company, Sprague Electric Company and many others whose names could not be secured. Mr. Leonard F. Requa was at the height of his glory and was highly elated over the success of the party and the enjoyment of his guests. After three hours of fishing, the guests started on their homeward course, without any sea-sickness; all spoke in high glee of the beautiful sail and the beautiful steamer that it was enjoyed in. The "Hildegarde" is a model pleasure yacht, at one time owned by the Prince of Wales, and has been around the world several times; having every convenience, the latest types of engines and boilers. Current for the electric lights is generated by a two-horse power Crocker-Wheeler dynamo, run by a Pelton water motor. An auxiliary storage battery plant is also used very successfully, this plant having been installed by Mr. Blizard of the Electric Storage Battery Company. The illustration of the yacht hardly does her justice. The guests, after arriving at the Atlantic Yacht Club, of which Gen. Whitlock is rear commodore, were further entertained with a dinner and the customary requisites. Many pages could be devoted to describing the attractions of this entertainment, but to say that it was the greatest and best entertainment ever given by any industry to its friends gives but a faint idea of this "fishing and pleasure party."

LITERARY NOTES.

The September Home Magazine (Binghamton, N. Y.) comes to us in all the glory of a new cover. It is a very pretty design, the winner in a contest for a cover for this popular magazine, and is certainly a decided improvement over the old cover. James C. Green, of New York, is the artist who made the design, and wins first prize in the contest, which was conducted under the auspices of the Sketch Club of New York.

The Home Magazine for September is a special travel number. There are a number of handsomely illustrated articles on places of interest in our own and foreign lands, chief among them being Harriet Maude Miller's sketch, "A September in Norway," and Mrs. Clara Spalding Brown's "In the Sierra Madres." "The Mississippi Forty Years Ago" is the title of an unusually interesting and profusely illustrated article by Hugh Wiley. These are personal recollections, which fact gives them additional charm. Another particularly timely article in these days of the Klondike and discussion of the seal problem is Ella Starr's sketch of "Alaskan Fox Farms," which describes a new industry in our far north territory.

THE WESTERN ELECTRIC COMPANY beg to announce that on August 16 their New York offices will be removed to their new building at 57–67 Bethune street, near West street, where they will open a store for the sale of their manufactures and other electrical supplies in addition to the store in the Thames street building. The telephone call for all departments will be 1725 Spring street. Customers will kindly remember that the retail store in the Thames street building will be retained as usual.

GEO. JOHNSON, care of L. J. Wing, 109 Liberty street, has a large stock of porous cups, square and round, of all sizes, that can be bought at a low figure.

NEW CORPORATIONS.

Troy, Ohio.—The Hobart Electric Manufacturing Co. has been incorporated with a capital stock of $30,000.

Albany, N. Y.—The Coxsackie & Greenville Traction Co. has been incorporated to operate a road from the terminus of the Greene County Traction Co.'s line in Coxsackie to Greeneville and Durham, a distance of 12 miles. The capital is $150,000.

Jackson, Mich.—A company has been formed with E. S. Hobbs, president; C. C. Bloomfield, vice-president; L. B. Trumbull, secretary; E. D. Warner, treasurer, and others; for the manufacture of electric signals for street railway and railway crossings. Capital stock of $100,000 paid in.

TELEPHONE NOTES.

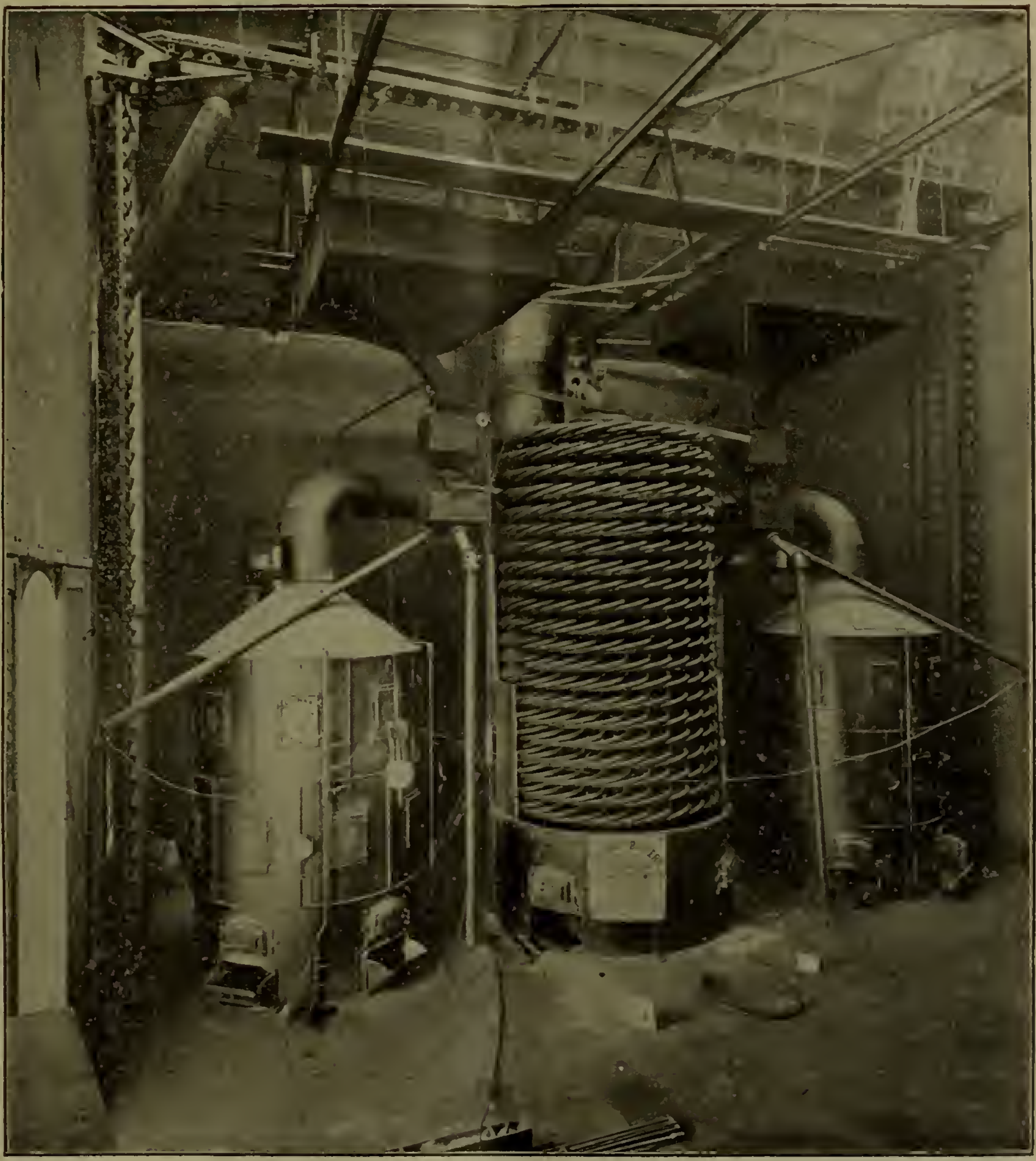
Coffeeville, Miss.—The Blount's Mineral Well & Telephone Co. has been organized, with I. T. Blount, president; H. T. Gaines, secretary, and G. W. Armstrong, of Coffeeville, treasurer; to construct telephone lines, etc.

Ironton, Ky.—The Lawrence Telephone Co. has been organized to construct telephone system. Capital stock, $12,000.

Stockton, Cal.—Sierra Telegraph Co. has been formed by Thomas S. Bullock, Sidney D. Freshman, S. D. Woods, George A. Brown, Jr., and R. L. Beardslee; to carry on a general telegraph business. Capital stock, $12,400; all subscribed.

The Electrical Age.

VOL. XX—NO. 10 NEW YORK, SEPTEMBER 4, 1897 WHOLE NO. 538



A Boiler Room of the Edison Electric Illuminating Co., Brooklyn, N. Y, The Arrangement of the Conveyor for Handling the Coal and Ashes.

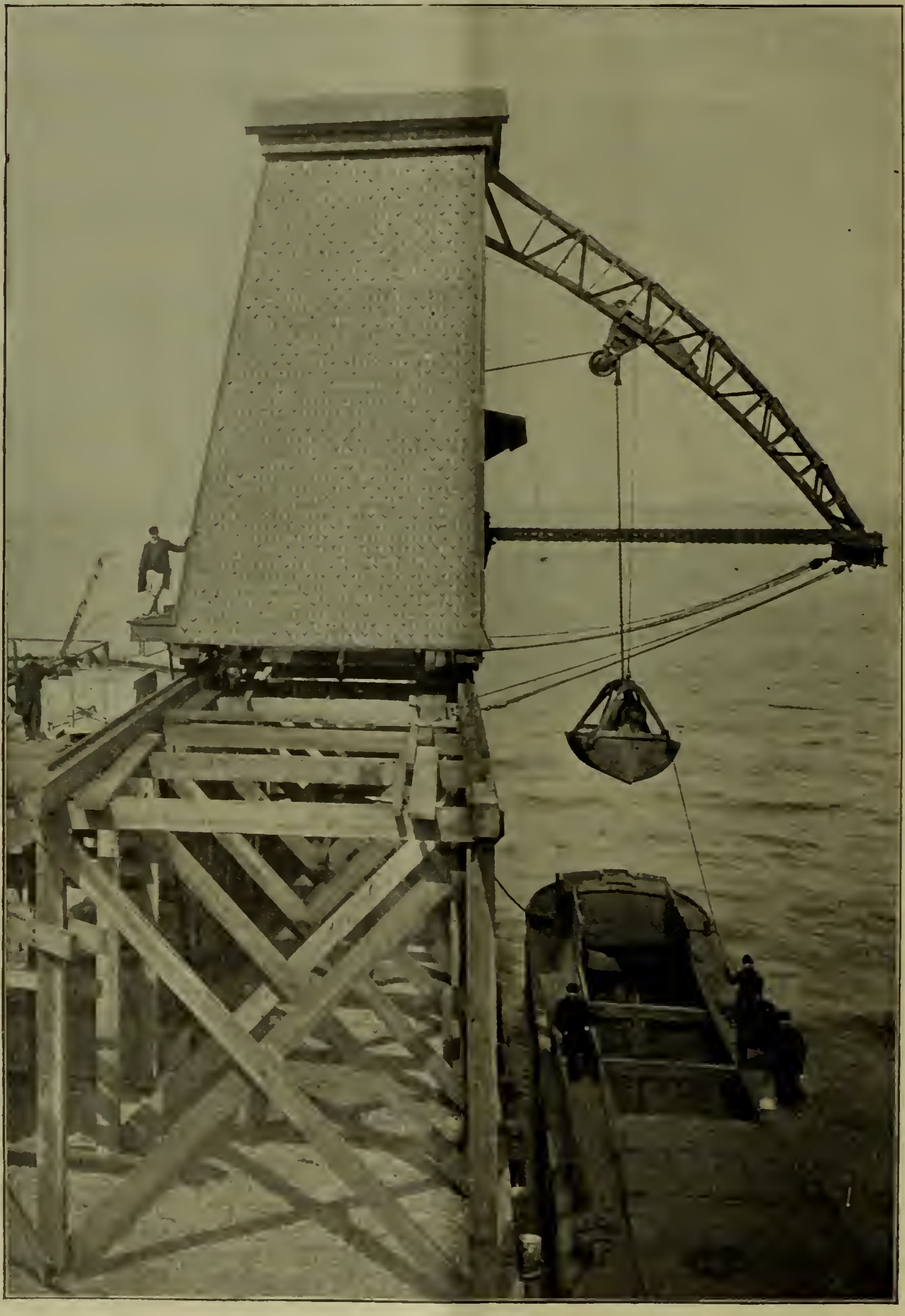
COAL DELIVERY IN ELECTRIC LIGHT AND POWER PLANTS.

The great monoliths of ancient Egypt represent the sweat and toil of multitudes. They were built at a time when mankind depended more upon the strength of its arm than the aid of iron and timber ; more upon millions of slaves than the great forces of nature.

The Ancients' ignorance of the art of applying these forces was excusable, because the science of engineering had not passed beyond its most primitive stages. The dawn of history had barely broken and wealth was measured in such barbaric times by the possession of men instead of machines. From the germ of thought implanted in the minds of future races by Hero of Alexandria sprang the great mechanical inventions of this age. The bottled energy of steam gave life to a new civilization, added a stimulus to art and science, and drew a magnificent horoscope of nations still unborn. The dependence upon the lowest type of laboring class for the transference of coal, ore, etc., to a vessel or from a vessel to shore, has been superseded by a system that performs the same work with almost lightning dispatch. There are many ports along the Mediterranean Sea, the coast of India, West Indies and China where Coolies and other poorly paid menials labor hour by hour with the patience and persistence of beasts of burden, loading and unloading freight from shore to ship. In localities where such conditions do not exist, and labor finds a high price and a ready market, such a method is not commercially practical and recourse must be had to mechanical contrivances that will serve this purpose and displace the panting laborer who, despite his utmost efforts, is slow, unsatisfactory and an incumbrance in moments of haste.

The main object of this brief sketch is to describe the means by which electric plants, whether for light or power, stock up with coal, and feed it with readiness to the boiler furnaces. The few illustrations added to this article will show familiar scenes in southern latitudes; the

Unloading Vessels in the West India Ports,



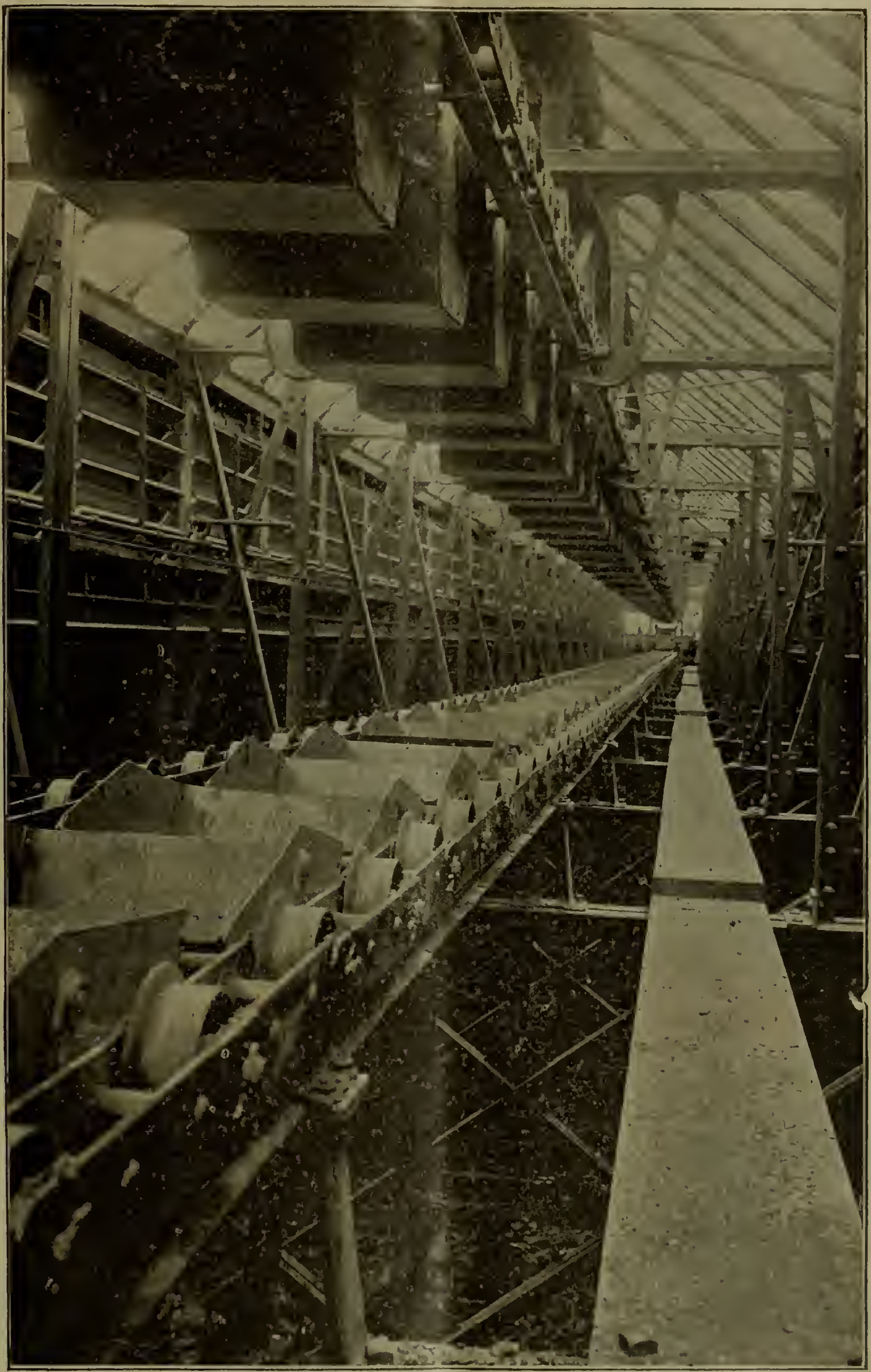
 No. 940,490.

Steam Shovel hnd Elevator at Southern Power Station. Brooklyn Heights Railway Company.

string of natives carrying their baskets full of coal and, in comparison with the same, the new and improved method of handling and delivering coal as perfected by the C. W. Hunt Company, of 45 Broadway, New York City. Although the first illustration does not relate directly to any electric light plant, it shows the method by which vast quantities of coal can be carried and delivered with astonishing speed at any given point.

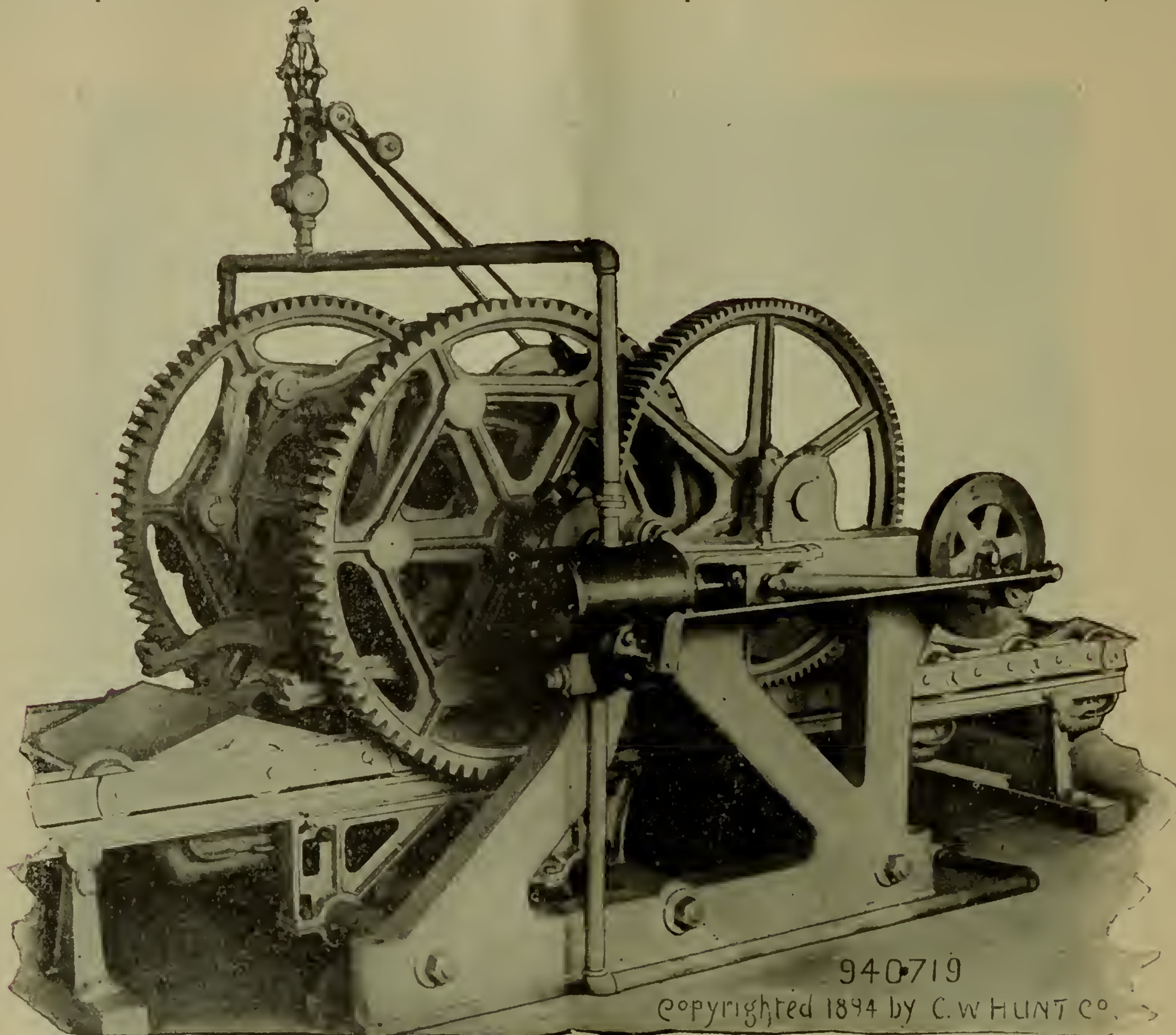
The Ridgewood Pumping Station of the Brooklyn Water Works is equipped as shown, the coal being carried by a conveyor which passes underneath the hopper, below the cars, where the buckets are loaded, thence passing vertically to the monitor of the storage building, where it is carried horizontally and discharged at any point.

The device illustrated in the first cut represents an apparatus that will unload a thirty-ton car in thirty minutes. The reader will not need to inquire into the advantage of this system over that which requires the aid of human carriers. The large and progressive railway companies make use of steam shovels in addition to conveyers in emptying coal barges. By means of the steam shovel very little breakage results. The scoops reach seven feet, pushing their way under a ton to a ton and a half of coal, which causes very much less breakage than taking a ton of coal up in about one hundred and fifty shovelsful and dashing one on top of the other in a tub. The Brooklyn Heights Railway Company make use of this improved method, involving a steam shovel and elevator, at



View in the Monitor of the Coal Storage Building of the Ridgewood Station of the Brooklyn Waterworks.

their southern power station. The facility with which coal is removed and the ease with which this gigantic shovel is handled and controlled leaves nothing to be desired, either in speed or in economy.



Conveyor Driver.

The Edison Illuminating Company, of Brooklyn, make use of an equipment for the delivery of coal to their boilers which enables them to save time and labor. The coal has to be taken from the wagons, carried to the furnaces and the ashes removed. The means by which this was achieved is described as follows: the coal was dumped into a hopper built beneath the sidewalk. It is carried by a conveyor system to coal tanks above the boilers, which on returning passes beneath the ash-pit of each furnace, thereby lifting the coal to receivers from which it drops almost into the furnace door; then removes waste products with a cleanliness and speed that is surprising. An illustration of the boiler-room, showing the hoppers placed above and on each side of the boilers, may assist the reader in gaining a definite idea of this ingenious method of delivering coal. The conveyor driver which operates this interminable string of buckets is in this case driven by an electric motor. An illustration of

General View of the Steam Shovel, Cable Railway and Conveyor at the Southern Power Station of the Brooklyn Heights Railroad Company.

a conveyor driver is given. The apparatus shown can of course be operated by steam-engine or belt. In this station a ten-horse power motor supplies all the power necessary for the supply of fuel and the removal of ashes.

There is probably no field of engineering which illustrates so clearly the economy of such a system than electric lighting. The primary object of all devices is to save time and money; in other words, to economize, and there is no better means of showing how this end can be obtained in the handling of coal than by seeing in actual operation a Hunt-conveyor system.

THE EFFECT OF HEAT ON INSULATING MATERIALS.

(Concluded from page 121.)

Question No. 3. A new specimen of plain red fibre .009-inch thick was wound with four layers of No. 26 B & S bare copper wire, the area covered being four square inches, and then subjected to the variations in temperature and exposure to moisture which are most likely to take place in dynamo electric machinery.

Insulating material when used in this way is subjected to repeated heating and cooling, being kept at a moderately high temperature for varying lengths of time, also being exposed more or less to the moisture in the air. Therefore, the following eight tests have been made under conditions approximating the above and upon the above described specimen.

In all of these tests the temperature is gradually raised from that of the air, 20° C., to 80° C., at which temperature it is kept constant for 3½ hours. The time taken to raise the temperature this amount is about 45 minutes.

Curve No. 5 has been obtained from the first heating. The specimen was then allowed to stand unexposed to moisture for 16 hours, at the end of which time a like test is made, giving curve No. 6. After a lapse of 24 hours, during which time the specimen was exposed to the atmosphere, which was very damp, the temperature is again gradually raised and kept constant as before, curve No. 7 resulting.

It will be seen by examination of these curves that the specimen after exposure to moisture returns to its original condition. The method of exposing the specimen to moisture is to remove the glass globe from the apparatus and the asbetos covers from the top of the earthenware cylinder, the specimen itself being undisturbed. Three days (72 hours) having elapsed, the specimen being undisturbed and unexposed to the atmosphere, is subjected to further test, giving curve No. 8.

Great care is now taken to protect the specimen from all moisture for 16 hours; at the end of which time, upon again testing, curve No. 9 is obtained. The test consisted, as before, in raising the temperature to 80° C., where it was kept constant for three and one-half hours.

All covering is now removed and the specimen allowed to cool to 23.3° C., the time occupied being three and three-quarter hours. Curve No. 10 is then obtained upon reheating.

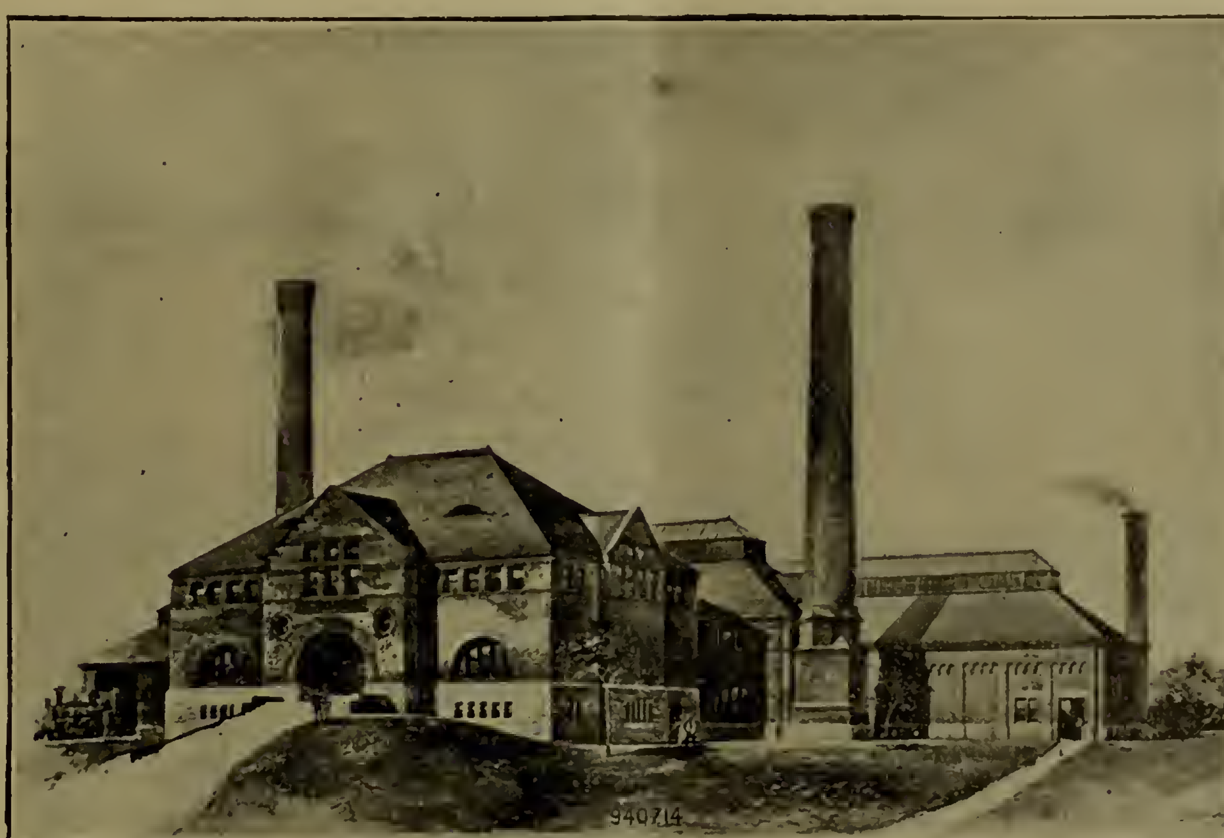
Again, great care is taken to protect the specimen from disturbance and all moisture for nineteen hours. On being again subjected to test, curve No. 11 results.

Now the specimen is allowed to stand for exactly five days freely exposed to the moisture of the atmosphere, it being situated in a room near a window which is left open a considerable portion of the time, thus subjecting the specimen to conditions of atmosphere similar to those occurring in a station or factory.

The weather during the five days was unusually damp. A number of severe-rain storms occurred, thus giving the specimen an exeremely good opportunity to absorb moisture. At the end of this time a test was made, from which curve No. 12 was derived.

The object of this test is to see if, after exposure to moisture, the material will return to its original condition. By a glance at the curve thus obtained it will be seen that this actually takes place.

Let us now compare the eight curves. Curve 5 represents the original resistance variation of the material. Curve 6 shows the increased initial resistance on cooling, the specimen having been protected from moisture in the meantime. Curve 7 shows the return to the original condition on absorption of moisture. Curve 8 the higher value of the resistance curve when the specimen has been kept at 80° C. for three and one-half hours and then allowed to cool, but not exposed to moisture. Curve 9 shows that the heating up to 80° C. has practically no effect on the resistance after the moisture has been driven out and not allowed to return. Curve 10 shows the condition into which the specimen was thrown when cooled while



The Ridgewood Pumping Station of the Brooklyn Waterworks.

exposed to the atmosphere. Curve 11 indicates that the moisture had again been practically all expelled and therefore the heat produced no change in the resistance.

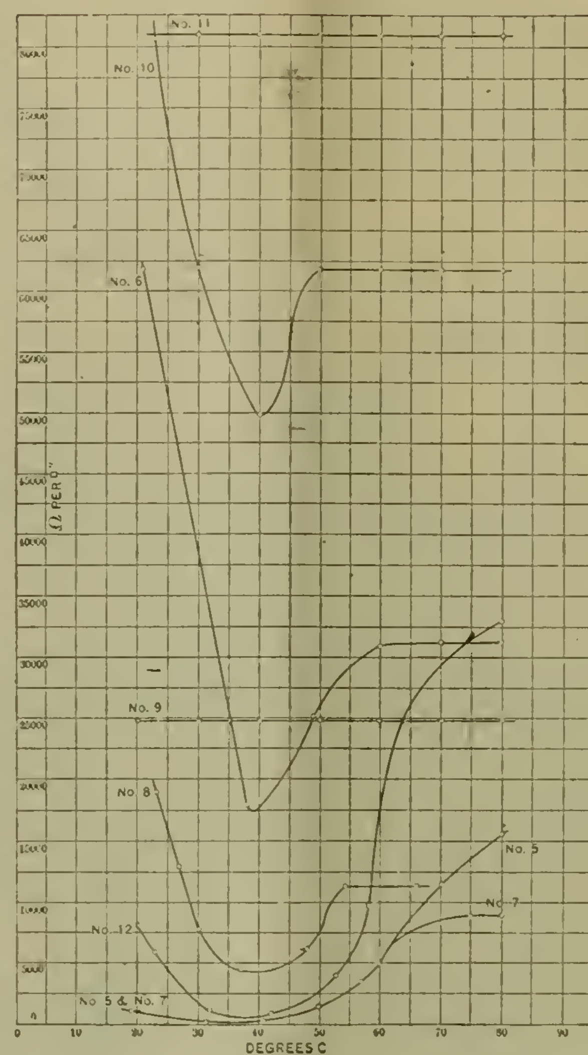


Fig. 3.

Curve 12 shows that the specimen having been freely exposed to moisture has returned to almost its original condition. In all these tests the resistance remained

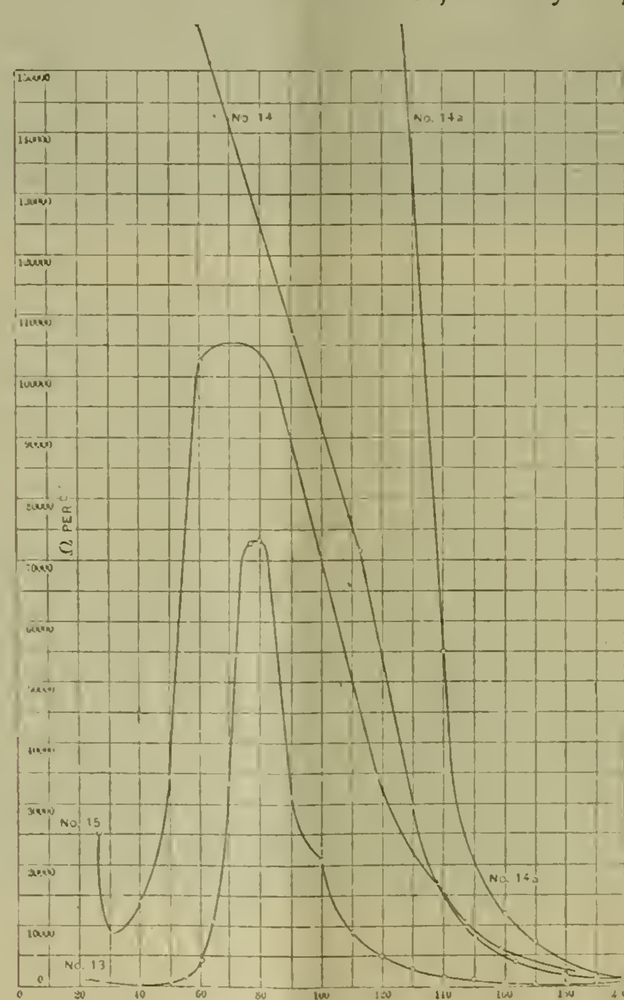


Fig. 4.

constant during the entire time that the temperature was kept constant. On examination, the specimen was found to be practically unchanged in appearance, mechanical strength or other qualities. One might therefore conclude, on inspection of the various curves in connection with these experiments, that the action which takes place in a fibre insulating material when heated up to about 80° C., merely depends upon the amount of moisture contained in the material at the time at which each measurement is made.

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CONTENTS.

PROSPERITY THAT HAS REACHED THE TRADE.

The daily newspapers impress upon the public mind twice a day the fact that times are better. They speak of the thousands of toilers who have starved for six months and now have lots of work and three square meals a day. They refer to the large factories situated on all sides of us in which the whirr and hum of busy machinery eloquently proclaims in favor of a business revival. There is no doubt, however, that the prospects have become brighter, not only among the great masses of unskilled labor but within our own circles of technical industry.

We are happy to notice that John A. Roebling & Sons' Company are erecting a half million dollar building; the New York Telephone Company are erecting a building worth $175,000, and the Metropolitan Street Railway Company, two buildings, costing respectively $200,000 and $350,000. We are glad that this change of tide has come about, and hope that all of our friends will lave in its golden waters to their hearts' content.

ALUMINUM SOLDER.

The method of producing aluminum is inherently an electrical one. At Niagara Falls, as is well known, thousands of horse-power are daily utilized in reducing it from its allied compounds. As an important article of commerce, it is slowly but surely finding a place for itself. Its remarkable properties, chief of which is its exceeding lightness, make it the most unique of all the metals. So far, however, considerable difficulty has been experienced by manufacturers and others making use of aluminum in sheet form in finding a solder that will successfully effect a junctionbetween two foreign pieces.

The Journal of the Franklin Institute has published in its September issue one or two recipes that will enable aluminum articles, sheets, etc., to be successfully joined. One, called Green's aluminum solder, "is not used with any flux, simply requiring the aluminum faces to be cleaned and first coated with the solder, then with a clean, hot soldering bit to wipe the soldered joint to be made.

"Green's solder is composed of zinc, 50.03 per cent; tin, 47.99; aluminum, 1.76 and phosporus, .22 per cent." Among the many fluxes advocated for this purpose stearine will be found about the best. When joints of aluminum are soldered, electrical currents are generated which flow between the solder and the aluminum itself.

Some of our friends that have yearned for a suggestion relative to the soldering of aluminum will now have an opportunity of exercising their talents in this direction.

THE HEATLESS LIGHT OF THE ARCTIC REGIONS.

The spectral light of the north, that glows with such variable luminosity, has been a mystery possessing weird and in many respects ghastly features. It possesses likewise considerable historical interest. The Holy Book makes mention of horsemen seen running in the air clothed in gold and glittering with ornaments and shining weapons. In 1716 a brilliant auroral outburst took place. One enterprising thinker imagined the brightness of the aurora to spring from flaming hydrogen, of which the upper atmosphere was then thought to be composed. In 1817 Blot located himself in the Shetland Islands, and attributed the existence of the aurora to volcanic dust heavily electrified. But the similarity of discharges in high vacua to those witnessed in the far north left no doubt as to the probable origin of this remarkable phenomenon. When a proper co-ordination of these facts takes place the eleven-year period, governing the appearance of sun spots, magnetic storms and auroral discharges, something more than the mystery of the aurora will be unveiled. Something not yet clearly manifest to the human senses is involved in this triply interesting series of phenomena. Whatever relation does exist between the sun, the earth and its north pole, it will when understood give coherence to a vast mass of disconnected facts.

Mobile, Ala.—The Electric Lighting Co., S. S. Rubira, president, is making arrangements to duplicate the present capacity of its plant, putting in new boilers of 500 horse-power, new engines of 400 horse-power, and five dynamos of the most approved style.

Fort Smith, Ark—Tom Ben Garrett, mayor, may be addressed concerning lighting of streets with electricity.

Pensacola, Fla.—The Pensacola Electric and Terminal Co., W. H. Northrop, president, capital stock $200,000, will erect an electric-power plant.

Augusta, Ga.—The Georga Railroad, Thomas K. Scott, general manager, will equip a large plant for supplying electric power to its shops.

Beeville, Tex.—J. S. Sale and Victor H. Koos are interested in electric-light system.

Abilene, Kas.—City Clerk may give information concerning erection of electric-light plant.

Henderson, Minn.—An electric-light plant will be established.

Question No. 4 may be answered by reference to the curves obtained from the three tests on one piece of insulating material wound with four layers of No. 26 B. & S. bare copper wire. Area of insulation under test was 4.125 square inches, and the thickness was .009-inch.

Curve 13 is the resistance curve for the first heating from 20° C. to 200° C.

The descending portion of the curve between 23° C. and 40° C. is probably due to the coalescing of the moisture within the material; that portion between 40° C. and 80° C. shows the rise in resistance due to the expulsion of the moisture and the remainder the negative resistance coefficient which insulators usually possess.

This test being completed, the specimen was allowed to stand undisturbed and protected from moisture for twenty-four hours. Upon reheating, curve 14 was then obtained. This shows the rapid drop from the enormous resistance acquired by the material on cooling from the previous test.

While the specimen was cooling from the heat applied in test 14, frequent measurements were made, resulting in curve (14*a*), which shows the rise to a still higher resistance than before. At 100° C. the resistance was too great to be measured by the apparatus at hand.

Now the specimen was allowed to stand undisturbed for thirty-six hours, during which time the air in the apparatus was kept moist. Curve 15 was then obtained on repetition of the test, showing that the material when repeatedly heated to 200° C. still retains its property of absorbing moisture, and the effect upon its insulation resistance is not as great as would be expected. But it should be noted that this high temperature of 200° C. greatly injures the mechanical strength of the insulating material.

From the foregoing we may derive the following general conclusions:

a. The presence of brass in the apparatus does not affect the shape and position of the curve.

b. The difference in the curves depends solely upon the amount of moisture contained in the material and its opportunity of escape.

c. Every time the specimen cools the resistance increases to a value much above any resistance that it possessed before, provided it is kept from absorbing moisture.

It is impossible to determiae the limit of this action with the present apparatus. But all the curves, particularly Nos. 5 to 13, clearly show this stepping-up effect, which is practically the same as the well-known result obtained by baking insulating materials.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.—ELECTRICITY DIRECT FROM CARBON.

Jersey City, August 23, 1897.

Electrical Age Pub. Co.

Dear Sirs: Of the many important problems in electricity to be studied out the most important to me seems to be the production of electricity direct from coal. Having noticed in the past several articles in the Electrical Age referring to this subject I take the liberty of asking for further information on the subject. (1) Whether it is entirely theoretical? (2) The relative cost of production compared with present methods? By answering the above you will oblige

Yours respectfully,
A. L. Culline.

(A.)—The original suggestion of obtaining electrical energy direct from coal cannot be traced either to science alone or an inventor's expectations. Ostwald, a distinguished chemist and physicist, has the honor of advancing this proposition and defining its limits. There is a practical basis for experiment in this line aside from the inviting theoretical aspect; but the commercial side cannot be touched upon until work has been done that is of a definite character.

(Q.)—POTENTIAL BETWEEN SOLUTIONS.

Baltimore, August 24, 1897.

Editor Electrical Age.

Dear Sir: Many interesting theories have been advanced by ambitious scientists to account for the flow of electrical energy occurring when two liquids of different density are brought together. The mystery surrounding this phenomenon is not so great as is generally supposed. I believe successful explanations will shortly be given to account for it in detail. Not being able to turn to any source that is original or that tells more than the newspapers might, I inquire at the public fountain head, the editorial office, for further information on the subject.

Yours respectfully,
S. Lavater, M. D.

(A.)—"The difference of potential between solutions of different concentrations, of the same electrolyte, is explained by Ernst as due to the different velocity of the ions set in motion by osmotic pressure, whereby the kations become present in excess in one solution and the anions in the other solution. Inasmuch as the ions bear electric charges with them, an accumulation of positive electricity is brought about in one solution and of negative electricity in the other; and if two indifferent electrodes are placed in the solutions and are joined by a wire, a current must be produced in the wire because of the equalization of the two electricities. Cells of this kind are called liquid cells."

(Q.)—INCANDESCENT LAMP FILAMENTS.

Schenectady, July 27, 1897.

Electrical Age.

Dear Sirs: The lamp filaments I have seen are thick and heavy; do you think I can make a filament that is hollow instead of solid and get the same light with less power? The few attempts I have made lead me to believe that a film of carbon is cheaper to keep incandescent than a solid piece. Awaiting your comments, I remain,

Yours respectfully,
J. F. Bates.

(A.)—Your idea is good but not original. The Bernstein lamp was made by allowing a carbonaceous gas to deposit upon a hot wire, which decomposed the gas and allowed a film of pure carbon to be used. The wire was then withdrawn and the hollow shell used as a filament. Any material that will conduct the current sufficiently to affect a gas and induce deposits will answer the purpose. As for the efficiency or superiorty of this filament over others, that will depend upon its durability and life. There is a saving of power, because less material is heated to a point of incandescence than before; or, if the same amount of material is used, more light is obtained because a greater surface is radiating it. A lamp built upon this principle would be adopted if its life could be assured.

Pipestone, Minn.—The Southwestern Minnesota Telephone Co. has been incorpotated by E. A. Cass, Oswald Cass, Mary M. Robinson, Louisa M. Cass and Thomas F. Robinson. Capital stock, $10,000.

Philadelphia, Pa.—The Bell Telephone Co. will erect three new branch offices.

MODERN OVERHEAD CONSTRUCTION.

BY BENJAMIN WILLARD.

(Concluded.)

This article was unfortunately set aside soon after it was begun due to press of other matter; we take this opportunity of completing it.

Where wood poles are used (or wood pole tops for steel poles), the ordinary five-eighth inch x twelve-inches eyed bolt threaded about four inches answers every purpose for the attachment of the span wires, and other devices more expensive used for the same purpose are not necessary. Poles when properly set will bear a given strain on the span wires for many years without much yielding, consequently an adjustable device is rarely if ever used. Hard drawn copper trolley wire of No. 1/0 B. & S. gauge has been found to be the most practical dimension of wire and is generally considered a standard for most trolley construction; therefore, overhead appliances are made of various manufacture to meet such requirements. There has been a trolley wire recently manufactured in the form of a figure "8" which is now in use on some roads and has given very good results. Where this wire is used it leaves a perfectly unobstructed surface for the trolley wheel and gives greater current carrying capacity, but in modern construction the hanging appliances have reached such a degree of perfection that the round wire can be used with equally as good results, and as the trolley wires on large systems are relied upon but little as a conductor for current capacity, I can hardly recommend anything that would be more practical than the round wire.

Fig. 1. Sectional Feeding Point.

Span-wire hangers and insulators are of various forms and compositions and many possess equal merit, and I would recommend for straight line work those most indestructible and possessing the best insulating qualities. The best forms of such hangers are those where the insulation is concealed from the weather as much as possible, and having a metallic covering to prevent them from being broken by accidental contact of the trolley pole. Brass hangers are more expensive than iron, but resist the moisture and are maintained at much less expense. Iron hangers if kept in good condition should be painted at least once a year, as the oxidization if allowed to accumulate will form a conductive contact between the conductors and span wires, and in course of time will cause the escape of current by leakage. Hard-rubber insulation for hangers is more expensive than many other compositions, but from my experience must say it has fine insulating qualities, and stands different conditions of climate with little or no deterioration.

Fig. 2. Switch Box.

Suspension ears are of as many varieties as hangers, and I have experienced the use of many such appliances and have concluded that a little modification of the old brass solder ear is the most practical and lasting of all, if properly attached. A solder ear should be fifteen inches in length, tapped for five-eighth cap bolt and provided with thin lips at either end so dimensioned as to encircle but little more than half the trolley wire, and one point which should be observed very particularly is to have the ends of the ears ground to a thin tapering end, so that they will become flexible with the vibrations of the wire. If the ends are made heavy or unyielding the vibrations will have a tendency to detach the ear at the points, and when this takes place it is a question of a short time before the ear is wholly detached.

central pull-off wires leading to the centre pole would terminate in an iron ring three inches in diameter fixed at a point about 20 feet from the trolley wire and attached to a single three-eighth inch cable fixed to the centre pole by ending in a strain insulator. Each of the other pull-off wires would lead directly to their respective poles, all ending in a strain insulator fastened to the pole top. Each of the suspension ears should be placed directly perpendicular over the track centres and each provided with a strain insulator between the trolley wire and pole.

Fig. 3. Distributing Centre.

Insulators and hangers for curve construction like straight-line material are of many designs and permit of wide selection. However primitive may seem my ideas of this particular part of construction, I can only give good results from my experience. I favor what is known as the goose-neck hanger which is simply a five-eighth inch steel forging formed of such dimensions as to allow good clearance for the trolley wheel and fastened to the soldered ear in a manner to permit it to swivel, also provided with an eye for the attachment of pull-over wires. Such devices are strong, and do not present an obstructive object for the trolley to catch in. There is no insulation attached to such ears and this is the only thing in their disfavor, but as there are many insulating devices to overcome this difficulty which can be attached to the hanger, this could be considered a minor point.

Fig. 4. Feed Line.

A great deal could be said about overhead curve construction, but there are so many different conditions to meet I will simply conclude my description with a double right angle curve of 60 ft. and 50 ft. radius. The pull-off ears should be placed 11 ft. 8½ ins. apart on the outside curve and those on the inside curve 9 ft. 10 ins. apart from centre to centre (commencing at point of curve) so that the pull off wires between the two curves run longitudinally from the axis of the track curves. The three

There is a wide difference of opinion relative to the arrangement of sections and the methods of feeding such sections of the trolley wire. In many installations a practice is made of leading each individual section feeder to the station and separating the trolley into sections by sectional insulations, making it possible to cut out the various sections at the power house. This is a convenience in one respect, and that is, it makes every section of the line directly controllable from the power plant, but there are other things equally as important to consider which may convince you that better results are obtainable through another method, and that method would be to have every feeder on the whole line doing a share of work at all times, whether the cars be assembled on one section or distributed over the entire line. This, of course, can only be done by means of connections representing the whole line as being in one general section, making short sections controllable by external switches. In the first method mentioned an accumulation of cars may be assembled on one section not estimated for carrying an abnormal load, consequently the feeder would be overtaxed on this particular section, whereas the feeders on other sections would be doing little or no work. Consequently, an unevenness of potential between the adjoining sections. If there is a bridge around each section insulator connecting each section together and connected by a feed wire so that the current will equalize itself between two sections, and so the current will distribute itself from all feeders, then we have a small amount of variation of potential from section to section, and every feeder is auxiliary to each other.

I have observed in most all instances that when an accident occurs to a trolley wire the whole line is for a time disturbed in its service until the proper attention has been given to the external circuit where the trouble occurs, and those on the ground are the ones who are depended upon for relief before the forces at the power house are aware of the extent of the trouble, and the switchboard tenders are always under instructions or advice from the emergency crew. Consequently, I maintain that efficient external line appliances that are controllable by emergency forces meet the most important requirement, and the most efficient line can be built with a general feeder system leading from the switchboard and controllable as a whole for each individual line, and not separated into sections requiring separate feeders for each section leading from the station. To accomplish this method of uniting the trolley sections the line is divided into sections by means of sectional insulators, (see photo No. 1) each section so proportioned as to meet the estimated feeding point where the feeder is to be attached. A switch box is placed on the pole (see photo No. 2) (at a convenient height) in which is contained two switches and fuses, one for the section on either side of the sectional insulator; the feeder is then divided by connection through each switch so that the feed wire delivers current to either section through feeder span wires attached to connections on each side of the sectional insulator. When the entire line is in operation there is an equalization of current in all sections and the trolley remains virtually as a solid conductor, but with all necessary features for disconnecting the sections.

Eye Bolts and Strain Insulators.

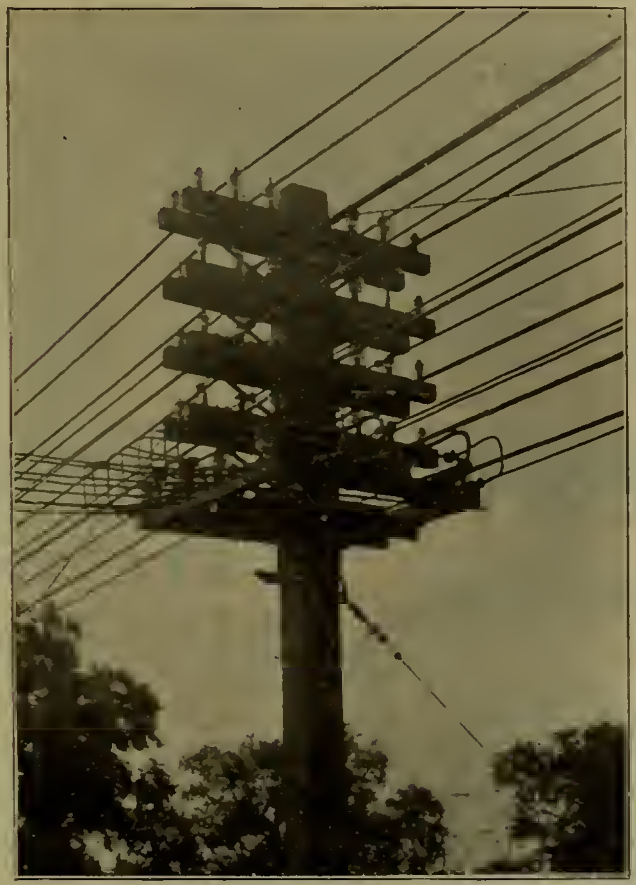


Fig. 5. Junction Pole and Frame,

Feed Line Construction at Curve in Street.

Feed wire distribution is an important item in all installations and varies with local conditions such as distances, amount of work to be done, and cost of producing power. As this is a mathematical problem that is made fitting to meet each of the local conditions, I will only undertake to define a general system for erection and distribution.

In most localities where a large system of feed wire distribution is required it is necessary to erect special construction for that purpose. The most economical plan is to select centres (see photo No. 5) of distribution reached by the most direct routes from the power station and established at such points what may be called junction poles, to which are attached the heavy trunk line feeders leading from the power plant, and smaller feeders for distribution to the trolley line. By this plan we may erect wires of 500,000 or million circular mils capacity from the plant to the junction pole, and end same to a junction frame or frames attached to the pole, which is provided with a bus-bar of sufficient carrying capacity to carry the current of the branch feeders. (See photo No. 3.) The large cables are dead ended in the junction frame by use of eye-bolts and strain insulators (see photo No. 4), and connections are made with the bus-bar with copper tee connections. The branch feeders are ended and connected in the same way, so that it is possible with little delay to cut out any feeder and make changes which are often necessary during progress of operation.

Anchor and Terminal Poles at Power Station.

Southern pine cross-arms five inches by three and one-half inches bored to receive one and one-half inch pins, and doubled on each pole, will make sufficiently strong construction to receive the heaviest wires. The pins should be of locust wood bored to receive a one-half inch bolt, which should extend vertically through the centre of the pin and terminate with a washer and nut on the under side of the arm.

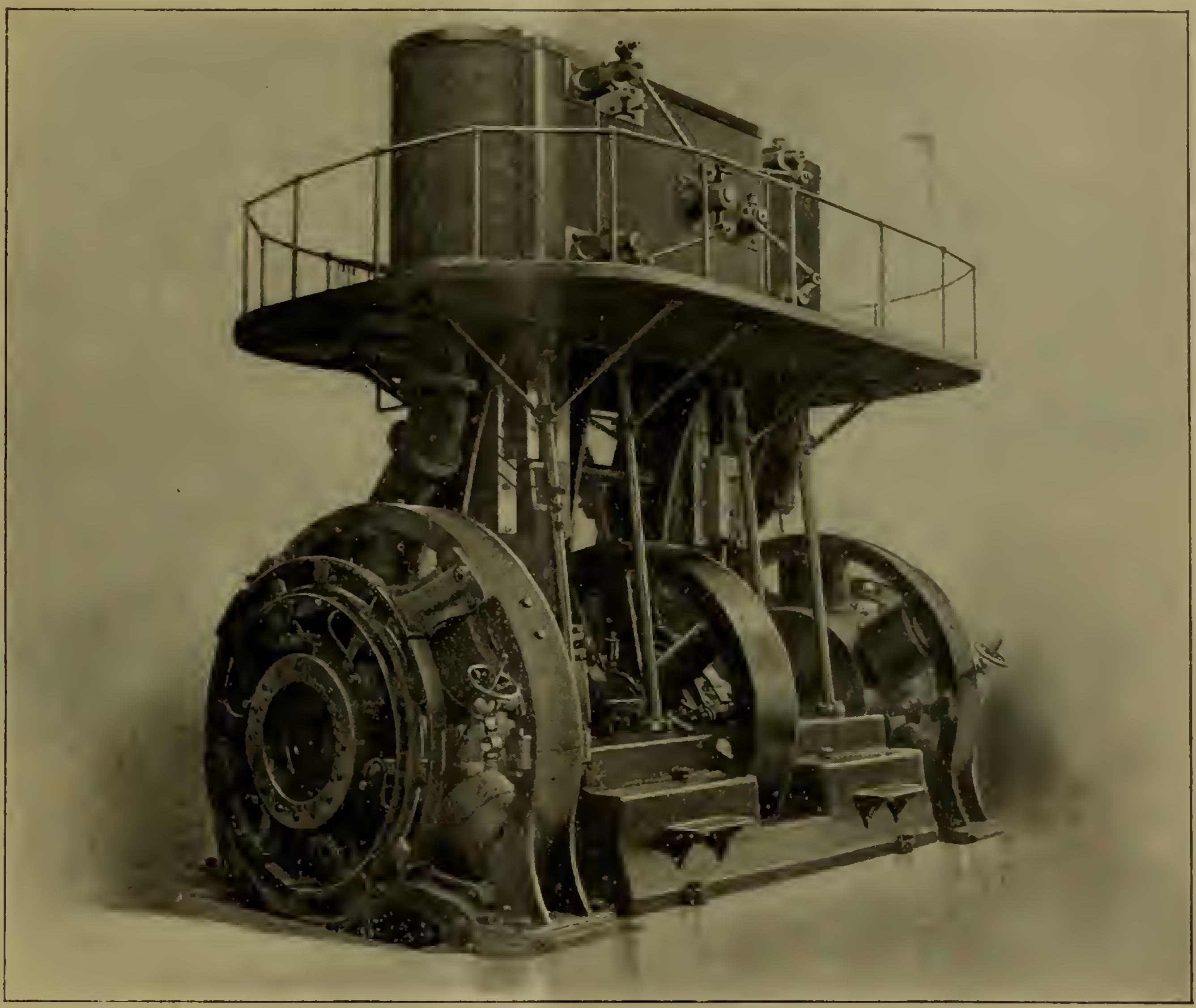
Top grooved glass insulators are desirable in all classes of heavy feed wire construction, and their adoption is to be recommended. Feed wire conductors of larger area than 0000 B. & S. gauge should be in stranded or in cable form, triple-insulated with the best waterproof covering. Care should be taken in splicing cables so that an even strain is brought on each smaller wire, and are not allowed to remain without good contact, and that all flux used in soldering is carefully removed before tapeing.

Devices have been used for connecting cables, but none are to be recommended in favor of the splice made with the cable itself.

Protection from lightning is now occupying the attention of many railway companies, and there is a wide difference of opinion relative to merits of lightning arresters and their application. I have received correspondence from many different railway companies, and in one instance there are two arresters located for forty-two miles of road, whereas in another instance there were six to the mile. The general idea seems to be two to the mile, and situated at or near the junction where the feed wire is attached to the trolley wire. It is somewhat difficult for me to explain all the details of construction in a manner to be digested intelligently in the mind without referring to some illustrations covering the points in question, so I have furnished the association with some photographic illustrations which may be used in conjunction with my description.

The Electrical Age.

VOL. XX—NO. 11 NEW YORK, SEPTEMBER 11, 1897 WHOLE NO. 539



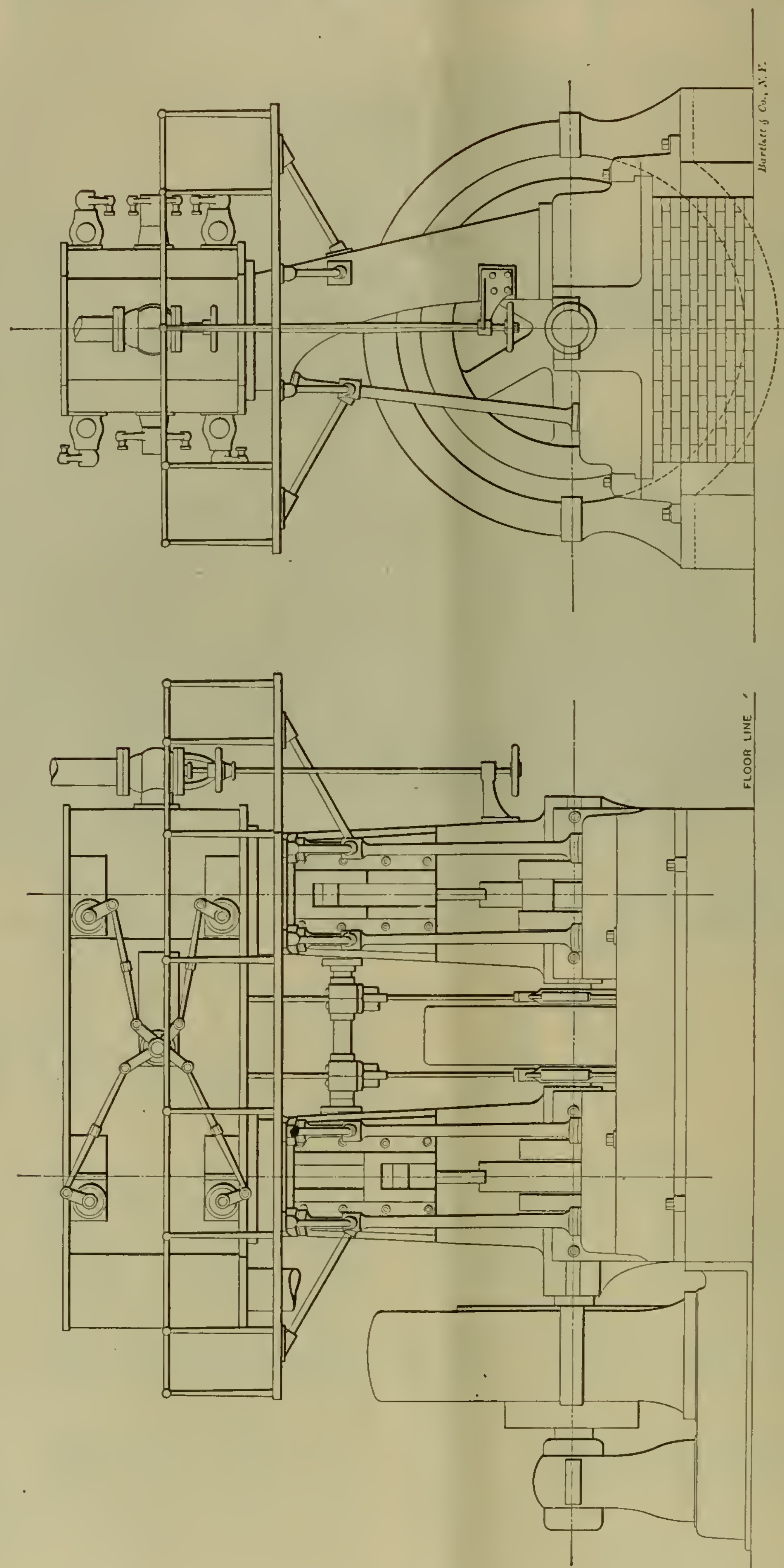
600 H.-P. Vertical Engine, Compound Condensing, with 200-K. W, Direct-Connected Railway Generators. Speed, 150 R. P. M.

ENGINES FOR ELECTRIC LIGHTING.

The design and construction of durable and efficient engines for electric lighting has reached a state of fine art. The Ball & Wood Company, with offices at 120 Liberty St., N. Y. City, and works at Elizabethport, N. J., have made a special study of automatic cutout steam engines, both as regards their design and direct utilization for electric power and lighting. The necessity for an engine that will run at a uniform speed with changes of load, has become so evident that it would be useless to attempt to sell an engine at present that did not at least make a pretence of fulfilling this function. For electric railway, power and lighting, certain demands are made upon engines which quickly assist in the determination of their various qualities. The Ball & Wood Company have taken particular care to build their engines to run smoothly and quietly, and with an efficiency that need cause no concern to those in charge of the coal pile. It is understood by engineers, that have been fortunate enough to intelligently review the work of the last twenty years, that the present development of the steam engine to its high point of finished perfection, can only be attributed to the prodigious advance made in electrical industries. Perfect regulation is required so absolutely for this work that it is safe to say, no one manufacturing engines can hope to survive the practical criticism they will be forced to pass through, if their engines fail in this respect. The Ball & Wood Co. have produced engines for which they can make the following claims : That the material and workmanship are of the best ; that the efficiency of their engines is greater than that of any other form of piston valve engine ; that their governing system is without a fault ; that change of load will not influence the speed ; neither shall boiler pressure until the latest point of cut-off is reached. We present to the readers' notice certain illustrations of direct-connected plants, *i. e.*, Ball & Wood Engines and railway generators, vertical compound condensing engines and incandescent dynamos, as well as views that show details of valve gear in their vertical engines. These magnificent types of high class American machinery represent the extent to which detail in design and finish has been observed and clearly demonstrate the infinite superiority of American over European machinery.

Fortunately for those steam users who visit New York and who are contemplating the employment of engines, a visit to the works of The Ball & Wood Co. is very easy.

These works are located in Elizabethport, one-half hour's ride from the main office of the Company in New York City. The property adjoins that of the Singer Manufacturing Co., and is 200 feet by 900 feet in extent. The main building is the machine shop, built on the gallery plan, and the other buildings are paint shop, boiler rooms, nickel plating and forging departments, etc. As evidence of its fine shipping facilities an engine can be loaded complete with boxes, wheels, etc., on a flat car in five minutes. The tracks of the Central Railroad of New Jersey run alongside the works, one track extending into the machine shop and covered by a heavy electric crane.



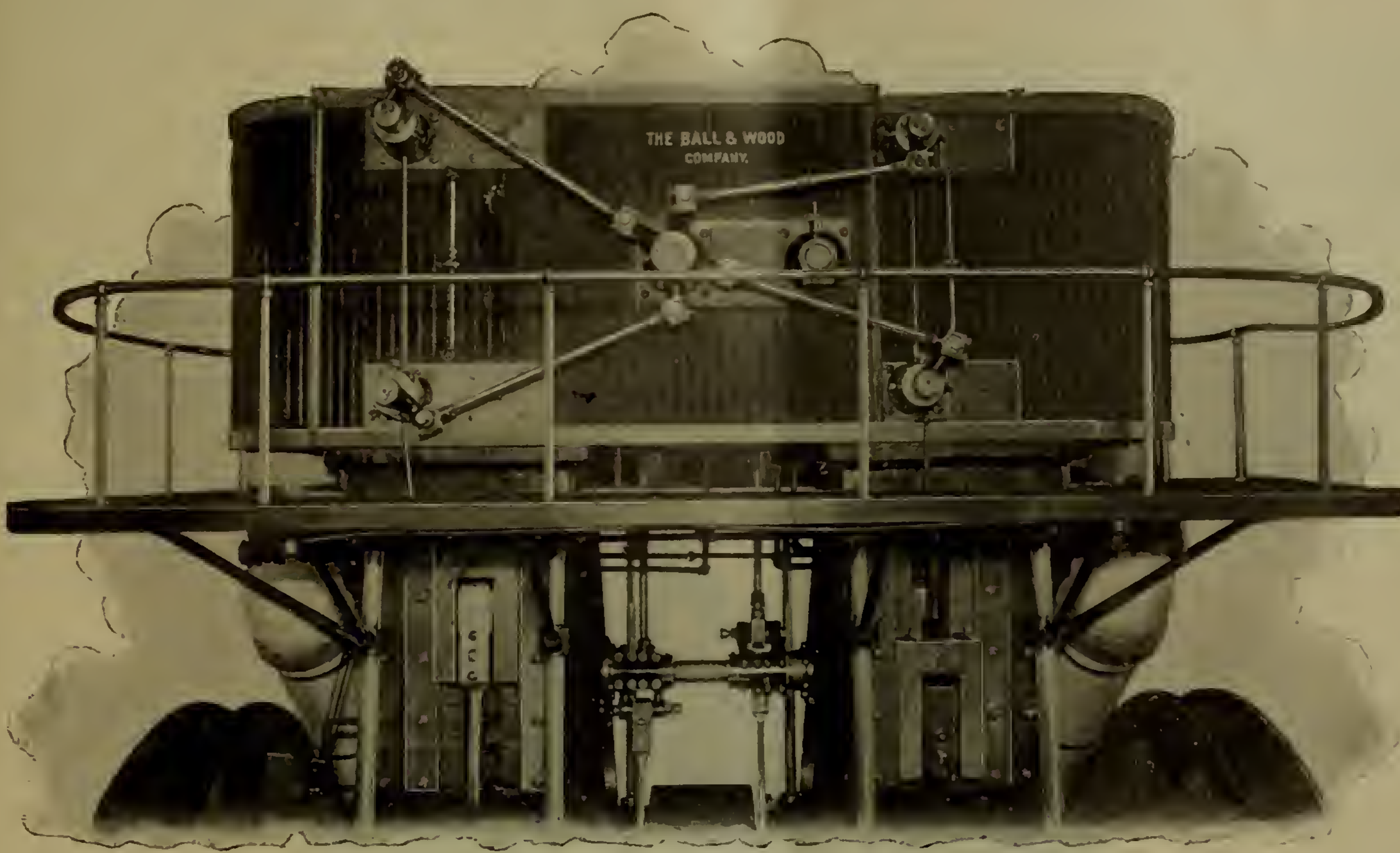
450 H. P. Vertical Engine, Compound Condensing, with One 300-K. W. Direct-Connected Railway Generator. Speed, 175 R. P. M. Ball & Wood Co.

In the machine shop the small tools are under the galleries and the large ones in the open centre, to be served by the travelling crane which handles the heavy castings. New tools are constantly been added, and it is the policy of the Company to leave nothing undone that will increase the usefulness of the plant or add to the efficiency of the machines produced.

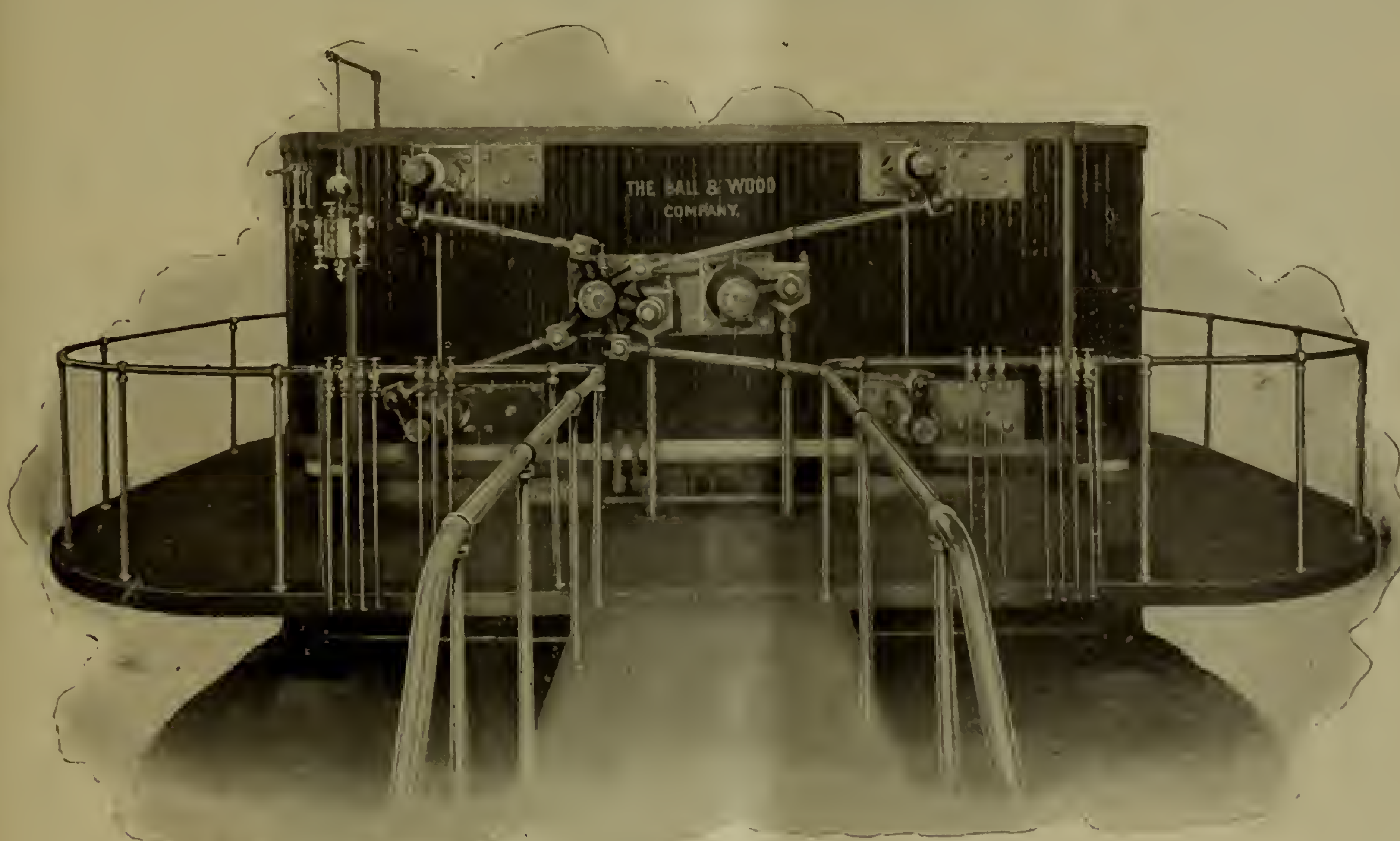
One of the most interesting departments of the establishment is the testing room ; every machine before being shipped is assembled and operated under load, to make sure that every part has been well constructed and the speed regulation perfect. The method of testing governor regulation is by the electric tachometer, a machine designed by this Company and used by it exclusively. It furuishes a sensitive and perfect test of speed regulation, and through its use the most minute variations in speed can be visually determined. No engine is considered perfect unless it regulates within one per cent. between abrupt changes from no load to full load, a regulation which would have been considered impossible a few years ago, and which is now so characteristic of the Ball & Wood Engine.

The demand for these engines has compelled this company to build them in all the various forms which are used in general manufacturing work, as well as in electric railway and lighting. They include the Simple and Compound Horizontal engines, with both the Tandem and Cross Compound types and Vertical engines of all sizes.

The Ball & Wood Company are prepared to connect their engines, either horizontal or vertical, to any of the standard makes of dynamos, being well equipped with patterns for this service and having a large portion of their business already lying in this direction. It is needless to add that they will be glad to consult with the dynamo builders and co-operate with them as to multipolar work, since in this field an exchange of ideas can be attended with excellent results, for since the new combination is to contain the best types of each component part, it is essential that the whole should be not less economical and efficient than the best efficiencies of either, taken singly.



Detail of Valve Gear. Vertical Engine. Front View. Ball & Wood Co.



Detail of Valve Gear. Vertical Engine. Rear View. Ball & Wood Co.

ELECTRIC METERING FROM THE STATION STANDPOINT.

(Concluded.)

Even today the pernicious influence of uniform bills the year through, which was created by the contract system, still lingers ; and the proportion of customers who complain because their winter bills are materially higher than their autumn and summer bills is quite considerable.

It will be said that the explanation is sufficiently simple; but unfortunately, however good and however simple the explanation, it has proved no simple matter to secure its acceptance and credence. I have lately been much impressed by a system which has recently been adopted by a prominent Western company to at least partially offset this difficulty. During the months which are growing darker they read their meters a day or two earlier each month, thus arbitrarily creating shorter months, whilst as the year progresses to the period of lighter days, the months are lengthened. This somewhat tends to even up the bill, is apparently quite as satisfactory to the customer, and is certainly entirely just and has created a very great falling off in the complaint list, for the character of the complaint keeps pace with the period of the year. Out of the hundreds of complaints which I receive annually, I find that by far the greater proportion in the summer are of slow meters and in the winter of fast meters.

I do not feel that I shall be doing justice to my subject should I fail to make at least brief mention of the application of meters to the measurement of station output.

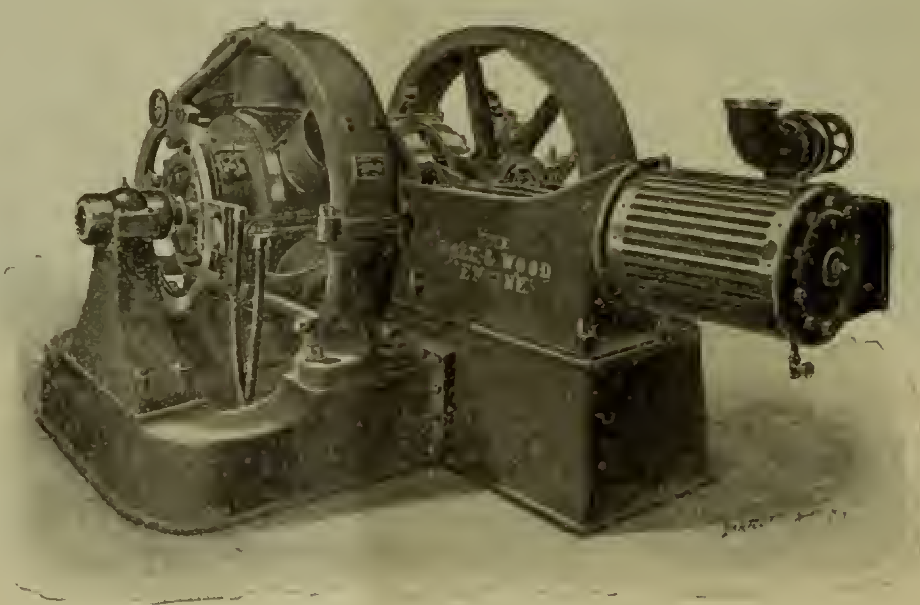
The gas companies, to whom all central stations look for precedents, long ago found it imperative that they should have some means of determining just how much of their commodity they produced and sent out through the mains. In all commercial enterprises it is difficult to satisfactorily guide and control a business unless there be some positive means of determining how much of anything is produced ; and it is surely just as important to all electric lighting companies to know how much of their commodity they manufacture as for any other concern. Until quite recently it has not been possible to obtain recording meters sufficiently large to care for the heavy outputs which are now so common, but such meters are now readily obtainable.

The value of a system of station meters must necessarily prove very great, since it furnishes an absolute check system upon coal and water consumption, and engine and dynamo efficiency; whilst it also furnishes a ready means for comparison between station output, customers' meter indications, line losses, leaks and grounds.

In closing, some brief consideration at least is due to the new fields into which meters are reaching, and to the help special metering features may perhaps give indirectly as well as directly, to the amplifying of the business of electric light and power companies and to their more economic operation.

There has recently been much iuteresting discussion regarding the question of the flattening of the peak of the load either by the systematic modification of rates under special time contracts, governing the hours of burning, which does not concern the immediate subject matter of this paper, or by an actual modification in one of several forms in the meter itself, which should practically make the meter automatically control the modification of the rates in such a way as to gain the same end with certainty, as is aimed at in the special contract system.

Whilst personally I have grave doubts regarding the actual feasibility of this plan commercially, in view of other and perhaps simpler methods by which it can be accomplished, I still have much respect for all of the various methods which have been proposed, and do not question that there will be at least many cases where they can be advantageously applied. Questions relating to the peak of the load, however, are subject to such great variations locally that a rule which would apply in New York might very readily fail in a system adopted in a smaller town.



Direct Connected Engine. Ball & Wood Co.

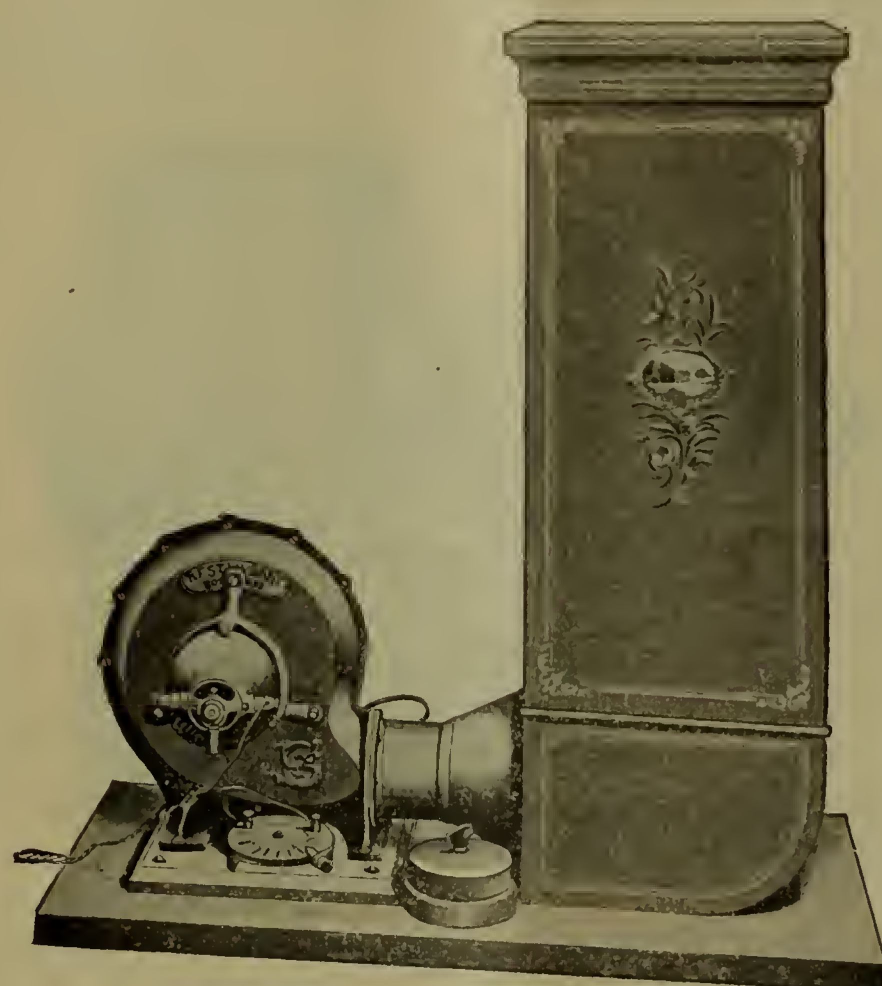
It is quite obvious that the best double-rate meter will be that which tends to flatten the load curve of the station, not by oppressing or discouraging the user of light, who must have his light at the period of the peak, so much as by encouraging the use of light at other periods. We do not want to provide means for cutting off the peak so much as we want means for raising the rest of the curve to the same height as the peak. In my personal opinion, it is in this respect that perhaps the most ingenious of all these double-rate meters falls short. I refer to that form of two-rate meter which proportionately increases its rate of record at such time as the local load which it is measuring is highest. This discourages the use of light at the period of the local peak, and if the local peak and the station peak are coincident, it absolutely fulfils its purpose. But if they are not it fails, because instead of discouraging the use of a large amount of light at the time of the local peak, it should actually encourage it. Encouragement of local peaks, which are not coincident with the station peak, is beneficial to the central station in the highest degree, for it tends, as I have pointed out it should, to raise the general load curve towards the station peak magnitude.

If two-rate meters are to be used, therefore, I believe that their increased proportional speed should be dependent purely upon the occurrence of the station peak, and should bear no relation whatever to the occurring of the local peak. Such an arrangement can be secured in a number of ways, all of them simple and all effective.

One other feature of metering, which has recently come into existence in Europe, is about to make its appearance commercially in this country. It brings with it much of promise for the increase of profitable business for central stations. I refer to the prepayment meter system—the drop-a-nickel-in-the-slot and get-your-money's-worth-meter. In gas practice this system has proved an unqualified success. I am informed that the London Gas-Light Company added 6,000 new customers of a profitable kind over and above their average annual growth in a single year; and other companies have had similar experience.

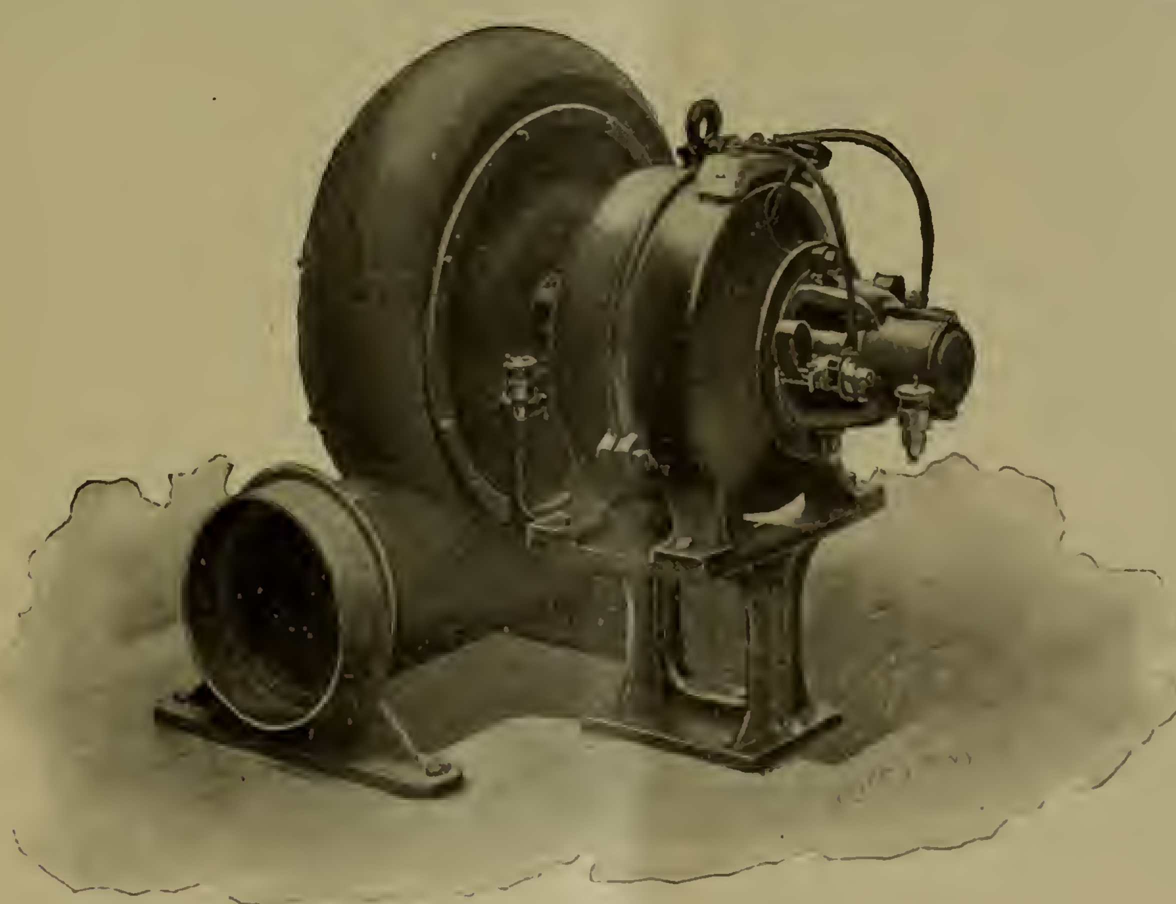
There is in every large city a considerable area into which illuminating companies have been unable to go by reason of the untrustworthy character of the people who would there be their customers. In other words, because the people in these districts are a floating population without credit, coming today and going tomorrow, and yet ready and willing to buy electric light at high rates.

The prepayment meter throws open this rich field and makes it immediately available ; and here I predict for it wide usefulness.



Lundell Motor, Sturtevant Blower and Gold Heater Combination.—Hot Blast System of Electric Heating.

Nashville, Tenn.—The Swartz Switchboard & Electric Co., of Knox County, has been incorporated by H. B. Branner, C. R. McCormick, Henry J. Swartz, W. S. Miller, and W. H. Goss. Capital stock, $10,000.



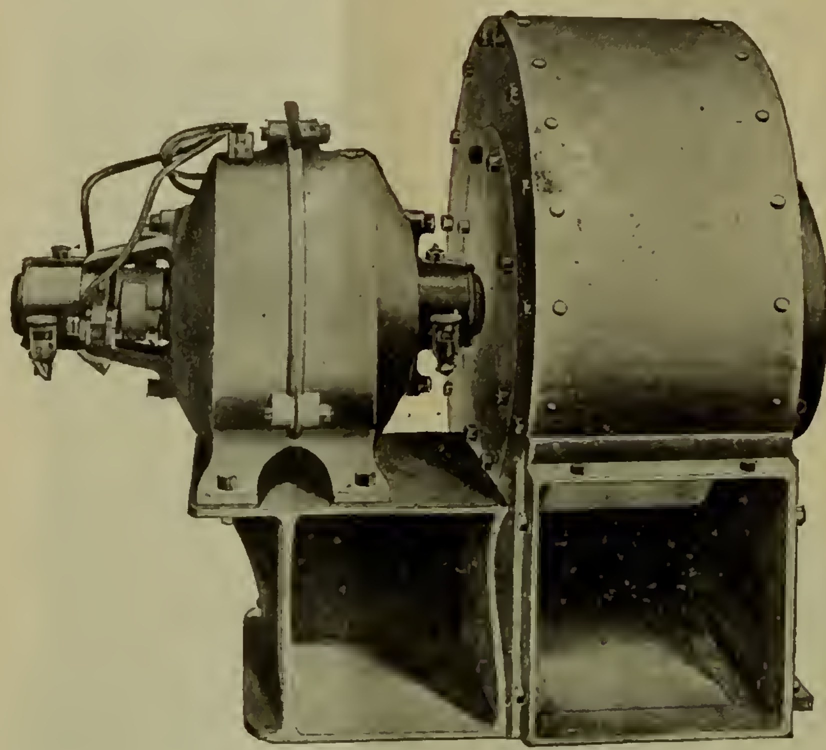
Buffalo Forge Company Lundell Motor.

Columbus, Ohio.—The Columbus Northwestern Railway Co. has been incorporated with a capital stock of $100,000.

VENTILATION.

Sailors had the habit of whistling for a breeze when a calm prevailed in the good old days of full rigged sailing vessels. They were confident that if they only whistled long enough the breeze would come. That habit would have quickly died out had such vessels been provided with a modern blower, equipped with a series of loud toned whistles. It is possible to get a pressure of many pounds per square inch from a blower such as is used for purposes of ventilation. Full equipments consisting of both blower and electric motor in direct combination, are sold by the Interior Conduit & Insulation Company, 527 W. 34th St., N. Y. City. The breeze one of their large blowers produces would seem sufficient to drive a vessel clear across the Atlantic, but if it failed in this respect it could be used in a more satisfactory capacity, that is, to drive pure, fresh air through the vessel itself. The holds of ships, cellars, basements of houses, restaurants, and innumerable other places, can and do utilize blowers of all sizes to the best advantage. The Interior Conduit & Insulation Company attach their motors to the best blowers made. They have on exhibition direct connected Lundell motors and blowers made by the Buffalo Forge Company, American Blower Company, etc., as the illustrations indicate. The size of motor varies according to the pressure of air required ; the equipments running in size, as regards power, from one-sixth of a horse to thirty-five horse-power.

Combinations of Lundell Motor and Sturtevant Blower in co-operation with a Gold Heater perform the function of sending three grades of heat into a room that is to be warmed. The motor has three speeds ; the amount of air handled per minute under full speed is three hundred and ten cubic feet ; the same can be delivered in that time at a temperature of two hundred degrees. This electric heating combination cannot be excelled for convenience and readiness of operation.



American Blower Co. Lundell Motor.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

The above Association represents the electric light interest of the greatest cities in the United States. They have settled upon Niagara Falls as the place of meeting for obvious reasons. It is one of the greatest sights in the world to either the man of sentiment or the lover of science. The rushing torrent is so vast that words are

Samuel Insull. President Association of Edison Illuminating Companies.

The Electrical Age.

Established 1883.

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NEW YORK, SEPTEMBER 11, 1897.

CONTENTS.

AN INTERNATIONAL TESTING LABORATORY.

A new scheme has been proposed which could only have originated in the minds of men living in the present era. It is one that speaks well for the ambition, enterprise and forethought of men that have risen to fame in scientific investigation. Dr. Hermann Wedding, the great metallurgist, refers to a meeting, or rather a congress held at Zurich, Switzerland, in 1895, in which a society of an international nature was founded, for the purpose of considering certain engineering methods of testing materials used in the erection of structures, etc. The scope of this work was of course limited to a particular field, but it has been concluded by those attending, that a central laboratory in which experiments and investigations could be carried on in all fields of science and industry would be more in the line of real progress and certainly the best aid for the advancement of whole-souled investigators. The city of Zurich was chosen and the ample accommodations given by those in charge of the federal polytechnic school, free of rent, for the establishment and centralization of a proper scientific workshop, has started this great scheme on its way to happy fulfilment. Hans von Jueptner, the chief chemist of the Neuberg Iron and Steel Works, in Austria, has been elected to the office of curator. Funds must be raised for the endowment and support of this laboratory; the expense of which will probably be about $10,000.00 per annum. It seems that the amount required can only be obtained by subscription. The firm of Krupp, of Essen, has subscribed $250.00 per annum to begin with, while other great ironworkers of Austria have built up a sum of $1,750.00 per annum. This great country with its vast industries can surely afford to help so worthy a cause and donate to this great international laboratory a small fraction of its profits. The Bible says, "give one-tenth to the poor." This is more than charity because the good derived therefrom is not local but of world-wide benefit. The next meeting of the International Society will be at Stockholm, Sweden, August 23, 1898.

WASTED GOLD.

It is well known by those who have visited gold fields in any part of the earth, that a great quantity of gold is wasted whenever the panning process is employed. Reports from Alaska indicate this fact very clearly by mentioning the mounds of panned earth left by miners as containing thousands of dollars' worth of fine gold. In Alaska, during the winter, the earth is frozen black and solid and water cannot be used. This same difficulty presents itself in regions remote from Alaska. There are great dry plains in West Australia so hot and alkaline that the most miserable savage shuns them as he would a plague. There are gold fields to be found there, but the absence of water excludes the possibility of ever getting at the hidden treasures. An engineer and explorer coming from West Australia believes that some electrical method can be employed through which the gold can be extracted by a dry process. There may be some ingenious mind ready to make use of this suggestion which is merely a hint in the direction of wealth. A dry method of extracting gold might be found more valuable to its owner than the rich mines of El Dorado, Cripple Creek or the Yukon district.

CONVENTION MEETINGS.

There will be several important conventions held next week by the representatives of street-railway and electric-light interests, as well as a meeting of the International Association of Fire and Police Telegraph Superintendents. It is interesting to note the gradual organization of allied interests for purposes of protection and instruction, or for the purpose of improving the nature of the work they are called upon to perform, by social communion. In a short time there will not be a single department of electrical engineering that has not unified its interests by the formation of an association in which those representing it can meet from time to time for their own mutual benefit. It is remarkable to realize how great a development has taken place in lines of work that but a few years ago were practically unknown. The benefits derived from these individual co-ordination of interests are noticeable in the steady progress that is achieved in every branch of industry or science that has so acted.

Wenonah, Pa.—An electric-light plant is to be established.

Gainesville, Fla.—An electric-light plant is to be established.

Gainesville, Ga.—An application has been made for charter to build a new street railroad for Gainesville.

Saco, Me.—The Saco River Electric Railroad granted permision to run its tracks through North and Elm streets.

Greenville, S. C.—An electric-railway plant will be established.

Tampa, Fla.—F. A. Salomonson and others have been granted permission to build and construct a street railway.

Siloam Springs, Ark.—A combination plant will be erected to furnish the city with water and public lights.

weak in description; the enterprises that have crystallized at this spot so gigantic, that large commercial interests are supported by them. The Association of Edison Illuminating Companies could seek far and wide to find a more interesting place to meet. The dates fixed upon are the 14th, 15th and 16th of September, for the gathering of the clans.

The convention will be held at the Cataract House, the leading hotel at the Falls. Accomodations for all members can be secured at this house at special rates of $3.50 per day for each person; it being expected that at this rate one person will occupy a single room and two persons a double room. Should one person occupy a double room, the rate will be $5.00 per day. All members having already reserved accommodations through the Secretary will receive a ticket direct from the hotel before September 1st, giving the number of the room, etc. All members who have not as yet reserved accommodations should communicate at once with the Secretary of the Association. All members who expect to arrive before the morning of September 14th should communicate this fact to Mr. Green of the Cataract House, so that there may be no misunderstanding as to their accommodations, as the Secretary has in all cases reserved accommodations only for September 14, 15 and 16.

The meetings of the convention will be held in the large ball room of the hotel, which is admirably suited in every way for this purpose. The sessions will be called to order at 10 A.M. each morning, commencing with September 14th, and 8 P.M. every evening, ending September 16th, the afternoons of the three days being devoted to the entertaining of the representatives, ladies and guests.

The programme of the convention will consist of papers and discussions upon methods of charging for current, construction and practical use of the photometer as applied to the gas industry, storage batteries, economy in distribution of electrical energy, recent developments in electrical measuring devices, besides reports of various committees and Lamp Testing Bureau.

The entertainment will comprise a visit to the power house of the Cataract Construction Company, a ride through "The Gorge" on the new electric road, tally-ho ride, etc., etc. A large number of favorable replies to the former notice of the Secretary has already assured a very large attendance; in fact, the convention promises to be the most successful one in many years.

The officers of the Association are, for the years 1896-97:

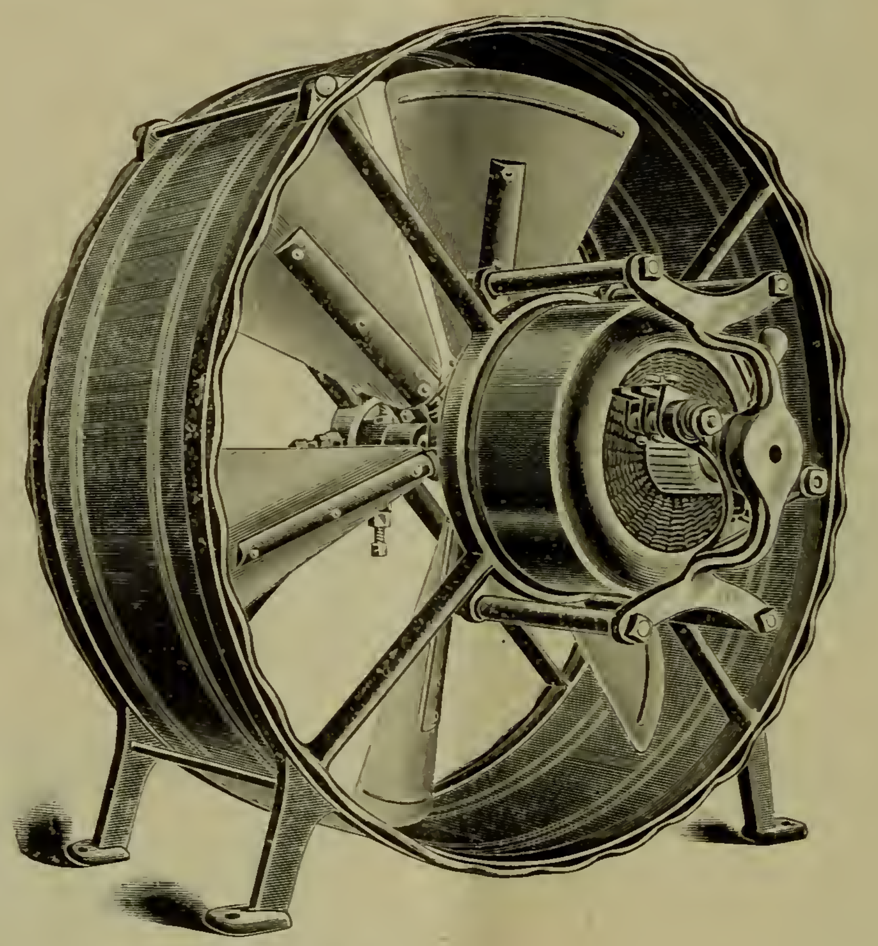
President, Samuel Insull, Chicago, Ill.
Vice-President, R. R. Bowker, New York, N. Y.
Secretary, W. S. Barstow, Brooklyn, N. Y.
Treasurer, J. W. Lieb, Jr., New York, N. Y.

Executive Committee, 1896-97:

C. L. Edgar, Chairman, Edison Electric Illuminating Co. of Boston, 3 Head Place, Boston, Mass.
Alexander Dow, Detroit, Mich.
J. H. Vail, Philadelphia, Pa.
G. R. Stetson, New Bedford, Mass.
A. W. Field, Columbus, Ohio.
Samuel Insull, (ex-officio,) Chicago, Ill.
R. R. Bowker, " New York, N. Y.
W. S. Barstow, " Brooklyn, N. Y.
J. W. Lieb, Jr. " New York, N. Y.

Those desiring further information can address the Secretary, Mr. W. S. Barstow, 358 Pearl St., Brooklyn, N. Y.

THE WING DISK FAN.



Wing Disk Fan.

Since the beginning of the nineteenth century the habit of raising the wind has become so general that it is not so strange to find certain departments of trade engaged entirely in this interesting work. Perhaps among them all there are none that appeal so directly to the imagination as those that achieve this object by manufacturing fans. It is our pleasure to state that this interesting vocation is most successfully followed by the firm of L. J. Wing & Company, 109 Liberty street, N. Y. City. It can be truthfully said that the extent to which they raise the wind is practically due to the unique and perfectly designed fans and ventilators they produce. The solid construction and scientific curve and pitch given to the body proper and blades of the Wing disk fan, testify to their efficiency and durability as wind raisers. The illustrations show a combination consisting of the Diehl Electric Manufacturing Company's motor and a Wing disk fan, direct connected. Remarkable results are obtained from this intimate co-operation of power and fan. Perhaps there is no better method of raising the wind than by using one of L. J. Wing's improved disk fans.

THE CONVENTION OF THE STREET-RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.

NIAGARA Falls represents one of the greatest and most rapidly growing power centres in the world. It will be a scene of unusual activity on the dates set by the Street-Railway Association of the State of New York for their fifteenth annual meeting. The headquarters of the association will be the International Hotel, and the convention will extend over a period of two days, September fourteenth and fifteenth. This growing association now represents the most powerful street-railway interests in New York State, and many familiar faces will be present at Niagara to do honor to this event. A definite programme has been arranged, which will include business meetings, in order that proper attention may be given to matters of direct interest to the association and to provide time for discussions and papers on street-railway questions. The general order of procedings will be found under the following head:

Tuesday, September 14.

9:30 a. m.—Meeting of the Executive Committee.
10:30 a. m.—Meeting of the Association.

Order of Business.

1. Call of the Roll.
2. Approval of the Minutes.
3. Address of the President.
4. Report of the Executive Committee.
5. Minutes of Special Meeting of the Executive Committee.
6. Report of the Treasurer.
7. Reading of Papers on Practical Street-Railroad Questions by well-known gentlemen. Names and subjects to be announced.
8. Discussion Ensuing.
9. General Business.
   (I) Appointment of Nominating Committee.
      a—Nominations of Officers.
      b—Selection of place of next meeting.
   (II)—Election of Officers.

5:30 p. m.—Executive Session of the Association.
7:00 p. m.—Banquet (International Hotel).

Wednesday, September 15.

9:30 a. m. —Meeting of the Association. General Business.

There will be a great many amusements provided for in order that gentlemen escorting ladies may find means of interesting them in matters not pertaining directly to electricity, and for that reason another programme has been prepared which will comprise visits to all points of natural beauty as well as a chance of inspecting some of the great power generators supplying current to street railways and manufacturing interests. Details concerning the same will be found as prepared by the local committee entrusted with the office of entertaining delegation visitors at the approaching convention.

H. M. Littell.

First Day, Tuesday, September 14.

Arrangements have been made for a delightful excursion for the ladies to Toronto and return, at reduced rates.

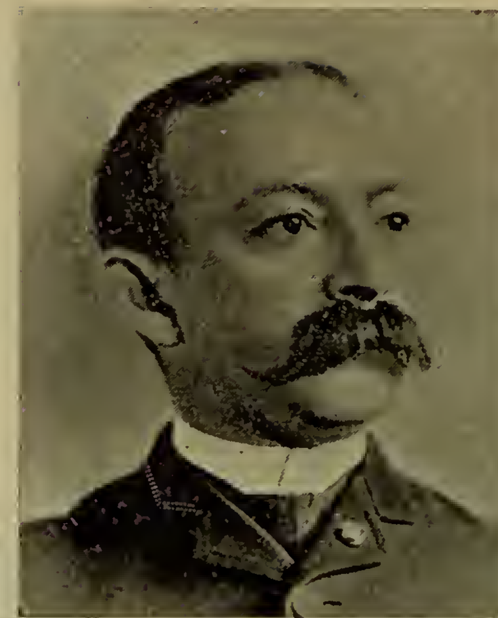
7:00 p. m.—Banquet (International Hotel).

Second Day, Wednesday, September 15.

Trip 1.

Across the bridge of the Niagara Falls and Clifton Suspension Bridge Companies to Canada; thence by special cars over the Niagara Falls Park and River Railway to view the Horseshoe Fall and Rapids and to Chippawa, and thence to Queenstown; thence by the Niagara River Navigation Company's steam ferry to Lewiston, N. Y., returning to Niagara Falls by the Great Gorge Route.


A. J. Corriveau.


Capt. W. L. Candee.


John Brill.


Harry Evans.


J. S. Speer.


Edgar Peckham.


F. A. DeRonde.

PROMINENT FACES AT THE CONVENTIONS.

Trip 2.

A visit to the plant of the Niagara Falls Hydraulic Power and Manufacturing Company. In this plant the electrical installation is 250 feet below the top of the high bank of the Niagara River. This plant furnishes 6,000 electrical and hydraulic horse-power for lighting, railroad and manufacturing purposes, and is now being enlarged to furnish a total of 16,000 electrical horse-power.

Trip 3.

By the cars of the Niagara Falls and Suspension Bridge Railway Company to visit the plant of the Niagara Falls Power Company where 15,000 electrical and hydraulic horse-power is now being generated for lighting, railway and manufacturing purposes. The enlargement of the plant is now in progress sufficiently to generate a total of 50,000 horse-power. Here also may be inspected the machinery from which 1,000 electrical horse-power is now being transmitted to Buffalo for the purposes of the Buffalo Railway Company. This transmission line when completed will transmit 20,000 horse-power.

Trip 4.

A visit to the New York State Reservation and Islands, and upon the steamer Maid of the Mist.

9:00 p. m.—Grand Ball (International Hotel).

On the morning of the 16th the entire party will be conveyed to Buffalo in special cars of the Buffalo and Niagara Falls Electrical Railway through the courtesy of that line, the Niagara Falls and Suspension Bridge Railway Co., and of the Buffalo Railway Company.

The above list of events should serve in itself a sufficient inducement to attract a large number of delegates and guests irrespective of the promised interest and benefit to be derived from the Association meeting.

Every street railroad in the State should be well represented at Niagara Falls September 14th and 15th.

The president of the Street Railway Association of the State of New York is Mr. G. Tracy Rogers, of Binghamton, N.Y. Mr. W. Caryl Ely, of Niagara Falls, 1st vice-president. John N. Beckley, of Rochester, 2d vice-president. Henry A. Robinson, of New York, secretary and treasurer. The executive committee is composed of the following gentlemen: G. T. Rogers, H. H. Vreeland, John W. McNamara, Henry M. Watson, Clinton L. Rossiter and H. A. Robinson. The president, Mr. G. Tracy Rogers, is one of the most active men in Binghamton, N. Y. He is considered one of its most representative citizens, his energy and enterprise having assisted considerably in the development of that large and growing town. We expect to find many friends present at Niagara whose capacity for work and pleasure at the same time is unlimited. They belong to the class of men that draw a line of division between labor and laughter, and when circumstances call for attention to either one are found ready and willing to enter into a consideration of the same without hesitation. We publish a few of what we call "familiar faces" which will be found at the coming convention. We predict for them and all delegates and visitors an enjoyable time and a pleasant trip.

INTERNATIONAL ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS.

In accordance with resolution passed by the Executive Committee, at its meeting held on May 15, the second annual meeting of the "International Association of Fire and Police Telegraph Superintendents" will be held at Nashville, Tenn., on September 14, 15, 1897, at 10:30 A.M. Headquarters at the Maxwell House. It is hoped that a large attendance will be present, as business of the utmost importance will be transacted. Valuable papers will be read touching upon many important subjects connected with their daily business experiences. Officers are to be elected for the coming year, and, to a great extent, the future welfare of the association depends upon a successful meeting at Nashville.

F. C. Mason, Pres., International Ass'n Fire and Police Telegraph Superintendents.

The officers of the above association are:

President—Frank C. Mason, Brooklyn, N. Y.
Vice-President—Morris W. Mead, Pittsburgh, Pa.
Secretary—L. Lemon, Baltimore, Md.
Treasurer—Adam Bosch, Newark, N. J.

This association has done a great deal of good work in the past year by creating new interest in this field of work and consolidating into one great organization the fire and police telegraph superintendents of America.

A large number of superintendents who were elected to membership last September have promptly paid their annual dues for 1896 and '97; there are still quite a number who have failed to do so. To those who have failed to respond to the secretary's notices requesting payment of yearly dues, amounting to only $5, an earnest appeal is made. Kindly notify Mr. Mason without delay if you desire to retain your membership in this association, which is sure to be of great value to you in the future. This money is to be used for stationery and printing papers read at Nashville, the same to be distributed among the members. "The Old Time Telegraphers" and the "United States Military Telegraph Corps" meet in Nashville at the same time set for the meeting. Those attending are sure of having an instructive and enjoyable time.

If it is your intention to attend this meeting it is suggested that you secure your room at least two weeks in advance. The Maxwell House is strictly on the European plan, and the rooms can be had at from $1 to $3 per day for each person.

Mr. Frank C. Mason is the president of this association. His resolute and energetic spirit has been efficient in developing this movement and inspiring its members with a deep and abiding interest.

M. W. Mead, Vice President.

HARVEY L. LUFKIN.

It will no doubt come as a painful shock to the friends and acquaintances of the late Harvey L. Lufkin to learn that by his death, his widow, a most estimable lady, has lost her sole support, and, what is more, has been left without any source of income whatever. Realizing her situation, Mrs. Lufkin has therefore bravely determined to make her own way in the world and is now seeking to obtain such employment as she is best fitted for. Up to the present time, owing to the absence from the city of many families, in which she might find a fitting place, her efforts at self-support have been unsuccessful. She has therefore, at the solicitation of friends consented to make her distressful condition known to the friends of her husband, and to ask for aid to enable her to tide over her temporary difficultiies.

A committee has been formed to undertake the collection of funds for her benefit, and Mr. James W. Godfrey has kindly consented to act as treasurer.

It is earnestly hoped that this appeal will meet with a prompt response, and the committee would impress upon contributors the fact that any contribution, however limited, will be welcome. The case is an urgent one.

James W. Godfrey,
George F. Porter,
C. O. Baker, Jr.,
Robert B. Corey,
Joseph Wetzler,
of the Committee.

Address all contributions to Mr. James W. Godfrey, 15 Cortlandt street, New York.

S. Lemon, Secretary.

ASSIGNMENT.

Notice is hereby given that Louis J. Auerbacher and Henry Venino, composing the firm of Auerbacher & Venino, carrying on the business of electrical engineers and contractors and dealers in electrical supplies, at No. 317 Market street, Newark, N. J., have this day made an assignment to the subscriber of their estate for the equal benefit of their creditors, and that the said creditors must exhibit their respective claims against said estate, under oath or affirmation, to the subscriber, at his office, northwest corner of Tremont and Berkeley avenues, Orange, Essex County, New Jersey, on or before November 23, 1897, being three months from the date of said assignment, or be forever barred from coming in for a dividend of the estate.

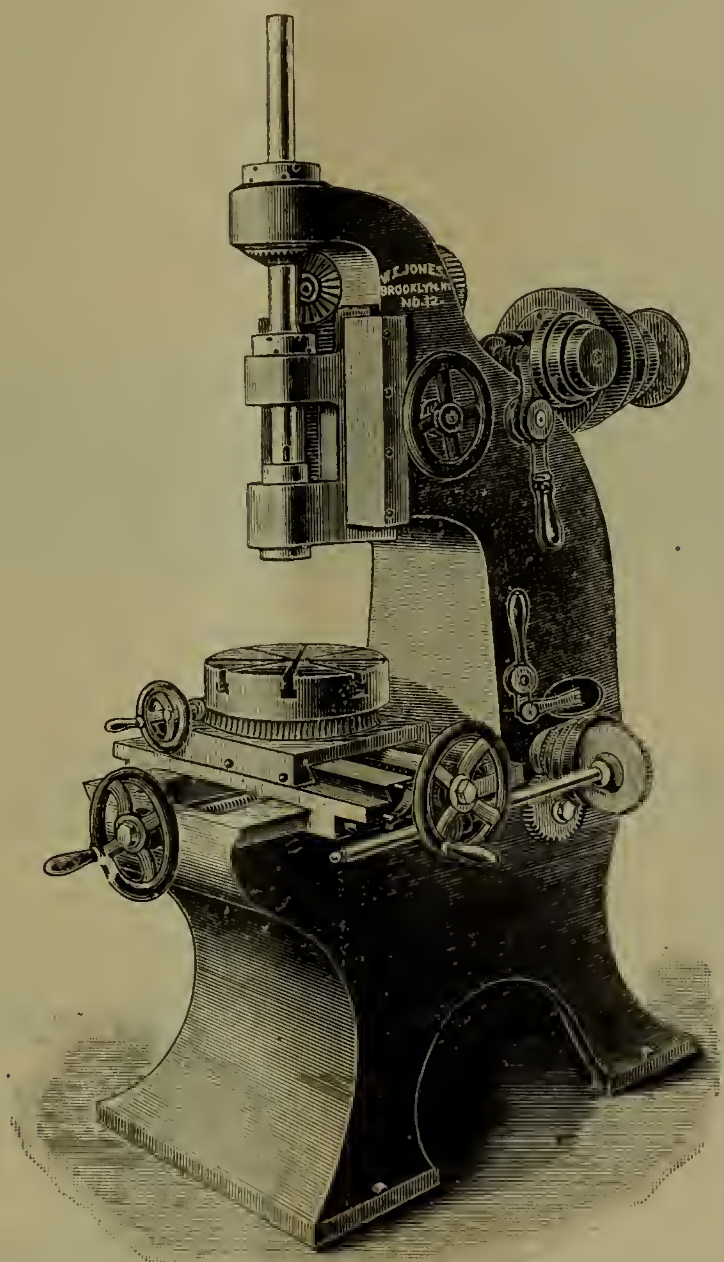
Dated Newark, N. J., August 25, 1897.

Albert W. Venino,
Assignee.

Waverly Mills, S. C.—The Waverly Telegraph & Telephone Co. has been organized by St. J. M. Lachicotte, president, and L. C. Lachicotte, secretary and treasurer.

VERTICAL MILLING MACHINES.

Mr. W. E. Jones, Nos. 14–16 Water street, Brooklyn, N. Y., has designed and built a series of types of vertical milling machines whose merits are outlined in the following article. The vertical milling machines are constructed in three sizes—the illustration will convey to the reader's mind an idea of their general appearance and superior points of design. Many unsatisfactory elements are eliminated, the remaining features contributing collectively to make them models of strength, elegance and durability. They are powerfully geared throughout. The body boxes and brackets are cast in one piece. The head is set close to the body, has long and deep bearings, and is also powerfully geared for raising or lowering the spindle to bring the cutter into suitable position for operating on work of various depths.



Vertical Milling Machine. Scale, Seven.eigths of an Inch to the Foot.

The spindle is of large diameter, having long taper bearings provided with vertical adjustments for taking up the wear.

Longitudinal and cross feeds are automatic in both directions. All feed wheels and reverse levers are within reach of the operator while attending to the work.

The rotary table has hand feed, but can be provided with automatic, if desired. The size of table given will revolve around the cutter at either end of the longitudinal or cross feed. If desired, a large table can be substituted.

They are also built without the rotary table; a long bed having three T slots running its length is provided. All cone pulleys have four steps, and the countershaft has two sets of driving pulleys for two changes of speed.

Mr. Jones is a manufacturer of presses, dies and special machinery which represent the highest grade of mechanic art. The reputation he has secured for high-class work is the direct result of enterprise, persistence and care.

C. F. Parsons has an interesting article on "The Inoffensive Dead," which tells of the development and progress of the crematory idea in this country, with illustrations of well-known crematories. Then there are articles, short stories and poetry by such well-known writers as Richard Henry Savage, Joel Benton, Clarence Hawkes, Charles Burr Todd, Yates Olcott, Henry Chadwick, Verner Z. Reed and hosts of others. Two especially strong short stories are "The Rose's Story," by Lewis Worthington Smith, and "An After-Dinner Story," by J. Frederick Thorne. To the latter W. B. Green contributes two of his characteristic illustrations. All in all the September number is perhaps the best yet issued under the new editorial management. The aim of this magazine seems to be to have something in each issue to interest everybody.

Fred Ellsworth Kennedy has a timely paper on "Mr. Debs and the Social Democracy" in the September Home Magazine. Mr. Kennedy thinks that Debs is on a wild goose chase, but gives him credit for being sincere in his ambitions.

One of the most popular of the regular features of The Home Magazine is the department of book news and reviews, which is conducted by Editor Vance himself. These reviews are different from the ordinary, and for their originality and strength in treatment have attracted considerable attention in the literary world.

POSSIBLE CONTRACTS.

Opelousas, La.—Sanders & Porter, Columbia Building, Louisville, Ky., will construct a water-works and electric-light plant to cost $30,000.

Greenwood, S. C.—D. C. Du Pre, mayor, may give information concerning construction of electric-light plant.

Williamson, S. C.—The Williamson Oil and Fertilizer Co. will install an electric-light plant. They are in the market for same.

Huron, S. D.—The Huron Electric Light and Power Co. has sold its plant to Harry S. Sterling, who will at once put in a perfect system. The new plant will be in operation within the next thirty days.

MR. F. W. EGBERT makes a specialty of marine electrical installations, wiring and repairs. He is now busy wiring and equipping the Sound steamer Nutmeg State, lying at Pier 39 East River, N. Y. Mr. Egbert was formerly connected with the Edison General Electric Company. His offices are at the Bennett Building, N.Y., and No. 48 Arrietta street, Tompkinsville, S. I.

THE MILLER-KNOBLOCK COMPANY, South Bend, Indiana, whose electric street-sprinkling cars are well known, has added to its already large business an electrical department, which is under the direct supervision of A. W. Morrell, an experienced electrical engineer and constructor, who has had years of experience in street-railway motor work. It is the intention of the company to manufacture and carry in stock, ready to ship at a moment's notice, Morrell's improved assembled motor commutators for street-railway motors. The fact that street-railway men can procure assembled commutators for any and all standard street-railway motors, will be appreciated. They will also carry in stock armature coils for all the standard motors. A complete equipment for the rewinding of armatures has been put in. Mr. Morrell, who has charge of the electrical department, has had long experience in electric street-railway work, and is well kuown at St. Louis, Minneapolis, Indianapolis and Cleveland, where he has had charge at different times of important works.

THE CHESLEY ELECTRIC CO., No. 601-605 Newark street, Hoboken, N. J., have moved their main office to the Havemeyer Building, N. Y., which is now situated in the heart of the electrical industries. The want of a more central office caused this change, and no doubt the greatest benefits will be derived therefrom. They do all kinds of repair work of the dynamo, motor, etc.; buy and sell new and second-hand electrical machinery of all kinds. They have just bought the engines and dynamos of the Hotel Empire of N. Y., which they still hold as a bargain for somebody.

STANLEY & PATTERSON.

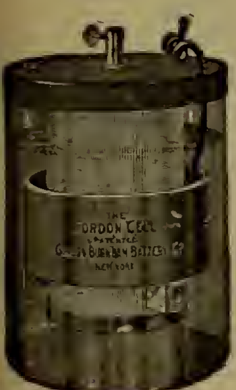
The well-known firm of Stanley & Patterson, No. 32-34 Frankfort street, N. Y., have issued the tenth edition of their catalogue of electric bell, battery, telegraph and telephone supplies, in addition to the catalogue of electric lighting and railway supplies. There are few concerns better known to electricians in general than the above, and fewer still from whom such great quantities of electrical goods have been bought for the wiring of buildings, equipment of electric light, power and railway plants or construction of telegraph and telephone stations and lines.

Their catalogue contains a carefully indexed list of new and valuable books as well as an alphabetically arranged list of supplies and materials. It is a source of instruction to glance through so complete a catalogue, and the satisfaction of readily finding the article sought makes it exceedingly valuable to the contractor, dealer and superintendents of lighting and power plants.

MR. JOHN P. MADDEN had awarded to him by the Queens County Board of Supervisors the contract for improving and paving Myrtle avenue from the Brooklyn city line to Richmond Hill. The work will cost, according to the contract figures, $109,180.00. Mr. Madden was the publisher of "Electrical Doings," New York. Contractor Madden is a well-known Queens County politician. He is leader of the Jeffersonian Democracy of Long Island City, and one of the most active opponents of Mayor Gleason. Recently Mr. Madden was appointed by Comptroller Fitch, of New York, as one of the experts to examine the accounts and records of the borough of Richmond. Mr. Madden has been a member of Assembly from Long Island City, was for one term private secretary to the late State Senator Floyd-Jones.

THE A. L. BOGART COMPANY has purchased from the estate of Mr. E. E. Bogart, deceased, the stock and good will of the electric gas lighting and electrical supply business that had been carried on by him in this city under the trading name of A. L. Bogart. The address after September 1st will be changed from 22 Union Square to 50 East Twentieth Street. Mr. A. Livingston Bogart, son of the founder of the business, the late Mr. Abraham Bogart, is president and general manager of the new company.

Thos. H. Lewis, the electrical contractor, is the eastern agent for Laidlaw, Dunn & Gordon, 116 Liberty street, New York, pumping engines, steam pumps and hydraulic machines. They are using the Lundell motors exclusively for their electric pumps, having installed them in Child's grand new restaurant on Broadway, New York; on Washington square, and a number throughout the city.



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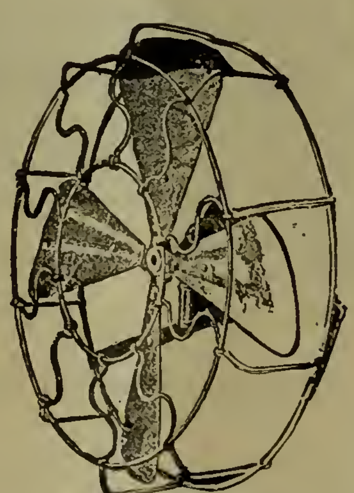

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The Electrical Age.

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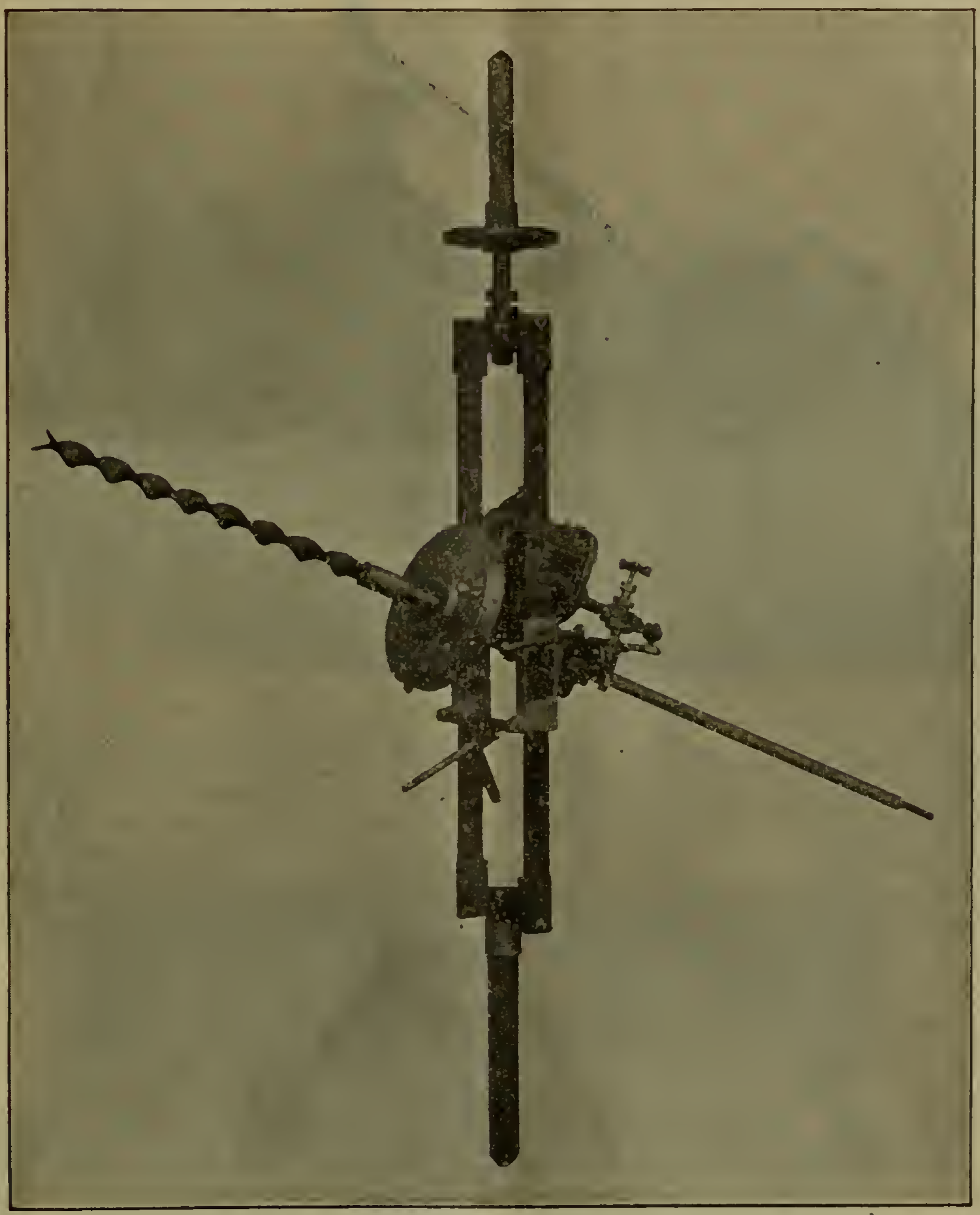


Fig. 5. Air Power Drill.

MINING MACHINERY.

One of the greatest sources of revenue to private individuals is to be found in the possession of mining property. It is not necessary to point to examples, for it is well known that the United States is as rich, if not richer, than any other country on the face of the globe in mineral wealth. Although mining machinery had been made and used since the days of remote antiquity, it is not until within recent years that attention has been paid to the application of electricity for mining purposes.

The Jeffery Manufacturing Company, of Columbus, Ohio, manufacture many types of reliable apparatus which utilize the electric current. They have by so doing proved in many respects the superiority of their machines to those using other forms of power.

In the following article attention is called to certain machines which have exercised a great influence in the development of mining industries, and whose convenience and efficiency have added to their general success from every practical standpoint. The description and number of the illustrations follow in regular order.

Number 1.—The Standard Mining Machine Truck. This truck is used to transport the machine from one point to another in a mine. It is made of oak with forged axles and wheels, to suit the conditions. On the rear you will see a windlass, which is operated by a pawl and ratchet by means of the lever. The chain attached to this windlass is used to draw the machine on to the truck. The hook at the end of the chain is placed in an eye on the rear end of the machine, and by winding the windlass the machine is drawn on to the truck.

Number 2.—The Standard Air Chain Machine. This machine is designed to operate in coal mines, and is what is called a breast undercutting machine. The capacity of this machine is from 700 to 1,700 square feet in ten hours; the amount of coal produced varying with the height of the vein. The machine itself weighs about 2,600 pounds, is very rigidly built and capable of withstanding very rough usage. The engine is designed to be operated by compressed air and is capable of developing about twenty horse-power. The height over all is twenty and a half inches; the length varies according to the undercut; the standard undercuts being five, six and seven feet. A five-foot machine will measure over all about eight and a half feet; the others in proportion.

Number 3.—The Standard Electric Chain Machine. This machine is designed for the same purpose as the one just referred to, the difference being in the means of operation. In this case the power is supplied by means of an electric motor instead of an engine. Experience has proven that machinery operated by the electric motor is much more economical than that operated by compressed air. In regard to the width of these machines, they vary

Fig. 6. Standard Electric Locomotive.

from thirty-nine to forty-four inches wide by four inches high, and from five to seven feet deep. Such a cut can be made in six minutes, including the time the machine takes in withdrawing from the coal.

Power Coal Drills for Electricity and Compressed Air.— The use of power drills in coal mines, where electricity and

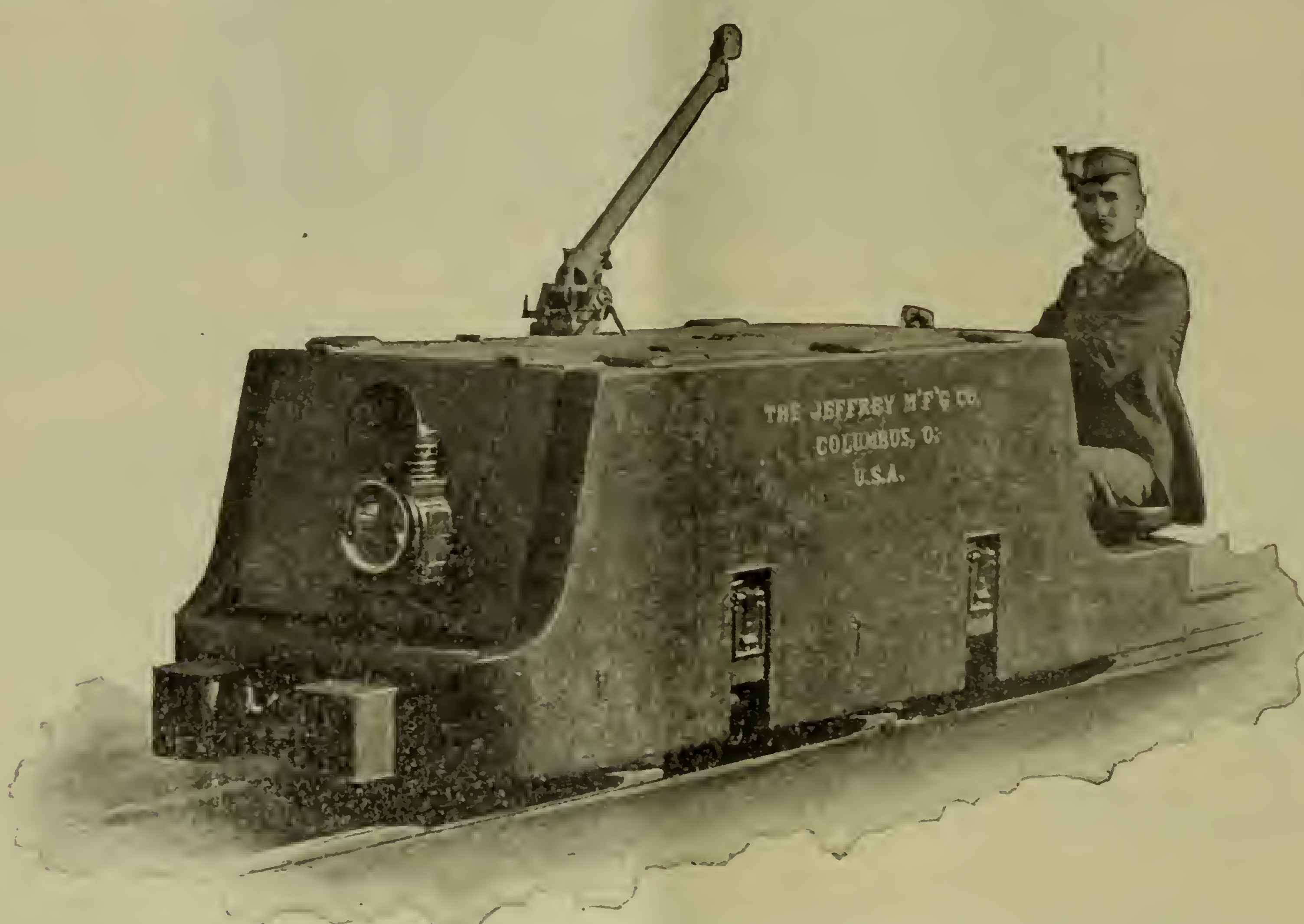


Fig. 7. Standard Electric Locomotive.

compressed air plants are installed, has not in the past received much consideration. The true value of a drill of this kind was not appreciated until the introduction of the drills manufactured by the Jeffrey Manufacturing Company; the illustrations given herewith show their general design and construction.

As machinery of this kind is subjected to extremely rough usage, the design and construction of these drills are carried out with this point in view. A great many of each style of drill are being used in various localities under varying conditions, and the results obtained from them are encouraging for their general adoption by operators having power at their mine.

Fig. 4 is a cut of a Standard electric drill with a double post. As will be observed, the general design of this drill insures its ability to withstand heavy strains and severe usage. The compactness allows it to be handled rapidly and with ease. Its weight complete is about 150 pounds. The drill as shown is made up of three parts—the motor, the frame, and gears and feed.

The motor is of the multipolar type, with iron-clad armature. It is completely encased by the frame and is fully protected from injury by accident.

The terminals are so arranged that they are readily accessible, and contact can be made or broken without delay.

The armature and field coils are thoroughly insulated and protected from grounds or short circuits. All parts are readily accessible and removable, and can be reached without delay when necessary.

The frame is made of rolled steel side bars firmly bolted to castings at top and bottom. The jack and jack pipe are at the top and are built to be adjustable within certain limits determined by the height of coal, according to the special conditions existing in the mine where they are to be installed. These frames are built to suit any height of coal.

The motor and feed bar can be adjusted between the side bars in various positions according to the desired location of the hole to be drilled. The hole can be drilled at any height between the side bars, and can be drilled at any angle in a vertical plane from 0 degrees to 60 degrees in either direction from the horizontal; it can also be drilled at any angle in a horizontal plane from 0 degrees to 90 degrees in either direction from the vertical plane passing through the centre of the drill, and at right angles to the face of the coal. This arrangement allows the hole to be drilled in any position without re-

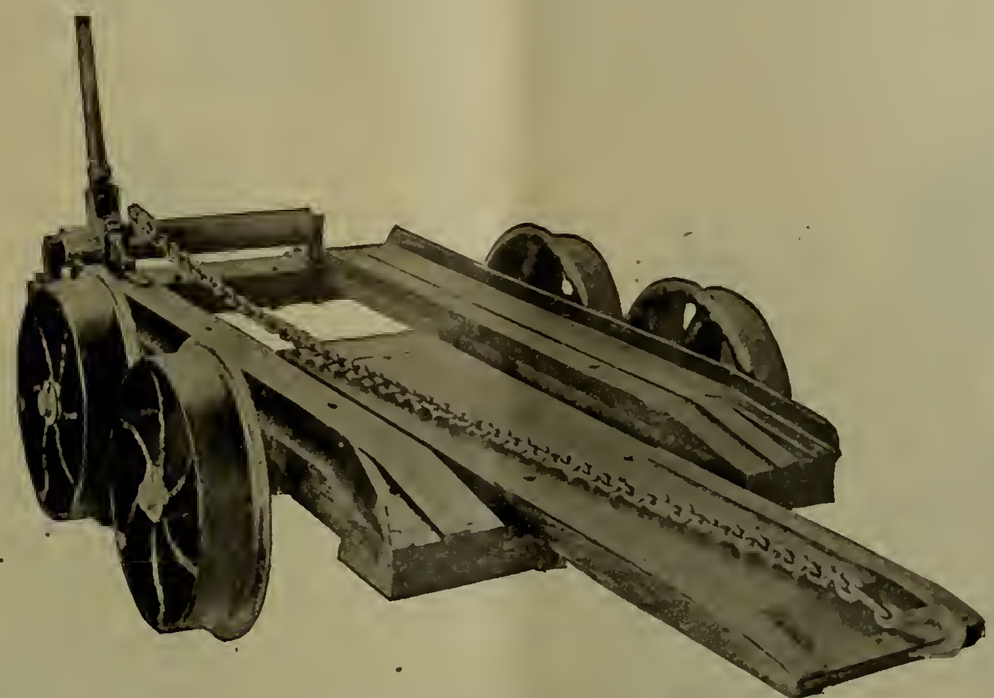


Fig. 1. The Standard Mining Machine Truck.

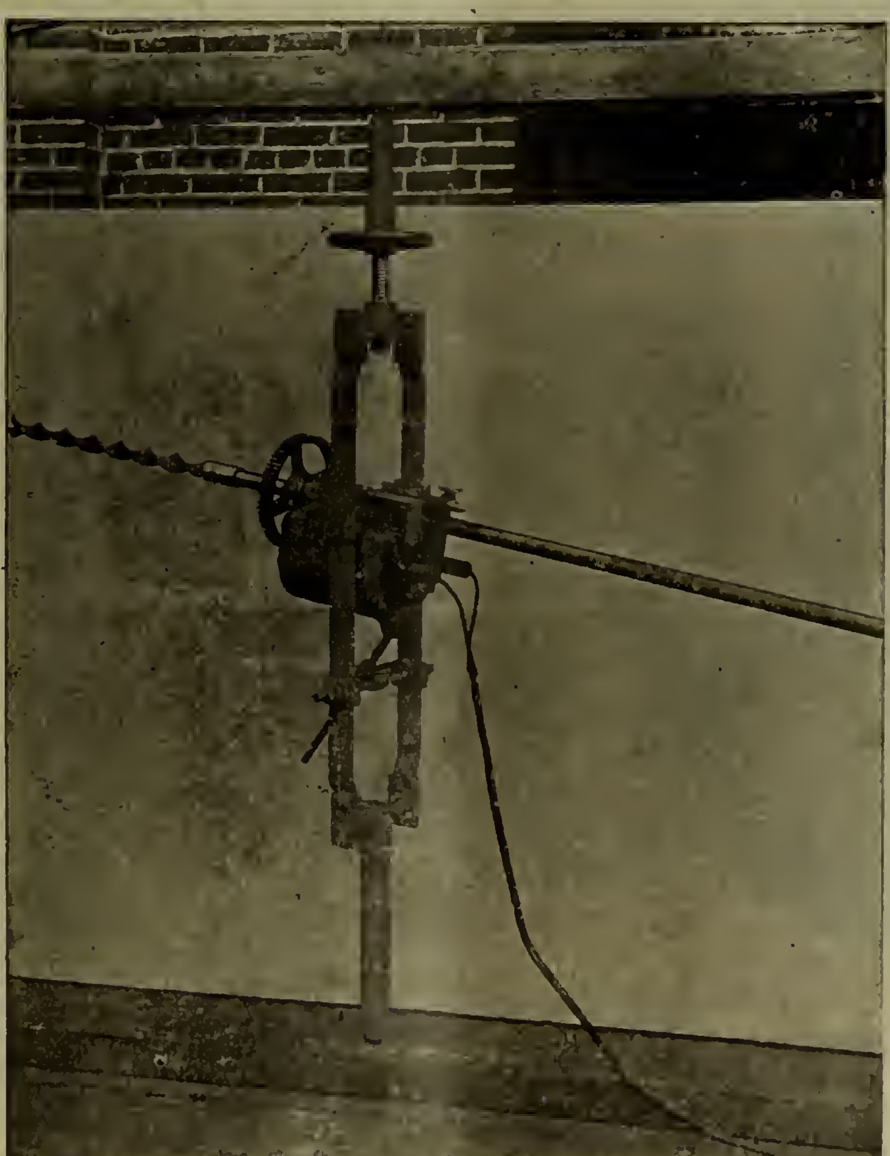


Fig. 4. Standard Electric Drill.

setting the drill.

The shaft carrying the gear or master wheel has its bearing on top of the field frame. The shaft is hollow and carries two keys diametrically opposite each other.

The feed bar is 5½ inches in length, threaded its entire length, having eight threads to one inch. On one end of this is a socket to receive the auger. This bar passes through the hollow shaft of the master wheel and is splined in order to receive the two keys. The feed nut is arranged in front of the drill and is supported by a pin. It is made up of two parts which are connected on the side by a hinge joint, and on the other side, when in position about the bar, by means of a thumb screw. The threaded part of the nut forms a liner for the clamps and can be removed, when worn, without replacing the entire nut.

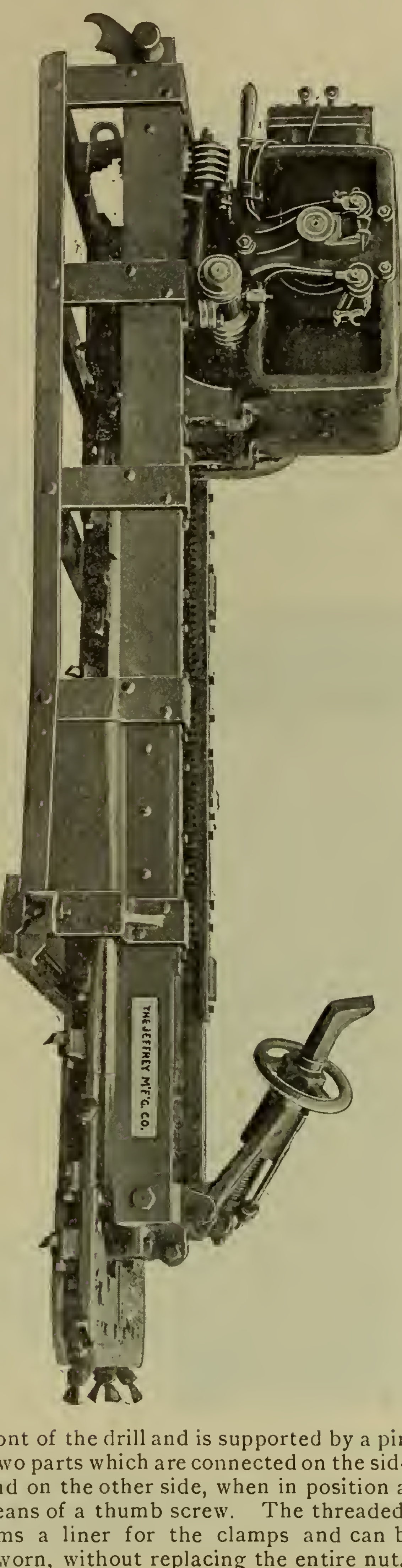


Fig. 3. The Standard Electric Chain Machine.

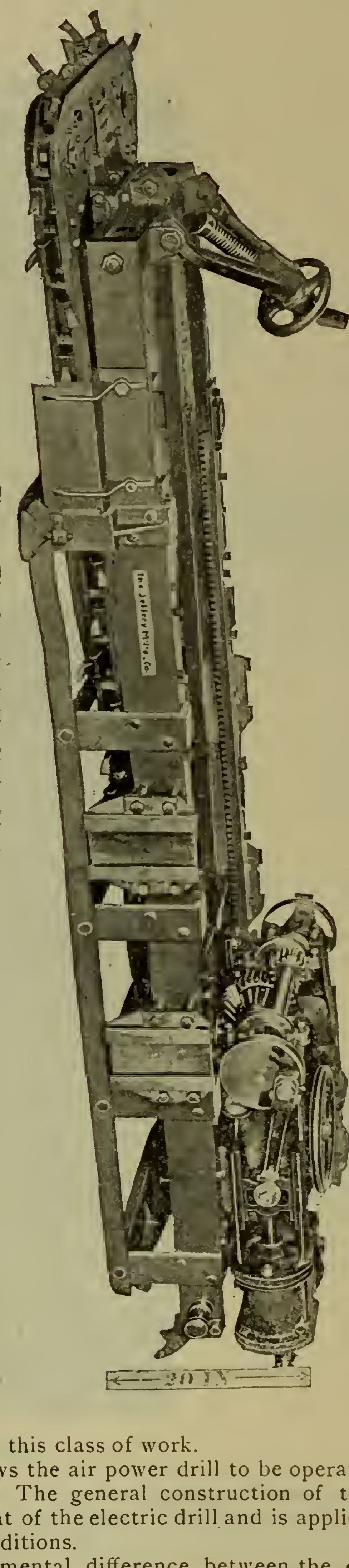


Fig. 2. The Standard Air Chain Machine,

The nut is held in position by a collar about which passes a spring steel friction band, which can be adjusted to allow the nut to turn with the auger at any pressure desired. This insures a release of strain on the drill when the auger strikes any hard substance such as sulphur, hard slate or other foreign material. This automatic stoppage of the feed prolongs the life of the drill and allows the machine to work under a uniform strain.

The auger is made of special steel and is of the usual type used for this class of work.

Fig. 5 shows the air power drill to be operated by compressed air. The general construction of this drill is similar to that of the electric drill and is applicable under the same conditions.

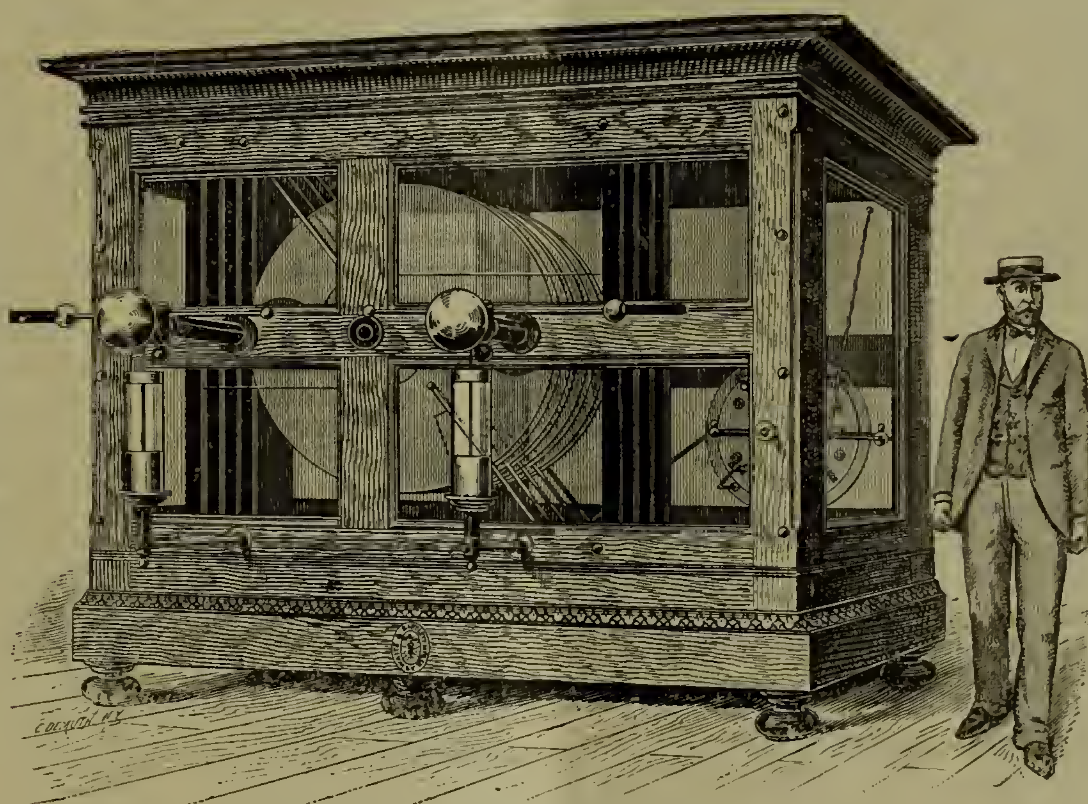
The fundamental difference between the electric and compressed air drills exists in the motor. On the latter the motor is of the rotary engine type, being extremely simple and of few parts.

The economy of drilling by means of power drills is sufficient to recommend them to the use of all operators. With either type of the above described drills from 300 to 600 lineal feet per day of ten hours can be drilled. The drill can be operated by one man and a boy.

We are informed that the Jeffrey Manufacturing Company, Columbus, Ohio, are placing a number of these drills in various parts of the country to demonstrate what can be done under the conditions.

We feel certain that operators desiring to investigate this new method of drilling will receive prompt attention by addressing the above named Company.

Number 6 is the Standard Electric Locomotive with the man located in the middle.



The Largest Holtz Machine in the World.

Number 7 is the Standard Electric Locomotive with the man located on the end.

These locomotives are being used in all parts of the United States, and under variable conditions and for various purposes. The standard sizes vary from 10 to 80 horse-power with a limit in minimum gauge of 18 inches. The principal field for their operation is coal mines, gold mines, copper mines, steel plants and yard engines. There are at present over fifty of these in operation, and are all giving excellent results.

THE LARGEST STATIC MACHINE IN THE WORLD.

An enormous static machine has been built by the Waite & Bartlett Manufacturing Company, 143 East 23d street, N. Y. City. This remarkable machine is eight feet high, carries eight plates, sixty inches in diameter, which are charged by a Toepler-Holtz machine, whose plates are thirty inches in diameter. The speed of this colossal generator of static electricity is two hundred and fifty revolutions per minute. It will easily give a thirty-inch spark, which can be compared to nothing else than a lightning discharge of remarkable brilliancy. The case in which this machine is enclosed is air-tight and moisture proof, thus keeping the interior dry and enabling it to preserve its charge. In addition to the four pairs of sixty-inch plates there are four other plates of longitupinal shape, placed above and four below, between the other eight.

The latest Holtz machines are greatly benefited by the addition of fixed and apparently useless glass plates, their object being to increase the induction, thereby intensifying the discharge. All Holtz machines with multiple plates are connected up in parallel, it being found very difficult, in fact, impossible in practice, to connect them in series. The longitudinally-shaped plates spoken of above are permanently fixed, not revolving, as the eight circular ones do. The Waite & Bartlett Manufacturing Company produced its first static machine in 1884. In 1886 it built a large one with eight thirty-six-inch plates for Dr. H. Moeller. The next large one, with forty-inch plates, received the only award of all competitors, either foreign or domestic, at the World's Fair. It was sold to a Dr. Owen of Chicago. Another of the same size sold to Dr. Kohnstamm, of New York. The Battle Creek Sanitarium have one in their possession with forty-five-inch plates. The giant, to be seen on exhibition, was sold to Dr. F. A. Gardner, of Washington, D. C. This is the third machine from the Waite & Bartlett Manufacturing Company.

The illustration will give the reader an idea of the appearance of this latest Holtz generator, but it will not in any way enable him to judge of the enormous dimensions that constitute its real size. The discharging apparatus, Leyden-jar attachment, etc., are most conveniently arranged, so that the purchaser of machines of similar type will experience neither difficulty nor risk in applying the charge for either electro-therapeutic or other purposes. We recommend our friends to call upon Dr. Waite at the above address at once, or they will miss an opportunity of seeing this proof of their skill and handiwork.

HISTORICAL SKETCH OF THE FIRE-ALARM TELEGRAPH.

BY ADAM BOSCH.

On June 3, 1845, the Boston Advertiser pnblished a communication by Dr. W. F. Channing, in which public attention was called to a new application of the telegraph in these words: "There is a highly important application of the Electric-Magnetic Telegraph to which public attention has not as yet been directed. This is its use in our cities, to give an instantaneous, universal and definite alarm in case of fire. The peculiar properties of the telegraph — rapidity and precision of communication— are, in this instance, preeminently needed."

The writer then goes on to unfold his plan, substantially as follows: A central office was to be established in some public building, in which the necessary battery, together with a Morse register and an alarm bell, should be located; a double wire to proceed from thence over the housetops successively to every engine-house and fire bell in the city, and return again to complete its circuit to the place from whence it started. In every station thus established, a Morse register in connection with an alarm bell was to be placed; also a key, by the simple depression of which an appropriate signal would be instantly conveyed to every other station on the circuit.

He also suggested the modification of having five or six circuits, or even a circuit from every station, to the central office. By this method the operator would be able to communicate directly to all the stations, and, if so desired, every alarm of fire might be made to pass through the central office before being communicated to the different stations. From among the many modifications to which his design is susceptible, Dr. Channing calls special attention to one, in these words: "There is, however, one which deserves to be specially mentioned. By a slight change of the arrangement at the alarm-bell stations, and increase of machinery, the hammers of the bells could all be disposed so as to strike mechanically on the communication of a galvanic impulse from the central office. The agent (operator) would therefore be enabled, by depressing a single key with his finger at certain intervals, to ring out an alarm defining the position of the fire simultaneously on every church bell in the city." This description clearly indicates the electro-mechanieal bell striker, which had not yet been invented. In conclusion, Dr. Channing urges the municipal authorities to take his project into consideration; and, as the city had been behindhand in the matter of giving alarms of fire, the adoption of this system would place her in advance of other cities.

The next effort to apply the telegaph to fire-alarm purposes was made in 1847, by F. O. J. Smith, who was at that time in charge of the Morse telegraph interest in the New England states. Mr. Smith consulted Moses G. Farmer, whom he considered one of the foremost electricians in the country, as to the possibility of striking a number of large bells simultaneously by means of electricity. Farmer agreed to produce an apparatus by means of which this could be done, and in a short time exhibited to Smith a model of his invention, the simple and beautiful piece of mechanism which afterward became well known as the falling ball electro-magnetic escapement. This was substituted for the mechanical escapement on a church-clock striking apparatus, in common use at that time. Mr. Smith was highly pleased with the apparatus and immediately submitted a plan for establishing a fire-alarm telegraph to Josiah Quincy, Jr., Mayor of the City of Boston. This plan proposed connecting fifteen engine-houses by telegraph, and equipping three large bells with electric-bell striking machines, the same to be operated simultaneously from some convenient point. Mayor Quincy, in his annual address, January 3, 1848, recommended this subject to the consideration of the Board of Aldermen, which body acted on this recommendation to the extent of ordering two bell-striking machines for the city. They were made under the directiou of Farmer, and, when completed, submitted to a public trial, which proved very satisfactory. After this the city authorities took no further action in the matter, and Mr. Smith abandoned the subject.

Early in the year 1851 Dr. Channing, who had in the six years since the first publication of his plans relating to the establishment of a fire-alarm telegraph spent much time and thought in his endeavor to shape public sentiment favorable to his project, sent an elaborate and well-considered communication to the Mayor and Board of Aldermen of the City of Boston, commending his fire-alarm system to their consideration, accompanying this communication with diagrams of the proposed signal and alarm circuits, a map showing the division of the city into six districts, a description of the apparatus required, an estimate of the probable cost, and also an offer to give a practical exhibition to demonstrate the feasibility of the system, if desired. The general outline of the system as proposed was as follows:

The city was to be divided into six fire districts. Three signal and three alarm circuits were to be constructed. To avoid possible interruptions of the circuits, all wires were to be run double. The ground was not to be used as any part of the circuit, for the reason that unauthorized persons might complete the circuit by establishing connection between the wires and the ground. The whole of the machinery of the signal stations was to consist of a signal key locked in a small box.

The central office was to be located at the City Hall, and the apparatus to consist of a receiving magnet (relay) on every signal circuit, and a local circuit to operate a register and alarm bell. For an apparatus to transmit alarms to the large bells, the employment of an instrument moved by clockwork, then well known in connection with the Morse telegraph, was suggested. This consisted of a cylinder made of wood, having a metal core, over which a number of keys fashioned like piano keys were arranged, and, under each key, strips of metal in groups were fastened to the cylinder and connected with the core. When this cylinder was set in motion and one of the keys depressed, a spring would bear on the cylinder, and, if properly connected, a signal was given corresponding to the number and position of the metallic strips under this particular key. It was in connection with preparations for the proposed exhibition, previously mentioned, that Dr. Channing made a search for the two models of bell-striking machines made in 1848 for the city. He found them stowed away in a lumber room, and covered with dust. He had himself devised an electric escapement for bell-striking machines, but he quickly recognized the great superiority of the one invented by Farmer, and therefore decided to use the models in his public demonstration. Desiring to obtain the inventor's assistance at this exhibition, he sought an interview with Farmer, who readily consented. At this meeting they agreed to join their interests and co-operate in all matters relating to the establishment of a fire-alarm telegraph. An exhibition was soon given before the Mayor and Board of Aldermen, at which Farmer assisted. It proved highly successful, and resulted in an appropriation of $10,000 by the city government for the purpose of carrying out the proposed plans.

At the urgent request of Dr. Channing, Farmer was appointed Superintendent of Construction. He entered upon his duties at once and with characteristic energy. The task before him was not an easy one. "Something new under the sun" was about to be established. For months nearly all the work was experimental; apparatus was constructed and discarded as defects manifested or improvements suggested themselves.

In the construction of the signal boxes the first departure from the original plan was made by adding a wheel and crank to operate the key. This wheel had certain definite projections upon it, their width and position varying with the signal to be conveyed, the wide projections being for dashes, the other for dots. On turning the crank each projection on the wheel would in its turn open the key, and keep it open for a longer or shorter period of time according to the width of the projection. The handle of the crank was weighted for the purpose of maintaining the wheel in its normal position where none of its projections were in contact with the key.

(To be continued.)

Wharton, Tex.—An electric-light plant will be established.

The Electrical Age.

Established 1883.

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CONTENTS.

THE RELIABILITY OF AUTOMATIC DEVICES.

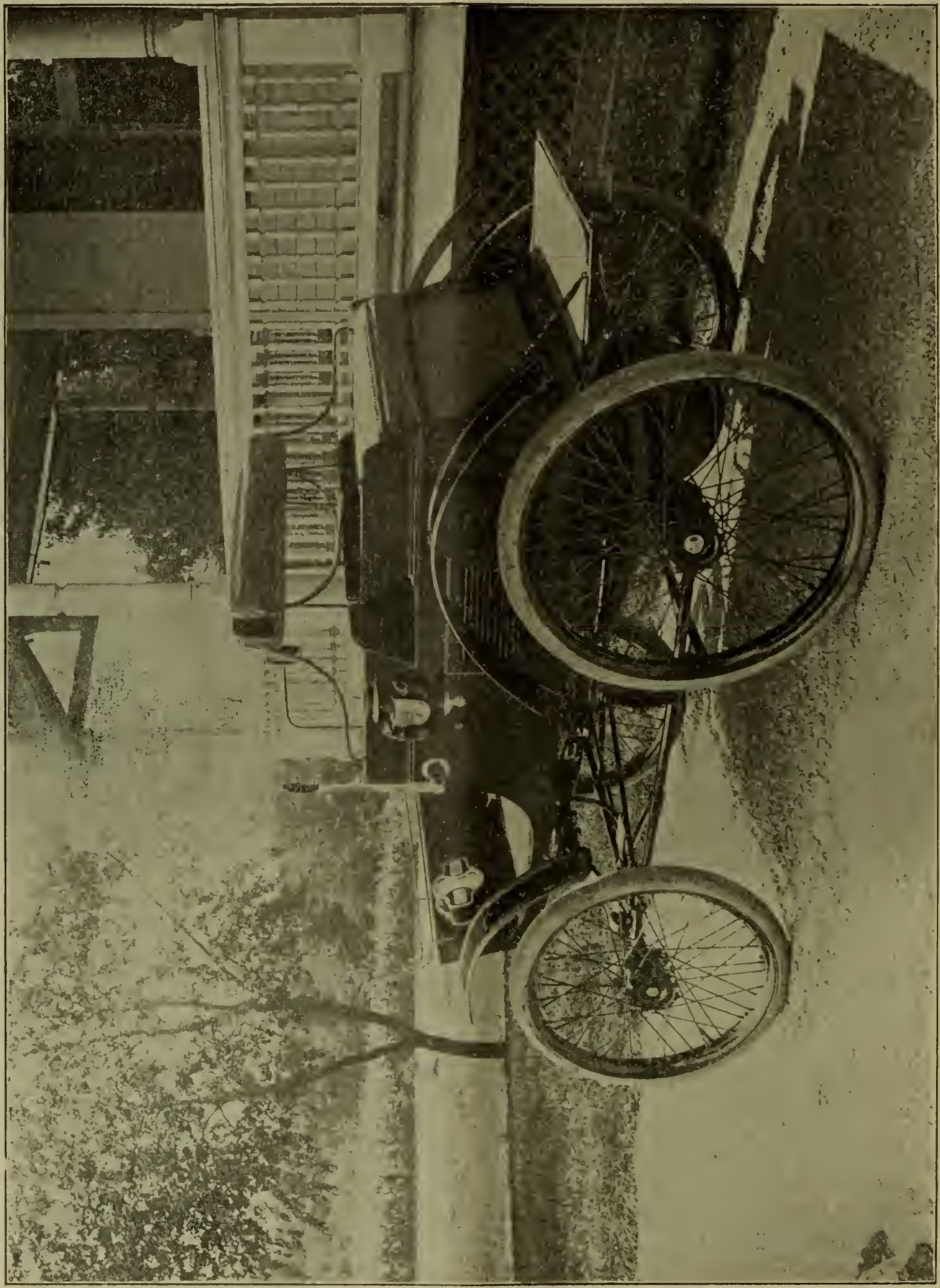
The history of invention comprises no department of work more interesting than that which touches upon automatic appliances. It is peculiarly the nature of electrical devices to be in many respects more automatic than those actuated by some other source of power. There is charm and fascination about automatic machinery which appeals to the observer in a double sense. It fills him with wonder to see the regularity with which the machine performs its functions and with surprise to realize that the mechanic arts have been brought to such a high pitch of perfection as to be able to carry out the commands of its human creator with unfailing fidelity. It has often been asked by laymen and engineers, are automatic devices reliable, and it seemed as though the answer, until within the last decade, was to be found in the negative. But of late, and especially towards the end of this century, a tendency has become clearly defined which illustrates a remarkable change in opinion and practice. There seems to be a tendency which this era actually demands of inventors to produce automatic devices. This may be taken as a proof that automatic devices have obtained a position in the practical world; in other words, that they have become reliable. The truth of this can be easily seen by an examination of the list of important inventions that have revolutionized civilization and brought about important changes of great influence and lasting benefit. It seems as though the slide-valve of the steam engine was the first indication of the change that would affect the world of scientific application. Then follows in rapid succession, as representing the most complex of automatic devices—first, the telegraph; then annunciator and call systems, which include fire alarm and police telegraph apparatus; telephone equipments, the worthy object of many inventors being the improvement of these to purely automatic systems, with self-operating central stations; then thermostatic apparatus, automatic stokers, circuit breakers, railway systems and a host of valuable inventions too numerous to mention, which are made use of in almost all departments of engineering and domestic life. In the light of these facts it must become evident that the characteristic most prominent in the field of invention is this practice of building automatic machinery. It may be said that the most brilliant achievement of mankind will only be made when his work is done by the aid of mechanism which operates with the definiteness and precision of an intelligent creature, doing its work without complaint, weariness or irregularity. It seems that many important departments of industry owe their existence to the use of automatic machinery.

The bicycle is now made by special machines in so rapid a manner that it is difficult to determine which is the more remarkable, the machine producing the bicycle parts or the man entrusted with its rapid assemblage. One of the greatest sources of wealth to both England and America is the Bessemer process. Without it, steel ingots could only be made by the greatest labor and the expenditure of many valuable hours of arduous effort. There is in the air a hint that steel will shortly be produced direct from the ore by means of electricity, and it may be that this vast field of labor will pass into the control of electricians whose most wearisome duties will be limited to the throwing of switches. The work of Tesla and Marconi, in the line of wireless telegraphy, is another illustration of the fact that human communication is about to be established on newer and broader lines and will be included within the realm of automatic appliances to such an extent that, were additional mechanism invented to supply the signal that only thought and intelligence can originate, this system would become a living entity in itself, composed of brass and iron, sending out its innumerable quiverings into the large sphere of its vicinity. There will soon be but few fields of work which will not consist of the mere care of automatic mechanism regulated and controlled, no matter how vast its labors, by the touch of a finger or the throw of a switch. We will truly say that we place every reliance upon our automatic machinery when we know that our six million, two hundred and twelve thousand, six hundred and seventy-one tons of steel annually produced have been manufactured and moulded by iron fingers which respond without hesitation to the touch of a guiding and controlling intelligence.

Professor Faraday, Sir Humphry Davy's successor, made his first experiments in electricity by means of an old bottle while he was still a working bookbinder. And it is a curious fact, that Faraday was first attracted to the study of chemistry by hearing one of Sir Humphry Davy's lectures on the subject at the Royal Institution. A gentleman, who was a member, calling one day at the shop where Faraday was employed in binding books found him pouring over the article "Electricity" in an Encyclopædia placed in his hands to bind. The gentleman, having made inquiries, found that the young bookbinder was curious about such subjects, and gave him an order of admission to the Royal Institution, where he attended a course of four lectures delivered by Sir Humphry. He took notes of them, which he showed to the lecturer, who acknowledged their scientific accuracy, and was surprised when informed of the humble position of the reporter. Faraday then expressed his desire to devote himself to the prosecution of chemical studies, from which Sir Humphry at first endeavored to dissuade him; but the young man persisting, he was at length taken into the Royal Institution as an assistant; and eventually the mantle of the brilliant apothecary's boy fell upon the shoulders of the equally brilliant bookbinder's apprentice.

THE RIKER ELECTRIC CARRIAGE.

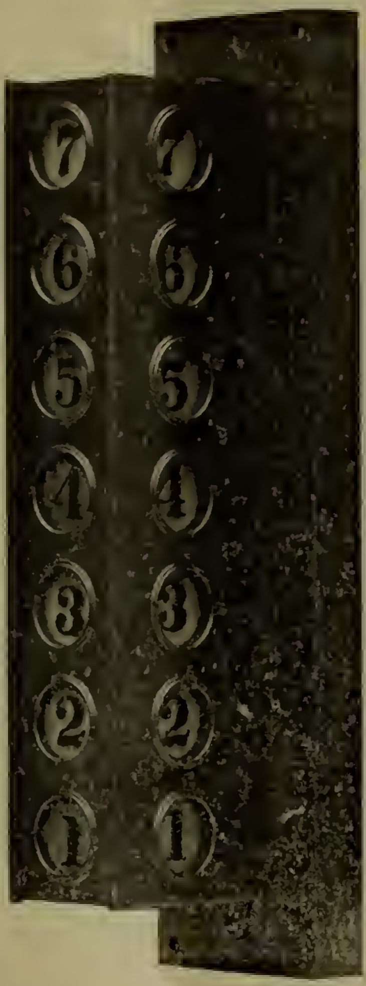
In the illustration may be seen one of the most improved types of electric carriages, manufactured by the Riker Electric Motor Company, of 45–47 York St., Brooklyn, N.Y. This carriage is a four-wheeled one, capable of seating four people. It weighs complete, not more than eighteen hundred pounds. Four wheels are fitted with pneumatic tires, the front ones being thirty-two inches and the back thirty-six inches in diameter. The motor proper is held by the frame of the gear, the back portion of the motor being fastened to a tube encasing the axle ; the front, elastically supported by springs from the cross-rod between those on each side. The Riker motor driving the carriage weighs one hundred and forty two pounds, has two-K. W. capacity, and rotates at a speed of one thousand revolutions per minute. The gears reduce this down at the ratio of nine to one. All the apparatus is protected from dust, moisture, etc.



Riker Electric Trap.

The storage batteries used for driving the carriage consist of thirty-six cells of one hundred and fifty ampere hours capacity, lasting about ten hours. The elements are of the composition type, zinc-lead, each being nine inches, by seven inches, by three and one half ; the total weight not exceeding seven hundred and sixty pounds. The apparatus is so designed and the batteries situated that no dead weight acts in any portion of the carriage to cause wear and tear. A footbrake can be operated with ease and controls a brake pulley on the motor shaft. A controller placed under the seat of the carriage is moved by a hand lever at the side. Pushing this lever forward increases the speed; backward, reverses it.

An excellent improvement in this carriage is to be found in the arrangement which throws off the power when the brake is thrown on, preventing the motor from operating until said brake is entirely free again. Each vehicle is provided with an automatic cut-out, so that the batteries when fully charged will be automatically disconnected. Each vehicle is equipped in addition with gong, side lamps, and head light, a voltmeter and ammeter and an overload switch combined with a break switch. The use of this last is to automatically cut out the motor when the load upon it rises above three hundred to four hundred per cent. Three regular speeds limit the rate of acceleration, the maximum being twenty-five miles an hour. Every possible means of providing conveniences have been made for the benefit of the purchaser. There is no automobile or carriage of any other description that can begin to compare with this piece of excellent mechanism as improved by Mr. A. L. Riker.



Indicator, Zimdars & Hunt.

THE THIRD-RAIL SYSTEM OF ELECTRIC TRACTION.

By Howard Lee Davis, in the Yale Scientific Monthly.

As a result of the law passed by the New York State Legislature compelling all elevated railroads of a certain class to light their cars in some way other than by the use of oil, the Manhattan Elevated Railroad Company found it necessary to adopt other methods of illumination. Up to this time their trains were very poorly lighted, and consequently there were many complaints, which was, in fact, the prime reason for enacting the law. In making this change the railroad company had to choose between gas and electricity; and although gas tanks were placed in the cars, still at the same time the advisability of using electricity for power and heating, as well as lighting, was considered.

Under the direction of the Electric Storage Battery Company of Philadelphia an electric locomotive was constructed at the Ninety-ninth street shops of the Manhattan Elevated Railroad Company, and after two or three initial trips on the Third avenue line was placed for trial on the Thirty-fourth street branch on October 5, 1896, and took the place of one of the steam locomotives running between Third avenue and the Long Island Ferry.

The locomotive was constructed on the engine frame of an old standard elevated railroad locomotive. On each of the two driving axles was mounted a motor, made by the General Electric Company, wound for five hundred volts, and being capable of exerting a draw-bar pull of 2,000 pounds. The cab was built in the centre, and in the compartments at either end were placed the storage battery cells. These compartments were covered with lids, which were fastened on the side next to the cab by means of hinges, and sloped down at either end so as to afford as extensive a view of the track as possible.

The original plan was to carry the two hundred and fifty-four Tudor cells on the locomotive, but after it had been built and all the cells were put in place it was found that the locomotive was too heavy for the branch road. By taking out two hundred cells it was found that it could be run safely, and these were placed on the platform of the ferry station, while the remaining fifty-four cells were left in their regular places. A third rail mounted on insulators was used to convey the current from the cells at the ferry station to the motors, and two sliding "shoes" were used to make contact with the rail. The cell in question is an element of a storage battery having four negative and three positive plates. The cells on the motor were then used for lighting, heating and switching when not in connection with those on the platform. In the cab were placed the standard General Electric series parallel controller, for G. E. 2,000 motors, switches for the third rail, the main motor switch, and another for throwing in the fifty-four cells for switching purposes when no other power was attainable. In the cab were also placed heaters, lighting and heating switches, and the cylinders for the compressed air-brake.

The power-house equipment consisted of a direct-connected 12x12 Ideal engine and a fifty kilo-watts Eddy dynamo (500 volts), together with voltmeter, ammeter and switches.

The current from the power-house was passed through the third rail, which served the same purpose as a trolley wire, while the train was moving at a high rate of speed along a level stretch or going up grade. When the train stopped or was moving on a down grade the current in the rail, which would otherwise have been wasted, was stored up in the cells and was in turn drawn upon when more current was needed than the power-house could supply. In case any accident should happen to the dynamo furnishing the current the storage batteries could be called on, and in that case could furnish all the power needed to run the train for some hours. In this way no power is lost and accidents at the power-house, so often stopping travel on electric car lines, in no way interfere with the running of a train. As a proof of the economy of this system the power-house engine, in combination with the storage batteries, was run at a full and constant load; that is, the engine was at all times run at its maximum efficiency without the unnecessary loss of any power. The conditions which prevailed while making the tests on December 19, 1896, are to be found in the following data:

Final weight of locomotive: 39,000 pounds.

Two standard cars were pulled, the weight of each being 29,500 pounds.

Power-house output, charging batteries and running trains, 18½ hours.

Average amperes,	74.3	Watt. Hours.
" volts,	471.	18½ hours.
" Watts,	34,995	647,407.

Electric horse-power, hours, 904.

Mechanical horse-power, hours (say efficiency of dynamo and engine 80 per cent.), 1,084.

Motor runs, not including lay ups, 16½ hours.

Average electrical horse-power hours in which motor runs, 44.8.

Average mechanical horse-power hours in which motor runs, 56.

Motor runs with two cars and heaters 9¾ hours.

Motor runs with one car and heater 6¾ hours.

Heaters require 15 amperes per car.

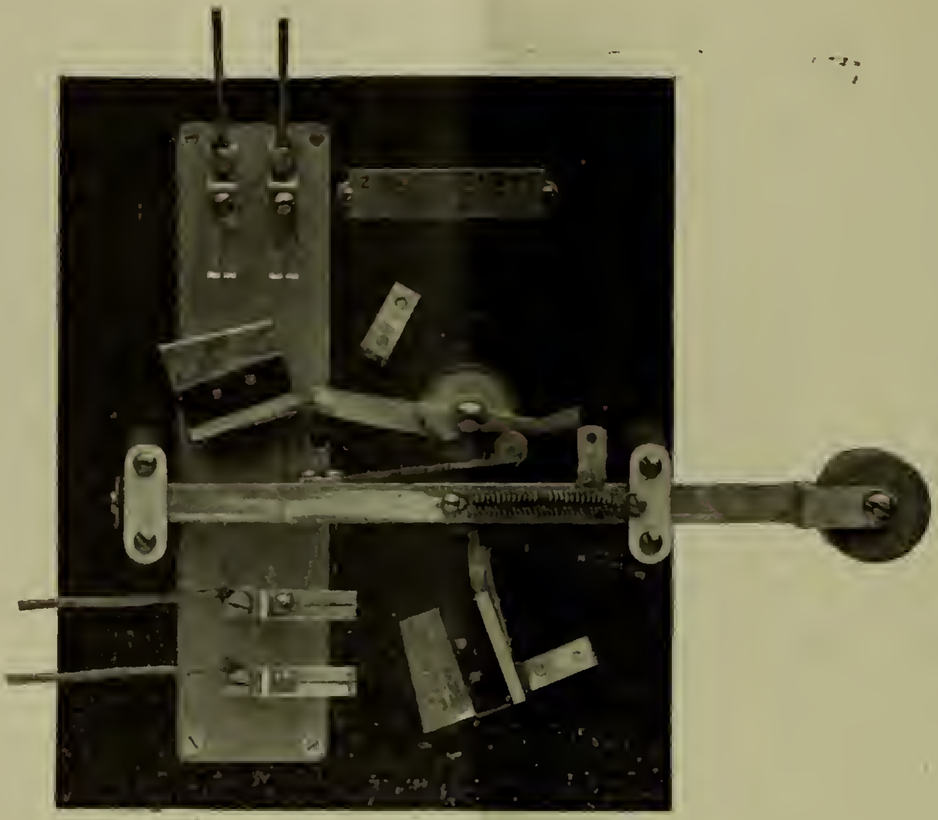
Motor starts running with two cars at 6.34 A. M. and lays up at 11.30 A. M. Starts again at 12.14 P. M. with one car and takes on the second car at 3.15. Lays up again from 7.58 P. M. until 8.30 P. M., when it again starts with one car, which is run until midnight. This is the regular work of a steam locomotive.

The test proved in every way satisfactory and showed that it was entirely practical, economical and reliable to run an elevated railroad by this system.

AN ELECTRIC ELEVATOR INDICATOR.

There is now in use in the Petroleum and Stock Exchange Building, 60 Broadway, N. Y. City, an Electric Elevator Indicator, manufactured and installed by Zimdars & Hunt, Electrical Contractors, 127 Fifth Ave., N. Y. City.

This indicator is a very ingenious arrangement, showing the position of the elevator car when ascending or descending, by lighting up each number consecutively. A switch, as shown in illustration, operates the electric circuits, opening and closing them, and is thrown into action by the car in its upward or downward course. The indicator proper, as shown in illustration, consists of a series of compartments, which are separately illuminated ; the elevator car, by moving, throwing the switch in or out and thereby lighting up or cutting out the current supplied to that lamp which indicates the floor. The cam-



Indicator Switch. Zimdars & Hunt.

bar at each end of the car pushes in the projecting arm of the switch, thereby closing the circuit and illuminating the indicators on every floor, denoting which floor the car is on. One of these connects with the main, the other with all local circuits, indicating the floor which the elevator is passing. The arm of the switch springs back after the car has passed, opening both circuits, thereby throwing out the lamps illuminating any special compartment of the indicator. The next floor, however, sends the signal through the house to all the other indicators that the car is at and passing that particular point, by means of its switch, which operates in common with the other switches on the other floors in a similar manner. By this system of elevator indication, the car pushes the button and the indicator does the rest ; every indicator in the house lighting up at that floor whose switch the car is operating. Separate circuits are run from lamp one of all the indicators to the switch on floor one ; lamp two of the indicators to the switch on floor two, etc., etc.

The absence of any electro-magnetic device makes this a very positive and exceedingly reliable method of showing people the position of the elevator. Its simplicity will recommend it to every contractor and the trade in general. All of the mechanism is practically represented by the switch, which is solidly built to stand whatever wear and tear it may have occasion to pass through.

Easton, Pa.—Work is about to commence on construction of new electric road from Easton to Bethlehem.

THE DRY BATTERY.

BY J. HART ROBERTSON, OF THE AMPERE MFG. CO. OF 89 PEARL STREET, BROOKLYN, N. Y.

The important position held by dry batteries in the electrical field can be appreciated when it is known that a few years ago the entire output in the United States only amounted to a few thousands per year, whereas it now reaches as many millions.

There is no doubt but that the dry battery has been the means of extending enormously the different applications of electricity through bringing within reach of the people a cheap and compact source of electrical energy requiring the minimum amount of skill to apply it.

Before dry cells were introduced the liquid Le Clanche was the recognized open-circuit battery of the world, and notwithstanding the fact that it requires a certain amount of skill to set them up and some attention to keep them in working order there are still millions of them in use, in spite of the strong competition of the dry battery, which requires no attention whatever and only enough skill to connect wires to the terminals.

many cases over a number of years. Allowing that the dry open-circuit battery has advantages over the liquid ones, which it undoubtedly has, among others being non-liability to breakage, no liquid to freeze, evaporate or spill, compactness of form and requiring no attention to keep in condition, it will not be out of place here to say a few words about installing plants where open-circuit batteries are adopted to supply the motive power, especially as there are daily additions to the numbers of electricians already in the field, many of whom although skilful mechanics, have not yet attained the electrical knowledge to enable them to successfully compete with those older in the business.

The reason that some electrical contractors go ahead while others go backward is, that they give their first attention to the source of power necessary to operate their instruments; the same as an engineer gives to his boilers or an architect to his foundations.

A competent engineer never attempts to run a hundred horse-power with a twenty horse-power boiler.

He believes in having an excess of power, and uses one capable of developing more than the engine is liable to call for. So, also, does a successful electrician.

The Ampere Dry Cell.

The majority of people who continue the use of liquid open-circuit batteries are those who never tried any others, and would rather spend time in attending them, as long as they gave fair satisfaction, to making any change for something new that they know nothing about. Others again have tried dry batteries of certain kinds, and finding them to fall far below the extravagant claims advanced by their promoters, have fallen back on the liquid ones with very strong prejudices in their favor.

Many persons have the idea that a dry battery has an unlimited amount of energy and can be used equally well on open-air or closed circuit. This idea has been fostered by unscrupulous parties who have demonstrated that what they call an open-circuit battery will run a motor or ring a bell continuously for a great many hours. It should be borne in mind that it is a very simple matter to fix a dry cell by using powerful chemicals, so that it will ring a bell continuously for fifty or one hundred hours, but that is done at the expense of its life and future efficiency and is no criterion whatever of the qualities that a thorough open-circuit dry battery should possess.

Those of this class really encroach on the field of the closed-battery circuit type, but are inferior to them in as far that the elements cannot be taken out while not in use. They eat themselves up when idle and only give seemingly great results when exhibited soon after being made.

A true open-circuit battery differs very materially from the above inasmuch as, although it polarizes comparatively fast on a closed circuit, it recuperates rapidly and has very little local action when not in use, thus insuring long life, or life approximately, in proportion to the amount of useful work done which, being naturally intermittent and the periods of close circuit short, extend in

He puts in plenty of battery power, as he knows that without it the most elaborate equipment would be practically worthless. Many contractors equip buildings with hundreds of dollars' worth of instruments and wiring and barely battery enough to operate same, although it (the battery) is the foundation of the entire plant and costs a mere fraction of the entire installation.

A simple rule to follow, and one that will save endless trouble in equipping buildings with call instruments, etc., is to put in cells, one by one, until the instruments are just operative, then *double the number*.

The cost is such a mere bagatelle, compared to that of the instruments and labor, that it should never stand in the way of doing a thorough job.

Use good cells and plenty of them. It will save the trouble and time required in testing the resistance of instruments and circuits with the idea of proportioning the battery to them.

When an electrician has not the facilities or time to test a battery, faith in the assertions of the manufacturer will have to be his guide in buying.

Reputable manufacturers often unknowingly place inferior dry cells on the market. There are many reasons for this, among which may be the variations in strength of chemicals and of hydraulic pressure on the cores. It is mere carelessness if inferior chemicals are used, as it is a simple matter to find out if they are as guaranteed; it is also a simple matter to have the ingredients constituting the core weigh the same, in all cases, when forced into a given space by hydraulic pressure. The main trouble is in the irregular resistance of slabs or rods to which the battery terminals are attached, the last thing in the dry battery that would be supposed to have any influence on its output.

In making the best slabs firmly divided gas retort carbon is mixed with a binding substance, then moulded to the required shape and carbonized. The binding substance must be exposed to an intense heat under the proper conditions to bring it as near as possible to the resistance of the particles of retort carbon for which it first served as a cohesive medium. This binding substance is generally, if not always, a fair insulator, and must be thoroughly carbonized before its condition is enough changed to make it a conductor. When thousands of slabs are carbonized in a batch there are generally some whose binding substance has not been enough acted upon to kill its insulating qualities or, at least, to make its resistance low enough to even approximate that of the retort carbon particles which it serves to hold together.

A manufacturer of standing should not only test the quality of chemicals used, but should also test every slab individually, and before the assembled parts constituting the battery are placed on the market give them a final and thorough test.

Those who pursue this policy are always to be depended upon, but it is unfortunate there are so few of them.

Among the professions benefitted by the introduction of dry batteries the medical one heads the list.

Numbers of physicians have cabinets containing fifty or more open circuit batteries which, until the dry cell was introduced, consisted of liquid ones requiring more care than a professional man could spare from his practice, and necessitating the hiring of outside help to keep them in order ; not only that but a large space, which in a physician's office is generally very valuable, had to be monopolized for these liquid batteries.

The strictly high grade dry battery made today requires no attention whatever, and fifty cells occupy a space slightly over one and a half cubic feet. They are also adapted for recharging from an incandescent or battery circuit, when exhausted. When in normal working condition their capacity can be greatly increased for temporary experimental purposes by so recharging.

Mr. M. L. Vought, of LaCrosse, Wisconsin, has recently placed upon the market an adjustable hanger for incandescent lamp which seems to be destined to fill a long felt want in this direction. The hanger is sold at a very low price and is having a very large sale. The U. S. Electrical Supply Co., of 120 Liberty St., are the Eastern sales agents.

THE STANDARD UNDERGROUND CABLE CO. have just established a Southeastern Sales Department, with headquarters in the Betz Bldg., (Rooms 1225 and 1226), Philadelphia, Pa., and with Mr. T. E. Hughes in charge as Manager of the Department.

J. F. CUMMINGS, manager and inventor of the Armorite Interior Conduit has been in town all the week looking after the interests of his specialty in this market. R. B. Corey, of 711 Havemeyer Building, New York, has taken the selling rights for this territory, and the Armorite Co. can be congratulated on securing so able a representative. They speak in glowing terms of the large orders placed for the Conduit in the East, and are well satisfied with its adoption by electrical contractors of note.

New York, N. Y.—Eastern Engineering Co. has been incorporated by Francis E. Tyng, Franklin R. Haines, and Sewell T. Tyng; to carry on a general mechanical and electrical engineering business. Capital stock, $5,000.

Chattanooga, Tenn.—Steps are being taken to construct an electric railway from Clarksville to New Providence.

Denver, Col.—A two-mile trolley line is to be built between Pueblo and River View cemetery.

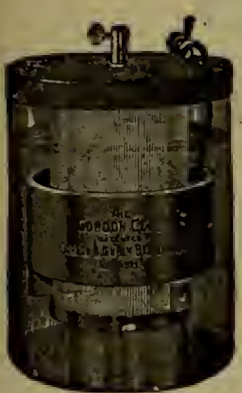
Baltimore, Md.—An electric railway will probably be constructed to connect Pen Mar with several Cumberland Valley resorts.

Charlottesville, Va.—The Albemarle Telephone Co. will be organized with J. Edwin Wood, president; James F. Harlan, vice-president, and others; to furnish a better and cheaper telephone service to the business men of Charlottesville and the University of Virginia.

Holland, Mich.—Ottawa Telephone Co. has been incorporated, with a capital stock of $10,000.

North Wilkesboro, N. C.—John T. Finley is interested in the establishment of a telephone system.

St. Paul, Minn.—The Northwestern Telephone Exchange Co. stockholders will amend articles of incorporation, increasing capital stock to $3,000,000, divided into 60,000 shares of $50 per share.



THE GORDON PRIMARY CELL speaks for itself, and we speak for it by guaranteeing it as represented, and others speak for it because they have found it to be as represented in every respect.

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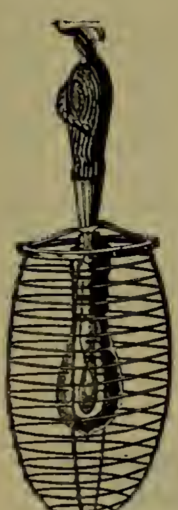

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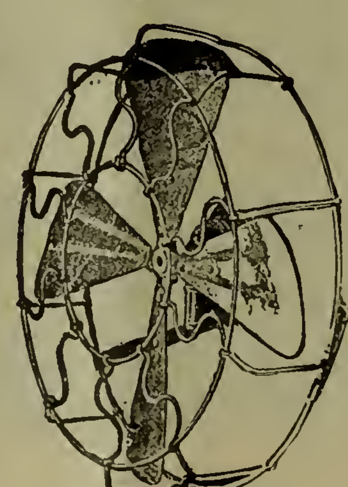

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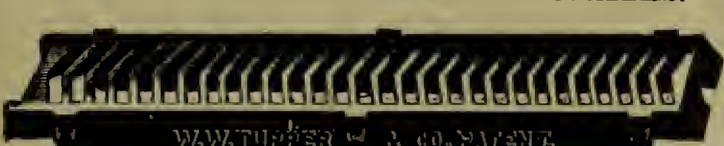

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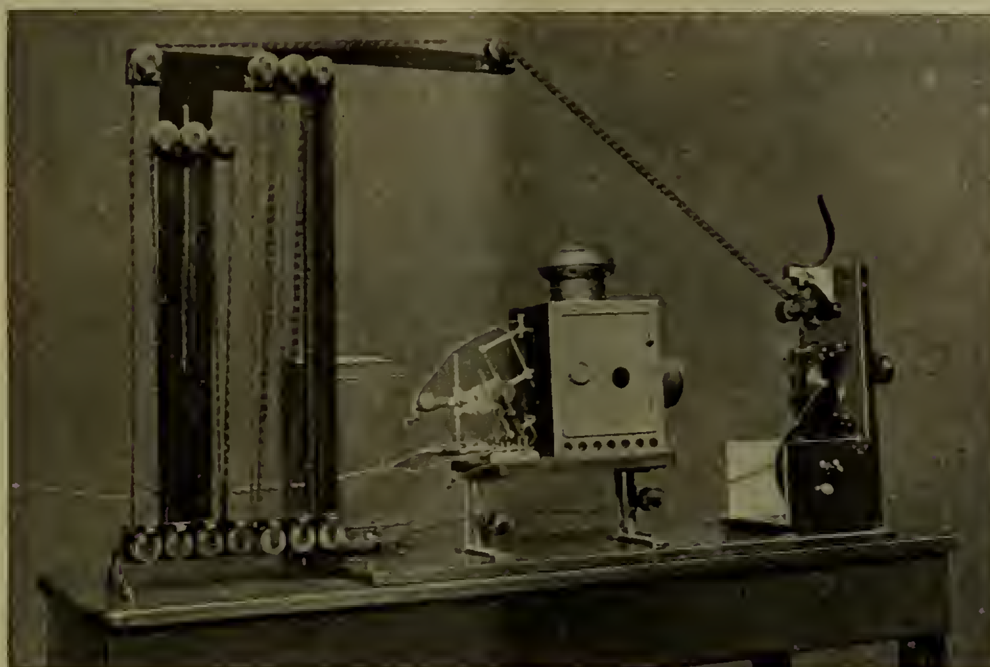
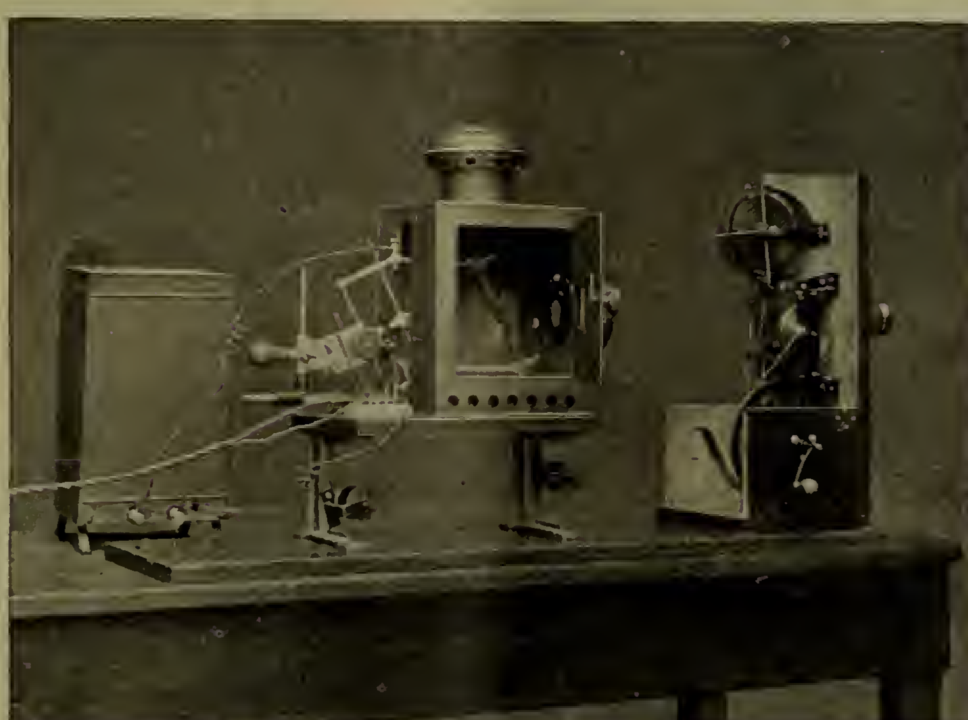
The Electrical Age.

Vol. XX—No. 13 NEW YORK, SEPTEMBER 25, 1897 Whole No. 541



Edison Kinetoscope, Showing Spool Bank.

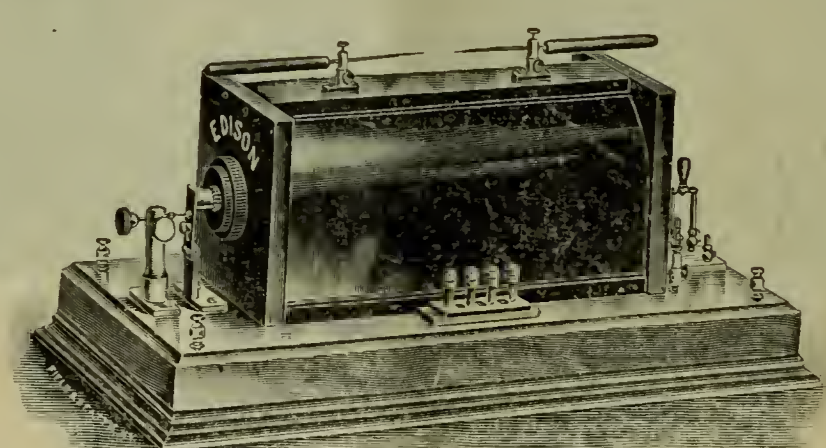


Edison Kinetoscope, Showing Reels.

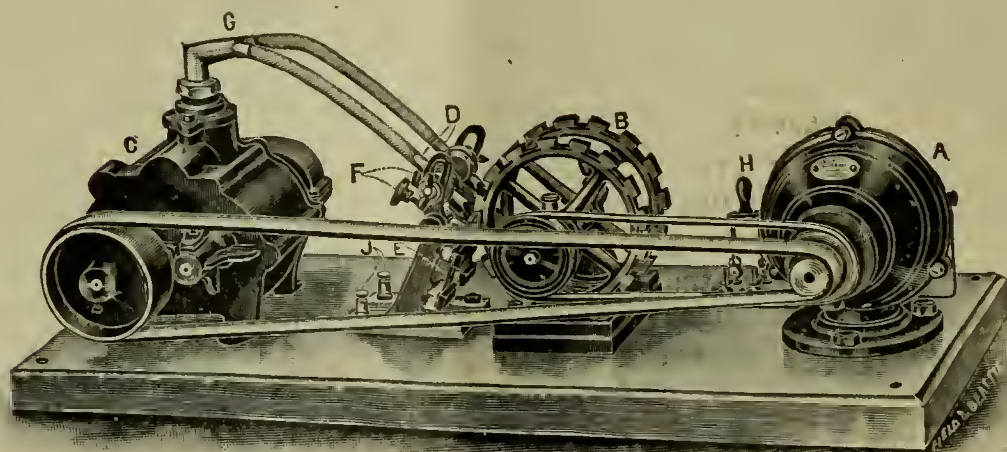
SOME OF EDISON'S INVENTIONS.

The inventions of this century are so numerous that we are safe in our conclusions regarding it as the most fruitful and important of all that have belonged to the past or will belong to the future. Brilliant discoveries have crowded in upon each other and marvelous advances have been made in all that relates to science and mechanism. From the time of Watt to the present, a series of remarkable inventions has been made of such consequence and importance that their creators represent the stepping stones of civilization, the real levers of progress. The inventions of Thomas A. Edison are full of interest to those that like to learn the history of great men. Even the most prosaic life may have an atmosphere of romance surrounding it which will deepen the tints of perfection and add increased lustre to its owner's name. It is said that Edison was originally a train-boy, but that on one fortunate occasion while crossing the railroad track he noticed the child of a station telegrapher in the pathway of a thundering express. He snatched this child from the arms of Death, and the grateful father, anxious to show his appreciation, taught young Edison the elements of telegraphy. The slumbering genius of the lad was fanned into a flame by this opportunity and his fruitful mind soon produced a system of quadruplex telegraphy which brought him wealth and notoriety. In many other ways better known to the public has Edison shown proofs of his genius. There are few new principles discovered which do not find a ready application in his hands, and in this brief sketch a few of the devices he has perfected will be referred to. The Edison projecting kinetoscope, which throws an image of clearness and brilliancy, is shown in the leading illustrations. It consists of an outfit containing a condensing lens, objective lens, electric lamp, lamp-house and resistance. The distressing vibration is hardly discernible in the clearly cut views, and the ready application of this remarkable instrument to either calcium or electricity makes it readily available on all occasions. Edison films are supplied for use with reels and all appliances that tend to perfect this outfit as a whole. The popular use to which these instruments have been put needs no description by us, but as one of the most wonderful inventions there is no doubt that it heads the list. A host of other minor inventions used in connection with X ray work, electro-therapeutics, dentistry and general experimental work would cover many pages of manuscript, but a few might be mentioned that the reader may be already cognizant of. The Edison-Lalande cell, used for phonograph and fan-motor purposes, of three hundred ampere-hour capacity is represented. It is the final outcome of considerable experiment and stands forth as the acme of cleanliness and economy. The Edison Ruhmkorff coil, the general lines of whose construction recommend it as being of the greatest aid in X ray work; its uniformity of action, brilliant spark and real efficiency making it the superior of other similar pieces of apparatus. In connection with Roentgen ray work Mr. Edison has perfected an instantaneous air-brake wheel.

Therapeutic Sinusoidal Machine, for Use on the 110 to 120-Volt Direct Current.

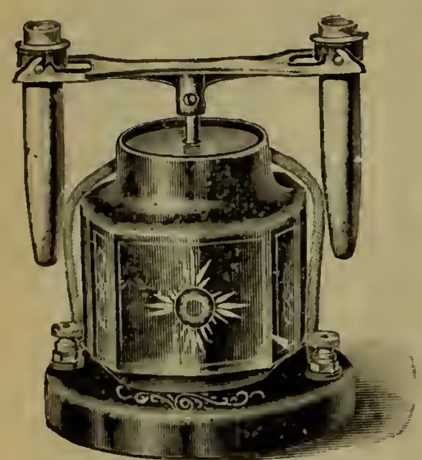


The Edison Ruhmkorff Coil.

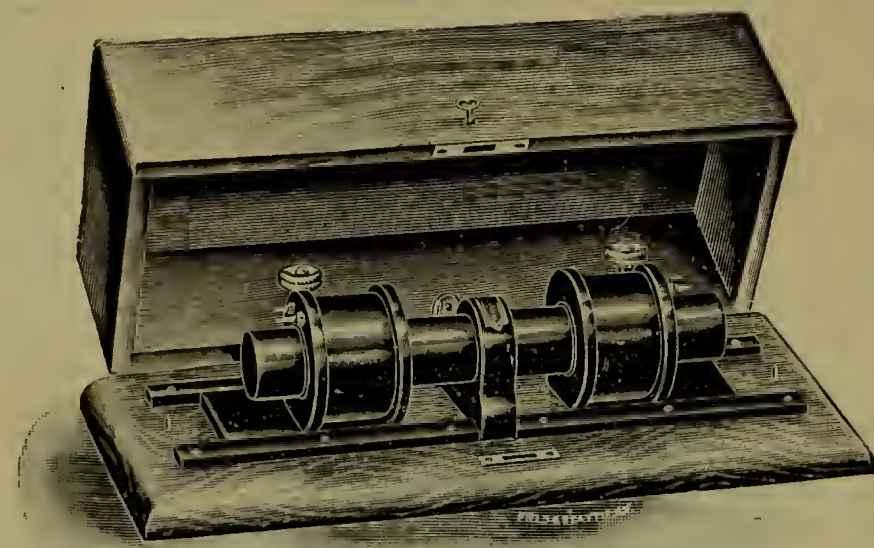


Edison Instantaneous Air-Break-Wheel.

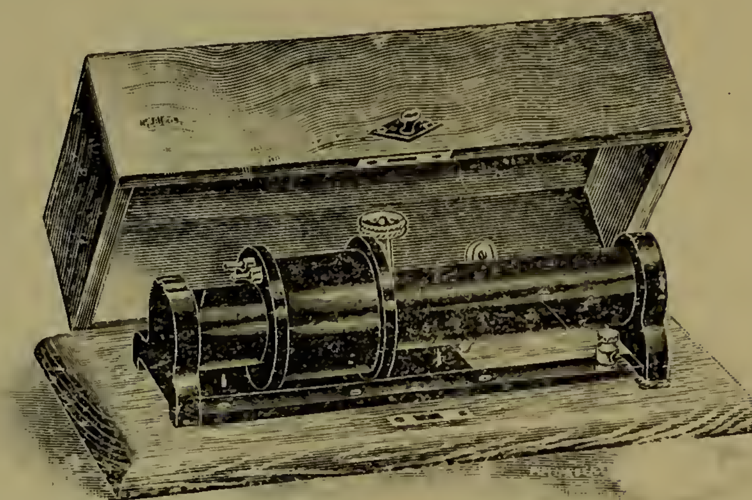
By means of this device one hundred and ten volts can be used in the primary of his Ruhmkorff coil, the vibrator being displaced. A rotary blower connected to a motor supplies the air pressure required for the annihilation of sparks. The combination of this coil and brake-wheel with his portable focus-tube holder, or focus-tube and stand, enables physicians and experimenters to proceed with facility and convenience. The tubes manufactured



The Heiman Electrical Centrifuge.

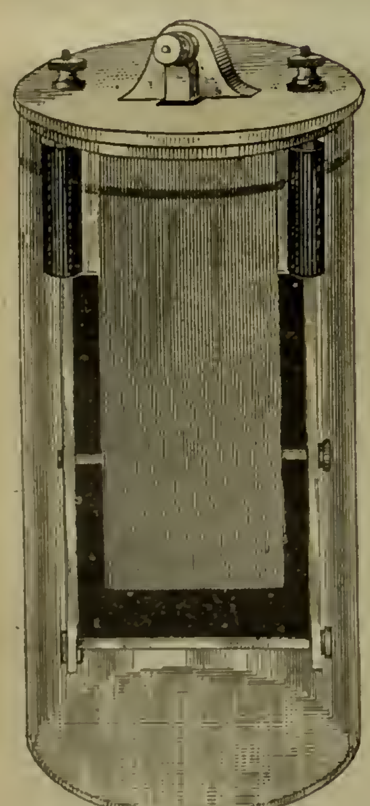


The Edison Alrernating Current Caalery Transformer. For use on the 52-Volt or 104-Volt Alternating Current.

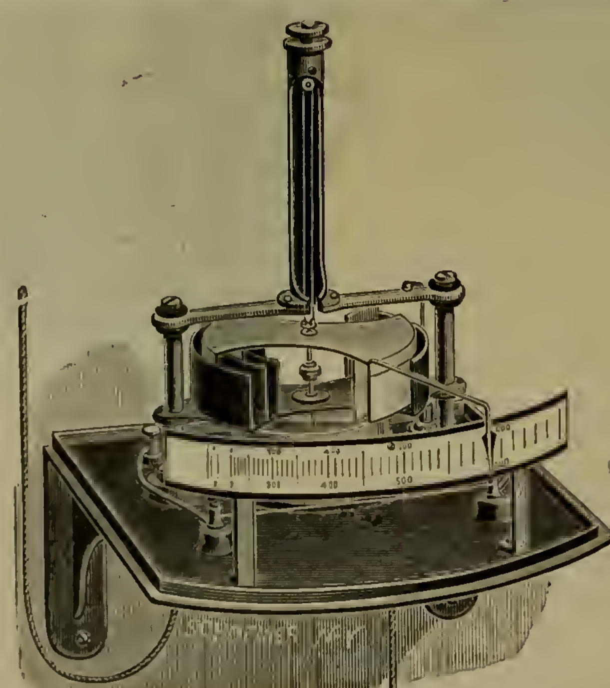


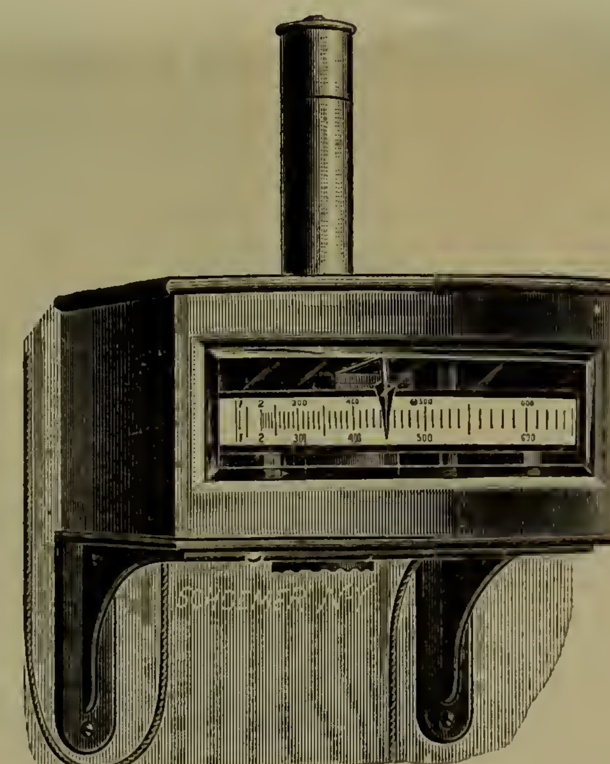
The Edison Alternating Current Compination Transformer, For use on the 52-Volt or 104-Volt Alternating Current.

Edison Fluoroscope.

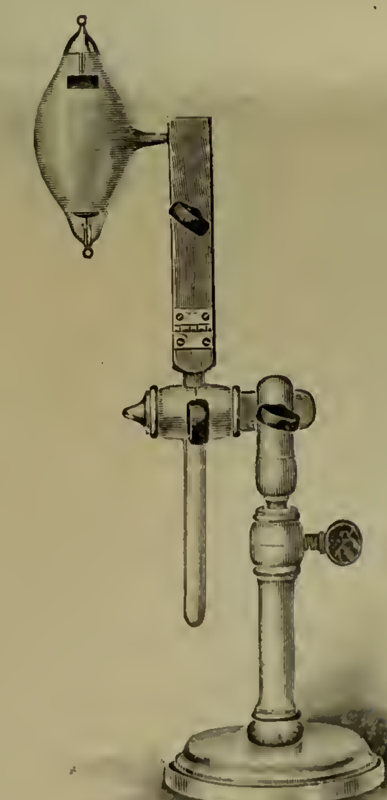


Type "S" Cell. Phonograph and Fan Motor Model.





Kennelly Standard Static Voltmeter. For High Tension Currents, both Continuous and Alternating.

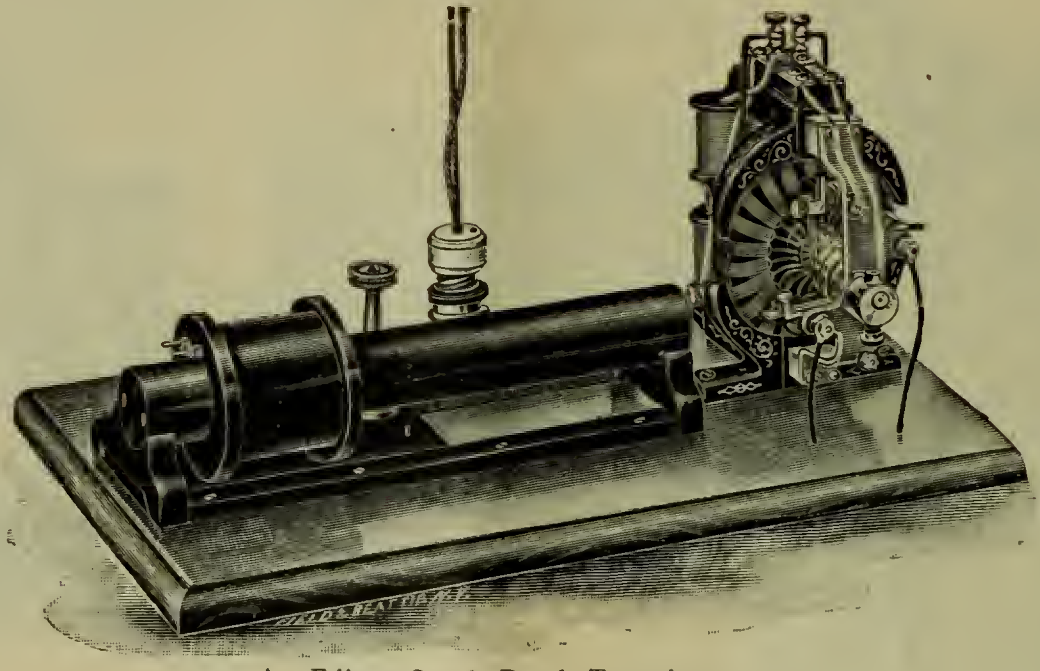


Edison Focus Tube and Stand.

by Mr. Edison are merely modified forms of those originated by Sir William Crookes. By their use in combination with the Edison fluoroscope remarkably clear pictures of sharp definition are obtained. This interesting field of work has been thoroughly developed by Mr. Edison, and many important improvements have been made of the utmost consequence to the layman and the physician. For medical purposes the Edison alternating cautery transformer used on either a fifty volt or a hundred volt alternating current is a model of convenience. In a modified form of the same, called the combination transformer, two movable coils are supplied so that the physician can use both the cautery apparatus and the laryngoscopic lamp, regulate both and use them together. A direct current cautery transformer used on a hundred and ten or a hundred and twenty volt current has also been perfected by Mr. Edison and is excellent for hospital work, proving its usefulness on many important occasions. The Edison Manufacturing Company, of which Thomas A. Edison is proprietor, have show-rooms at 110 E. 23rd St., N. Y. City, and a factory at Orange, N. J. Many curious devices can be seen on visiting this establishment; for instance, the Kennelly Standard static voltmeter, for continuous and alternating high-tension currents, built on the principle of the electrometer, that is, measuring without consuming current. It is unaffected by dynamos, does not need readjustment and can measure from zero to twelve hundred volts with accuracy. The Heiman electrical centrifuge, which is used from an analysis of blood, bacteriæ and urine, is sold by the above concern. An ironclad motor whose shaft runs on a jewelled bearing, rotates two graduated capillary glass tubes in which is placed the blood or other liquid to be examined. The shaft of this apparatus rests vertically upon the bearing already mentioned and carries horizontally a metallic frame holding the glass tubes. The velocity of the tube carrier with battery outfit is over fifteen hundred revolutions per minute. With the hæmatocrite attached, a speed of eight thousand revolutions can be readily obtained. This velocity is greater than that actually required for the examination of blood or bacteriæ.

A piece of mechanism called the Kennelly therapeutic sinusoidal machine, used for the production of a true sinusoidal current which is required in electro-therapeutic treatment, is likewise illustrated. This convenient little device with lamp resistances, Bailey rheostat and all additions required for its use, represents a most complete outfit for medical men. The many curious applications of the electric current may be found in the most unthought-of fields of work. On many sides and in the most unexpected places we find visible traces of Mr. Edison's progressive touch.

The Edison Portable Focus Tube Holder.



An Edison Spark Break Transformer.

Scotland Neck, N. C.—Mr. S. K. Fountain of Rocky Mount will establish a Telephone Exchange in this city.

Greenville, Texas.—The Southwestern Telegraph and Telephone Company, suit filed against them by The Gulf, Colorado and Santa Fe Railroad.

Eastman, Ga.—A Telephone Exchange will probably be established shortly. For further information address the Eastman Electric Light & Telephone Co., incorporated, with William N. Lietch, President; Walter M. Clements, Secretary-treasurer.

Gadsden, Ala.—R. L. Adams, President of the Alabama & Georgia Long Distance Telephone Co., will make surveys for a long distance system at this place.

THE BONDING OF RAILS.

The difficulty of securing perfect electrical connection between rails has been discussed by scientific as well as practical men. In past issues of The Electrical Age, articles have from time to time appeared, mentioning the necessity of immediately improving and utilizing a good rail-bonding system. The dangers, expense and possible law suits arising from electrolysis, as well as the troubles developing, which directly affect the dividends of a street railroad company, have been frequently reviewed. But, fortunately, the time has approached when to hear of such news is to realize that some company has refused to accept improvements or have been too careless to investigate in order that they might find and use something which would remove such faults. A system of rail-bonding has been practically developed, which should leave no ground for further complaint. Copper wires ending in a plug, which fits into the rail where the web and lower flange meet are now used. The contact in the steel is seven times that of the cross section of the copper bond and over. This absolutely certain contact removes all resistance practically, and establishes continuity between rail and rail. The holes in the rail are carefully drilled and reamed to receive the coned end of the bond. The purest copper is used for bond wires, and when the joint is once established between them and the rail, the practical bonding of tracks has become a certainty. A few illustrations, showing diagonally drilled holes in rails, with bond inserted, and machine for drilling the same, are presented to the reader's notice. The writer's personal investigation has shown him that hundreds of thousands of dollars' worth of power have been and are being wasted, due to the insufficiency of the contact between bond and rail. Feeder systems supplying lines are in many cases thirty per cent. heavier than they need be, and the direct consumption of coal, due to this almost reckless waste amounts to thousands of tons, annually. The Harrington Rail-Bonding Company, of 120 Liberty street, N. Y. City, will answer all communications regarding the nature of their improved bond and system of applying it.

Drilling.

Reamed Holes.

Heovy Bonding.

THE NEW YORK STATE STREET RAILWAY MEETING.

The fifteenth annual meeting of the New York State Street Railroad Association was held at the International Hotel, Niagara Falls, N. Y., Sept. 14, 15 and 16, 1897.

President J. Tracy Rogers of Binghamton, called the meeting to order on Tuesday morning at 10.45 o'clock.

The roll was called and it was found that the following gentlemen were in attendance at the meeting :

Delegates of Street Railway Companies.

John W. Boyle, Pres. Utica Belt Line St. R. R., Utica, N. Y.; J. C. Brewester, Supt. N. F. & S. B. R. R. Co., Niagara Falls N. Y.; J. B. Cahoon, Gen'l Mgr. Elmira & Horseheads Railway Co., Elmira, N. Y.; J. P. E. Clark, Gen'l Mgr. Binghamton Railroad Co., Binghamton, N. Y. ; H. S. Cooper, Schenectady Ry. Co., Schenectady, N. Y.; Wm. W. Cole, West Side R. R. Co., Elmira, N. Y.; Chas. Cleminshaw, Pres. Troy City Ry., Troy, N. Y.; R. E. Danforth, Buffalo, Bellevue & Lancaster Railway, Bellevue, N. Y.

W. Caryl Ely, Pres. N. F. & Buffalo Ry. Co., Niagara Falls, N. Y.; H. C. Evans, Nassau Electric R. R., Brooklyn, N. Y.; J. H. Stedman, Rochester Ry. Co., Rochester, N. Y.; Thomas H. Fearey, Buffalo, N. Main St. & Tonawanda Ry. Co., Buffalo, N. Y.; Wm. E. Havens, Supt. Citizens St. Ry. Co., Fishkill-on-Hudson, N. Y.; W. H. Heller, Lewiston & Youngston Frontier Railway, Lewiston, N. Y.; Chas. B. Hill, Niagara Falls & Susp. Bridge Ry., International; H. L. Johnson, Pres. Nassau Electric R. R., Brooklyn, N. Y.; Henry A. Johnson, Metropolitan St. Ry. Co., 621 Broadway, N. Y.; Godfrey Morgan, Buffalo St., Main St. & Ton. Ry. Co., Tonawanda, N. Y. ; C. K. Marshall, N. F. & B. Ry.. Niagara Falls, N. Y.; Ambrose P. McCabe, Metropolitan St. Ry. Co., 621 Broadway, N. Y.; F. P. Mooney, C. & H. Traction Co., Cortland, N. Y.; F. G. Maloney, Electrician, Elmira & Horseheads Railway Co., Elmira, N. Y.; John H. Maffit, The Rapid Transit Ry. Co., Syracuse, N. Y.; J. H. McCormick, Gen'l Supt. Brooklyn Heights Ry. Co., Brooklyn, N. Y.; John W. McNamara, The Albany Ry. Co., International.

Henry S. Newton, Syracuse Rapid Transit Railway Co., Syracuse, N. Y.; Edmund O'Connor, Attorney of Association, Binghamton, N. Y.; B. W. Porter, Saratoga Traction Co., 99 Cedar St., N. Y.; Alex. J. Porter, Director N. F. & S. R. R., Niagara Falls, N. Y.; T. C. Penington, Sec'y Am. St. Ry. Ass'n, 2020 State St., Chicago, Ill.; G. T. Rogers, Pres. Binghamton R. R. Co., Binghamton, N. Y.; Geo. H. Sliney, Nassau Electric R. R. Co., Brooklyn, N. Y.; Chas. H. Smith, Supt. Troy City Ry., Troy, N. Y.; C. B. Story, Hoosick Ry. Co., Hoosick Falls, N. Y.; E. F. Seixas, Amsterdam St. Ry. Co., Amsterdam, N. Y.; Burt Van Horn, N. F. & B. Ry., Niagara Falls, N. Y.; Thomas H. Fearey, Pres. Canandaigua Electric R. R. Co., Canandaigua, N. Y.; W. W. Wheatly, Sec'y Brooklyn Heights R. R. Co.. Brooklyn, N. Y.; Henry H. Watson, Pres. Buffalo Ry. Co., Buffalo, N. Y.

Representatives of Manufactories.

Giles S. Allison, St. Louis Register Co., 18 Broadway, N. Y.; A. E. Acby, The Pennsylvania Steel Co., 2 Wall St., N. Y.; H. E. Adams, Central Electric Co., Chicago, Ill.; R. H. Beach, General Electric Company, 44 Broad St., N. Y.; Wm. J. Clark, General Electric Co., New York, N. Y.; H. C. Evans, The Johnson Co., New York, N. Y.; Thomas H. Fearey, General Electric Co., Buffalo, N. Y.; J. A. Granger, New York Car Wheel Works, N. Y.; G. W. Haskell, J. G. Brill Co., Philadelphia, Pa.; Percy Hollbrook, Weber Joint Manufacturing Co., Cotton Exchange, N. Y.; Geo. J. Jackson, Sec'y National Conduit & Cable Co., New York, N. Y.; E. J. Lawless, American Car Co., 115 Broadway, N. Y.; E. T. Long, Peckham Motor Truck & Wheel Co., N. Y.; Elmer P. Morris, McGuire Mfg. Co., 15 Cortland St., N. Y.; Frank MacGovern, Rossiter, MacGovern & Co., N. Y.; Frank A. Morrell, Sterling Supply & Mfg. Co., N. Y.; Geo. T. Manson, The Okonite Co., N. Y.; D. W. Pugh, The Stephenson Co., N. Y.; R. K. Polk, Wm. Wharten, Jr., Mfg. Co., Philadelphia, Pa.; H. N. Ransom, Consolidated Car H't'g Co., Albany, N. Y.; Franklin Sheble, Edison-Brown Rail Bond, Philadelphia, Pa.; G. W. Swan, John A. Roebling's Sons' Co., New York, N. Y.; Wm. H. Tenbroeck, Diamond Truck & Car Gear Co., Kingston, N. Y.; A. C. Vosburgh, The New Process Rawhide Co., Syracuse, N. Y.; C. A. Vincent, Vice-Pres. The Ball-Wood Co., N. Y.; C. N. Walsh, McIntosh, Seymour & Co., New York, N. Y.; H. D. Watson, The Ed. P. Allis Co., Milwaukee, Wis.; D. F. Potter, General Electric Co., Buffalo, N. Y.; J. McGhie, General Electric Co, N. Y.; Edgar P. Anderson, Dublin United Tramways Co., Dublin, Ireland; S. Beeton, Dick, Ress & Co., Hove, Sussex, Eng.; Wm. Anderson, Sec'y & Mgr., Dublin United Tramways Co., Dublin, Ireland; Frank M. Baker, R. R. Commins Owego Works, N. Y.; Ashley W. Cole, N. Y. State Railway Commission, Albany; Geo. W. Dunn, R. R. Commissioner, Binghamton, N. Y.; J. B. Concannon, Dublin, Southampton, Barcelona & Tramway Union Co., London, Eng.; Alfred Dickinson, European Tramways, Birmingham, Eng. ; George Flett, Managing Director, Dick, Kerr & Co., London; J. F. Murphy, Dublin Tramways, Dublin, Ireland ; Wm. Martin Murphy, Dublin & Belfast Tramway, Dublin, Ireland ; Peter C. Deming, Superintendent Buffalo Railway Company, Buffalo, N. Y.; T. Stoddard Beattie, The Municipal Record and Advertiser, New York, N. Y.; T. J. Nicholl, Rochester R'way, Rochester, N. Y.; John A. Read, Tonawanda R. R. Co., North Tonawanda, N. Y.; F. A. Esteh, Pres. R. D. Nuttall Co., Allegheny, Pa. ; Edward P. Sharp, Manufacturers' Agent, Buffalo, N. Y.; Pemberton Smith, N. Y. Car Wheel Works, Buffalo, N. Y. ; H. L. Shippy, John A. Roeblings Sons' Co., New York; E. B. Waite, Tonawanda R. R. Co., North Tonawanda; Charles N. Wood, R. D. Nuttall Co., 31 State street, Boston, Mass.

The Press was represented as follows :

Electrical Age, Walter Mueller; Electricity, Chas. D. Shain; Electrical Engineer, T. C. Martin; Electrical Review, Chas. W. Price; Electrical World, L. H. Parker; Street Railway Journal, James H. McGraw, W. H. Taylor; Western Electrician, J. B. O'Hara ; Stenographer, T. E. Crossman; Street Railway Review, F. S. Kenfield.

W. Phillips, Niagara Falls Park & River Railway, Niagara Falls, Ont.; Ames Van Etten, Kingston City R. R. Co., Rondout, N. Y.; C. R. Barnes, Inspector State R. R. Commission, Rochester, N. Y.; Frank A. Estep, Pres. and Treas. R. D. Nuttall Co., Allegheny, Pa.; F. C. Randall, Christensen Engineering Co., Hartford, Conn.; A. C. Vosburgh, Sec. & Treas. The New Process Rawhide Co., Syracuse, N. Y.; E. Peckham, Pres. Peckham Truck Company.

Abstract of the address of President G. Tracy Rogers of Binghamton, N. Y., at the fifteenth annual meeting of the Street Railway Association of the State of New York, Niagara Falls, September 14, 15, 1897.

Gentlemen of the Convention : In behalf of the Street Railway Association of the State of New York, it is my privilege to extend to you all a cordial welcome to this, our fifteenth annual convention. It seems most fitting that we should meet here at Niagara, if for nothing more than to observe the object lesson which nature unfolds before us. The power exhibited here in nature's workshop is awe-inspiring, and could it be utilized would propel every street car in our state.

The past year will long be remembered by those connected with street railroads, in many cases, as one of the most discouraging since the adoption of rapid transit. Trade and commerce have, we hope, reached their lowest ebb. The bicycle is now our too successful competitor.

The Electrical Age.

ESTABLISHED 1883.

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

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THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, SEPTEMBER 25, 1897.

CONTENTS.

CONCERNING STORAGE BATTERIES.

When Sir William Grove attached the wires of a battery to his water-decomposing apparatus and found to his amazement that the galvanometer recorded a current, though the battery had ceased to supply any, he unconsciously set into action certain wheels in the mechanism of trade which have been revolving ever since. He also started a series of speculative inquiries which to this day have not been very effective in throwing more light upon the nature of that mysterious phenomenon which he accidentally stumbled against. The theory of the accumulator, as well as the accumulator itself, has developed so that one is accepted because there is no better; the other because it represents the final limitation that progress in that particular direction has defined. With the storage battery, have grown innumerable uses for it, which today appear under the head of the horseless carriage, the electric car, the reserve fund of power in electric-light stations, a corner in isolated plants, and others of minor importance, including electric launches, medical outfits, etc. The objection to the storage battery has assumed two forms. In the past its durability was questioned; at present only its weight. It seems as though weight were an indispensable element of all cells using lead or alloyed grids; yet it seems as though the peculiar and hidden electro-chemical changes occurring in a storage-battery plate might call for a different construction. Grove's discovery of the accumulator was made with two strips of platinum and the natural gases, but for some reason or other it was not thought necessary to experiment further on these particular lines, so attempts to use oxygen and hydrogen as gases, with electrodes for them to act upon, were not continued further than this first-recorded experiment. The spongy surface of a storage-battery plate undoubtedly absorbs or rather condenses immense volumes of gas. The infinitesimal cavities into which the gas enters and the relationship established between it and the walls of its prison have not been thoroughly understood. It is likely that experiments made with the two gases in the same manner as Grove used his electrolytic device, might, with these gases under pressure, bring to light some new principle worthy of practical application in the history of electric accumulators. We may then find a means of transforming so that leaden plates will not be required, but a compact and equally economical apparatus wiil be used which performs its functions as well as the storage battery and disposes of its most objectionable feature—excessive weight.

THE VALUE OF ELECTROLYTIC PROCESSES.

The means employed to separate molecule from molecule, or atom from atom with any degree of success, is one of a purely electrical nature. We have found that an analysis or general examination of the properties of metals is greatly furthered by the use of an electrolytic bath. The practical outcome of its application in fields of industrial life has been the establishment of great mining concerns, the rearing of electro-plating houses, and the development of a certain field of fine art which belongs under the head of electro-metallurgy. The application of a current to a liquid bath containing metallic constituents is like the entrance of a selective hand into a bowl full of fish. Only certain of them are grasped and the rest allowed to remain.

The electro-plating of copper from a copper solution presents a parallel case to this. Copper is deposited upon the cathode, but the other elements fall to the bottom or remain without interference. Not only in a commercial sense need we place a value upon electrolytic processes, but we are forced to realize that the selective power of a current gives us control of certain channels of investigation. For instance, we electroplate with anode and copper in a somewhat crude state and find in the sludgethat falls to the bottom gold, silver, and other metals, which in some mysterious way were associated with the copper.

For several years many reputable scientists, including some famous for their investigations, have believed that elements as they appear to us are compounds, admixtures of some description, which might under the influence of pressure and terrific heat be reduced to their primitive and possibly original condition. The presence of strange metals in such intimate association with another metal might incline us, without offence to the world of fact, to the belief that they are but diversified forms or compounds of the original metal-making material. This is, of course, a mere suggestion. It is more than a vagary and moves along in the trend of modern thought with considerable dignity. The only means that we can ever employ for the purpose of finding out the truth will be an electric current; whether it will produce a heat sufficient for our purposes or develop in the electrolytic bath some new phenomena, we cannot say, but we think that the reason of mankind would look forward with more certainty to a *single* source of inorganic supply than it would to many. It would sooner believe that metals represent the influence of varying forces and differing circumstances than it would the almost unthinkable origination of each one from some hitherto unthought of beginning.

Statesville, N. C.—The telephone line to Bradford's and Yount's stores in Shiloh township has been completed.

Winfield, Iowa.—Telephones and electric lights will probably be established here.

It operates without franchise of track, and pays no taxes. On the contrary, cinder paths are constructed, pavements laid down, and in many cases pavements changed for its benefit. As a means of locomotion the bicycle has come to stay, but as a novelty it is being overdone and will share the fate of other novelties, and I believe it has reached its zenith.

Notable improvements have been made recently in motors and car construction, especially for the suburban and interurban roads. Cars with all the comforts and conveniences of a steam passenger coach are now in operation on some lines.

The Legislature and New York City officials have been dawdling with the question of rapid transit for a number of years, but whatever results have been accomplished in this direction may be attributed to the enterprise of the railroad companies. They have recently obtained the consent of the State Board of Railroad Commissioners to adopt electricity, instead of horse-power, over a distance covering one hundred and ten miles of track. This change involves an expenditure of $12,000,000, and I am informed that contracts have already been made for a large portion of the work. Contracts also have recently been closed between the Brooklyn Bridge trustees and the Brooklyn surface roads by which the trolley roads of Brooklyn will extend their lines across the bridge. This great improvement will cost the Brooklyn roads $500,000.

Nothing has been done within the past ten years which has inured more to the benefit of the people of our state than the adoption of rapid transit and the consolidation of street railroads in cities, both large and small.

Consolidation, which was at one time regarded as a menace to public welfare, is now universally recognized as redounding to its advantage.

It is far within the bounds of truth to say that for every dollar invested in a street railway, another dollar has been given to the people through the resulting increase in property values alone. The street railways have handsomely repaid the public for their franchises. The populistic element, with its plans for obtaining cheap fares and its ideas of municipal ownership, together with high taxation of railroads, if allowed to be successful, will materially cripple street railways. The free transfer system has been so liberally adopted in this state and the margin of profit is already so small that any legal reduction in fares, however little, would compel a complete abandonment of the far-sighted policy which is building up the cities of our state. Vested right is the last remedy we should seek in order to protect our franchise rights, but in many instances such measures must be resorted to in order to protect us from the clamor of the socialistic element. A number of decisions have been made of late which should be very gratifying to us.

More bills affecting street railroads were introduced in the Legislature last year than ever before; no doubt, a majority of them at the request of constituents. Had they become laws and been put in operation the public, as well as ourselves, would have suffered. We found the members ready to listen to our arguments and anxious to enact such laws as would be of service to the public good.

During the past year there has been organized an Association of Street Railroad Accountants. This association should have a cordial and hearty support. Next to the manager of a road, I consider the accountant the most important official; in fact, the successful manager must rely upon him largely as a guide in the management of the road. An important advance made by the street railroads since the adoption of rapid transit is the improvement in the character of employees. Better discipline is now maintained and more courtesy shown in catering to the public. As our business grows in technical and scientific requirements, it naturally attracts a class of men to whom there was formerly no call or inducement to enter its service. Nearly every road has a mutual benefit society or employees' club connected with it. Each has a plan agreeable to the ideas of the employees, and in nearly all instances the management has not only endorsed, but become a part of these societies. A number of roads have furnished club rooms and other substantial assistance for them. We cannot take too much interest in the men connected with the operation of our roads.

The organization of mutual indemnity insurance companies for electric railways has been suggested as a protective measure against the prohibitive rates we are now charged. For years insurance companies have been experimenting with insurance upon street railroads. From the results obtained I should judge the business was not satisfactory. The insurance companies have either refused to write this class of risks or have established, in many instances, prohibitive rates. In a measure, this may be the fault of the street railroad manager, who, feeling the responsibility in part removed, may have been more careless in the handling of his road. A number of roads still have low rate policies, but they are based upon the record of the roads' casualties. Not long since, the rate for fire insurance was almost prohibitive, but I am pleased to state that we are now being insured at a fair rate, as compared with other business risks. Owing to the insurance regulations we are now debarred from the sale of power, which, in many cases, would be a large source of revenue, and under the present restrictions commercial lighting from the electric railway circuit will have to be confined to out of doors.

The rapid increase in the number and size of parks and pleasure resorts owned by street railway companies and operated by them as traffic promoters has been one of the striking developments which have accompanied the introduction of electricity as a motive power on street railroads. The general opinion of street railroad managers, who have had experience in this direction, is that such pleasure resorts properly conducted, with a judicious selection of amusements and entertainments, tend to increase the ordinary traffic of a road. An amusement league for the interior cities of the state has been suggested. The idea is worthy of consideration and, if properly handled, should be a saving and convenience to the roads in such cities.

The experiment of carrying the United States Mails has proved a success, and the postal car service on our roads is appreciated by the public and accepted by the Government. New freight and express routes are being established, which operate not only as a convenience to the people, but as feeders to the steam roads.

The application of electricity to the existing steam roads is, today, a question of great importance to the practical railroad man. We have, no doubt, made inroads into their local passenger receipts and probably will continue to do so. Our roads are so situated that in most instances we are at an advantage. We can operate at a much less cost than they and our depots are at our patrons' doorsteps. The convenience and cheapness of our transportation recommend themselves. I believe there is room for us both, and, in a measure, the electric roads are feeders to the steam roads, and the more closely they are allied, the better for both.

It is still a question as to whether the storage battery is becoming a practical factor in the operation of our roads, and whether at the present cost we can use it to advantage in our central stations and at the ends of our feeders, thereby assisting in maintaining the potential on the trolley lines. Compressed air and the many other powers now being tried may have some surprises in store for us. The results of these experiments and inventions may be the beginning of a new era in the street railway world.

I congratulate you upon the financial and physical conditions of your roads, for notwithstanding that the past year has been the most depressing in our history, it is the first year for some time during which a receiver has not been asked to take charge of some road of our state.

Many of the improvements I have referred to have been very materially promoted by the intelligent discussions they have had at the meetings of our association. I am a believer in the importance and good results that can be accomplished by united action. I know from personal experience the past two years that this association has been a tower of strength in protecting the legitimate rights of the street railway interests of this state, and I hope that the same earnest and energetic support it received during that time will continue to be given it by all persons charged with the duty of looking after such properties. The growth of our association and the interest taken in it by nearly all of the roads are subjects of congratulation. It is the desire of the management that the active men connected with our roads take more interest in the association and especially in the convention work. I sincerely believe in the future of the association, but it will become what we make it.

At the Banquet.

Toastmaster, Hon. W. Caryl Ely.
Welcome, Hon. Arthur C. Hastings.
"The Empire State," Hon. Jas. M. E. O'Grady.
"The Niagara of Today," Hon. Thos. V. Welch.
"Street Railroads from the Consumers' Standpoint," John Kendrick Bangs.
"Our Hosts," Hon. Edmund O'Connor.
"The Railroad Commissioners," Ashley W. Cole, Wm. Murphy.
"Our Transatlantic Visitors," Mr. J. B. Concannon.
"The Association," John W. McNamara.
"The Railway Press," J. H. McGraw.
"The Ladies," J. H. Stedman.
"The Supply Men of Today," W. J. Clark.

John M. Brinker, Esq., was also called upon to make some remarks.

Officers, 1897–98.

President—G. Tracy Rogers, President Binghamton Railroad Co., Binghamton.

First Vice-President—W. Caryl Ely, President Niagara Falls Electric Railway Company, Niagara Falls, N. Y.

Second Vice-President—J. T. Nicholl, Vice-President Rochester Railway Company, Rochester, N. Y.

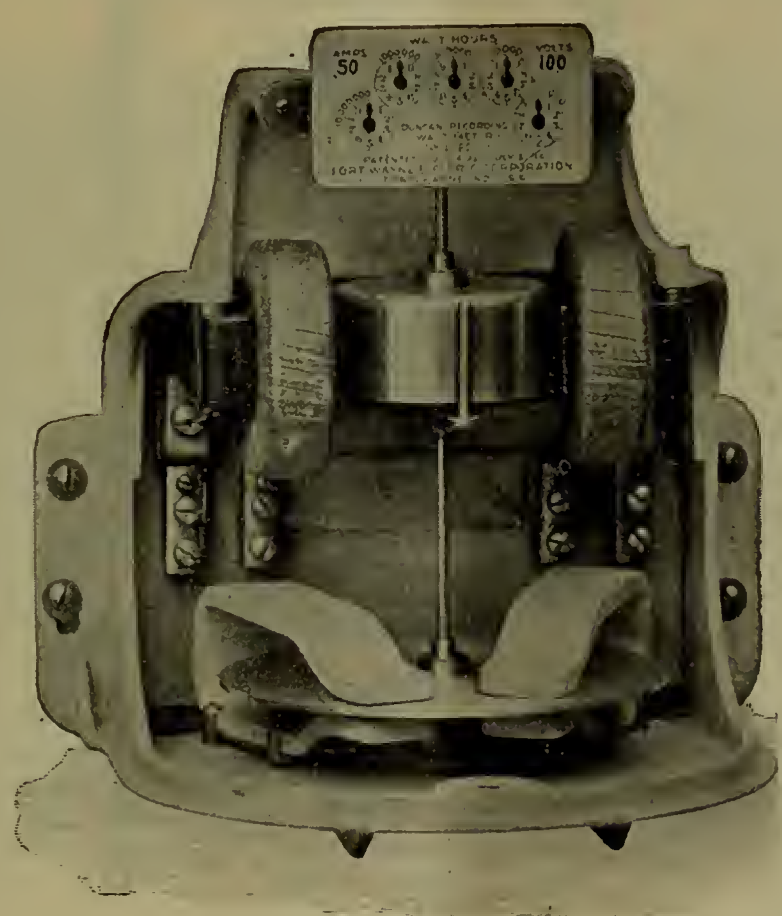
Secretary and Treasurer, Henry A. Robinson, Vice-President Metropolitan Street Railway Co., New York.

Executive Committee—President and Secretary, and Herbert H. Vreeland, President Metropolitan Street Railroad Co., New York; John W. McNamara, Treasurer and General Manager, The Albany Railway, Albany; Henry M. Watson, President Buffalo Railway Co., Buffalo; Clinton L. Rossiter, President Brooklyn Heights Railroad Co., Brooklyn, N. Y.

The 1898 meeting will be held in Brooklyn, N. Y.

DUNCAN METERS.

The modern meter of recently improved construction is an example of accuracy, mechanical perfection and undoubted durability. The new Duncan integratiug lamp-hour and watt-hour meters have received the highest recognition from prominent authorities on station and private-plant installations. The meters designed by Mr. Duncan are absolutely correct in the measurement of amperes and volts and without exception represent the *par excellence* of embodied principles.



Duncan Watt-Hour Meter.

A friction compensator for the regulation of the speed and the consequent correction for light loads adds an element of reliability to the watt meter illustrated which brings it above comparison. The lamp-hour meter has never driven a consumer to acts of desperation, but instead, has been to him a source of consolation due to its faithful record of his actual indebtedness to the electric-light company.

Alternating-current meters have reached a pitch of perfection which insures their universal use.

The Fort Wayne Electric Corporation of Fort Wayne, Ind., will sell one or many of the above meters to owners of electric-light plants or private individuals. The range of these instruments makes them as serviceable for one as for one thousand lights.

New London, Ohio.—An electric light plant is to be established in this city.

Ironton, Ohio.—An electric light plant will probably be established here.

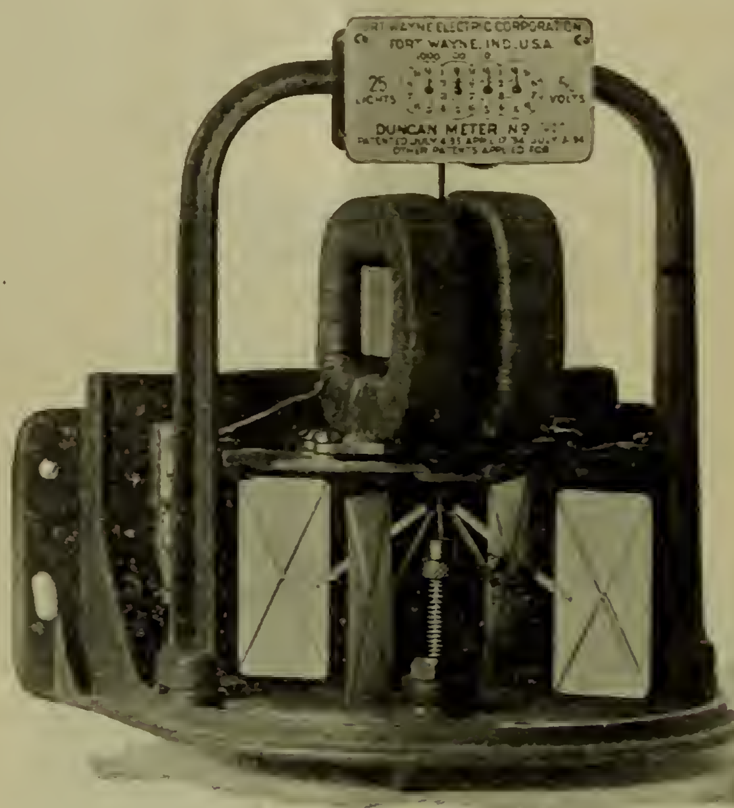
ELECTRO-VOTING MACHINE FOR THE U. S. SENATE.

To the Hon. Committee of Public Buildings.

Gentlemen :

Allow me to solicit your attention through the columns of the "Electrical Age," to a clause in Hon. J. W. Walker's speech delivered in the house on "House Rules", Mar. 3d, 1897. Rule XV, which reads as follows: "If we are ever to adopt a mechanical device to expedite roll calls, it must be done in some such a way as that proposed in this clause ; that is to say, by allowing the new or old method to be used at the discretion of the speaker."

Since the publication of this speech in the "Congressional Record," I have given the subject special attention, and am now prepared respectfully to submit to you a plan for the use of congress, a "mechanical count" of votes that will give almost instantaneous results, and without the least liability to error.



Duncan Lamp-Hour Meter.

I will briefly give the general outlines, leaving details for future consideration if demanded. The principles involved are electricity and weight. To begin with, either alone, would not effect our purpose. The electrical part performs but a small part of the work. At a convenient place in the chamber is placed a board of boxes (or rather in frames 4 x 5 in.) in pairs, the upper one for the aye vote and the lower one for the nay vote. To each member is assigned a pair of these boxes, and there is an electrical communication from each member's desk to his boxes. The rear of each box has an half-ounce metallic ball, padded with gum elastic, which lies loosely on a tilting concave surface, that can be readily dislodged by an electrical current from each desk. After the ball is dislodged it is received by a metallic conductor (padded with felt) and drops into a vessel below. This vessel is suspended from a conspicuous register, a disk of about three or four feet in diameter, and is placed above the tier of boxes in full view. The back contains a spring apparatus, and gives the exact weight of the balls as they drop in the vessel below. As the affirmative side cast their votes, almost simultaneous results will follow. The negative voting which follows is equally as expeditious. Where the apparatus is duplicated, except the boxes, both sides can vote at the same time. The result of a vote taken is not only read from the face of the register; but as each box that had been acted upon will remain open (until closed by a page) the member can see for himself if his vote went through.

The balls for the affirmative side are all of a bright red color; on the negative side blue. Each of the balls has its own receiving vessel with corresponding color. The electrical keys at each desk are separately covered with spring lids, and the one required is only exposed long enough to vote ; after this is done, the lid closes itself automatically. The whole machinery is exceedingly simple, and is not likely to get out of order. If there is any part that needs a watchful care it is the electrical part, and that may not require attention for an entire session.

Those "not voting" are readily ascertained by adding those that voted together, and subtracting the minor number from the principal. A quorum is ascertained by all members present to vote the red ball.

I respectfully submit the above plan for taking the vote of the Senate for your serious consideration. Please don't think lightly of the weighing part ; it may appear rather crude, but it will serve the purpose for permanent exactness—true as the scales in the mint. No other process is likely to take its place.

It will be constructed with a view to make it as noiseless as possible. The only part exposed to the eye from the front is the tier of boxes and the disk above.

I am respectfully,

Your obedient servant,

Austin, Texas. G. P. Hachenberg, M. D.

A GREAT PUMP.

If the details and figures given by a correspondent of the Chicago Record are exact concerning one of the pumps of the Calumet and Heela mine, it is, without doubt, the greatest mechanism of the kind in the world. its capacity of water delivery being some 2,500,000 gallons every hour in the twenty-four, and even then without reaching its utmost. The apparatus is a triple expansion pumping engine, with a capacity of 60,000,000 gallons, standing nearly fifty feet in height, and requiring 1,500-horse power for its operation; and it has been proved by actual tests that its nominal performance can be easily maintained for an indefinite time without injury or strain, and that, pushed to the full extent, the pump could handle approximately 75,000,000 gallons in twenty-four consecutive hours. The purpose of this pump is to furnish water for the great stamp mills of the Calumet and Hecla Co., which has twenty-two steam pumps in continuous operation, daily pulverizing 5,000 tons of conglomerate rock into sand so fine that it can be carried away by a stream of swiftly-running water. The pump is located near the lake shore and below the mills, so as to force a steady stream of water to the upper portions of the mill, where innumerable small jets play upon the great slime tables and jigs. Here it is that the specific gravity of the fine particles of copper contained in the rock separate the valuable mineral from the mass of worthless sand, the size and force of the streams of water being so nicely regulated as to wash away the sand and yet carry with it the minimum of copper.

A SUCCESSFUL NEW DEPARTURE.

Many of our readers have manifested much interest as to the practical workings of the electrically propelled delivery wagon recently purchased by Chas. A. Stevens & Bros., the silk house of Chicago, from the American Electric Vehicle Co., also of this city. Both merchants and electricians are keenly watching the result of the new departure undertaken by these leaders in their respective lines.

Motocycle carriages, more or less acceptable, have been seen here and there in various countries but none that met the requirements until the American Electric Vehicle Co., of Chicago, brought their output to its present perfection. This firm now distances all competitors in its adaptation of electricity as a power for the propelling of the merchandise-delivery wagon.

Mr. S. L. Tompkins, manager of Chas. A Stevens & Bros., expressed the satisfaction of the house with the new departure. "While our electric delivery wagons have not been in use very long," he said, "we have had ample time to judge of their efficiency and economy; in fact we have just ordered four more of them to be turned over to us by the first of October, when our busy season commences; meantime, I am keeping a record of their work—the drivers report from the odometer—the only correct way of getting at the service rendered. The electricity costs us, we find, just about a cent a mile, as was estimated by the Vehicle Co.

"Without an odometer a driver will naturally overestimate his run, but statistics show that where this test is applied about 20 miles is a good average day's run for a horse-power delivery wagon. Although this is not our busy season, our wagons register from 30 to 42 miles a day each. Here is the tally: 200 miles in six days. We anticipate no difficulty in running 50 miles a day when business requires it, with one charging of the storage batteries. This is much below the record. After a 30-mile run, our batteries are not half empty at night.... Yes, we examined into the matter for months before we came to a decision, for motocycles are being made in other countries; but, as frequently happens, American ingenuity brings our invention to the front and Chicago takes the lead. Some of the other vehicles seemed to us ponderous, ill-proportioned and slow. In others the batteries were so heavy as to weigh nearly as much as all the rest of the vehicle, and so bulky as to be cumbersome and destroy the appearance of the carriage."

A neatly uniformed driver was next interviewed and declared that it was no trouble to handle the electric wagon. He practiced for about ten minutes in the wareroom of the American Electric Vehicle Co., on Wabash avenue, then took the wagon out on the street, guided it to the house and at once commenced the delivery of goods.

He liked the electric vehicle because he could deliver more goods with it. It went faster, responded quickly and accurately to the slight pressure of the guide lever, and was perfectly reliable. By removing the little lever at his right hand, which reverses the motion of the wagon, he could lock its wheels and carry the carriage in his pocket, so to say.

Electric Delivery Wagon. Made by the American Vehicle Co. of Chicago.

From Mr. C. E. Corrigan, the wide-awake manager of the American Electric Vehicle Co., some additional facts were learned that will be appreciated by experts and other interested parties.

The company owns the patents on their electrical apparatus. The batteries are 75 per cent. lighter than any other in use—a very important consideration—yet have a greater mileage capacity. Occupying but little space, they can be so placed as not to injure the appearance of even a pleasure vehicle, of which they are building several.

The electrical equipment consists of 44 storage batteries—the "Crowdus batteries" of the heterogeneous type—of 100 amperes per hour capacity each, weighing 13 pounds each. This is from 60 to 75 per cent. less weight, for the same output, than any other anywhere invented. It is, indeed, a splendid showing—a great stride forward, and this it is which enables the American Electric Vehicle Co. to produce carriages at once so powerful and speedy, yet so symmetrical.

These batteries are also a radical departure from old forms in that they are the first to have a practically flexible, lead, supporting-grid. They connect with a 3½ horse-power motor of the company's design and manufacture; an iron-clad and waterproof structure, of the four-pole pattern.

The charging of the carriage batteries is a very simple matter, such as can be managed easily by any purchaser possessing no technical knowledge. The apparatus consists of an automatic stationary rheostat which is equipped with meters indicating the proper volume of current and the number of amperes stored in the vehicle batteries. These have an apparatus which automatically disconnects them from the charging circuit, when fully charged. The plugs of the connections, and the binding posts of the batteries, and the rheostat are correspondingly marked, positive (+) and negative (–), so that the veriest tyro cannot err in placing them.

With a turn of small lever at his left hand he easily guides it exactly where he wishes it to go. A smaller lever at the seat reverses the course of the carriage and, when removed, virtually ties up the vehicle.

The wheels bear on frictionless ball-bearing axles and have three-inch pneumatic tires. One of the wheels carries an odometer and this has proved that as great a distance as 64 miles has, under favorable circumstances, been run with one charging of the batteries; of course, this is an astonishing showing.

The essential features and strong points which these gentlemen named need not dwarf the importance of the fact that the electric batteries afford exceptional opportunities for furnishing beautiful, illuminating wagon signs, an attractiou which the expert advertiser will quickly foresee. The brilliantly electrically lighted lamp will also contribute to the safety of all vehicles and to the beauty and luxury of the family carriage.

The above facts will serve to indicate why the American Electric Vehicle Co. have an encouraging number of orders on their books, and many letters of commendation and interested inquiry. Mr. Corrigan ought to feel well pleased with the past progress and future prospects of his company.

THE GARVIN MACHINE CO., Spring and Varick streets, N. Y., have just issued List No. 20, of New and Second-hand Machinery, in stock for immediate delivery. The list of new machinery comprises, besides their own manufacture, many of the well-known makes of lathes, planers, shapers, drill-presses and shears, grinding machines and many miscellaneous machine tools, and special bicycle machines. The second-hand list is nearly as complete, and has also a number of their well-known milling and screw machines listed; which are in as good condition as when new. The list will be sent to any one desiring one of them.

SIBLEY & PITMAN, electrical supplies 59 Duane street (corner Elm street), New York, take pleasure in announcing that they have formed a partnership under the name of Sibley & Pitman, for the purpose of carrying on the business of electrical supplies. They have opened a store at 59 Duane street (corner of Elm), formerly occupied by the New York Electric Equipment Company.

CHAS. A. WHITE, president of the Bibber White Manufacturing Company of Boston, Mass., died Sept. 16, at Malden, Mass.

Hartford, Conn. — The Hart & Hegeman Manufacturing Company, electrical supplies, George S. Hegeman, vice-president, deceased.

NEW CORPORATIONS.

Huntersville, N. C.—The Huntersville Improvement Board has been organized, with E. W. Savage, president, L. B. East, Vice-President, and J. F. Cutchin, Secretary, to consider a proposition to pave the streets, construct sewerage systems and erect an electric light plant.

Albany, N. Y.—The Amsterdam Electric Light, Heat and Power Company will increase its capital stock, from $500,000 to $1,000,000. The liabilities are $300,000.

New York, N. Y.—The Transcontinental Railway Company has been incorporated, with a capital stock of $200,000,000 for the purpose of operating trains by electricity on an elevated road.

TELEPHONE NOTES.

Nashville, Tenn.—Emma Vance, administratrix of Bose Vance, has entered suit in the Second Circuit Court against the Cumberland Telephone & Telegraph Co., to recover $10,000 damages for the death of Vance, who was killed by falling from a pole on Line street.

Baltimore, Md.—A syndicate, composed of five Philadelphia capitalists, two of whom are connected with the Pennsylvania Railroad Company, is negotiating for the purchase of the Home Telephone Company, of Baltimore.

Alexandria, Va.—Telegraph office at St. Asaph station was broken into, and telephone and telegraph instruments moved.

MR. BOSCH'S PAPER on the "Fire Alarm Telegraph" will be continued next week.

The Electrical Age.

VOL. XX—NO. 14 NEW YORK, OCTOBER 2, 1897 WHOLE NO. 542

Running by the Third-Rail System.

THE THIRD-RAIL SYSTEM OF ELECTRIC TRACTION.

An excellent article with the above title was printed in this journal. It was written by Howard Lee Davis for the Yale Scientific Monthly, but unfortunately, on account of the editor's absence, the original cut was not obtained until this week.

The readers of the Electrical Age were probably much interested in the article referred to, on account of its straightforwardness and simplicity of style as well as its direct statement of important facts.

Third-rail systems are growing in popularity; they are of such a nature that no mechanical objection exists against them. An electrical and possibly municipal objection may be rehearsed. The exposed rail, in severe storms, whether snow or rain, would cause heavy leakage. It would likewise endanger man and animals, whether in city or country. To look from some high point down upon a trolley system is sufficient to show the flimsiness of an overhead equipment. From the Brooklyn end of the bridge the street below seems covered at every corner or junction by an impending wire network—a veritable cobweb. A powerful gale or blizzard would make short work of any weak point, but it would be powerless against a conduit or third-rail system; even the fiercest storm—although preventing traffic, would at least leave the conductors intact.

A well-insulated third rail does not necessarily cause such losses as are predicted. There are not always equinoctial rains or seven feet of snow on the g,ound; and if people keep away from railroad tracks in general, they will be particularly impressed with the necessity of still doing so when a third rail is laid down.

The following extract will help to describe the illustration of an electric locomotive referred to in the "Third-Rail System of Electric Traction:"

"The locomotive was constructed on the engine frame of an old standard elevated railroad locomotive. On each of the two driving axles was mounted a motor, made by the General Electric Company, wound for five hundred volts, and being capable of exerting a draw-bar pull of 2,000 pounds. The cab was built in the centre, and in the compartments at either end were placed the storage battery cells. These compartments were covered with lids, which were fastened on the side next to the cab by means of hinges, and sloped down at either end so as to afford as extensive a view of the track as possible.

The original plan was to carry the two hundred and fifty-four Tudor cells on the locomotive, but after it had been built and all the cells were put in place it was found that the locomotive was too heavy for the branch road. By taking out two hundred cells it was found that it could be run safely, and these were placed on the platform of the ferry station, while the remaining fifty-four cells were left in their regular places. A third rail mounted on insulators was used to convey the current from the cells at the ferry station to the motors, and two sliding "shoes" were used to make contact with the rail. The cell in question is an element of a storage battery having four negative and three positive plates. The cells on the motor were then used for lighting, heating and switching when not in connection with those on the platform. In the cab were placed the standard General Electric series parallel controller, for G. E. 2,000 motors, switches for the third rail, the main motor switch, and another for throwing in the fifty-four cells for switching purposes when no other power was attainable. In the cab were also placed heaters, lighting and heating switches, and the cylinders for the compressed-air brake.

The power-house equipment consisted of a direct-connected 12x12 Ideal engine and a fifty-kilowatt Eddy dynamo (500 volts), together with voltmeter, ammeter and switches."

PAPER ON "STREET CAR WHEELS—SHOULD THEY BE MADE HEAVIER?"

By F. D. Russell, Rochester, N. Y.

It seems to me this subject might be better handled by some practical street railway man, the user of the wheels, than by the maker, for one knows from actual experience what is needed, while the other can only get his knowledge second hand, as it were, from observation, and by keeping in touch with what is going on. However, to see what can be done with the subject by the maker, suppose we first glance at the motors, beginning with the earliest, their weight and power, and then at the character of the service, and see what is now required of wheels.

Mr. Sprague's Richmond motor, of the summer of 1888, which I understand is the same as Edison No. 6, had 15 nominal h. p. and could work up to about 23 under favorable conditions. Its weight was about 1700 lbs. and it required a 3¼ in. axle. The F. 30, another double reduction motor of 1888, was rated at 20 h. p.; could develop 30 and weighed 2200 lbs. The S. R. G. of 1891, and the W. Ps. 30 and 50 of 1892, as also the G. E. 800 and G. E. 1000, which brings us to the spring of 1896, together with the Westinghouse motors of corresponding period, are so well known to all of you that I will not go into detail regarding them further than to say that by the spring of 1896 we arrived at 35 to 50 h. p. motors, nominal capacity, and weight of 2100 to 2400 lbs., using 3¾ in. or 4 in. axles. I understand the Westinghouse Company has made a speeial 62½ h. p. motor for Pittsburg, using 4 in. axles, and that there is a G. E. 51 rated at 80 h. p. competent to work up to 120, and weighing nearly 4000 lb. This uses a 4¼ in. axle. Of course, there are larger motors, but this is about the limit at the present time for street car service. I confine myself for purposes of illustration to these two lines of motors and no neglect is intended toward any other makes.

Of course, motor wheels have been undergoing during the last nine years a somewhat similar development to that of the motors, trucks and cars, and may be said to have kept pace with what has been required of them. Our first 30 in. motor wheel weighed about 250 lbs. or 260 lbs., and our first 33 in. was a 300 lb. wheel, and, I may add, this is a good pattern yet, for moderate sized cars at not over 15 or 18 miles. Next we came to 280 lbs. for the 30 in., and 325 lbs. for the 33 in., and then, which was about four years ago, to 300 lbs. and 350 lbs. respectively, and remained at that for a couple of years or so, with the exception, of course, of special lots from time to time. About a year and a half ago we added about 20 lbs. to wheels for interurban service, which brought us to 370 lbs. or 380 lbs. We also brought out a 400 lbs. wheel, having eight spokes or arms instead of the usual number of seven, for fast, long runs, also snow plow and snow sweeper and sprinkler service. These are all 33 in. wheels. On 30 in. we now run about 325 lbs., sometimes to 335 lbs. and 350 lbs., but 325 lbs. is probably heavy enough for a 30 in. wheel.

I do not wish to be understood that mere weight is in any sense desirable. The lighter the wheel, in fact, the lighter the whole equipment within limits, the better it is for the roadbed. The service is bad enough for the tracks as it is, without adding any more weight than is absolutely necessary. A comparison of the weights of the motors will show that the increase has been mainly in capacity. Take, for example, two Westinghouse motors, viz., the 15 h. p. of 1890, and the 50 h. p. of 1896. These both weighed 2400 lbs. And so it has been with us to an extent. There is a great deal in the manufacture of a wheel besides the mere question of weight. The question of the pattern, the careful proportionment of all parts to obviate strains in cooling, the mixture and treatment of the iron, as well as the annealing of the wheels, not to mention any number of minor things, which have to be watched carefully, all these must be combined to produce a thoroughly reliable wheel. To sum up briefly, and taking the 33 in. wheel for a standard, our conclusion is that 380 lbs. to 400 lbs. on 2¼ in. and 2½ in. tread is not any too much for the present service.

(To be continued.)

PAPER ON "CONSTRUCTION AND MAINTENANCE OF CAR BODIES AND TRUCKS."

By Robert Dunning, Buffalo Railway Co., Buffalo.

As the life of a car body depends almost entirely upon the bottom framing, nothing but well seasoned and perfectly sound, straight grained timber should be used. Ordinary kiln dried lumber is not suitable for car framing, and even when timber has been in the drying shed for a long time it should be given a couple of weeks seasoning after its first working, for well dried timber will show a slight shrinkage after being worked. Too much care cannot be used in the cutting of mortises and tenons to see that they are tight all the way round and all the way through. The placing of cross sills will be influenced somewhat by the style of car, and motor equipment, and there is probably nothing better than strong diamond bracing to hold the frame square. Lead the mortises and tenons, and when the frame is driven together, put in the tie rods, draw up tight and put on corner angle plates and finally square and level up the whole work.

The end and side framing should be assembled with the same care and set up in solid sections on the bottom framing, and lastly put the roof framework in place. Avoid splicing and do not use two short pieces where one long one can be made to do the work. Secure all corners inside and out with light steel angles and, where possible, the inside and outside angles should be held in place by the same bolts.

The framing of the platforms should be well considered and made to meet any emergency. The size of timbers will in any case be proportioned to the carrying capacity of the car. The application of the outside covering, inside lining and trimming, should be carefully studied as to its efficiency in the covering of joints and to keeping the frame dry, as well as to its appearance. The main principle to be observed in the whole framework, is to produce a combination truss that will offer the greatest resistance to any strain that may be imposed upon it, and the avoidance of the introduction of useless material.

The present tendency in painting is toward simplicity as to colors and ornamentations and is certainly to be commended from a practical standpoint. The use of a few colors and those that do not fade quickly make retouching easy and satisfactory and reduce the cost of painting very materially. The neat effect of natural wood finishes in the inside of the car is also to be commended for beauty and long wearing qualities. As to the methods of applying paint, any one which embodies the principle of good materials well mixed, carefully applied and cut down, will produce good results. Nearly every boss painter has some little difference in the method of handling his work, but if he is intelligent and unprejudiced he will produce good results.

In truck construction we have nearly as many patterns as there are of life guards and each makes claims to embody some principle which no other truck has, and all other trucks are therefore fatally defective. With one the great principle of a perfect truck lies in the bearings; with another it is in the frame; another the springs; another the amount of traction, and so on, with additions, subtraction, multiplication and divisions, and the end is not yet. Taken collectively the truck builders have wrought a great work, and when the day comes that produces a truck in which each of the principles they claim is brought to the perfection they now claim in each instance, we can cease our looking for improvement in that direction and reflect complacently that Solomon was certainly mistaken when he said that there was no perfection under the sun. As it is we must be content with the knowledge that there is one *best* truck on the market, and though each maker claims it is his, we still have the privilege of choice and can act accordingly, even to experimenting a little ourselves when we feel like exploiting a pet theory. The ideal truck is the one which gives the maximum amount of traction, rigidity of frame, flexibility of operation, ease of running and the minimum amount of oscillation and weight. These and many minor principles go to make the perfect truck. How to attain them is the study of every mechanical engineer in the street railway business and some outside. To enter into a discussion of the principles involved is impossible in this paper, as any one of them would require a long article which time forbids, so we will pass on to the maintenance of cars and trucks.

(To be continued.)

OPENING FOR AMERICAN ENTERPRISE IN CHINA.

Under date of May 11, 1897, Consul Read of Tientsin, says:

I inclose a copy of a communication from Messrs. Taylor & Co., of Tientsin, as to opportunities for doing business in China. Messrs. Taylor & Co. have recently established themselves at Shanghai and Tientsin, and their partners at this port have already gained a reputation for business integrity and sagacity. Their statements with regard to the advisability of our large firms in America being represented by one American firm of assured standing, are in accord with those frequently expressed by me to the Department.

I earnestly trust and strongly urge that these suggestions may be utilized to the advantage of our trade.

The letter of Messrs. Taylor & Co. (dated Tientsin, May 8, 1897) is, in part, as follows:

As one of the most popular movements in the United States is the advancement of American commerce, and as many prominent men are interested therein, we would ask you to make the subject part of an official communication to the Department of State.

China in the next few years, will be a buyer for all classes of machinery, and especially railway materials. It has been demonstrated that America has chances as good as those of any other country to secure orders.

If our American manufacturers will make the proper efforts, it will result in millions of dollars of trade.

A commercial representative should be selected, care being taken that he has influence in the proper quarters, which, as you know, is absolutely essential. This representative should be the sole agent in the East. He should be authorized in the proper form, as are the representatives of European houses, with the seal of the foreign office; and his name should be registered here in the consulates.

In the construction of a railway, the Chinese require rails, sleepers, couplers and structural iron for bridges and locomotives. If the best houses in America will place their respective business interests in the hands of one good business firm in Tientsin, this firm can bid for everything wanted, will appear strong in the eyes of the Chinese, and each transaction will, perforce, strengthen the mutual business relations between America and China.

If we may be allowed to do so, we would advise that you lay all we have to say before the officials of the Department of State at Washington, with the suggestion that they call the attention of our manufacturers of railway materials, including the Westinghouse Air Brake and Wharton Switch companies, and manufacturers of firearms, locomotives, and men-of-war to the existing opportunities for doing business in this section of the world.

We have information that the Chinese Emperor has issued an imperial edict authorizing the purchase of six first-class battle-ships, six first-class cruisers, six second-class cruisers, and twelve torpedo boats. The Chinese Government is going to create a loan of 100,000,000 taels, a part of which will go toward purchasing the vessels.

His Excellency Li Hung Chang (who is now at the head of the Tsung-li Yamen), in recognition of the assistance of America in bringing about peace in China's war with Japan, is anxious to do something for America, and if there is half a chance we can secure a large share of this business for that reason.

There will be an enormous trade done here within the next few years, and if America can gain her part, it will mean additional labor to thousands of our workingmen and the bringing to our country large returns in profits to manufacturers.

We write in this manner, not looking so much for personal advantage, as from the standpoint of public-spirited Americans, and if the benefit does not accrue to us, we want to see the business placed upon such lines as to insure to our people at home their rightful share of it. Any assistance toward achieving this end that we can render you will be given with pleasure.

Unfortunately, America has suffered by the class known as adventurers and fortune hunters, who have no visible means of existence, and who come to China willing and anxious to advance or accept any visionary scheme that offers the least prospect of success—schemes that no business man would have anything to do with, and each failure sets American interests further in the rear.

From the unceasing energy and active interest you have ever shown in the past to advance everything American, and from your high standing among Chinese officials and merchants of all nationalities, we feel that this communication will meet with your approval.

Mr. Read speaks of the presence in China of Mr. C. D. Jameson, representing the Baldwin Locomotive Works, of Philadelphia. It seems that Mr. Jameson made a contract with the Chinese Government for four locomotives to be delivered at Tangku on or before June 30, 1897; also, for eight locomotives to be delivered between July 20 and September 20, 1897. In a communication dated Tientsin, June 8, 1897, Consul Read says that all the locomotives were shipped by steamer on or about the middle of May. The first four would arrive slightly after the date they were due, but as the other eight would reach China some time in advance, the consul adds that the Chinese seem satisfied.

THE ELECTRICAL EXPOSITION FOR 1898.

Ever since the Electrical Show held in New York City during May, 1896. there has been a feeling in the trade that it should not be the last. Its splendid success in the way of bringing trade to exhibitors has led to a very general demand that it be repeated.

A company has been formed with $20,000 capital, and a live, up-to-date Board of Directors to conduct such an exhibition in 1898. Articles of incorporation were filed in Albany on Wednesday of last week, and these gentlemen were named as officers and directors: Cyrus O. Baker, Jr., president; Ferd. W. Roebling, vice-president: and George F. Porter, secretary and treasurer. These officers, with Leonard F. Requa, Chas. A. Lieb, J. W. Godfrey and H. H. Harrison, constitute the Board of Directors. Executive Committee: C. O. Baker, Jr., Leonard F. Requa, and H. H. Harrison. Mr. Marcus Nathan has been selected as general manager.

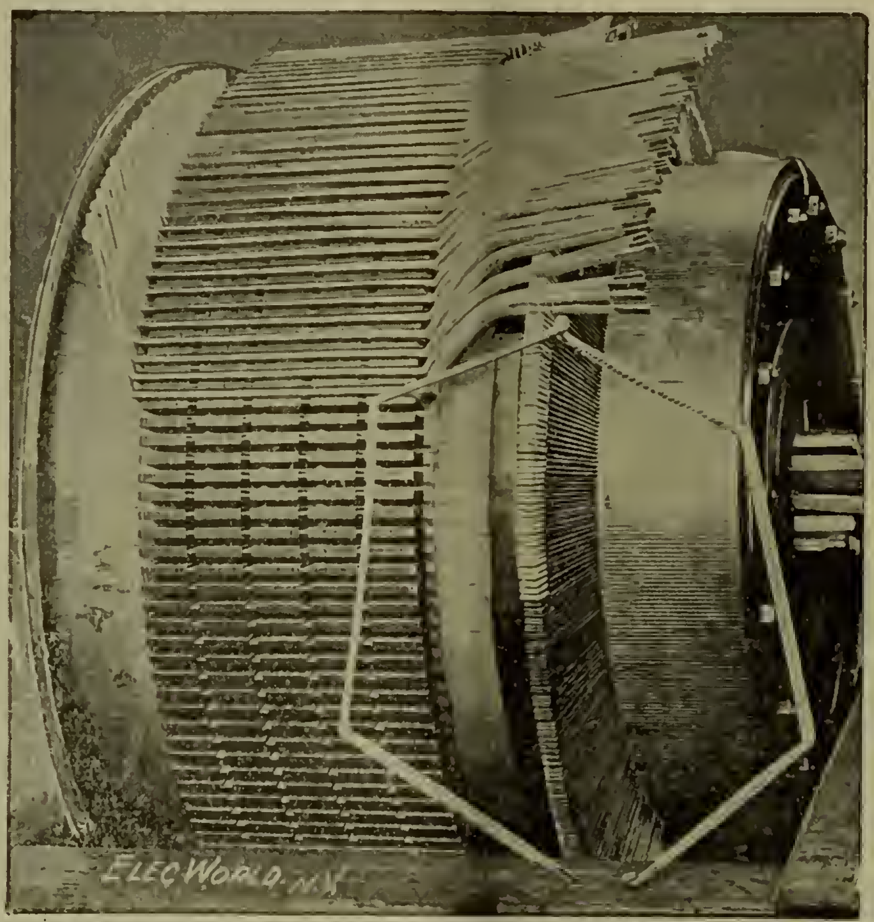
This practically insures a first-class exhibition. The new electrical inventions and improvements developed since the last show will be an important factor. The interest and co-operation of many manufacturers already assured will count for much towards making this a more complete demonstration of all the applications of electricity and its branches than was possible in the first exhibition in 1896.

Dr. Edwin Houston and Mr. A. E. Kennelly were making some calls and enjoying the felicity which a visit to Greater New York now brings.

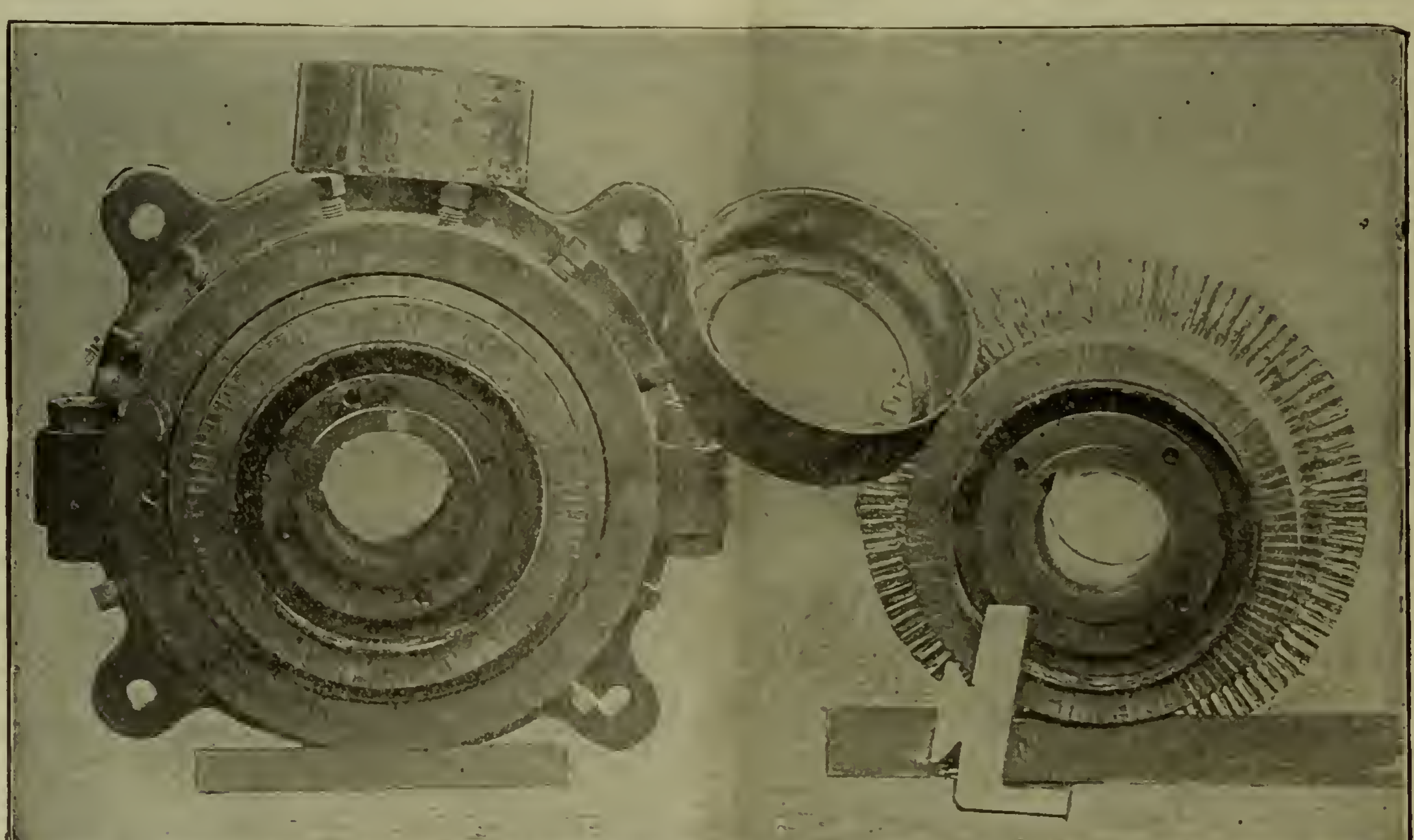
Paducah, Ky.—The People's Light, Heat & Power Co., has been incorporated by G. C. Wallace and W. F. Paston, with a capital stock of $50,000.

THE EFFICIENCY, REGULATION AND CONSTRUCTION OF PERFECTED GENERATORS.

Electric-light plants have become an indispensable part of a city's equipment. They are almost as important as the City Hall, criminal courts, street-cleaning department, or in fact in the very largest cities as the police force itself. The function of an electric-light plant, particularly if used for municipal lighting, is of a high and important order. That city is best protected which is best illuminated. The old habit of turning-off the lights so common in continental days, is practiced no longer. Both streets and home are brightly lit, thus subduing the criminally inclined and providing the lonely wayfarer with

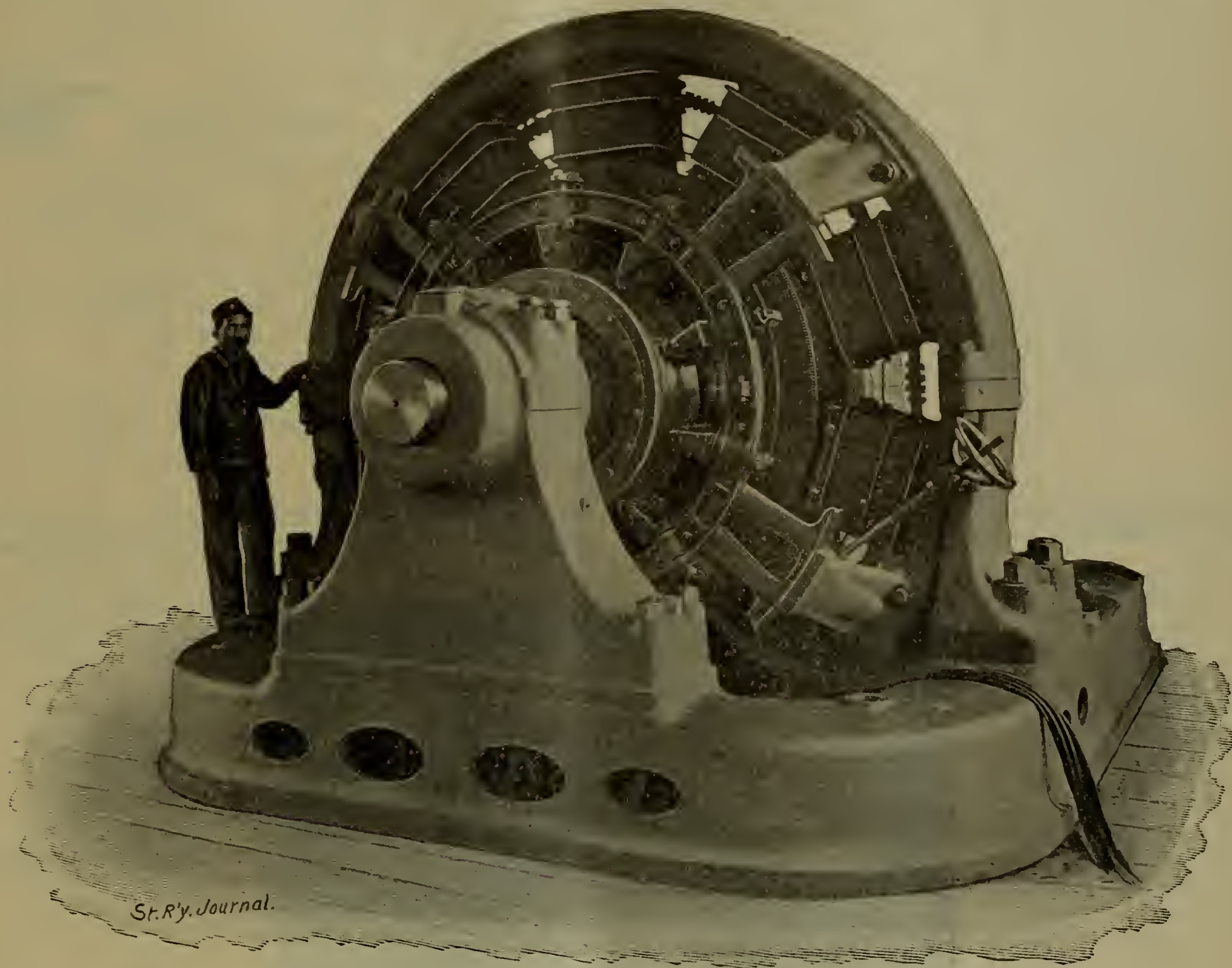


The Walker Armature,

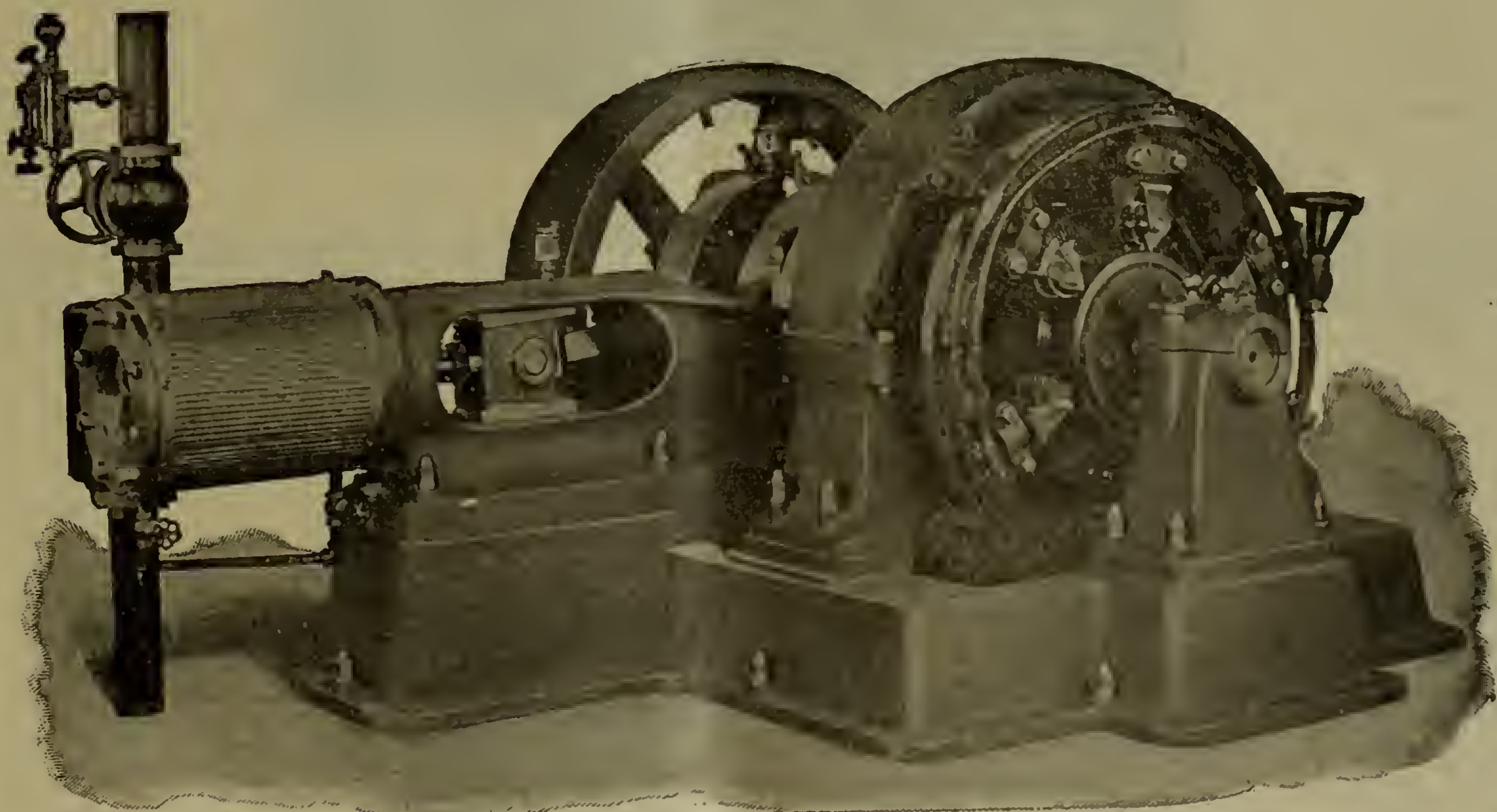


The Walker Commutator.

an essential means of defence. To produce a uniform, brilliant and economical light, a dynamo must be used which is as this article indicates—efficient, self-regulating

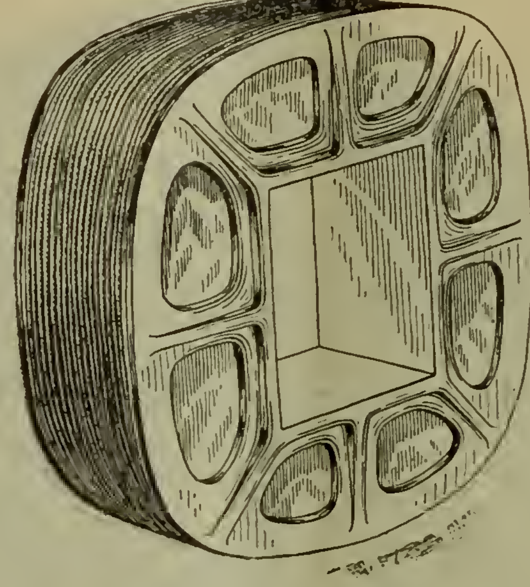


Walker Generator at Chicago City Railway Co,, Chicago.



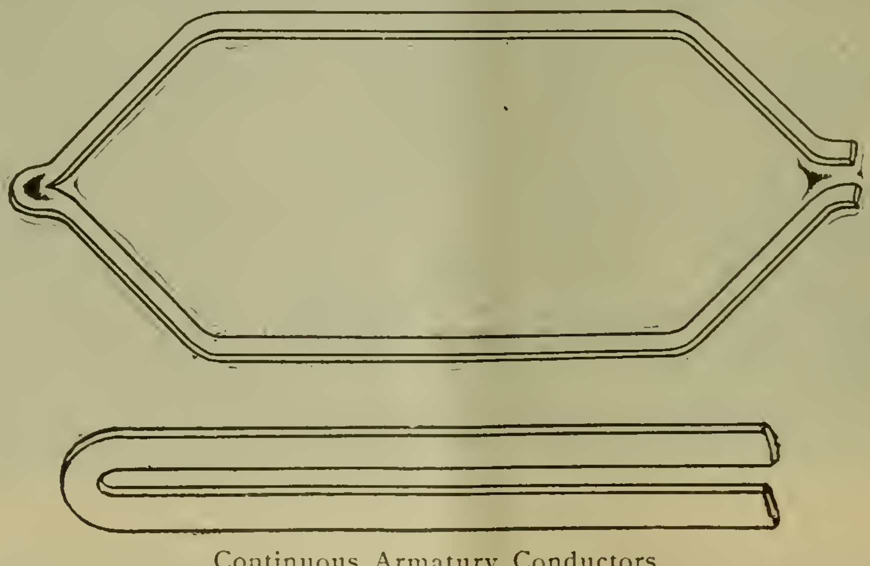
A Direct-Connected Model Plant.

and well constructed. To those that may choose a dynamo, from the experienced business man to the capitalist seeking for means of investment, a few points of information will prove exceedingly valuable by helping to guide him in his choice of durable and well-made electric-light machinery. The average business man knows more about the quality of his wife's silk dress than he does of the good features that collectively comprise the essential parts of a first-class dynamo. An efficient dynamo is in many respects a savings bank for landlords. By using an efficient dynamo, money that would otherwise be wasted, without leaving a trace of its past presence except in the shape of bills, is saved. This point we desire to present in the most emphatic manner to those reading this article. It is not a difficult matter to build two dynamos identical in appearance, weight and fineness of finish, yet which will differ from each other to such an extent in operation, that a decision of their relative merits would be rapid and certain by even a layman. This fact may be understood by realizing that some dynamos are only efficient when carrying all the lights; others, which are undoubtedly of the superior class, operate with pronounced efficiency under all circumstances. Curves are presented which compare the efficiencies of two machines, one showing uniform efficiency, the other a final efficiency. If a dynamo produces abundant heat from its coils, either of field or armature, it cannot be efficient. One of the inevitable signs of loss is heat in any part of the dynamo. If elab-



The Coil Field Frame.

Laminated Pole Pieces.



Continuous Armaturv Conductors.

The Electrical Age.

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CONTENTS.

THE CHARGED MOLECULE.

The different departments of science practically embrace the same territory. There are no high walls which separate one from the other, but all seem to blend and form a huge mosaic of theory and fact. In the study of molecular physics, a concordance of opinion exists regarding the general nature of a molecule. It is a difficult thing for us to say exactly what it is, but still harder to determine what it is not. Certain principles that lay in abeyance for many years have lately come to light and exhibit a marked vitality in assisting us to tear aside the veil which hides from our eyes much of real in nature and much more of its actual operations. Some very curious facts have been discovered which show us, from a purely electrical standpoint, how indebted chemistry is to the servants of electricity. It seems as though a study of chemistry will soon be transformed into an assimilation of the principles of electro-chemistry, and a study of light into a systematic review of electro-optics. If we but realize how different and yet how similar are the movements, properties and characteristics of different molecules, a suggestion of their common origin will pass across the mind like a fleeting memory. Experiments have proven that ions migrate with different velocities through a liquid; that is, an electrolyte into which dip two electrodes. The hydrogen ions of hydrochloric acid move towards the cathode with five times the velocity that the chlorine ions move towards the anode, and it is difficult to determine as to whether these varying velocities are due to differences of potential or specific qualities possessed by the ions themselves. Svante Arrhenius, in 1887, published his theory of the electrolytic dissociation of ions, which seemed to prove in harmony with Kohlrausch, a most marvellous fact, that ions move with a velocity that depends entirely upon their chemical natures. Arrhenius in his scientific deductions, based upon experiments and logic, came to the conclusion that the "molecules of electrolytes in aqueous solutions are already dissociated into their two ions which are loaded with their respective electric charges." In other words, the electric current does not affect the molecule as was previously supposed; the fact that they are in solution is the cause of this separation and each ion thus divorced is electrically charged. In this rather scientific field of thought it would seem as though theory predominates, but it must be understood that in any case conclusions like these could not have been either the creation of a fanciful mind or the dream of some deductive philosopher. Built upon a foundation of rigid investigations, strange facts have come to light, which will affect the great field of chemistry in every department. It may change the old theories of selective attraction and bring it down to a newer and broader basis, the coalition of ions oppositely charged.

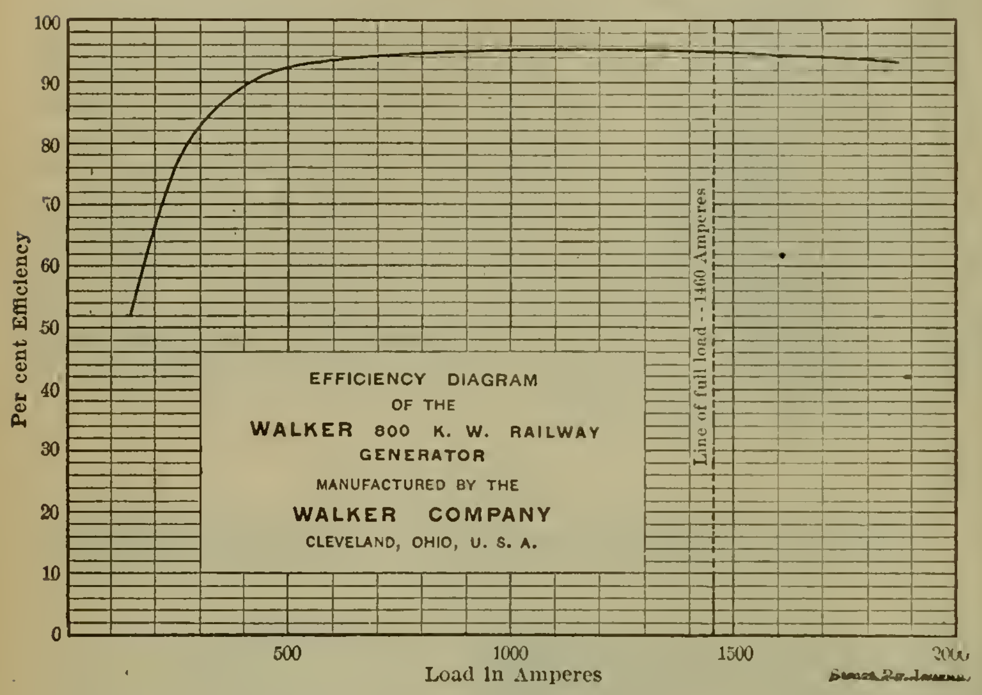
STEAM, COMPRESSED AIR AND ELECTRICITY.

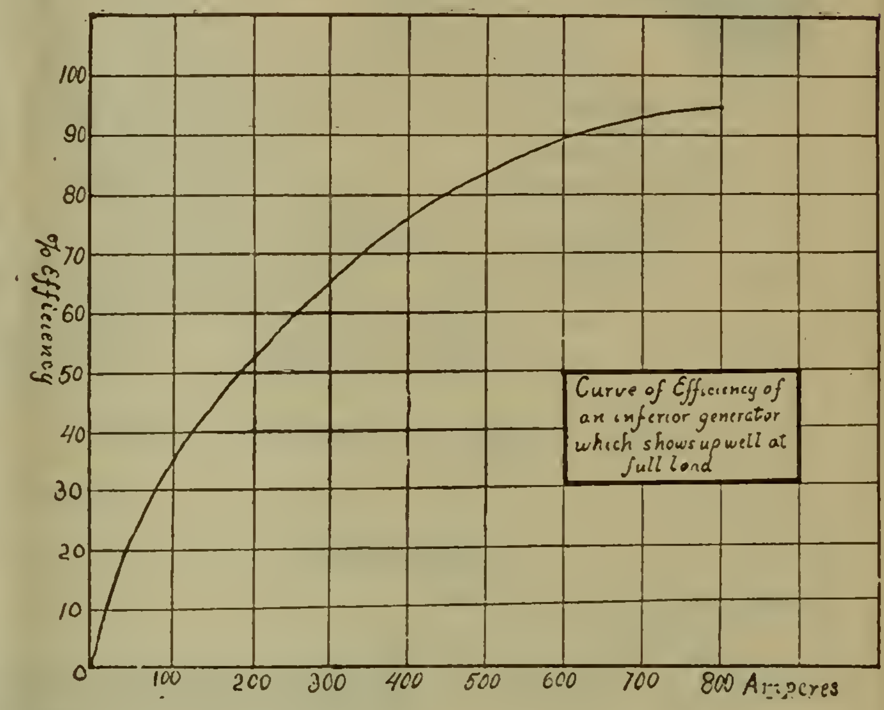
The kaleidoscope of science has produced such marvellous designs that we are no longer surprised or enthused by them. We are accustomed to innovations, and the magnificent discoveries which form the props of modern civilization, though great are old. A blasé spirit has manifested itself in matters scientific; the world no longer stands like a country bumpkin, open mouthed and open eyed, listening in wonder to tales of continents that signals with lightning speed, of voices wafted over a thousand miles of space, of light that passes through solid flesh as if it were transparent jelly. All these things have become old, prosaic, and in many respects without further interest to the world at large. Yet, in the last days of the closing century, a new scene presents itself. The three musketeers of applied science stand forth in open view, each armed with rights and prestige. They are steam, compressed air and electricity; and the question now at issue is one that asks which shall prevail; to whom shall be given precedence. As the test of true literature is time, so likewise is the test of good engineering. That which is not full of vitality must pass away, and even the very greatest of discoveries and inventions that possess the world for centuries ultimately take their place with other moss-covered monuments of progress. From a purely technical standpoint, the question is full of interest, and although many may claim that the age of steam is over, it would be wiser to say that it has really begun. The same with the other two. There are certain peculiar and unexplainable elements which invest particular forms of energy, either making their use popular or limiting them, and it may be said right here that many years must pass before we can claim sufficient familiarity with each to be able to judge. Our own particular science has made prodigious strides in the last twenty years. It has found ready application on all sides and has entered into the household as a useful servant. It may be said that this is one of the greatest tests that any form of power can pass through, for which its promulgators hope to establish an extensive field. Steam has already done this, and when the time was ripe electricity received a hearty welcome. There are great possibilities for compressed air in domestic life. Refrigerating, the freshening and cooling of the atmosphere, and even the operation of elevators may make it a permanent and in certain respects indispensable accessory to home comforts. At any rate the three of them stand upon the platform of public inspection, and the world, as it gains experience and learns more and more of their respective qualities, will find for each a place best suited to its virtues.

orate preparations are made for its ready dissipation, one may be sure that a heavy waste of power is occurring.

Another important point requiring attention is the regulation of a dynamo. By this is meant its power to respond so quickly and effectively to a change in light that not even the least flicker is perceptible when the majority are turned on or off. This object may be attained by following out two principles; one is, the use of a low-resistance armature, the other, a magnetic circuit that is immediately susceptible to changes in the magnetizing power. An armature with as few conductors, as heavy conductors, and as short conductors as possible, answers the first purpose. The use of pole-pieces that are laminated will remove any tendency towards sluggish regulation. With an increase of lights, as a general rule, the pressure falls; a decrease causes it to rise. A dynamo which regulates automatically will preserve a uniform, external pressure. The lamps, therefore, never suffer from too much potential. Considerable breakage of filaments is thereby avoided, and what is more important, complaints from consumers are unknown. The sketches supplied in this article are those which lay bare certain details in the construction of Walker apparatus built by the Walker Company, of Cleveland, Ohio, and New Haven, Conn. The object of good regulation is one of the best a manufacturer of electric-light machinery can start with.

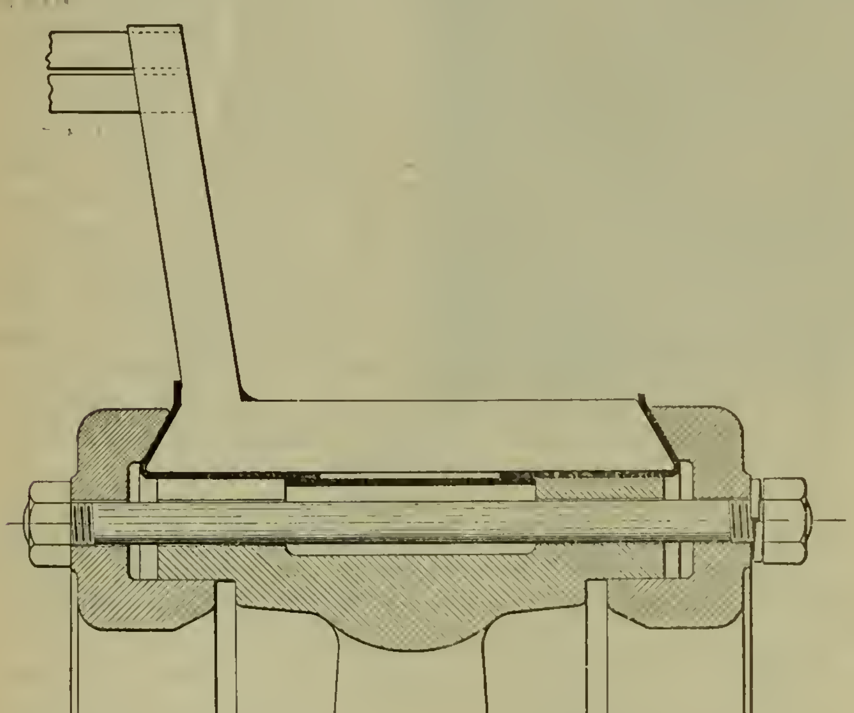
Thousands of dollars are wasted annually not alone in the lamps but in repairs, and by a further extension of the idea, in the coal-pile itself. Efficiency and regulation go hand in hand, and the future of a generator depends to a large extent upon their high value and perfection respectively.





Comparative Curves,

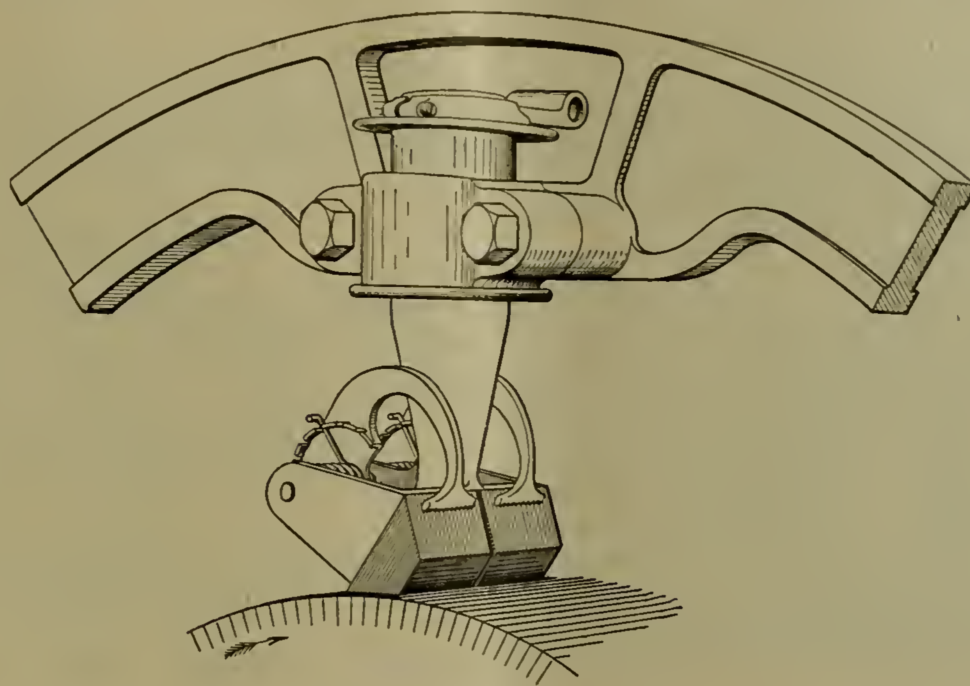
The construction of a dynamo necessarily involves certain technical considerations. They depend upon the principles of dynamo design for their fulfilment, and the shape and dimensions of each part is more a matter of engineering than of æsthetic taste. But the builders of machines are apt to produce apparatus which though following the working drawings closely as far as size and outlines are concerned, depart from them when material is selected. The best is often not selected because it is the most expensive. The worst is often chosen because it appears to be as good as the best. As an example of this, a commutator segment is shown which is one of a lot of others seemingly better but possibly worse.



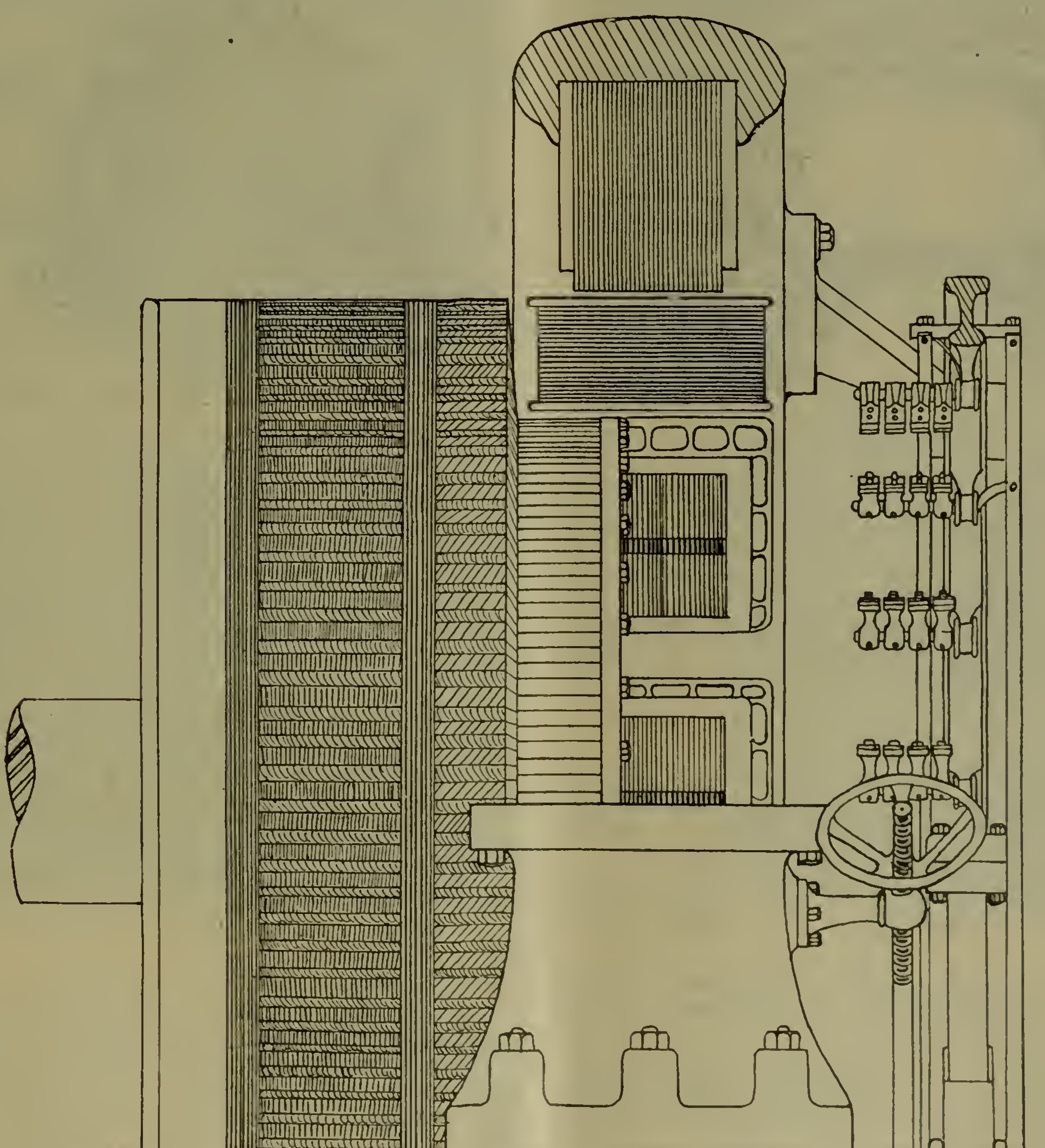
Details of Commntator Construction.

A Flaw in the Segment.

The brush-holder used by the Walker Company is so constructed that the current passes directly into the metal part supporting the brush. Neither springs nor weak parts are depended upon for the transference of current; the brushes, therefore, making good contact, run cool and without sparks. Many sketches are reproduced, showing the Walker commutator, sectionally and partly assembled, the armature wound, and being wound, and the general shape of an armature conductor which answers in every respect to the principle previously outlined by being as heavy and as short as possible. Finally there is shown a photographic reproduction of a fully assembled Walker generator that combines within itself all the latest principles in modern design. The construction of the Walker armatures is such that it would appeal to the technical mind at once. There is so much ingenuity as well as solidity represented that it would undoubtedly resist strains which would ruin other armatures. The use of a slotted core and the provision made at the ends of the conductors for band-wires gives the armature an exceedingly neat appearance when completed. As models of

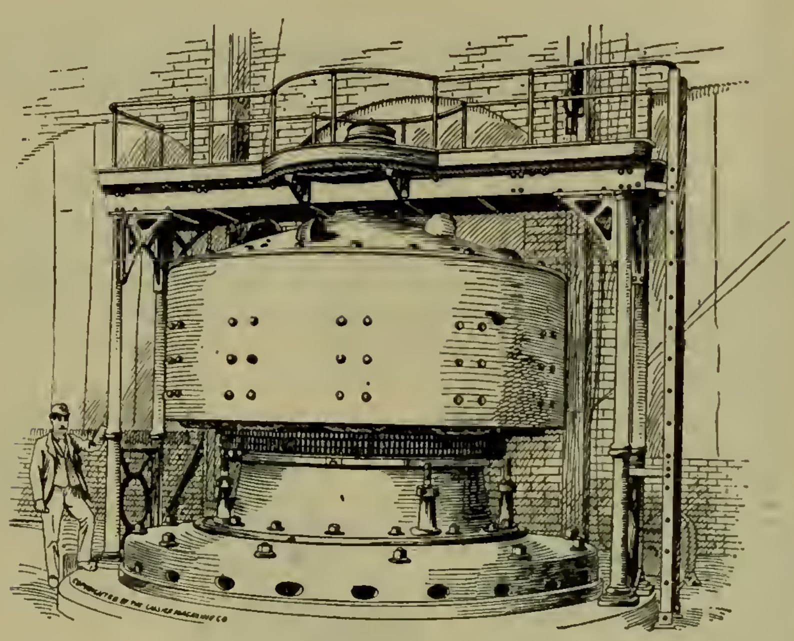


Perspective View of Walker Brush Holder.



Semi-Perspective View of Walker Generator.

symmetry there are few that could equal them; as armatures that fulfil their functions, in every respect they occupy a position of pronounced snperiority. There is not one joint in the entire armature in any conductor. When the reader realizes that an armature bears the same relation to a machine that the heart does to the human body, he will understand why a dynamo however otherwise well built will never give satisfaction with a poorly constructed armature. No man is strong who has a weak heart. Tests have been made during three or four hours which show a capacity for one hundred per cent. overload in Walker generators. A guarantee of fifty per cent. is made without the least hesitation. A dynamo capable of standing this strain will outlive its competitors, which through inherent weakness cannot. If, in addition, a commutator built with the utmost nicety (and after being assembled exposed to a high temperature and pressure) is supplied, but one conclusion can be reached—that so excellent a combination presents a standard of perfection which is indeed the outcome of efforts aimed to produce high efficiency, good regulation and the finest construction. If in the United States, generators supplying one milllon horse-power are used and twenty per cent. of this power is wasted; if a horse-power costs but $25.00 a year, then the waste of 200,000 horse-power represents an aggregate loss of $5,000,000.00 per annum. No one can afford to lose this money; every man can help to save it; but the responsibility of its loss rests mainly upon the heads of those entrusted with the selection and buying of power apparaus. This final conclusion is one that should not be forgotten, as it directly affects the expenses and dividends of any corporation using or selling electricity.



A Niagara Alternator and Turbine.

It is our pleasure to state that Silvanus P. Thompson, of England, was in town this week and has been visiting the laboratories of various technical schools and colleges in New York and its vicinity.

Allegan, Mich.—A new electric plant will be established in this city. O'Keefe & Orbison are interested in the project.

Athens, Ala.—The Birmingham Railway and Electric Company have purchased the Powderly dummy line, and will equip the road with electricity.

Richmond, Va.—The Long Distance Telephone Company has leased the large room at No. 1004 Hull street, to be used for their Manchester Exchange.

Louisville, Ky.—Aaron Kohn, chairman board of public works, may be addressed concerning electric lights to be established throughout the city.

GENERAL PRINCIPLES OF DESIGN IN ALTERNATING AND CONTINUOUS-CURRENT MACHINERY.

The electromotive force produced in any case is due to a variation in the lines of force, or the movement of the conductor through them. The three factors we have to deal with in the armature of any dynamo are—

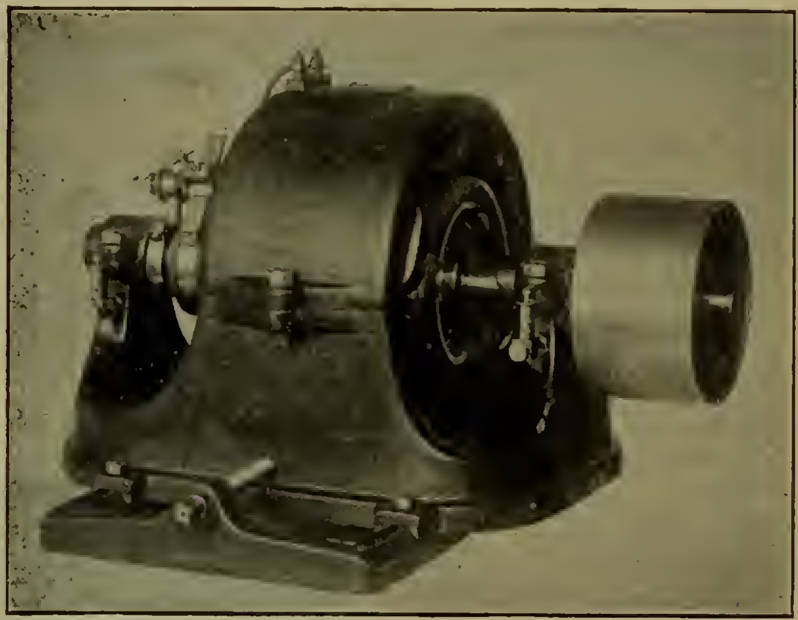
N = Lines of force.
I = Inductors in series.
R = Revolutions per minute.

Whether it be an alternating or a direct-current armature the method of calculating the electromotive force is practically the same, the two formulæ being—

$$\text{Continuous current } E = \frac{I \times R \times N \times P}{10^8 \times 60}$$

$$\text{Alternating current } E = \frac{2 \times I \times R \times N \times P}{10^8 \times 60}$$

Where P = number of pairs of poles.



Alternating Current Motor.

In the winding represented, the two halves of the alternator armature are in multiple, therefore the E. M. F. is one-half.

Illustrations of a turbine generator and alternating-current motor are represented. A turbine plant is merely a combination of a dynamo and water-wheel in direct connection. With an alternator generating current, a motor for developing power at the other end is necessary.

Alternating current motors may be—

Single-phase synchronous.
Single-phase non-synchronous.
Two-phase.
Three-phase, etc., etc.

Multiphase or polyphase motors are generally used, because they are self-starting and develop enough torque to resist change of load satisfactorily, that is, from lower to higher load without stopping.

Single-phase motors were unreliable for many years, being non-synchronous, but have been improved so as to perform their work with a certain degree of satisfaction.

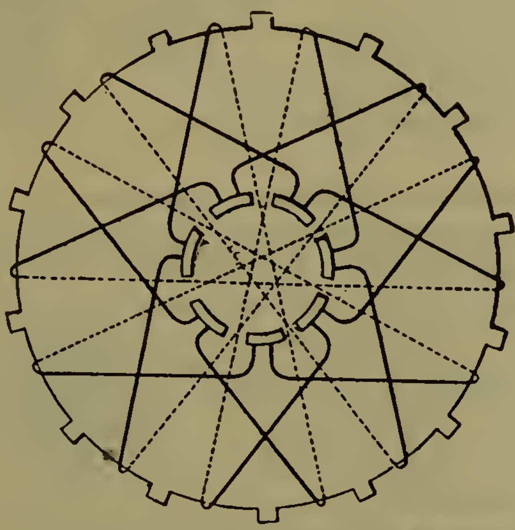
The alternating-current transformer differs from the continuous-current transformer in construction and design. Its chief purpose is the reduction or increase of pressure, and in this respect both are alike. One transforms an alternating, the other a continuous current.

The basic formula in designing a transformer of alternating currents is

$$\frac{E_p}{E_s} = \frac{T_p}{T_s}$$

where E_p = E.M.F. of primary,
E_s = " " secondary,
T_p = turns of primary,
T_s = " " secondary.

The volts of either continuous or alternating-current transformers are due to the reaction between certain inductors and a magnetic field.



Continuous Current Armature Winding.

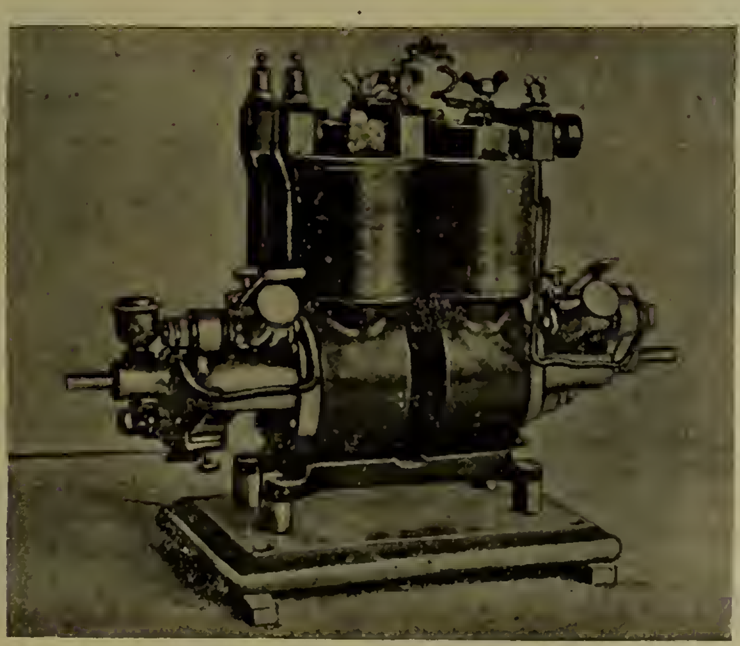
In the continuous-current transformer we simply have a motor and dynamo in one. In the alternating-current transformer a magnetic circuit of laminated iron with two coils wound upon it; one primary, the other secondary. One receives the pressure from the dynamo, the other transforms it. There are

Step-up transformers,
Step-down transformers,

for single or multiphase currents.

The frequency and self-induction so modify the condition within the transformer that in many respects the resistance is a negligible quantity.

At no load, with the secondary circuit open, the self-induction in the primary is very high. At full load with the secondary closed the self-induction in the primary is very low. Regulation is effected so that power enters the primary only as it is required in the secondary without excess or waste.



Continuous Current Transformer.

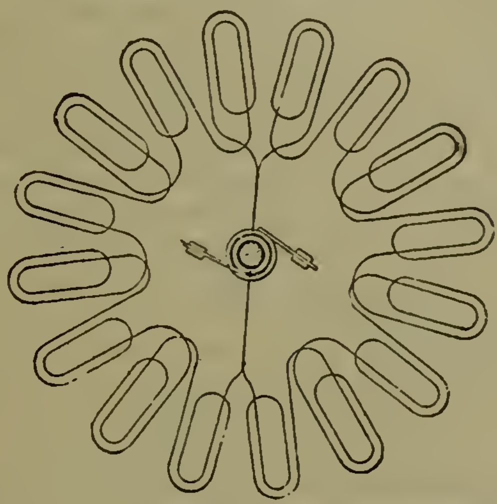
Hillsboro, Wis.—An electric line is to be constructed between Union Center and this place.

HISTORICAL SKETCH OF THE FIRE-ALARM TELEGRAPH.

BY ADAM BOSCH.

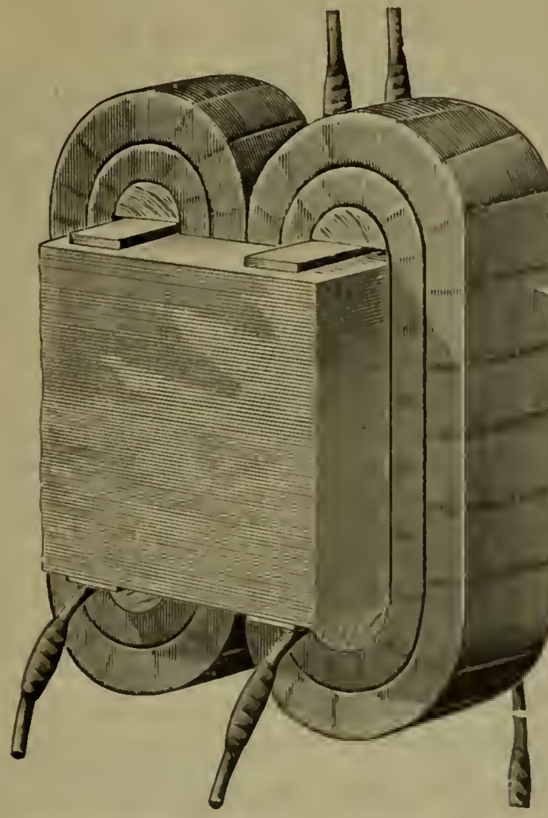
(Continued from page 180.)

It was soon discovered that considerable skill was required to operate this device with any degree of regularity; the motion of the crank in unskilled hands was so irregular that the signals could not be distinguished as printed by the register. This was therefore discarded, and other apparatus constructed with the same break-wheel, but the crank was so arranged in connection with two gear wheels that two revolutions of the crank were necessary to produce one revolution of the brake-wheel.



Armature of Alternator; the Two Halves in Multiple.

Considerable trouble was also experienced in the point of contact of the signal keys. This was remedied by substituting a sliding contact. In the original plan the signal box was designed simply to transmit the number of the district in which it was located. The improved apparatus also gave the station number; the district number by dots, and the station number by dashes and dots; this added greatly to its value as a means of indicating the exact locality of a fire.



Alternating Current Transformer.

But the most radical departure from the plan was made by placing the signal boxes on the outside instead of the inside of buildings as originally intended; this change necessitated better protection for the apparatus. This was effected by placing the iron case which contained the mechanism into a strong iron box, in form similar to the one in general use for that purpose at the present time.

If the difficulties encountered in the construction of the signal box apparatus were great, those met with in the construction of the bell-striking machines were gigantic. Farmer's original models were made to strike bells weighing from 75 to 150 pounds, and now nineteen machines were to be built to strike bells weighing from 300 to 3700 pounds.

It was necessary that all the bells whether large or small should be struck successive blows in the same short period of time, and, to satisfy the public, that they should be struck with a force no less than that by which they were formerly struck by means of rope and tolling hammer. To accomplish this, weights of from 800 to 2,000 pounds according to the size of the bell to be struck were found to be necessary. Every point in connection with these machines had to be determined experimentally. It was a problem without any known factors. Machines were built, tried and discarded. For the largest size bells three machines were built before one was found to answer the purpose.

Locality had to be considered. In some of the belfries the space for the machines was ample, in others it required various modifications of the apparatus in order for it to be properly placed. What added greatly to the perplexity of the situation was the fact that all the experiments had to be made in public. To test the machinery it was necessary to strike the bells, and, it is therefore not to be wondered at that complaints about the incessant clanging of the bells were heard all over the city. The citizens were far from being unanimous in favor of the experiment. The man who knows it won't work, as well as the man who knows that even if it does work, it won't be as good as the old method ; both resided in Boston at that time, as they reside everywhere where important improvements are about to be made. Dr. Channing, who was a charming writer, wrote many articles for the daily papers in order to create a stronger public sentiment in favor of the experiment.

(To be continued.)

LITERARY NOTES.

W. L. Calver has an unusually interesting paper in the October Home Magazine, on "The Defenders of the Chew House," which brings to light some forgotten facts about the battle of Germantown, where Washington's army won a victory and relinquished it. It is handsomely illustrated with reproductions of old prints and photographs. Another article of interest is Mr. Addison Ellsworth's, on the various State and National floral emblems, and illustrated with drawings from nature by the author. Then there are some splendid short stories and poetry by the popular writers of the day, including Richard Henry Savage, Zoe Anderson Norris, Elizabeth Harman, Julia Zitella Cocke, Edith Keeley Stokely, George J. Southwick and others.

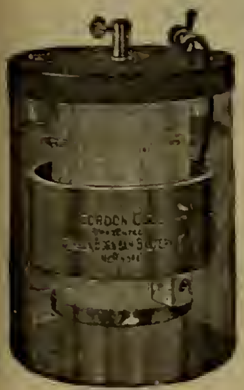
Of serious interest are the articles of Senator Butler on the "Initiative and Referendum," a calm and non-partisan discussion of the pros and cons of this economic principle, John Southworth's description of the workings of the co-operative colony at Ruskin, Tennessee, and Dr. C. W. Ingraham's on the most approved methods of fighting the modern plague, consumption. Dr. Ingraham advocates that the state take care of and provide isolated hospitals for its consumptive citizens. The array of facts he brings forward as argument in favor of his plan is certainly startling.

In the editorial and news departments will be found the usual array of well selected matter. There is also a department of book reviews and one of Commercial Travellers' stories, both of which are deservedly popular.

Published by the Commercial Travellers' Home Association, at Binghamton, N. Y. Every cent of profit goes to the National Commercial Travellers' Home.

THE MICROMOTOSCOPE.

A micromotoscope has been invented which is a kinetoscope for photographing cell life in motion as seen in the microscopic field. The pictures are taken by the gelatine film at from 5,000 to 15,000 magnifications, and at the rate of from 1,600 to 3,500 per minute. The images being magnified thousands of times when projected upon a screen, the views of some of the families of microbes are very realistic. It has been learned that some of them possess great intelligence. The photographs of the blood in circulation in the thinnest part of the ears and webs of the fingers, showing its capillary and arterial motion and the changes going on in the white cells are of great interest. They indicate something of the nature of life and disease. The stream of circulating human blood is so swift that the eye cannot keep pace with it, and the changes in the white blood cells are correspondingly rapid. Some of the pictures show a white cell on the fast moving stream, like a white cap on the sea, constantly changing its shape. It throws out or takes in its arms like an octopus, seizing the microbes in its path. In disease this movement of the arms takes place with much less energy than in health. These pictures cannot fail to be of great value in the study of diseases. The micromotoscope will greatly aid in the investigation of phenomena of action of ameboid life in water.



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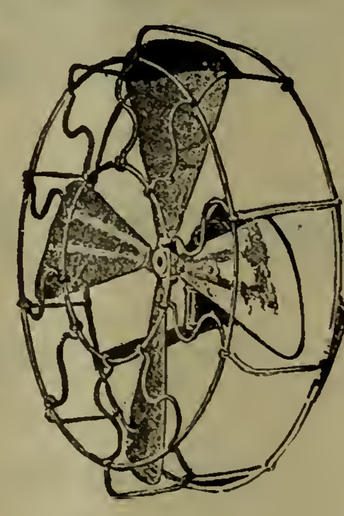

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The Electrical Age.

VOL. XX—NO. 15 NEW YORK, OCTOBER 9, 1897 WHOLE NO. 543

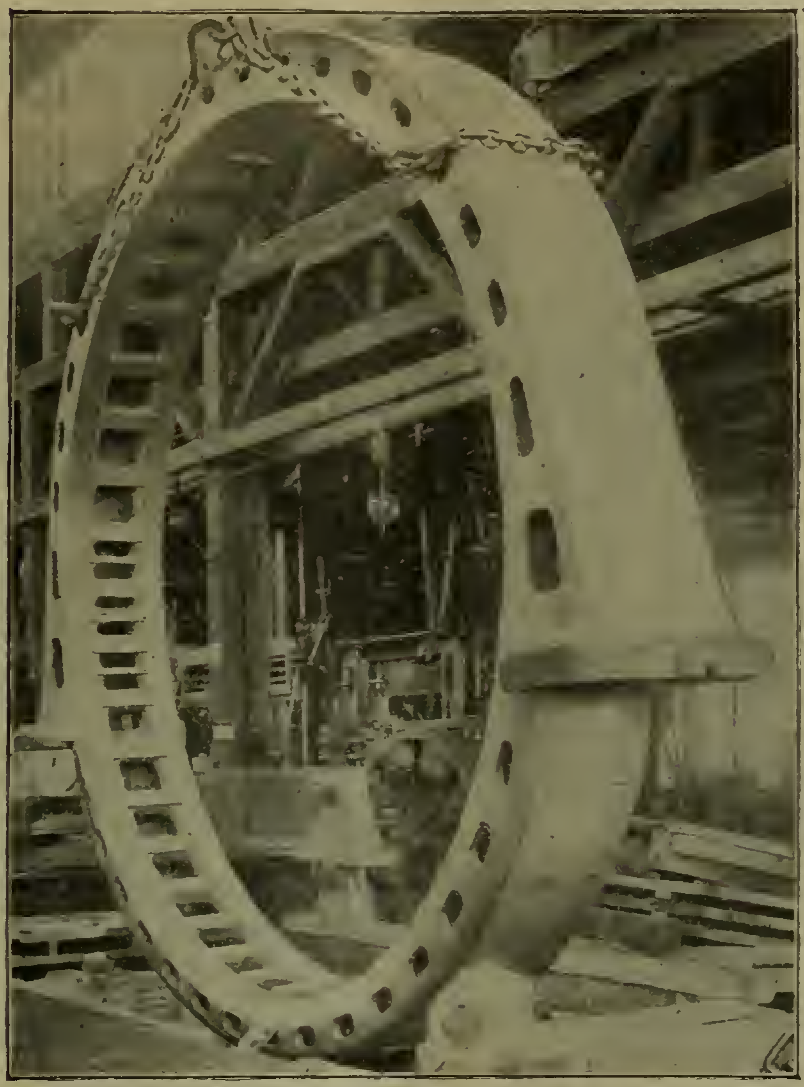

Fig. 2. Armature Frame, Brooklyn Generator.

A TWO THOUSAND HORSE-POWER THREE-PHASE DYNAMO.

The great three-phase alternating-current dynamo, intended for the new station of the Edison Electric Illuminating Company of Brooklyn, N. Y., has been shipped from the works of the General Electric Company, Schenectady, N. Y. To transport this exceptional generator to its destination, not less than five flat freight cars were needed; and Fig. 1 shows the train with four of them hauled by the G. E. switching engine to the tracks of the New York Central Railroad.

The generator is rated as A. P. C 40–1500–75, that is, it is an alternating-current three-phase machine, of the revolving field type, with forty poles and a normal output of 1500 kilowatts when running at 75 revolutions. In designing this the instructions so far as cost and expense of operation were duly considered in relation to the conditions of service, but the design was left entirely to the General Electric Company. The machine which has resulted would under ordinary conditions be considered one of 2,000 kilowatts. In use it will be driven directly by an engine giving its highest economy at a little over 1,500 kilowatts, or which can be operated to advantage, and will probably be operated at an output of 2,000 kilowatts. The engine selected is a four-cylinder triple-expansion engine built by the McIntosh & Seymour Company.

The dynamo is wound for an output of 2,000 kilowatts at 6,500 volts. The armature windings are mounted upon the stationary part of the machine, shown in Fig. 2. These windings form one of the most interesting features of the construction of this class of machine, the method of coil construction and insulation being especially adapted to high voltage work. The armature frame is built to give perfect ventilation to the windings and the machine is guaranteed to operate continually with a heavy overload with only very moderate heating.

The field structure is built upon a cast-iron spider, with a steel ring bolted to the ends of the spokes. To this ring are bolted forty field pole-pieces, each built up of carefully annealed sheet-iron laminations. Each pole-piece carries a coil made up of heavy copper strip wound on edge. All these coils are connected in series, the direct current used for excitation being carried through them. This field structure will be mounted on the steel shaft, 27 inches in diameter, of the triple-expansion engine. On the same shaft are the engine cranks and a heavy fly-wheel, of such weight that the angular variation of speed within each revolution at full load cannot exceed one-quarter of one per cent.

The armature structure will be supported on rails instead of a masonry foundation. This allows the armature to be moved along the rails away from the field, giving easy access to both field coils and armature winding.

The size of this machine and incidentally the range of the dynamo and motor work of the General Electric Company, may be gauged from the illustration Fig. which shows standing beside the armature frame a G. E. induction motor of one-half H. P. capacity. The dimensions of the generator are as follows:

Span of casting or lower half of armature frame .... 25 ft.
Vertical outside diameter of armature frame.. 31 ft. 2 in.
Length along shaft .... 51 in.
Weight of revolving field .... 59,000 lbs.
Total weight .... 165,000 lbs.

This machine is destined for the new station of the Edison Electric Illuminating Company situated at Bay Ridge, at the entrance to the Narrows of New York Harbor on the Long Island side. It will deliver the high

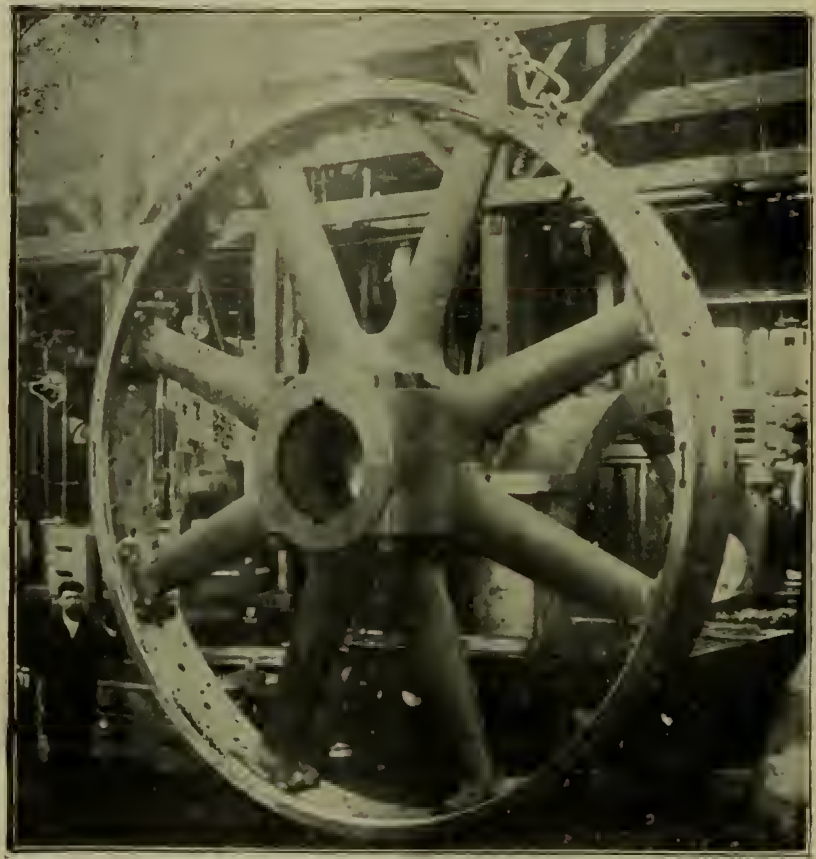

Fig 1, Revolving Field Frame. Brooklyn Generator.

potential three-phase current to a system of conductors over which it will be distributed at different voltages for many purposes. The territory over which the Brooklyn Company is preparing to operate covers over 75 miles; and by the use of a great central station at tide-water, with sub-stations at convenient points, the company proposes to distribute current over this vast section. A large portion of the current will be transformed down to 375 volts and then, fed to rotary converters, will be distributed as low voltage direct-current to the Edison

Fig, 3. Four of Five Cars, Loaded with Brooklyn Generator Only.

three-wire system now receiving current from the stations already in operation. A part of the high potential current will be used to drive synchronous motors directly coupled to arc machines as well as to drive other motors for various power purposes. With this source of power supply at their doors it is expected that the present users of steam-power in Brooklyn will avail themselves of the cleaner and more flexible system of drive, which the electric current offers.

AMERICAN MACHINERY.

The great English technical journal, Engineering, London, pays a handsome tribute to machine tools made in the United States, saying: "It is not a reassuring thing for those who would see the engineering supremacy of this country maintained to notice how certain American firms have ranged ahead of us in the production of a light class of machine tools, of which the bicycle making machines afford an example. At the present time, with the demand for bicycles still great, and new factories being started constantly, manufacturers have the greatest difficulty in obtaining the special plant. It is easy enough to purchase ordinary lathes, milling machinery, power mills, etc., but with these the bicycle maker cannot hope to produce his wares at anything like the same speed or at so low a cost as can those who are fortunate in possessing special labor saving and extremely accurate tools. No doubt a good many ingenious cycle making tools have been constructed in this country, but these have been largely designed by the cycle makers themselves—when they happen to have been mechanics also—and have not been put upon the market. Under these circumstances the American makers have stepped in, and are at the present time reaping a rich harvest in selling, pretty well at their own prices, special cycle making machinery of a nature which cannot be purchased from British manufacturers."

ELECTRIC PUMP FOR THE WATER WORKS.

The City of Buffalo will very likely have, within a few months, an electrical pump which will supply 30,000,000 gallons of water a day and which will be operated by power from the great cataract of Niagara Falls.

When the bids for the new city pump were opened by the Board of Public Works last Wednesday, a bid from the Buffalo Engineering Works was found for an electrical pump of the capacity named.

The company agrees to furnish the pump for $59,400, and the Cataract Power & Construction Company agrees to furnish the power through the Cataract Power & Conduit Company of Buffalo for $30 for each horse-power. As the engine is to be of 1,200 horse-power, this would mean that the operating expenses for a year would be $36,000. The General Electric Company agrees to furnish the motor.

The bid for the electric pump is much less than the lowest bid for a steam pump. The Lake Erie Engineering Works offer to make the steam pump for $64,280. The operation of a 30,000,000-gallon pump would cost $60 per horse-power, thus making the cost of the 1,200 horse-power $72,000 a year, or double the cost of operating the electric pump.

The Board of Public Works had not announced its decision up to the time of going to press, but there seems to be little doubt that the contract will be let for the electrical pump.

Electric pumps are in successful operation elsewhere, but none of so great a size as the one now proposed for the Buffalo Waterworks.—Greater Buffalo.

According to experiments recently conducted by Messrs. Holborn and Wien, the electric resistance of platinum theoretically sinks to o at —258° Centigrade.—L'Industrie Electrique.

LORD KELVIN AND OTHER NOTABLES VISIT THE GENERAL ELECTRIC COMPANY AT SCHENECTADY.

There are few men better known throughout the scientific world than Lord Kelvin, formerly Sir William Thomson. His first visit to this country was in 1884. His second was made last month, thirteen years later. He is an exceedingly vigorous old man, full of English vitality and representing a combination of mind and matter which is a pleasure to look upon. The General Electric Company, at Schenectady, N. Y., received Lord Kelvin and showed him through their immense works. Prof. Thomson and E. W. Rice, Jr., were entrusted with the honorable mission of showing this illustrious visitor every quarter of their huge buildings. Great railway generators of fifteen hundred horse-power capacity, for use on the Fourth and Sixth avenue lines of this city, and two two-thousand horse power machines were examined by him. He also saw a twelve-hundred horse power, smooth body armature machine, to be used in the Edison Electric Illuminating Company's station in New York City.

Lord Kelvin at Schenectady. Group Showing Lord and Lady Kelvin, Prof. Elihu Thomson, C. P. Steinmetz, E. W. Rice, Spencer Trask and Father, Capt. Eugene Griffin, S. Dana Greene, J. P. Ord, George Foster Peabody and Others.

Mr. C. P. Steinmetz, seen in the illustration, performed an experiment, starting an arc with a pressure of 200,000 volts and drawing it out a distance of five feet, a blazing stream of white incandescence. Prof. Thomson's magnetic blower was tried, its effectiveness being tested by a current of 1,000 amperes at 500 volts pressure; its action was perfect. The General Electric system of electric traction was shown with its surface contact and absence of trolley wire. It is a block system and acted very satisfactorily.

The photograph shows Lord Kelvin and wife, Charles Proteus Steinmetz, Elihu Thomson, and others well known in the profession. Lord Kelvin thought the General Electric shops were among the great wonders of America.

Donaldsville, La.—A new electric light plant, to cost about $14,000, will be established.

Kansas City, Mo.—Rev. S. D. Stephens and J. S. Chick are interested in a plan to build an electric railway to the Kansas City University, from the terminus of what is known as the Chelsea Park line.

THE WORLD'S IRON AND STEEL INDUSTRY.

The St. Louis Globe-Democrat says : A statement of the world's iron and steel industry appears in a recent issue of the London Iron and Coal Trade Review, which calls attention particularly to the fact that the United States has taken the lead. In 1866 this country produced 17,000 tons of steel and in 1896 a total of 5,600,000 tons. Even this amount was surpassed in 1895, when our production was 6,212,671 tons, or sixteen times that of thirty years before. Last year we led Germany, which stood second, by 172,000 tons, and Great Britain, which was third, by 1,400,000 tons. The fourth country in steel making is France, but it turns out only one-sixth as much as the United States. Austria has advanced with rapid strides in steel and is aimost abreast with France. We make nine times as much steel as Russia or Belgium, thirty times as much as Sweden and fifty times as much as Spain.

One reason why the United States has climbed rapidly to the top in steel production is that the industry itself on a large scale is modern. A thousand tons of steel are used now to one when Victoria was crowned. The total production of steel in the world in 1866 was 423,000 tons, and in 1896 forty times as much, or 16,551,000 tons. In the United States the manufacture of Bessemer steel was begun in 1867, with an output of 2,722 tons, which increased by 1889 to 2,175,000 tons.

THE PARAGON MOTOR.

Some day we will look back upon the art of motor construction and realize how swift has been the race between those engaged in that particular trade and the manufacturers of steam engines, gas engines and even steam turbines. A wonderful spirit of activity has developed itself in all fields of scientific application, but none more noticeably so than that relating to the development of electric motors.

Fig. 1, The "Paragon" Commutator. 1898 Type.

As a type which represents the co-ordination of all useful principles, none can be brought forward with more satisfaction than the "Paragon" motor. This well designed machine is manufactured in several sizes. It represents the latest type because it is iron-clad. It has been the work of careful designers as might be proved by an examination of its toothed and well laminated armature and cylindrical field.

Fig. 2. The "Paragon" One-sixth Horse-Power Motor, 1898 Pattern.

The illustrations show the 1898 armature, a one-quarter h. p. 1898 "Paragon" motor, in operating condition, in one case, and in the other exposed for inspection of its interior. An iron base which acts as an oil-pan, easily adjusted radial brushes, the shortest magnetic circuit imaginable and an armature running closely to the field supplies features worthy of the highest commendation from any technical critic.

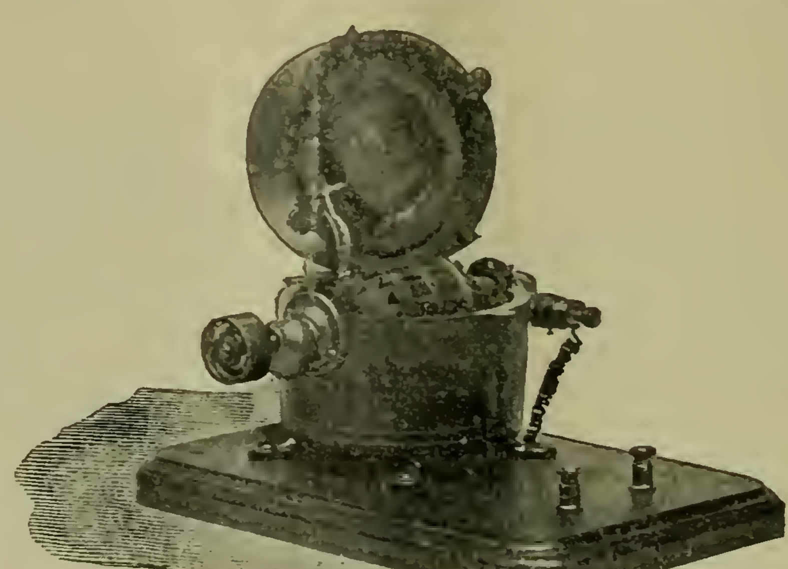

Fig. 3. Interior View of "Paragon" One-quarter Horse-Power Motor,

The manufacturers of the "Paragon" motor can show testimonials from Vallee Brothers & Company, of Philadelphia, Pa.; Manhattan Electrical Supply Company, New York City; Keelyn & Smith, Milwaukee, Wis.; Michigan Electric Company, Detroit, Mich.; Western Electrical Supply Company, St. Louis, Mo.; Wood & Speed, Louisville, Ky.; Paterson District Telegraph Company, Paterson, N. J.; E. G. Bernard & Company, Troy, N. Y., and many other concerns might have been quoted who would willingly recommend the "Paragon" motor for its excellent design and construction and satisfactory operation; they will all handle these excellent motors in 1898. On a three months' test, running ten hours a day, these motors have given perfect satisfaction.

Fig. 4. One-quarter Horse-Power "Paragon" Motor.

PAPER ON "CONSTRUCTION AND MAINTENANCE OF CAR BODIES AND TRUCKS."

By Robert Dunning, Buffalo Railway Co., Buffalo.

Continued from page 204.)

Perfect maintenance may be described as that which produces the greatest efficiency and best appearance extended over the longest period of time. The method of accomplishing this will differ in minor details under different conditions and service, but the main principles are the same. As to the car body, the words paint and varnish cover nearly the whole subject, and if the car be kept well varnished the question of painting, if well done in the first place, may be set aside for an indefinite time. A car in regular service should be revarnished once in nine months, or oftener if the locality in which it operates is subject to conditions which are specially injurious to varnished work, such as an excessive amount of smoke and coal gas in the atmosphere. Before retouching and varnishing have the joints of the car inspected and if any indication of shrinkage or working is shown see that it is put right.

In the truck, besides the painting and varnishing, other conditions are to be met, for here the wearing parts demand constant attention and should be gone over every time the car is run into the house. You cannot depend upon the driver or conductor to always report defects even though they are ordered to do so; their mechanical knowledge may be very limited. and as long as a thing works it is all right to them. In the matter of brake shoes see that the shoe sets true upon the wheel and is in perfect contact on the whole face; through carelessness in truck construction and the moulding of brake shoes we often see them worn through at one end and scarcely touching at the other, and again worn in such a way as to show they were set diagonally to the face of the wheel. Test the brake, track cleaners, sanding apparatus and wheels, for you cannot tell what may have happened to them while in operation and it may mean the saving of life and thousands of dollars to the company, if these things are constantly and carefully looked after.

In the matter of flat or skidded wheels, we all know the causes; we also know many remedies for the trouble and have applied them, but the wheels continue perversely to skid, and will probably continue to do so as long aa the braking power is applied to them and emergency stops are made. The regular sanding of the track has probably done as much good as anything that has been tried so far, but for the present there seems to be nothing better than to get as high a mileage contract as possible from the wheel maker with the necessary regrinding included.

To the electrical equipments, all the previous remarks relating to testing and careful inspection apply with double force. The power which is so quick and ready when properly conveyed and guarded will vanish upon the least relaxation of vigilance and leave disaster in its wake. How to properly care for motors, switches and wiring is also a subject too broad for this paper to attempt to cover, and only a few general points can be mentioned, one of the most important of which is cleanliness. Care in this direction will save many a break-down, and it is hardly possible to be too thorough. Dirt may be a good insulator at times, but it is scarcely safe to trust it.

Insulation is another point to be carefully scrutinized and the careful and solid connection and securing of the various parts is another. A loose wire if not attended to means damage sooner or later, and a poor connection, loss of power and possible burning. Some roads advocate the taking apart and thorough overhauling of motors and controllers once a month. This would seem to be somewhat oftener than is actually necessary and it would be an extraordinarily severe service that would require it. The chance of doing damage to electrical apparatus while it is undergoing an overhauling is quite a factor and it would seem to be more reasonable to use judgment in this matter than to take the apparatus out and put it back at regular periods without regard to other conditions.

The question of maintenance naturally merges into the one of repairs and it is difficult to tell where one leaves off and the other begins. The work of correcting and replacing the thousand and one little things constantly requiring it can only be realized by one who is fully experienced, and fortunate is the road that has efficiency and ability and thoroughness in this department. To say that a street-railway company is known by the cars it keeps may be an odd adaptation of an old saying, but it is true, and the road that is thorough in this respect will not stop here, but will keep its other departments up to the same high standard and its reward in nickels will be great.

Sacramento, Cal.—The Yuba Electric Light, Power and Irrigation Company has been organized with the following directors: John Markley, of Geyserville, Walter Longbottom, Hiram W. Johnson, Frank D. Ryan and W. Bassett of this city. Capital stock, $160,000.

Montgomery, W. Va.—The Montgomery Electric Light & Water Company has been incorporated by Alexander McNab, J. H. Dunbar, George Smith and others, for the purpose of erecting an electric-light plant and constructing a system of water works.

Galveston, Texas.—The Galveston Engineering and Electric Company has been organized by Carl Young, A. Cohen and others, for the purpose of supplying all kinds of machinery and to construct electric light plants and water works.

Elmira, N. Y.—The National Electrolytic Company, reported to have filed certificate of incorporation.

A Potent Factor in Civilization.

The Engraver's Lamp.

Forrest City, Ark.—The St. Francis Electric Light Co. has been incorporated with P. H. Thompson, president; I. S. Archer, Vice-President, and C. C. White, secretary. Capital stock, $8,000.

Doylestown, Pa.—Work will shortly be begun on an electric road between Doylestown and Willow Grove Turnpike.

SIR HUMPHRY DAVY AND MODERN WARFARE.

There is no knowing what we may hold Sir Humphry Davy responsible for in the future. As inventor or discoverer of the principle of arc lighting, he can hardly be blamed with intentions that are heartless, cruel or destructive. Yet it seems that the arc light used in the form of a search-lamp may lead, in case quarrels arise between powerful nations, to considerable rapid firing and dynamitic battles. The original arc lamp was of simple construction, being merely two carbons separated by hand. In its more improved form it became automatic, burning for eight or nine hours, turning the hours of night into day. Engravers found in it a means of continuing their work, independent of sunshine, thus giving the focussing

The Electrical Age.

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CONTENTS.

THE USE OF LARGE DYNAMOS.

In generating stations the use of fewer and larger units has become a noticeable feature. The changes in load at one time waited for with so much horror by the station manager, are now successfully met, without the least difficulty or distress. In fact, were it not for the indicating instrument it would not be easy to determine whether the load was heavy or light, sudden or gradual. While it cannot be said that this vast improvement in methods and mechanism is due to the development of a single department, it is nevertheless true that without automatic dynamos and improved appliances of very recent date, the handling of a station would be as difficult today as it was in the past. There is, however, a reason by which we can account for much of the simplicity in station mechanism as well as much of the assurance felt by those in charge of electric light or power machinery. It seems that the use of large dynamos, of a few great generators, instead of many small machines, has simplified station management, reduced the chances of a breakdown, and placed the machinery within the control of a few experienced men. It was formerly believed that the chances of deterioration were as great in the case of a large dynamo as a small one; therefore it was better to have the power subdivided—produced from smaller units. In addition, it was believed that at light load, a large generator was not as economical as a smaller machine. While this may have been true, eight or ten years ago, it does not appeal to us today, except in special cases, as an argument of very great value. The average load on all electriclight stations, supplying municipal districts, is large enough to remove this so-called objection to a light load on a large generator, and, in cases where the load should become so irregular that the cost of running the generating apparatus is high, the plant is undoubtedly too large for the trade it depends upon. The chances of break-down in a large generator have been reduced to such a minimum at present that there seems to be nothing more reliable for electric light or power work. Although many regard the safety of a station as dependent upon automatic dynamos and quick-acting devices, a large share of this safety is due to the use of heavy machinery.

AMERICA AND MADAGASCAR.

Ambitious firms desirous of establishing trade relations between foreign countries and themselves may find some benefit in reading the following letter, received by a Chicago concern, from Tamatave, Madagascar:

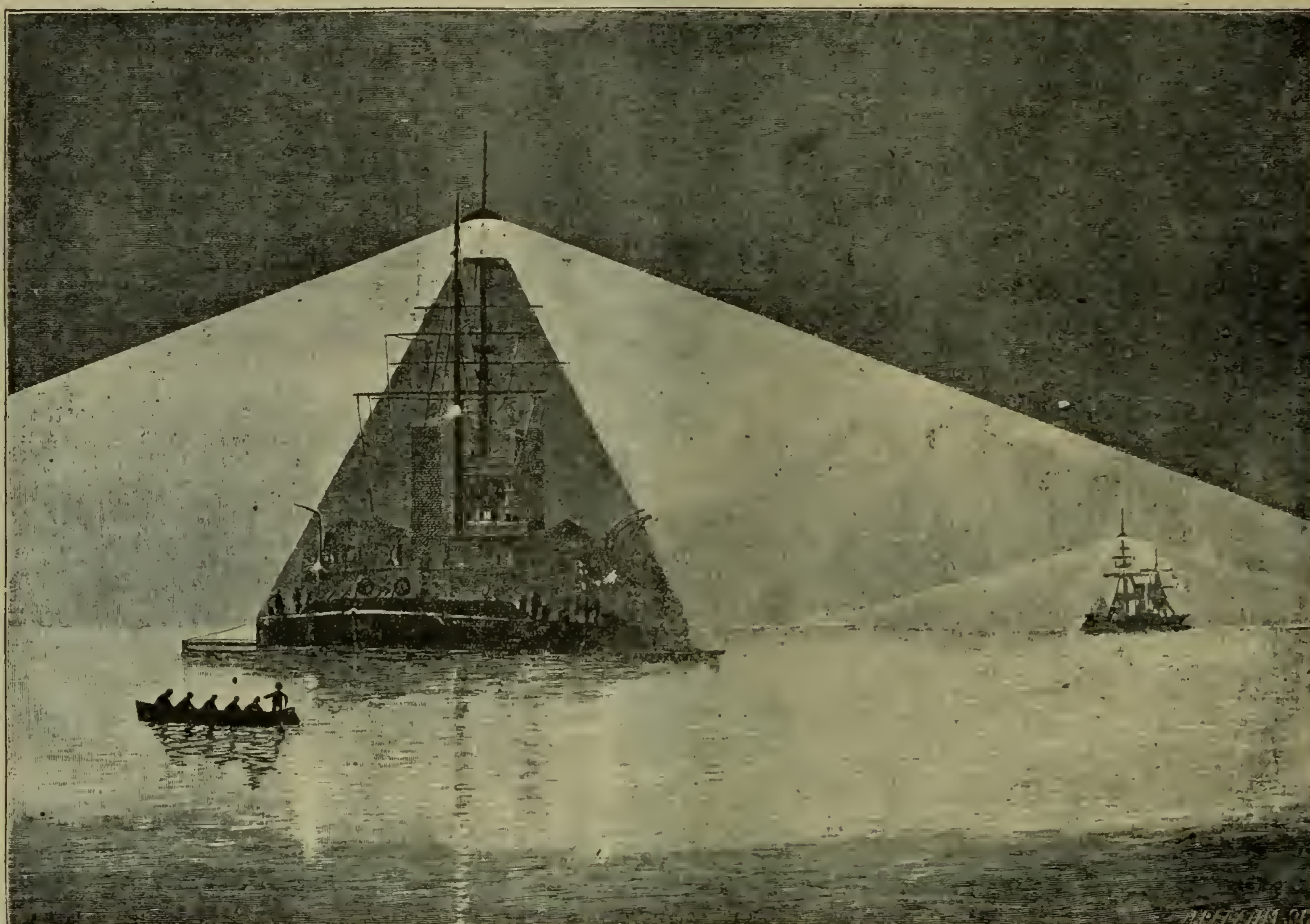
"There are many firms here who correspond in English, but for your line I would suggest that all catalogues and communications be in the French language. No introduction of American machinery has yet occurred in this country. A pump or two, as many sewing machines, a very few hammers and other small tools—not a dozen all told; a small 'Enterprise' handmill and one lawnmower, would cover the entire introduction here of American machinery, tools and implements in the last five years."

Other facts follow of interest to those dealing in general merchandise, as well as electrical goods and machinery. "There are no American concerns whatsoever introducing machines or machinery into this country. There are no native firms at all. Goods coming in for public work would probably be duty free, while for private persons and corporations American machinery would probably pay the same duties as in France." The writer further states that there is a prejudice against foreign machinery in the mind of French officials. But there is no doubt that this can be overcome and the development of Madagascar be as great as Transvaal if labored for by energetic and persistent Americans.

THE REASON WHY.

There is so much national competition in foreign countries that it frequently becomes more a case of Germany against France, France against Italy, and England against all of them, instead of a purely commercial competition. One of the consuls writes from Chemnitz as follows: "No land is so small or so far away as to escape the Germans." Figures are given by him showing a decrease in English trade and a rise in German trade. The British consul, in commenting upon this condition of affairs, believes that the developing business of German export houses is a result of their having sent out travelling salesmen "who study tastes, peculiarities, putting-up, prices, etc." He also notes the fact that he found in one Turkish province of Biblical fame twenty-nine German agents, eighteen Austrian, thirteen Frenchmen, four Englishmen, three Swiss, two Italians and one Belgian. It seems that this district is pretty well canvassed, but no American appears on the list, showing what little hold American manufacturers have upon residents in certain well-known foreign lands. It may seem as if quality and cheapness would count but American manufacturers in priding themselves upon their abilities in this direction seem to forget that others, so to speak, are "saying nothing but sawing wood." The great trade which Germany is developing is the direct result of systematic canvassing. They manage to plant their merchandise and machinery permanently, and the reason for this is given by the English consul in a most explicit manner: "The system adopted by Germany in sending out these technically-trained agents, especially into new territory, is the only effective way to win such success as has marked the footsteps of their travellers in recent years. Only in this way is it possible to get a good knowledge of other nations' needs, markets, etc."

lamp life and history. The United States Navy sees in its use in the guise of a search-light great possibilities. A netting and search-light are in fact more valuable to a war vessel at night than the greatest Krupp gun ever built. War vessels can sight and signal each other by means of a search-light. There may be a time when bombardments will take place between shore and ship, long after the gloom of night has fallen, by its aid. With far-fetching guns and the penetrating beam proceeding from these powerful lamps, warfare will be conducted on new lines, absolutely incomprehensible to those that



Search Light for Naval Use.

have lived in the days of wooden cruisers and heavy iron hulks. Sir Humphry Davy invented the miner's lamp that has saved many lives from the horrors of fire-damp, yet the arc lamp equipped for warfare may guide many a speeding bomb on its path of destruction.

PAPER ON "STREET CAR WHEELS—SHOULD THEY BE MADE HEAVIER?"

By F. D. Russell, Rochester, N. Y.

(Continued from page 204.)

There are two factors which try the very withers of cast iron wheels. One is the twist or torsional strain as the motor drives the wheel, and the other is the heating of the periphery of the wheel from the friction generated by high speed, or continued application of the brakes. This latter, I firmly believe, is the hardest part of the service required of a motor wheel, because it tends to expand the rim, and set up a severe strain where the arms, which remain cool, unite with the rim. All our patterns are designed to resist this strain.

Now a few words on the subject of standards—axle standards, I mean, for the wheels, in tread and flange, are gradually approaching as near to a standard as the varying conditions of service will admit. We lately purchased about 1000 bars of steel for axles, and it was nothing short of a Chinese puzzle to make up a list which would properly cover our needs. Taking the trucks in order of length of axle, we have :

Taylor,	axle 6 ft. 3 ins. long	
Peckham,	" 6 " 4⅜ " "	and 6 ft. 6⅜ ins. long
Brill,	" 6 " 5 " "	
McGuire,	" 6 " 5 " "	and 6 ft. 6 ins. long
Bemis and Baltimore	" 6 " 5¼ " "	
Diamond,	" 6 " 5½ " "	

I have not at hand the lengths of the DuPont or Dorner & Dutton, or any other axles not mentioned in the above list, but you can depend upon it, they are different.

The foregoing lengths are on standard gauge and usual tread, which means, not exceeding 2½ ins. All, I believe, are subject to variation where wheels have treads wider than 2¾ ins., and, of course, for wider or narrower than standard gauge.

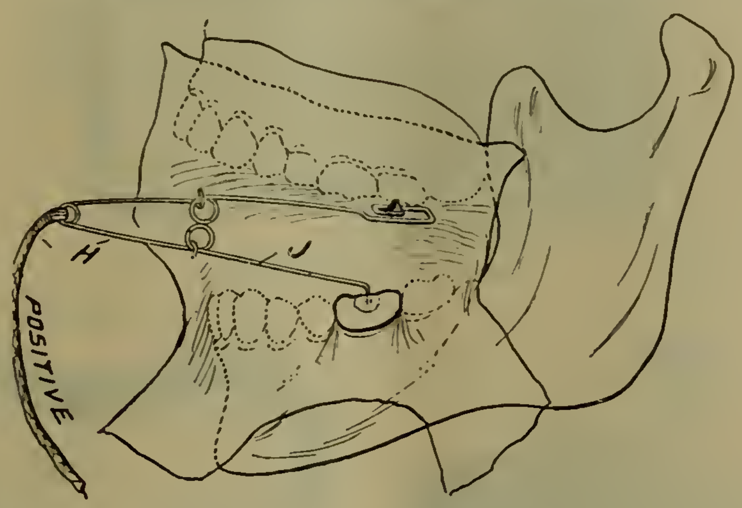
My idea in speaking of these varying lengths of axles, is to suggest whether you cannot get together and establish a standard axle, and by amicable arrangement with the various truck makers, bring about the adoption of a standard length of axle, a standard journal, a standard brass and a standard box. The Master Car Builders of the steam railroads long ago took exactly such action, and it is nothing new which I suggest. They have a uniform standard. Their axle is 6 ft. 11¼ ins. long, and the journals and boxes and brasses are interchangeable the country over. If *they* could establish such a standard, why cannot street railways arrange for the same? Instead of interfering with the interests of any truck maker, it seems to me it would benefit, and it certainly would simplify matters enormously for everybody concerned.

Montgomery, Ala.—Bids are being invited for lighting the streets and city buildings with electricity.

CATAPHORIC APPARATUS FOR DENTAL USE.

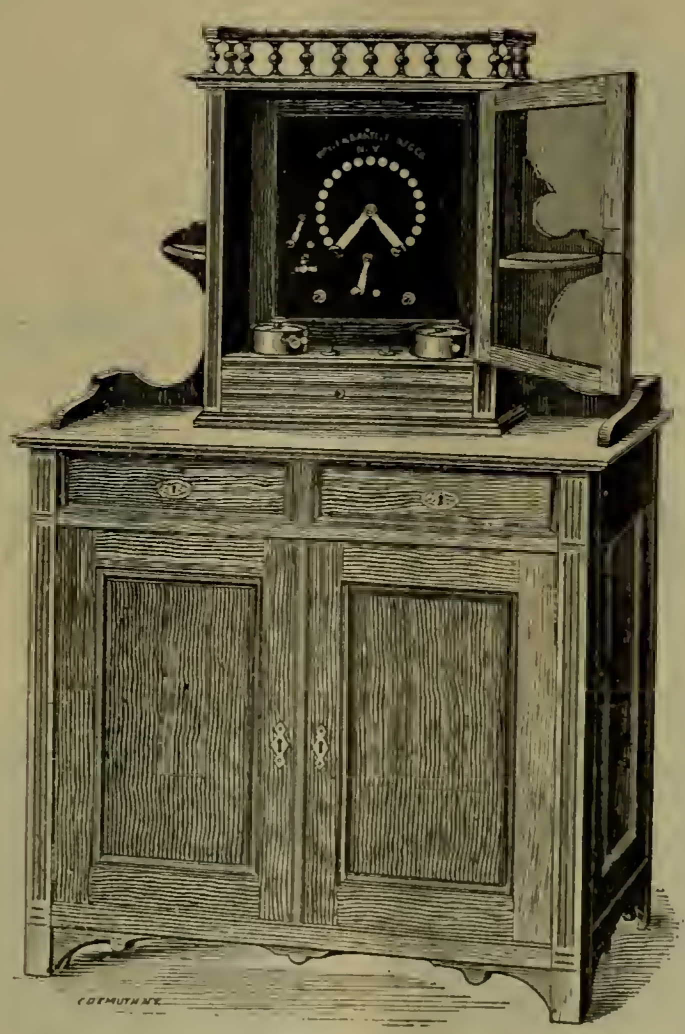
The application of electricity to ills and diseases of the human body has developed to such an extent that there are at present departments which individually treat each particular class of diseases. When an electrical current enters the body a certain muscular reaction occurs which is productive of the most violent contortions. On the other hand, the current may be used for an entirely different purpose, neither to affect the muscles nor to produce any direct change in the tissues, but rather to carry from point to point certain mendicaments which exercise an anæsthetic effect upon any given area. Prof. Starr has compared the application of static electricity to the effects of a cold bath, the muscle beating of the Swedes, twig-whipping in a Turkish bath, or the lomi-lomi of the Sandwich Islanders; but it is difficult to compare this peculiar transference of a drug from point to point in the human body with anything else. It is possible to drive cocaine so thoroughly into the cells of muscular tissues as to render them absolutely free from all sensation.

The Van Woert cataphoric apparatus for dental use, perfected by Professor F. T. Van Woert, of Brooklyn, N. Y., sold by B. & E. Hanfeld, 145 E. 23d street, New York City, and manufactured by Waite & Bartlett Mfg. Co., manufacturers of world-renowned electro-medical apparatus for therapeutic use, and the largest static machine in the world, 147 E. 23d street, New York City, is probably the most complete that can be found. When this principle of forcing a drug electrically to any part of the flesh is carried out, cataphoric action is clearly demonstrated and the term given to this class of operations is cataphoresis. In plain language it is an evidence of the power of a continuous current to carry a fluid along with it to the point of exit.

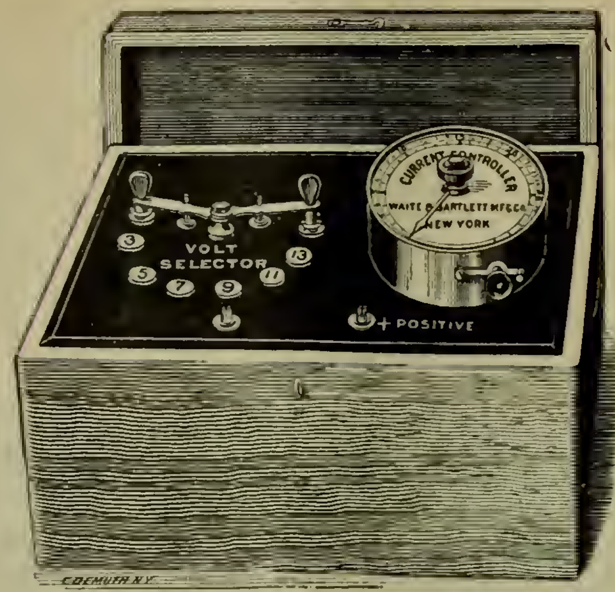


Spring Electrode in Position.

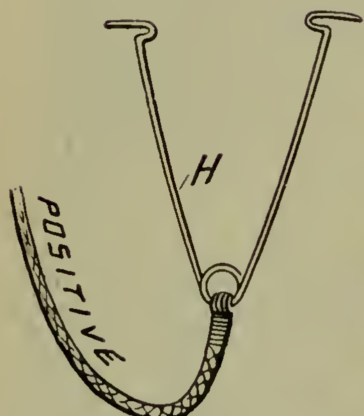
In dental practice, as the reader will well know, there is no pain more excruciating than that undergone by the prodding of dental instruments. Usually cocaine was applied by means of a hypodermic syringe. A simpler electrical process renders even this unnecessary—cocaine applied to the positive pole of the battery, the cocaine passing into the tooth at whatever point it may be applied; the other pole of course being connected to the hand, or wrist, or cheek, merely providing a means of escape for the current and completing the circuit. The apparatus illustrated for the successful application of a current to this purpose, represents a great deal of thought and arduous labor. The outfit in itself will last for many years, and the cells with care will continue to remain in good condition about a year and a half.



Cataphoric Cabinet, with Faradic Attachment for Diagnosis, Mouth Lamp and Electrodes.

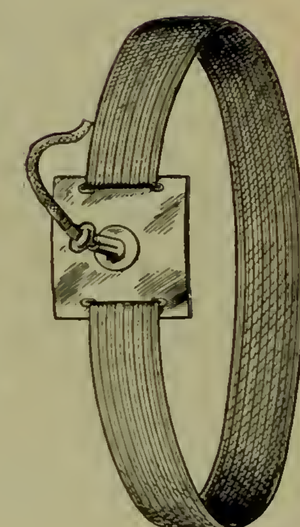


Simple Cataphoric Outfit.

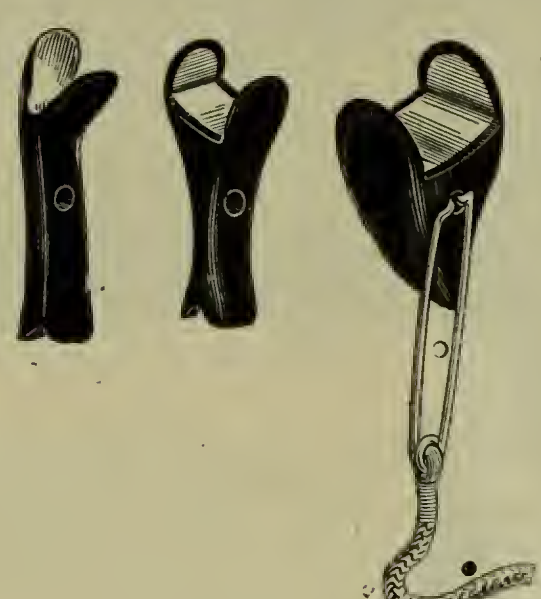


Spring Electrode.

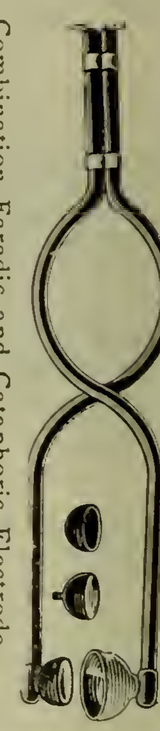
Combined Double Buckle and Negative Electrode.



Negative Wrist Electrode.

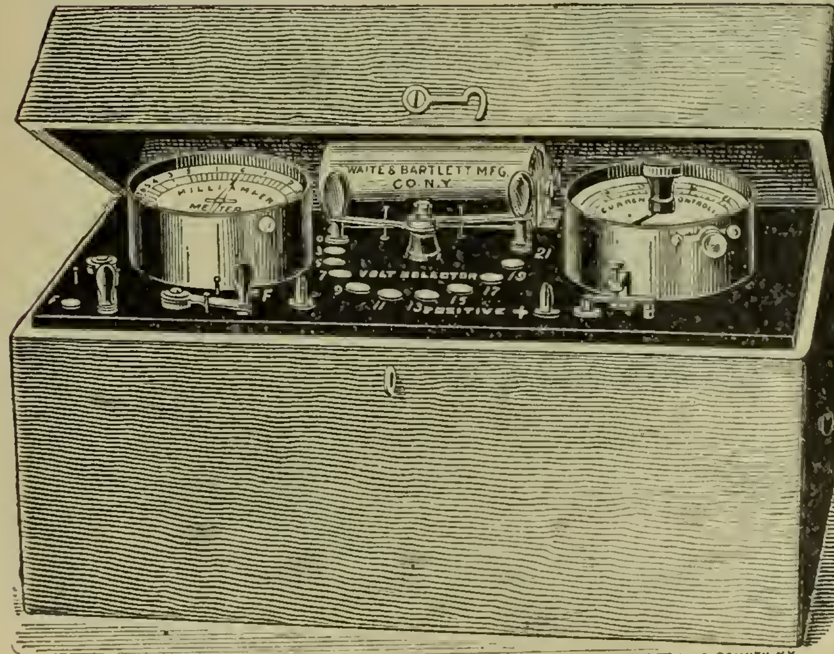


Dr. Morhard's Electrodes.

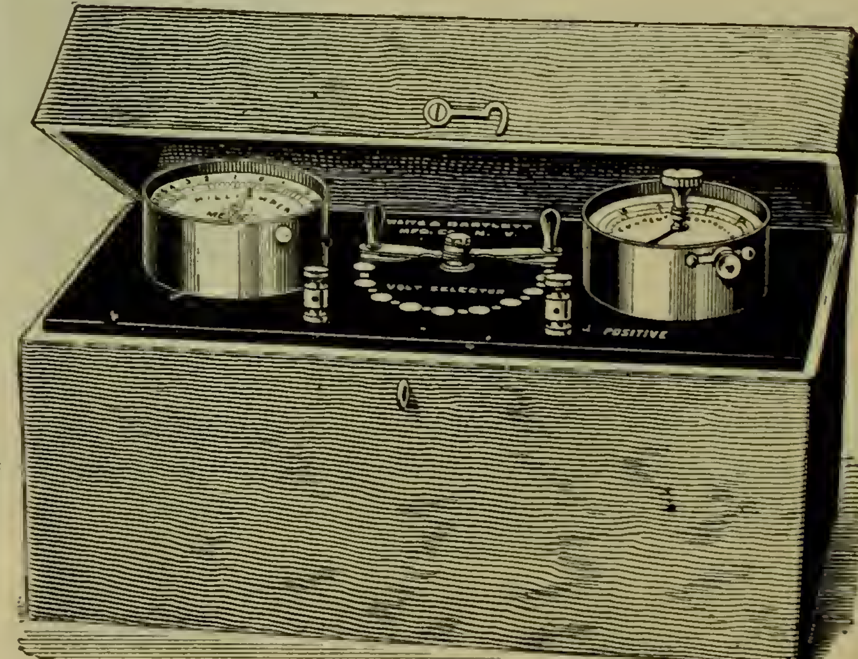


Combination Faradic and Cataphoric Electrode.

Cataphoric Medication in the Mouth Controlled by Patient.

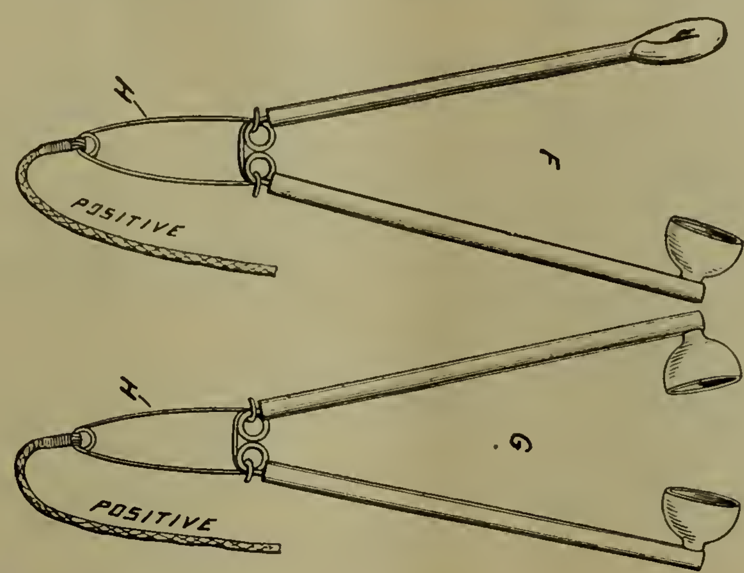


Cataphoric Outfit with Faradic Attachment, Milliameter and Current Controller.

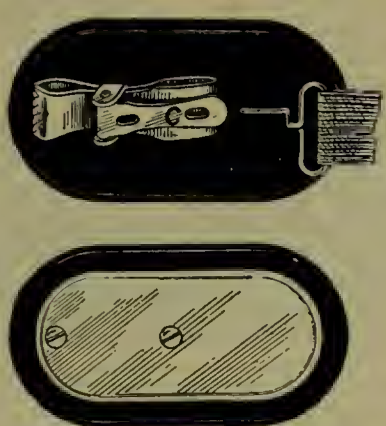


Cataphoric Outfit with Milliameter and Current Controller.

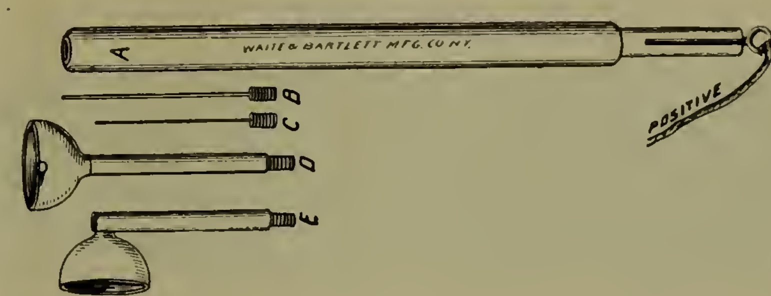
For cataphoric purposes a current that can be easily controlled is a prime necessity. It is therefore necessary to use a reliable battery, rheostat and milliampere meter, as well as a collection of electrodes, which will enable the dentist to be expert in his manipulations and quick in producing the result he desires. The milli-amperemeter used with the Van Woert apparatus is a compass needle acted upon by the current flowing below the needle; it is the only correct meter for cataphoric apparatus; it will never change by outside climatic influence or otherwise, and will register the current correctly as long as there is life in the batteries. Outfits have therefore been illustrated which have received the best of recommendations from eminent dental and medical authorities.



Cup Electrodes.

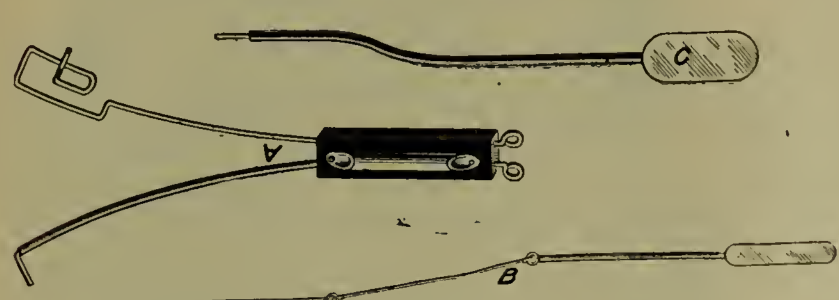


Combined Rubber Dam and Negative Electrode.

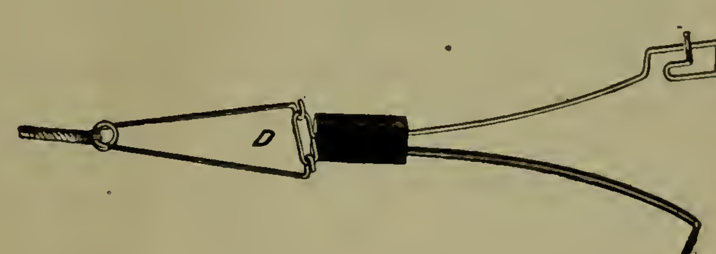


Hand Electrode for Inaccessible Parts.

The illustrations represent cabinet outfit, with faradic attachment for diagnosis, mouth lamp and electrodes and portable cases containing in addition to cataphoric apparatus, faradic attachments. They are sold with and without the faradic attachment, and range in price accordingly. An illustration showing the application of the apparatus for cataphoric medication in the mouth and the easy means of regulating the current is likewise represented.

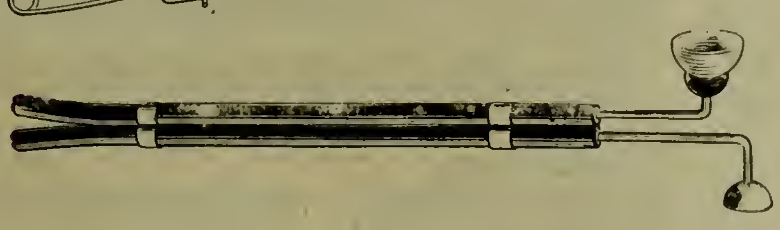


Combination Positive and Negative Electrode.

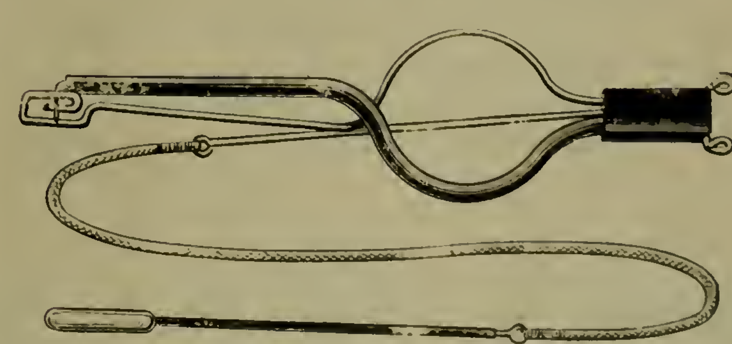


Spring Electrode for Conveying Current from Positive Pole of Battery to Cavity of Tooth.

German Silver Wire Spring Electrode for Use in Labial Cavities of the Incisors.



Combination Electrode for Soft Tissue.



Combination Membrane Electrode.

Different electrodes, for conveying the current to the cavity in the tooth from the positive pole of the battery, and others used for various professional purposes of the same nature will indicate the detailed development of this unique branch of dental surgery. Electrodes for the face, wrist, root canals, soft tissues, etc., are included among the sketches. In one of them is shown the spring electrode in position for anæsthetizing dentine pulps for extirpation, the position of the jaw and the application of the electrode while performing its functions requires but little comment. Dr. Morhard's electrodes are moulded into shape to fit the teeth. Within the cup of the electrode a cocaine pellet is placed, and anæsthesia quickly results when the proper connections are made. The cuts represent electrodes particularly designed for centrals, molars and bicuspids. The use of this cataphoric apparatus has saved many a patient from untold agony. The great feature of all cataphoric apparatus is its wonderful convenience and certain efficacy.

In dentistry, the old as well as the new practitioner will realize that his great war is with pain and that all modern means of destroying it should be adopted without the slightest hesitation. Cataphoric methods have received a hearty welcome from medical men, and the live, up-to-date dentist can easily be distinguished from the old-fashioned plodder by the readiness with which he turns to the most advanced methods. In addition we may say that B. & E. Hanfeld handle a line of supplies which are used by the ablest men in the profession. Their equipments are complete, up-to-date and reliable in every respect. Their suggestions are the fruits of experience and will prove of value to any dentist requiring a complete cataphoric outfit.

A. L. BOGART CO., successors to A. L. Bogart, 50 East 20th street, New York, telephone No. 507 18th st., manufacturers of electric gas lighting specialties, the Bartholdi automatic, frictional machines, multiple burners, dynamo gas lighting torches, report a very active paying business which amounts to a healthy boom. It has increased 50 per cent. over last year's and is of a better quality.

THE NORTH AMERICAN ELECTRIC COMPANY, No. 181 William street, New York, has changed hands and is now under a new management, that of Mr. F. E. Magee; president, William Cranston; secretary and treasurer, Joseph Nicchia; superintendent and electrician, J. E. Fuller. The original firm was organized over fifteen years ago and have been engaged in a special line of electrical work until within a few years ago. They have placed on the market a large quantity of batteries and battery motors; also incandescent fan motors and other electrical specialties. The work they were engaged in grew to such an extent that the old management could not give it the proper attention, and the change herewith noted was brought about. The new officers will extend the business into other electrical fields, adding to it some very attractive novelties in the shape of a bicycle dynamo and lamp combined, carried on the wheel frame. It is hardly noticed and is so small as to pass almost without observation. This dynamo weighs a little over one pound and is the greatest novelty of the season. In addition to this last device a new regulating socket, of durable character and ingenious design, has been perfected and is ready for sale. Mr. Fuller has had over twenty years' experience in the electrical and mechanical specialty line and is well known among practical electrical workers. His name is connected with a great many new and useful forms of apparatus, comprising quite a list of valuable inventions. Mr. Magee, the manager, is an old Law Telephone man, originally at 140 Fulton street, New York, and of the days when Frank Shaw and William Childs were well known characters. Mr. Magee was manager of the wire department, since which time he has been interested in various electrical and mechanical enterprises. Mr. Nicchia is a graduate of the largest technical college in Italy, being a practical mechanical engineer well versed in the art of construction and its many details. He has been in this country a number of years and has achieved considerable reputation in his particular profession. Mr. Cranston is a master in chancery and a very prominent attorney in Trenton, N. J. His legal abilities have brought him prominently forward on many occasions. With a strong arm to row and a good head to steer, the North American Electric Company have a great field of work opening before them. They have incorporated within themselves the very elements required for a successful present and a brilliant future.

THE BRITISH THOMSON COMPANY of London, through its representative, Mr. A. K. Baylor, has just closed an important electric railway contract with the companies operating the tramway systems of Dublin, Ireland, and Barcelona and Madrid, Spain. The contract for Dublin includes all steam, as well as the electric generating and motor equipment, and comprises six Allis horizontal engines of 500 h.-p. each with Babcock and Wilcox boiler capacity necessary; six 500-kilowatt multipolar General Electric generators for direct connection to the engines and complete switchboard and station equipment. The car equipment will consist of 150 complete motor and series parallel controller equipments, the motors to be mounted on Peckham trucks. This contract follows closely that made for the equipment of the Clontarf line of the Dublin tramway system, which will be opened within the next week or two. The apparatus for this was also supplied by the British Thomson-Houston Company. The contract signed for the Barcelona and Madrid roads cover five 400-kilowatt multipolar General Electric generators and three of 75-kilowatt each, all to be directly connected to the engine shaft. While the three latter will be lighting generators, they will also be wound for 500 volts. This contract also includes full station equipment.

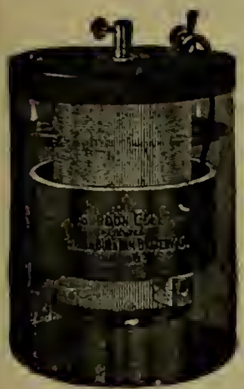
THE GROWING USE OF INTERIOR CONDUIT.

The great German steamship, Kaiser Wilhelm der Grosse, illustrated in the Scientific American of October 9, is the latest big German steamer that has been wired with interior conduit manufactured by S. Bergmann & Co. of Berlin, Germany, and made under the patents of The Interior Conduit and Insulation Co. of New York, U. S. All the German steamships are wired by the Bergmann Co. of Berlin.

POSSIBLE CONTRACTS.

Liberty, N. Y.—Liberty Light and Power Co., of Sullivan Co., has been incorporated by Van Wyck Rossiter, Frank McGovern, Isaac M. Sutton, H. Hobart Porter, Jr., and J. H. Sharpe; to manufacture electricity, and to supply the same to the villages of Liberty and Monticello. Capital stock, $25,000.

Chattanooga, Tenn.—The Chattanooga Electric Railway Company is contemplating the extension of its trolley system to Sherman Heights. J. H. Warner is president of the company.



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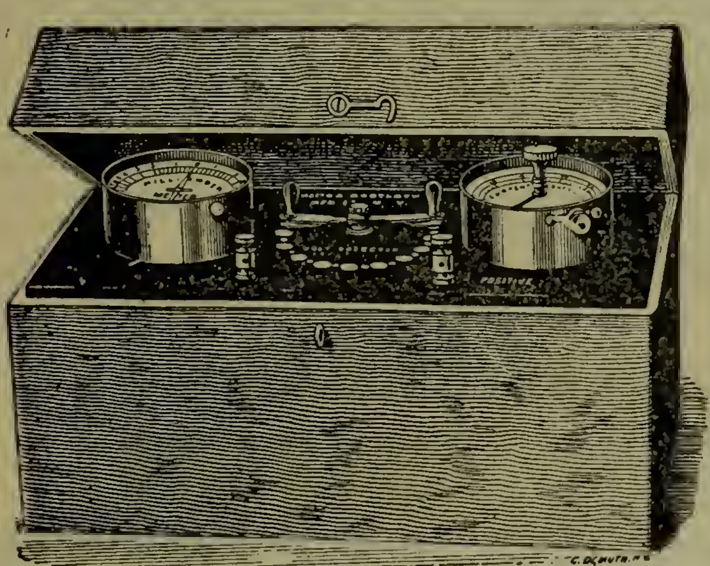

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The Electrical Age.

Vol. XX—No. 16 NEW YORK, OCTOBER 16, 1897 Whole No. 544

President Robert McCulloch. 1896–97.

" Rock of Ages."

View of Horseshoe and Rapids above the Falls from the Canadian Side.

THE AMERICAN STREET RAILWAY CONVENTION.

NIAGARA has been chosen as the place at which will be held the sixteenth regular annual meeting of the American Street Railway Association, between the dates October nineteenth and twenty-second. There is no spot full of greater attractions to electricians and none that appeals more to those controlling and representing electric power interests than Niagara City. ... the American Street Railway Association has been a good one, and its members will appreciate the wisdom which led to the selection of this superior location.

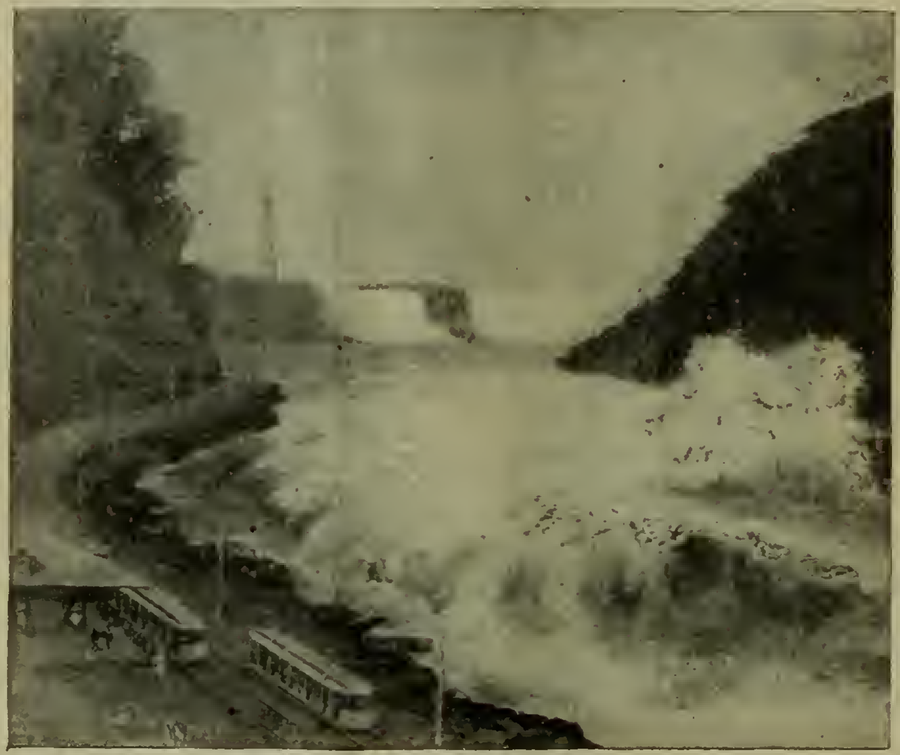
A great many valuable papers will be read by able men on subjects covering street railways, the applications of electricity in place of steam on many roads, the use of gas engines for power purposes, storage batteries for street railways, and interesting discussions on the subject of employees, transmission and use of multiphase current for railway purposes.

There is every evidence that the meeting will be well attended and every facility has been made use of for the purpose of rendering it an absolute success. An exposition of street railway supplies will be in order and a large building, capable of holding all that exhibitors will desire to show, has been secured. In fact, it has been recently completed for this particular purpose.

The American Street Railway Association held their first meeting at Young's Hotel, Boston, Dec. 12, 1882.

Walter A. Jones, Thomas Lowry, Henry M. Watson and J. E. Rugg. The first suggestion leading to its formation emanated from the lips of D. F. Longstreet.

A letter was prepared by the above gentlemen which went the rounds of all street railway companies in the United States and Canada, asking them to assist in organizing and supporting an association for "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."



Whirlpool Rapids, Showing Electric Railway.

The delegates met as per instructions and the first meeting was called to order by Hon. Moody Merrill. The constitution was framed and officers elected as follows:

H. H. Littell, President;
Wm. H. Hazzard, 1st Vice President;
Calvin A. Richards, 2nd Vice President;
George B. Kerper; 3rd Vice President;
Wm. J. Richardson, Sec'y and Treas.

Meetings have been held since the above-mentioned at various large cities in the following order:

2nd	meeting,	Chicago,	1882-3,	Pres.	H. H. Littell;
3rd	"	New York,	1883-4	"	Hazzard;
4th	"	St. Louis,	1884-5	"	Richards;
5th	"	Cincinnati,	1885-6	"	Walsh;
6th	"	Philadelphia,	1886-7	"	Ackley;
7th	"	Washington,	1887-8	"	C.B. Holmes;
8th	"	Minneapolis,	1888 9	"	Kerper;
9th	"	Buffalo,	1889-90	"	Lowry;
10th	"	Pittsburg,	1890-1	"	Watson;
11th	"	Cleveland,	1891-2	"	J.G. Holmes;
12th	"	Milwaukee,	1892-3	"	Longstreet;
13th	"	Atlanta,	1893-4	"	Payne;
14th	"	Montreal,	1894 5	"	Hurt;
15th	"	St. Louis,	1895-6	"	H. M. Littell;
16th	"	Niagara Falls,	1897	"	McCulloch.

Niagara Falls.

The presidents of the American Street Railway Associations are portrayed on our pages, including the present executive, Mr. McCulloch. Since the first organization the

W. H. Hazzard,
1883–1884.

H. H. Littell,
1882–1883,

Thomas Lowry.
1889–1890.
John G. Holmes.
1891–1892.
J. S. Walsh.
1885–1886.

T. W. Ackley.
1886–1887.

C. A. Richards.
1884–1885.

PORTRAITS OF PAST PRESIDENTS A. S. R. A.

T. C. Pennington, Sec'y 1896-7.

H. M. Watson.

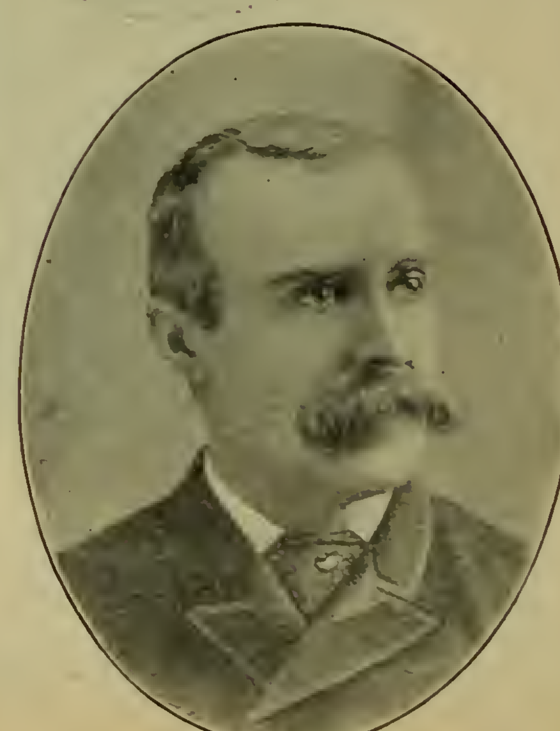
G. B. Kerper.

H. M. Littell.

Joel Hart.

H. C. Payne

C. B. Holmes.



R. E. Longstreet.

PAST PRESIDENTS,
A. S. R. A.

development of this association has been substantial and rapid. It carries upon its roll names illustrious in the history of practical street railroading—the names of men that have knitted together centre and suburb, town and village. It is due to their energy that the great systems of electric traction have found a place, both inside and outside the city walls ; it is entirely due to their efforts that the trolley has become an integral part of a great city's machinery and displaced the antiquated, creeping horse car.

We include matter obtained from a letter sent from the headquarters at Chicago regarding reduced rates of fare, hotel accommodations, etc., which will be found very valuable to those anticipating a trip to Niagara at this time.

Papers will be read on the following subjects :

Municipal Ownership of Street Railways.

Modern Electric Railways ; their Construction, Operation and Disadvantages.

Application of Electricity to Railroads now Operated by Steam Power.

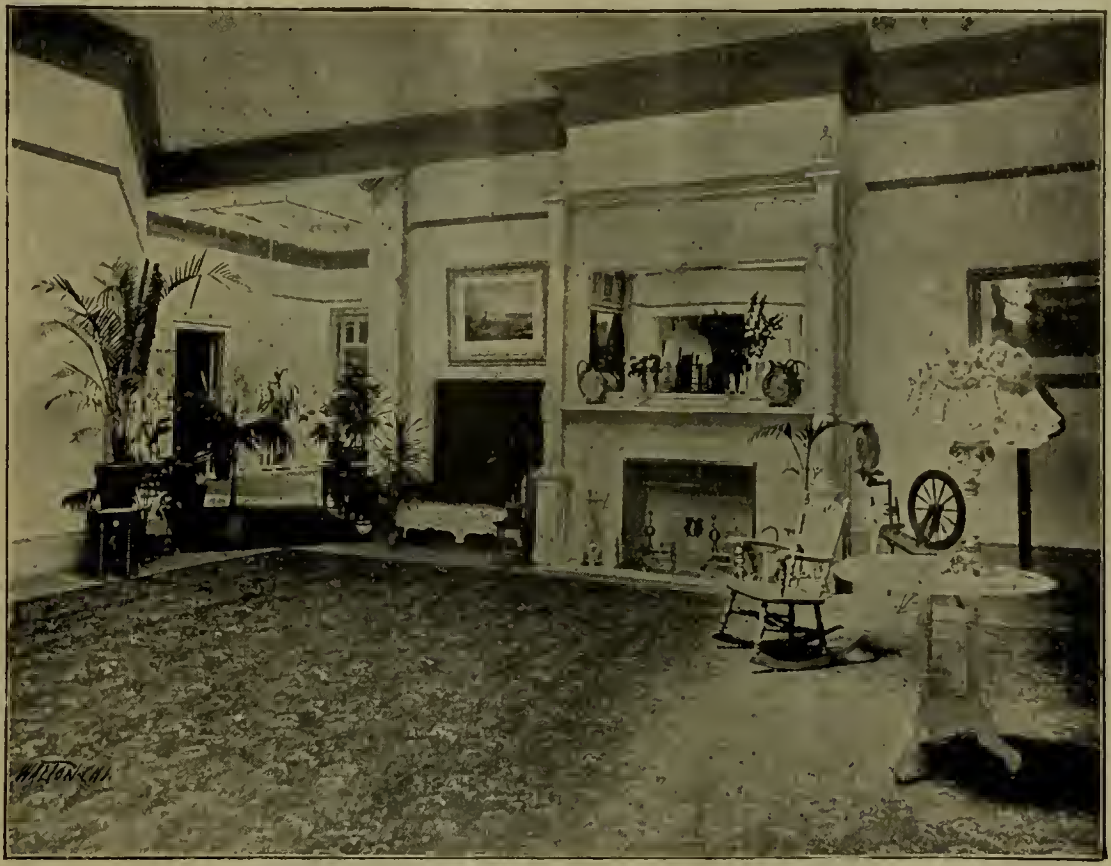
The Best Method of Settling Damage Cases, and the Prevention of Accidents by the Use of Fenders and Otherwise.

Producer Gas for Use in Street Railway Power Houses and Gas Engines.

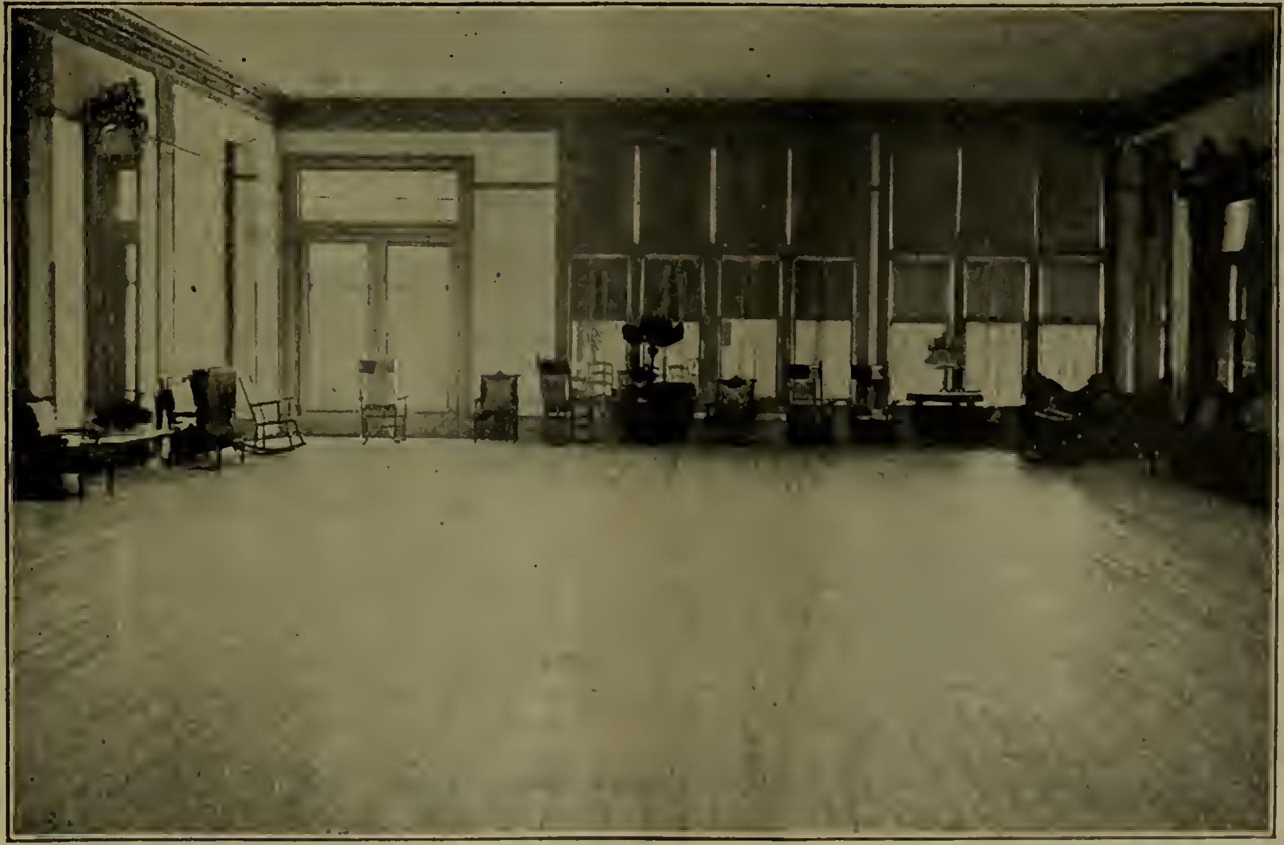
Storage Batteries for Street Railways.

Discipline of Employes.

Long Distance Transmission and the Use of Multiphase Current for Ordinary Street Railways.



Ladies Reception Room and Parlor at International Hotel.



Banquet and Music Room at International Hotel.

Exposition of Street Railway Supplies.

The A. S. R. A. will have a large exhibition of street railway supplies. A large building, 120 x 154 feet, is being erected for their use, with plenty of power, light and heat.

The meetings will be held on second floor of the building.

Reduced Rates of Fare.

The Traffic Associations have authorized the sale of tickets at reduced rates, namely, a fare and one-third for the round trip ; but at least one hundred tickets must be purchased and presented to clerk at Niagara Falls before concession will be granted.

N. B.—The rules governing reduced rates, strict conformity with which is required, are given as follows:

First. Each person must purchase (not more than three days prior to the date of meeting) a first-class ticket (either unlimited or limited) to Niagara Falls, for which he must pay the regular tariff fare, and upon request the ticket agent will issue a certificate of such purchase properly filled up and signed by the said ticket agent.

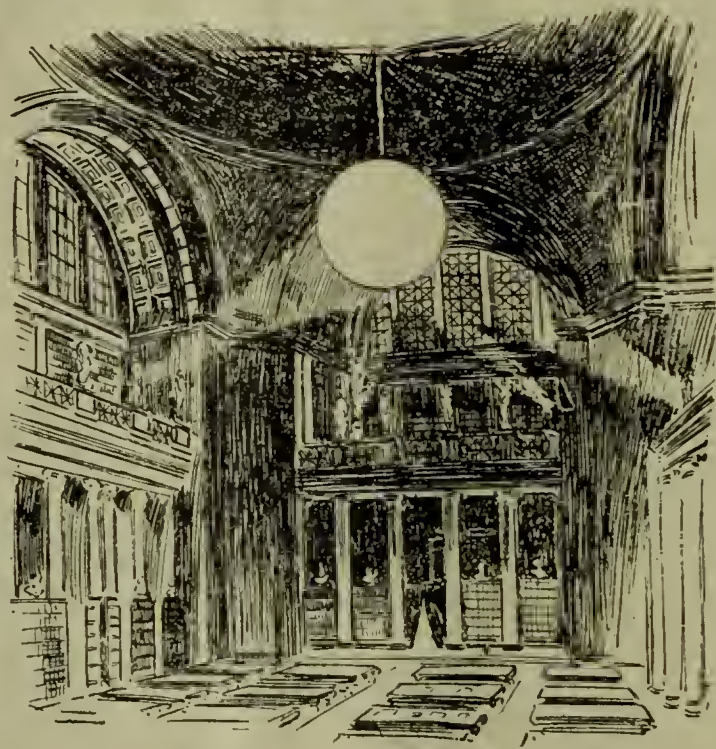
Second. Where the journey is made over more than one line, it may be necessary for the passenger to purchase separate local tickets and procure certificates thereof for each of the lines over which he travels in going to Niagara Falls, as some lines do not honor certificates of any other line. The passenger should ascertain from the ticket agent what portion (if not all) of his journey can be covered by the certificate procurable of him, and purchase his ticket and procure a certificate filled in accordingly. In case a ticket on the certificate plan cannot be procured at the starting-point, the person should purchase to the nearest point where such a ticket can be obtained, and there re-purchase through to Niagara Falls, requesting a certificate properly filled out by the agent at the point where the ticket is purchased.

Third. Tickets for the return journey will be sold by the ticket agent at Niagara Falls at one-third the highest limited fare to those only who hold certificates signed by ticket agent at point of purchase and countersigned by clerk of convention.

AN ARTIFICIAL MOON.

A scheme of illumination as beautiful as it is original is being put into operation in the new library of Columbia University. By a system of reflected lights a big, white moon whose luminous rays will light the whole interior, hangs suspended from the dark blue background of the dome.

Although electricity alone is used, and the most intense rays from arc lights are focussed through strong lenses on the great white sphere, the reflected radiance of the moon consists of rays so soft and diffused that it is refreshing to the sight. The students in consulting volumes in the library, while receiving the benefit of the light above them, will be in no wise inconvenienced by it.



Electric Moon in Columbia University Library.

The moon consists of a hollow sphere seven feet in diameter, constructed of wood and painted a dull white. It is suspended thirty feet from the dome by a wire cable and hangs just above the four great arches of the library, so that when the light is thrown on it the arches are in shadow.

On the second floor of the library, in the recess below every one of the four great windows, is stationed a row of bookshelves. In the corners of every row stands an unobtrusive box of finished oak about five feet high. There is no covering to these boxes, and in the depth of each burns a powerful arc light, whose rays are directed through a lens toward the wooden ball.

The strong electric lights, so painful to the sight, are entirely hidden. As I walked about the floor of the library yesterday and looked up, the eight boxes in their respective corners seemed portions of the woodwork. Even on the floor above, groping among the books on the shelves, the entire unsightly electrical mechanism was hidden from view.

Every one of the eight rays is about seventy-five feet long, and their combined radiance covers about three-fourths of the ball. The wooden sphere is intensely illuminated and diffuses a light which is similar to moonbeams.

[The idea was originated by Prof. Hallock, of the University, and not by the architect. J. B. Colt & Co., at 115–117 Nassau street, New York, supplied the lanterns and automatic self-focussing arc lamps used by the Columbia University.]

"It took a lot of study to evolve a system of illumination that would be in harmony with the handsome decorations of the library," said Mr. Baker.

"A great chandelier suspended from the dome would have been decidedly inappropriate. Had lights been stationed here and there over the arches they would have confused the eye. It was necessary to devise an illumination that would disclose the dome and lend a cheerful air to the library."

Mr. Baker expressed himself as delighted with the arti-

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CONTENTS.

THE ALLIANCE OF KINDRED INTERESTS.

It has become the most natural thing for the industrious of high or low degree to ally themselves together for purposes of protection, mutual instruction or from purely selfish motives. This co-ordination of interests can be viewed from either end of the opera-glass—from the labor union to the great scientific assemblage ; from the howling socialists to the gathering of selfish and grasping financiers. Whether for good or evil there is no tendency more characteristic of the century than this. It seems as though it were impossible for interests to become great unless they are co-ordinated, and from this system, as a rule, many benefits are derived by those thus gathered together. The street-railway representatives of the United States will meet at Niagara Falls for the purpose primarily of discussing certain interesting and instructive papers of a technical character and with the purpose of enjoying themselves just as clearly defined. This gathering of street-railway men is due to the efforts of certain pioneers whose intention to organize an association of mutual benefit has been annually demonstrated to be a complete success. The grandeur of the falls will appeal to the sentiment of those attending, but to others an allied feeling of admiration will arise when they stand before the great electric generators and contemplate the handiwork of their own fellow-beings.

It seems as though few places were better suited for the display of great human creations than the site of Niagara. Wonder and awe will be inspired by the controlled and silent force stealing away from Niagara's store-house, as well as by the cataract's own wild magnificence and tumultuous power. We can stand upon the brink of the great falls and see within its wildly dashing waters the essence of tremendous power; not the fabled spirit of Indian myth but a force, a power, a genius for untold good—a fund of energy which will turn mighty machines, night into day, and the labors of daily occupation into a mere recollection. There are few better places at which a convention could be held, that would teach so much in prose and poetry as Niagara; few that could illustrate better the play of mind upon matter, of intelligence upon an overwhelming force. Delegates should not forget that around this place hangs the breath of inspiration; for much of its electrical advancement may be traced to the persistent genius of Nicola Tesla. There are no polyphase electric roads today, but who knows what the future may bring forth when we view the remarkable developments which have already occurred at Niagara Falls in that direction.

At a dinner following the arrival of the carriages at Brighton, at a horseless cariage race, the mayor of that city remarked in the course of a lengthy speech:

"For sixteen long years the lovers of science have waited patiently. During all this long time, we have suffered with galling impatience that knowledge of the infinite superiority of machinery, which it always has had, and always will have, over all kinds of animal power, especially in the matter of traffic. Thank goodness, that day has come at last—a day of deliverance for our roads and highways from the reign of quadrupeds. We are today witnessing the dawn of great prosperity for all kinds of mechanical trades. We have been told this week by the highest authority that the safety bicycle trades have now reached to no less than £11,000,000 ($53,531,500) to £12,000,000 ($58,298,000) sales annually, while the capital of the companies is no less than £17,000,000 ($82,730,500). The orders and work for this great industry already received for next year are proving many times greater than ever before. Ten years ago we were considered foolish and too sanguine and these companies were criticised by the always-too-late kind of people—the wise after the event—but in spite of them, the British public have made millions and millions out of the bicycle company shares, and many a man finds himself in easy circumstances today with a little fortune which has arisen from these very critcised companies. But if that is so with the cycle—a comparative toy—what shall the motor become? How much employment will it give to even millions of engineers throughout the country? Nor will it take away, in my belief, anything from the ordinary road traffic. We have all heard of the great railway mania and excitement; as soon as the people got to understand what machinery meant, which, though it carries a whole nation by motors, has never interfered with animal-drawn cars in the least. Motor traffic, however, has a far greater range. Railways are limited to one road and to one distance from point to point. We, gentlemen, have railways everywhere, and for every kind of transport. We have proved today what can be done. We started this morning a litle before 11, and I am pleased to tell you that every one of the patent cars of the British Motor Syndicate arrived in Brighton quite safely, although many of the drivers had never driven on the road before. We have delivered British farmers' produce in London today for the first time by motor, and even with our 12 miles' limit we have shown it quite possible to leave London with market goods at five in the morning and arrive in Brighton at nine, return again to London by one o'clock, and once more return and make a second delivery here in the afternoon by five o'clock, returning to London again by nine o'clock in the evening—four journeys. The tremendous change which cycling has made in our habits was no more anticipated a few years ago than the immense changes now about to take place are anticipated. One thing is certain, they give those who are wise in time an opportunity to once more make such fortunes as our fathers made out of the introduction of machinery in superseding animal power."

ficial moon. He told me that the readers at the tables would be supplied with the ordinary shaded lights.

The idea of the artificial moon was put into practical operation a few days ago in the old library of the Columbia University, and proved itself a great success, although rays from only about three arc lights were thrown on the sphere.

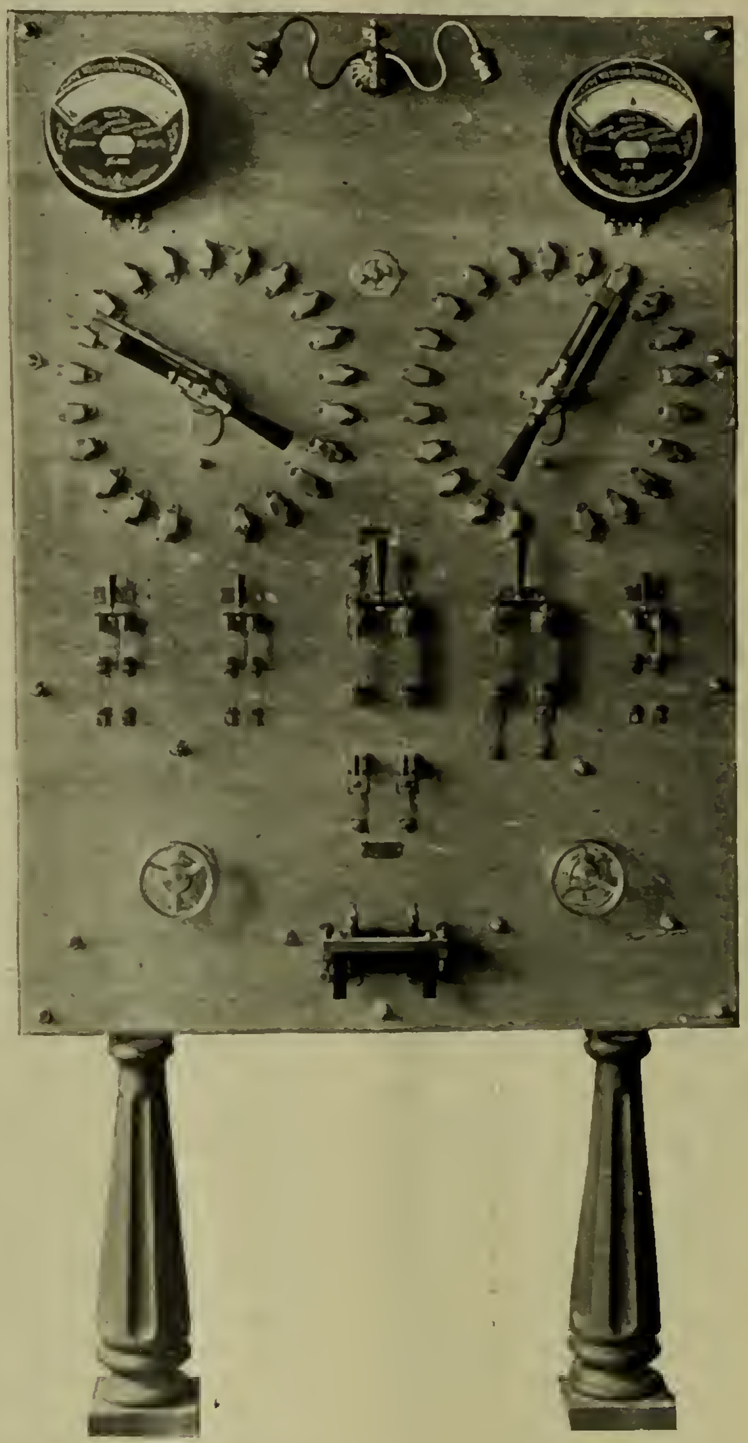
The experiment was made under the direction of William Hallock, professor of physics, and Charles McKim, the architect.

Although the idea of a globe suspended from the centre of the dome was embodied in the inception of the architect's plans, it was originally intended to construct a metal sphere to represent the globe, and surround it with a circle of incandescent lights.—*Ex. N. Y. Herald.*

of the lower end of board a storage battery underload switch. This beautifully finished switchboard is but one of the many engineering achievements of Mr. Wilson. The regulation of the discharge by the upper pair of switches provides a novel and interesting feature. The plant all but takes care of itself with so perfect a system of meters and switches.

This is the season of the year when ambitious young men are planning to use their leisure evenings for self culture. The advantages offered by the West Side Branch of the Young Men's Christian Association, 318 West 57th street, should have a strong attraction for all who wish opportunities for improvement.

The building was erected last year at a cost of over



Switchboard in Gov. Morton's Country Residence, Ellerslie Farm, Rhinecliff, N. Y.

A MODEL SWITCHBOARD.

Mr. James W. Wilson, of 779 Greenwich street, New York, electrical engineer and contractor, installed a model 400-light switchboard at Ellerslie Dairy, Rhinecliff, N.Y., situated on the estate of the Hon. Levi P. Morton. The switchboard proper is of pink Tennessee marble. On top of the board are mounted two Weston station meters. Immediately below may be seen two circular hand switches connected to storage batteries and regulating the discharge of same. The right hand switch below controls the five-hundred-volt dynamo. The switch in the centre is a double throw, connecting to lights in one way and to battery the other. On each side are seen the handles of governing rheostats and finally in the centre

$550,000. The equipment throughout is exceptionally fine. The gymnasium has a floor surface of 52 by 109 ft. with skylight overhead. There is an elevated running track, a swimming pool, bowling alleys and lockers with forced ventilation. The instruction in gymnastics given both afternoons and evenings in graded classes will begin the first of October.

On Monday evening, October 4th, the whole building was opened for inspection to the public and the opening exercises of the evening educational classes were held in the large auditorium. The subjects taught are especially intended to help young men to advancement in business; arithmetic, penmanship, bookkeeping, commercial law, stenography, typewriting, English grammar and composition, mechanical, architectural and industrial drawing, electrical engineering. Subjects for general culture are elocution, vocal music, orchestra music, first aid to the injured. On Tuesday and Friday nights lectures, concerts or social receptions will be given in the Auditorium or Parlors.

The fee for membership is only $5.00 per year with small additional charges for educational classes and gymnasium.

Full information concerning the work may be had of the secretary, Dr. D. E. Yarnell.

PAPER ON "TRACK BONDING—HOW CAN WE OBTAIN THE BEST RESULTS?

By H. C. Newton, Syracuse Rapid Transit Co., Syracuse, N. Y.

The true importance of rail bonding, that is, the really significant factor it becomes in determining the cost of operation of the road is but indirectly realized, I am inclined to think, by the large majority of railroad men. The dimming of the lights on the car on which he is travelling over his road in the evening is a source of regret to the street railroad manager always, for he realizes that there is something wrong; yet his conclusion generally is that there are some bonds loose somewhere, and his regret, when expressed, is most often for the decrease in the speed of his motors which accompanies the fall in voltage, not for the watts of electrical energy which are being consumed heating up bad track joints.

There is an old formula in elementary electricity which, if kept more constantly in mind by street railway economists, would explain some of the obvious faults in the ground return and the extravagant fuel records which have appeared in some first-class street railway power stations. This formula is that for the energy developed in an electrical circuit. It is expressed variously in terms of the current and voltage of the circuit as C. E., in terms of the resistance and voltage as E. R., or in terms of the resistance and current as C. 2 R. All or any one of these expressions may be used to advantage in calculating the magnitude of leaks, but they are all generally overlooked by the so-called practical man when reaching his conclusions.

An equipment consisting of a first-class 600-volt voltmeter and a 250-ampere ammeter with a motor car and an accurate knowledge of the voltage carried at the station, is all the apparatus and data necessary to determine the quantities involved and to obtain with fair approximation the loss which is going on in the circuit outside of the motors and the generators at the station.

The first factor in the determination, viz., the loss in the trolley line, is, to some extent, a known quantity. You have already, or can figure easily, the resistance of the trolley and the feed, and, by assuming a certain volume of current, the amount of energy lost, varying of course with the power consumed, is at once arrived at. The second factor must be obtained by the subtraction of the determined factor from the total loss. For this total loss your instruments come in play, and it is only by a series of readings on them with the car in motion on the road, and the determination thereby of the watts spent in running the motors, that a satisfactory result can be obtained. The difference between the voltage, as shown on the voltmeter, and the volts shown on the voltmeter at the station, multiplied by the current, gives us this result. The difference between this result and the loss obtained for the trolley and trolley feed lines by calculation should give us the loss in the track of the power employed for that individual car. The result is generally astonishing, especially if the traffic is heavy; and there are cities not a thousand miles from here where the sun of the horse car rail is not yet set, where reading will show fifty and sixty per cent. loss at certain times.

To obtain the best results a rail joint should have an equal or, better, a greater current-carrying capacity than the body of the rail itself. We have all heard this theory advanced before, but we are all bound to acknowledge that we have never seen it put in practice without it was on a new piece of electrically welded track, on which the joints had not had time to break. Yet every city has portions of track through which a congestion of traffic and a consequent piling up of cars is forcing such a volume of current as to lead to serious power losses therein. The engineer will possibly remember of specifying a four-ought copper bond at the time the last piece of nine-inch girder was laid in the congested district, and of congratulating himself on thus getting what he thought was a first-class job of bonding. And yet when he comes to consider that that rail has probably nine times the current-carrying capacity of the bond itself, and the bond is only riveted or upset in some way in the hole in the rail, and instead of having six times its cross section area in contact with the steel of the rail, it has possibly two, he will perceive that there is some reason to doubt whether he has such a first-class job after all.

(Concluded on page 244.)

PRINCIPLES OF STATIC ELECTRICITY.

LESSON LEAVES FOR THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

INTRODUCTION.

Static and Dynamic Electricity.—For purposes of convenience it has been best to classify electrical phenomena under two headings—

Static electricity,
Dynamic electricity.

When electricity is produced it may either be in a state of motion or rest. The friction of rubber upon flannel arouses in the rubber a stationary charge of electricity. It is not like the current from a battery, because it remains at the place where it was generated.

Frictional or static electricity, therefore, is electricity at rest, and the moving flow of electrical energy from a battery is dynamic electricity or electricity in motion. The peculiar difference existing between static and dynamic electricity may be always considered as due to the freedom of motion one possesses over the other. There is also another great difference, which is, that a static charge has mauy thousand times more pressure than a battery current, but the battery has in turn an enormously greater flow of current; it seems therefore that frictional electricity means a high potential charge and dynamic or current electricity a low potential flow. A great pressure and little current in one case and a large current and little pressure in the other case. When a pressure of millions of volts delivers upon discharge a powerful current, there is then the striking power of a static charge added to the heating and burning properties of a heavy current; in other words, all the effects of lightning may under these conditions be imitated; these being in fact the requirements of a dangerous flash resulting from surcharged clouds.

This brief explanation of the difference between static and dynamic electricity will suggest the special applications to which each may be put in practical life, and in addition serve as an introduction to a little of the history and earlier experiments of a few gifted observers.

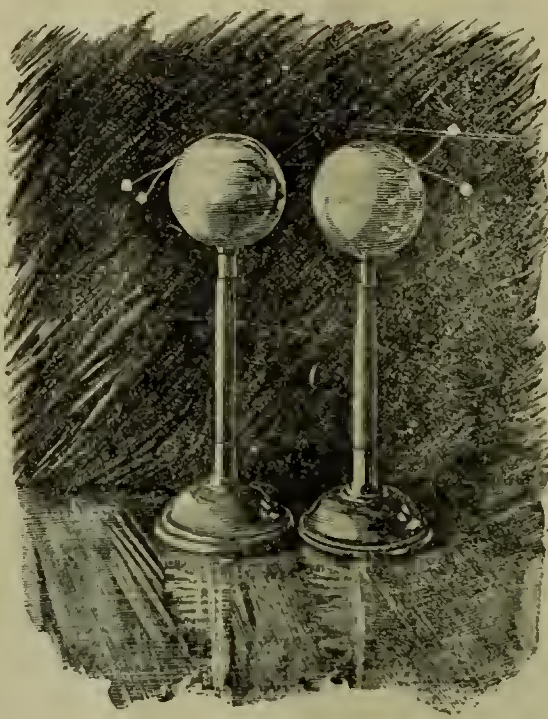
* * * * * * * *

Before the era of Christianity had dawned, and possibly even in the days of Joseph in Egypt, amber beads formed an article of barbaric ornamentation. Amongst the thousands that wore these polished tokens of prehistoric times one at least must have noticed the occasionally adhering particles of chaff and dust with sentiments of wonder. No records exist, however, to show an appreciation of the electrical properties of amber, but the Greeks spoke of it through one of their number, Thales, as a soul or spirit that manifested itself—amber being the tears of some sorrowing god; the attractive power it possessed, a sign of its immortality and awakened animation.

from a silk thread is used for detecting a charge. If a rubbed glass rod is brought near it, the pith-ball flies to it, remains an instant and then leaves. If the glass rod was sufficiently charged, the pith-ball, after touching, would show the strongest repulsion for the rod.

The reason is simple; the pith-ball upon touching the rod becomes charged; the charge on the pith-ball and rod are then alike; this causes the repulsion, illustrating the law that

Like charges repel each other.



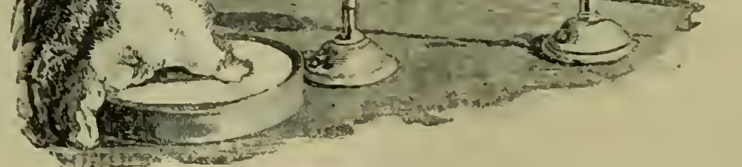
Static Induction.

A long stretch of time intervenes between Thales and Queen Elizabeth's reign in England. Dr. Gilbert, her court physician, unearthed the statement of Thales, regarding amber, and experimenting further discovered that glass, sealing-wax, sulphur, etc., would, when rubbed, also attract light substances to themselves like the amber.

Gilbert tried metals, but he did not know that the charge excited in them leaked away into his hand and body and prevented any attraction from being exhibited.

If a rod of sealing-wax is rubbed on flannel the pith-ball will behave in the same way towards it. Flying to it, resting and immediately leaving. The charge on the sealing-wax was communicated to the pith-ball as in the first case; both then repelled each other, and the pith-ball, being lightest, was thrown off.

If while the pith-ball is being repelled by the sealing-wax the glass rod is brought near, the pith-ball will be attracted to it. What the sealing-wax drives away the glass rod attracts.



The Conduction of a Charge.

The additional fact not comprehended by him was that there are two great classes of bodies, generally speaking, —one class, like sealing-wax and glass holding a charge; the other class, like the rods of metal he used, allowing it to pass away. In other words, bodies may be divided into the following:

Conductors,
Non-conductors.

Between the two may exist materials which do not allow electricity to pass very freely through them, yet are not insulators; they are called partial conductors—wet wood, earth or the human body being fair examples.

Positive and Negative Electricity.—A pith-ball supported

If the opposite is tried (while the pith-ball is being driven from the glass), it will be drawn towards the sealing-wax. The electricity on the glass and that on the wax act oppositely on the pith-ball. Their charges must be different; we call that on the glass positive, and that on the sealing-wax negative. The pith-ball, when full of positive from the glass, swings towards the negative on the wax; in other words,

Unlike charges attract each other.

QUESTIONS FOR REVIEW.

(1) What is the difference between static and dynamic electricity?

(2) Whose name was first mentioned in the history of electricity?
(3) What did Dr. Gilbert discover?
(4) How may bodies be classified electrically?
(5) What are the two general laws governing static phenomena?

THE NEOSTYLE.

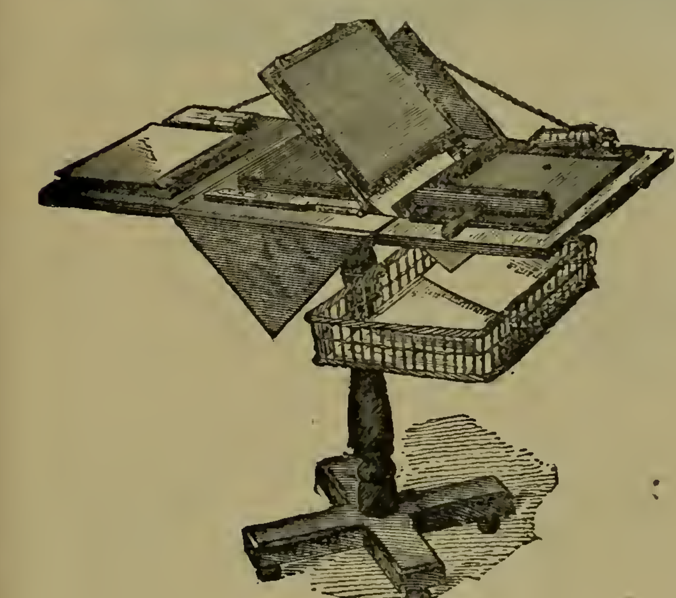
A satisfactory process or machine for duplicating a number of copies from one original writing, drawing, etc., has been a long-felt want. In almost every office the necessity arises for reproducing copies of either circular letters, notices, orders, etc., and to write a number of copies one at a time is a laborious, tedious operation, and a waste of time. Many attempts have been made to supply the demand for a machine capable of reproducing any number of copies, but the difficulties encountered to produce a machine adapted to all requirements have been hard to overcome. The old Hektograph worked well for a small number of copies and when the temperature was just right, but when the weather was too hot or too cold, or when a large number of copies were required, it was found inefficient.

We illustrate in this article a duplicating machine manufactured by the Neostyle Co. of 96 Church street, New York, which we unhesitatingly pronounce the solution of the problem. The Neostyle Duplicating Apparatus is extremely simple and easy to operate and the work it produces is simply perfect. It enables any boy to produce from one written or typewritten original 2,000 copies and the work is so perfect that it is difficult, if not impossible, to distinguish a copy produced by this process from an original.

Method of Operating Neostyle.


Universal Neostyle, Closed.


Automatic Neostyle.


Universal Neostyle, Open.

Neostyle Outfit.

The Neostyle Co. makes machines in various styles, all embodying the same principle but varying in speed and price.

An office having a large amount of this work to do would have use for an Automatic machine as illustrated in Figure 1. This machine throws off the copies automatically and practically works on the principle of a printing press. The original is either written with a pen or typewriter on a sheet of patented paper. All the operator has to do is to take the original writing, place it on the platen of the machine and operate the lever and feed in the copies. The machine automatically prints and discharges the printed copy, and the entire work of the machine is so completely automatic that a child who has never seen a machine can take off the copies, and with a little practice can get up to a speed of 2,000 per hour.

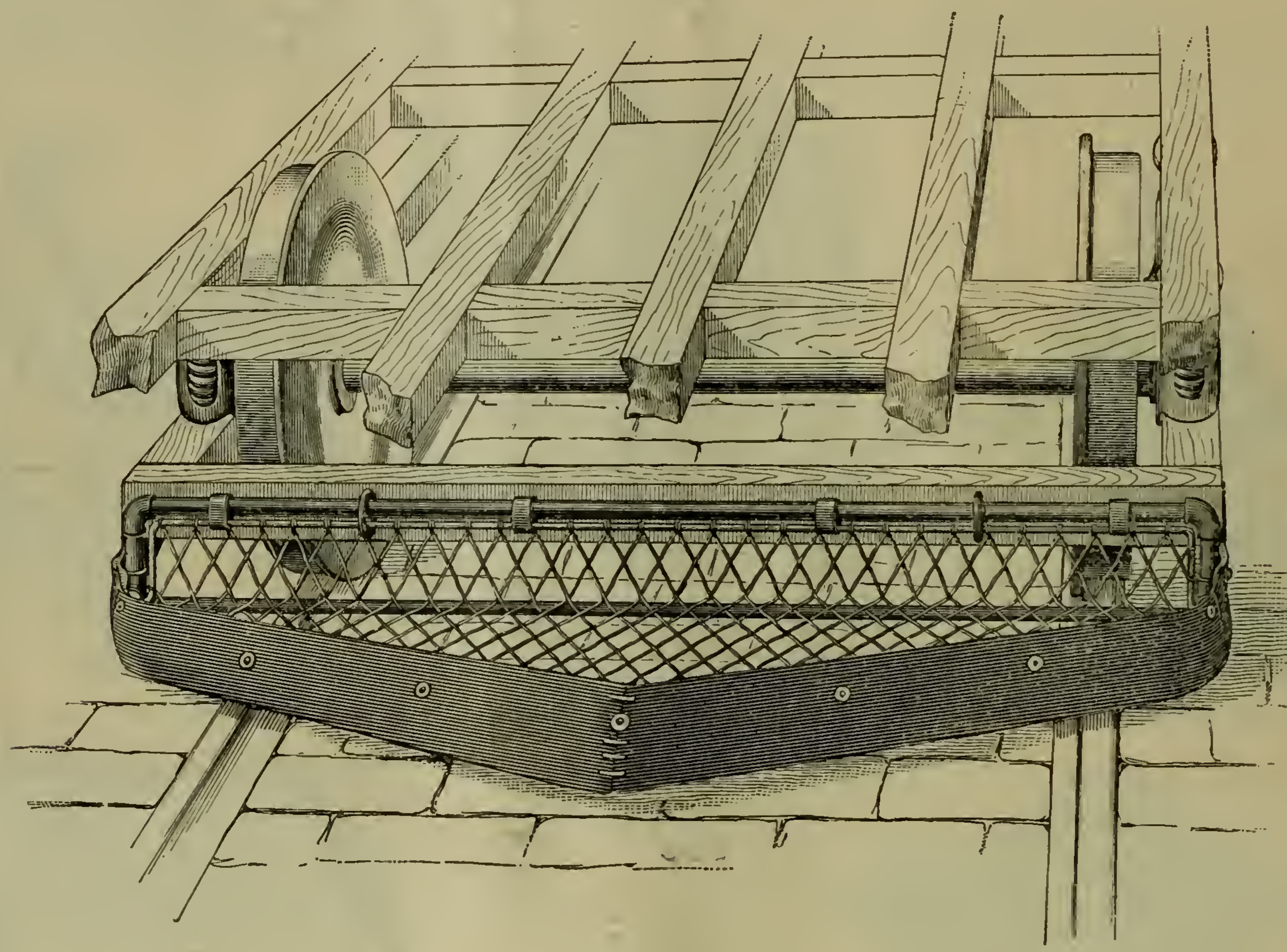
For those offices where there is not so much duplicating to do, the Neostyle Co. manufacture a machine which they call the Universal Neostyle, as shown in Figure 2. This operates on the same principle as the Automatic, except that the impression is produced by passing a roller over the stencil. The copy is discharged automatically into a basket or any convenient receptacle which can be placed under the machine. The speed on the Universal is not so great as on the Automatic, but the work produced is as good though it requires a little more care to operate it. The Universal is very convenient to use. The entire machine is supported on a pedestal which can be placed in a corner of an office taking up but about a square foot of space. It can be opened and operated in a few seconds and can be instantly closed if the operator is called away. It is certainly a most convenient machine, and from the fact that nearly 40,000 machines have been sold shows that it is appreciated by the public.

For those having only occasional use for a duplicating machine the Neostyle, put up in box form, as illustrated in Figure 3, will answer the purpose. This machine costs a little less than the Universal and answers the same purpose, excepting that when it is desired to use it, you have to open out the various parts and find a suitable place on which to operate it.

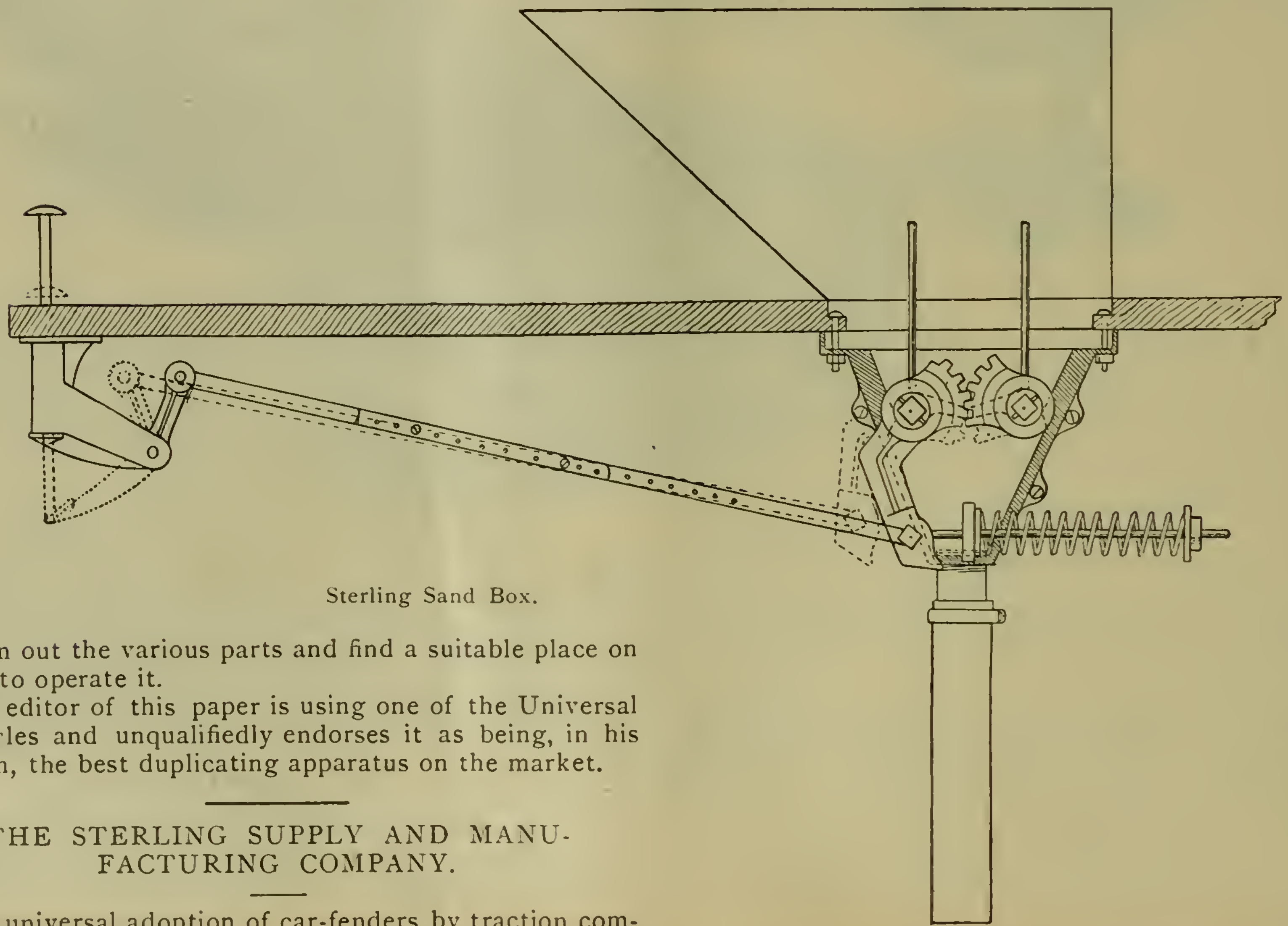
The editor of this paper is using one of the Universal Neostyles and unqualifiedly endorses it as being, in his opinion, the best duplicating apparatus on the market.

THE STERLING SUPPLY AND MANUFACTURING COMPANY.

The universal adoption of car-fenders by traction companies for the avoidance of accident has brought upon the market the Sterling street-car fender, manufactured by the Sterling Supply and Manufacturing Company, dealers in street railway supplies, 141–155 E. 25th St., N. Y. City. They occupy the third floor of the Lexington Avenue cable station. The Metropolitan Street Railway Company, Broadway and Third Avenue Cable roads of New York use the Sterling fender with the greatest satis-



Sterling Fender.



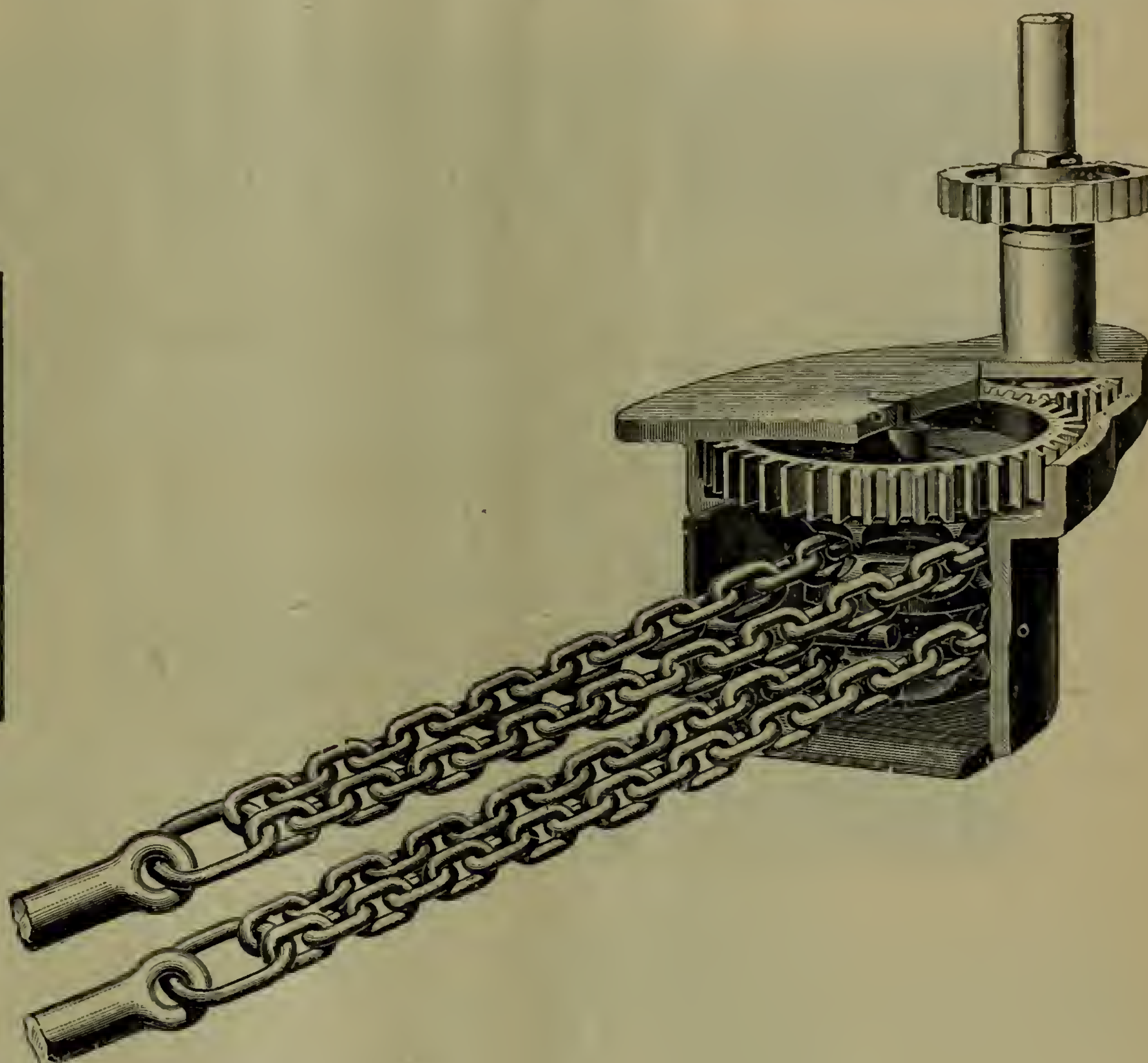
Sterling Sand Box.

faction. It is designed and constructed so as to be carried a short distance above the road bed. There is but little chance of obstacles passing under it and reaching the car wheels. There is no risk of having it smashed by other vehicles, as it is attached to the car truck beneath, away from injury. The risk to pedestrians hurrying across crowded thoroughfares is reduced to a minimum by the use of the Sterling fender. The illustration shows its principal features, method of application and appearance when in position.

and Manufacturing Company is the best on the market. It is rectangular in shape and notes the direction of its car, the number of fares and the sum total of fares. This register presents a fine appearance, never gets out of order and operates wherever installed to the credit of the manufacturers. More than twelve thousand Sterling Standard Registers are being used. Cars in New York city to the extent of twenty-five hundred make daily use of them. These registers are made single and double.

The manager of the company is J. H. Carson ; Perry

New Numeral Register.


Sterling Safety Brake.

The Sterling sand box seen in sketch is of a very practical construction. It is supplied with a circular valve and adjustable tube and a device for swinging the rubber tube clear of the wheel and track. Many sand boxes are built by other concerns which will not allow the sand to flow freely. In the Sterling sand box the sand is always loose and free to move. This appliance is simply and substantially built, all parts incurring strain being made of tough malleable iron. Sterling sand boxes are used by the Brooklyn City Railway Company of Brooklyn, N. Y., the Consolidated Traction Company, of New Jersey and the Metropolitan Traction Company of New York. The largest and best equipped roads in this country find the Sterling sand box an indispensable part of their cars' outfitting. They use it because it is simple, durable, easily handled and operates without hesitation.

The sterling safety brake for electric traction or cable systems is employed by all important street-railway companies. It has a double-chain connection and double-sprocket wheel (see sketch), thereby instantly affecting the brake-shoe. Its action is certain and rapid and its mechanism enables it to operate with tremendous power. The use of gearing between the brake post and large sprocket means a great mechanical gain to the motorman or gripman. A car can be instantly stopped and the muscular exertion of the operator, in bringing the car to rest, reduced very materially. Every part of this superior brake is thoroughly tested, making it when assembled strong and smooth in action.

The new numeral register built by the Sterling Supply

Tiffany, vice-president ; William Tiffany, secretary and treasurer. Representatives of the sales department are: Lewis E. Robert and F. A. Morrell. Mr. J. A. MacDonald represents the general steam and railway supply department.

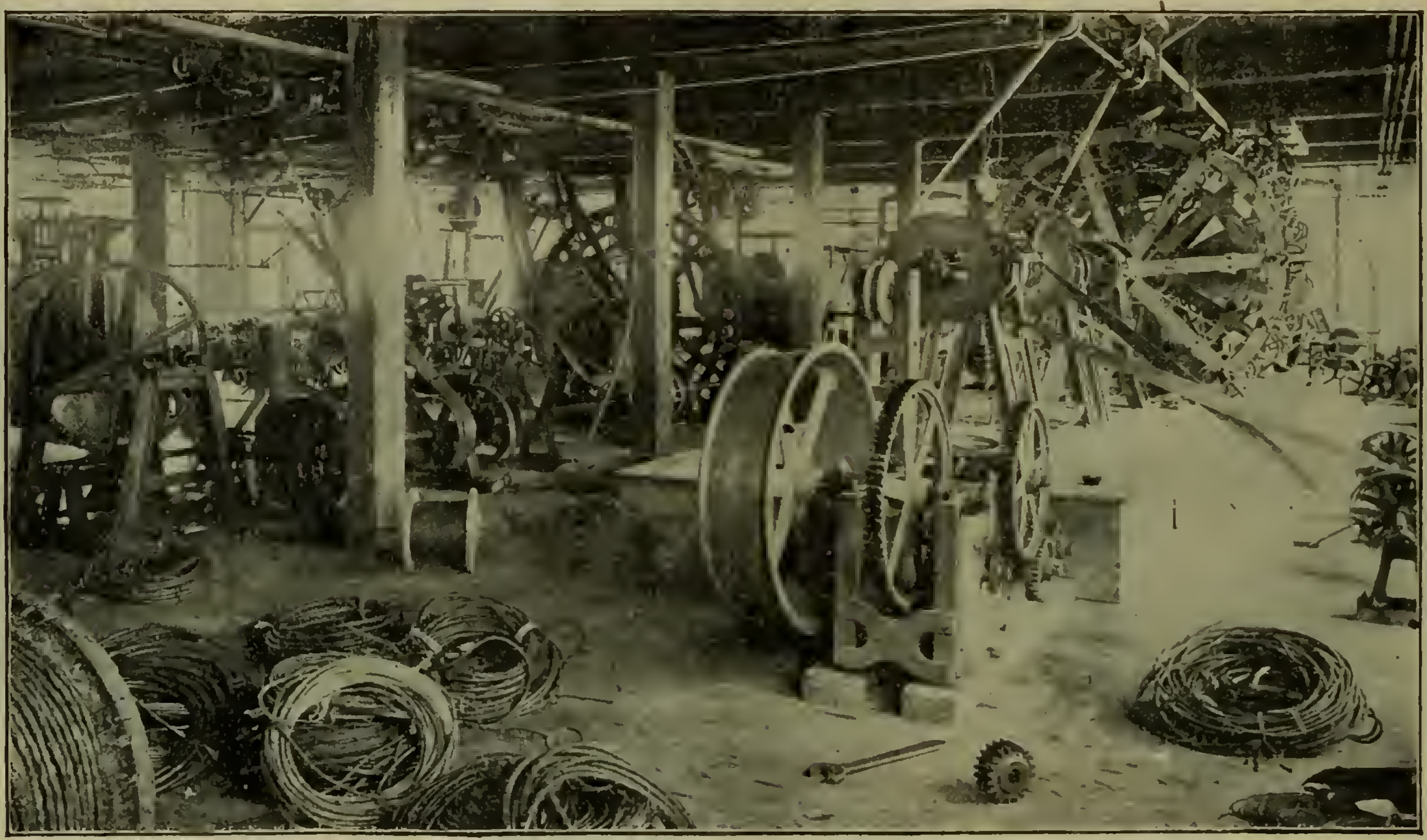
A FAMOUS WIRE MANUFACTURING CONCERN.

OKONITE

TRADE MARK.

THE Okonite Company, Limited, with offices in the Postal Telegraph Building, 253 Broadway, New York, represents one of the most prominent manufacturers of insulated wires and cables in the world. They control twenty-nine letters-patent in the United States, Canada, England and France, as well as other foreign countries. The trademarks for Okonite, Candee aerial wires, Manson and Okonite tape, commercial wire and Acme lead cables are owned by the Okonite Company, Ltd. Upon scientific tests the Okonite insulated conductors have shown results surpassing the expectations of interested purchasers.

The wires and cables are soaked for three days after manufacture in vats of water and then exposed to a double test—that of the reflecting galvanometer and from a two to thirty thousand-volt current. This test is unusually severe and will at once indicate the presence of an existing fault. The Okonite Company never allow any wire to leave the factory that has not undergone a rigid inspection. It is on account of this absolute reliability of their insulated wires that contractors use Okonite almost exclusively. Architects and builders recommend it on every possible occasion, regarding it as essential to the thorough equipment of office buildings, hotels, apartment houses and private residences.



A Corner of "Okonite" Factory.

The purposes to which this wire has been applied would cover a long list. Its successful use on special occasions and in open competition has brought it a diploma and a gold medal. For telegraph, telephone, electric light and railway systems, motor circuits, central stations, police and fire alarm telegraph, burglar, secret service and other systems it has won distinction and fame; and better than all, the confidence of the entire electrical profession. Its uses are so varied that a full list of them would resemble a national petition. In high class work it has no difficulty in showing its superior qualities. For military, naval and sea service it stands closely by its guarantee, though no usage is harder than that experienced by wires exposed to dampness, sea-air and possible corrosion. Mr. Willard L. Candee and H. Durant Cheever are managers of The Okonite Company; Mr. George T. Manson, general superintendent.

TRACK BONDING.—Concluded.

A water-works system which was so laid out that 10 per cent. of the power at the station was spent in overcoming friction in the mains, would not be regarded with much favor. On the same principle, a street railway system on which a similar percentage of the power is lost in the rail should hardly be considered as a perfect example of electric railroad practice. Yet I will venture the assertion that there are not more than a score of roads in the United States today that can prove a more satisfactory condition of affairs. The trolley feeder systems are carefully calculated, but the rail is bonded, how little or how well is immaterial, the ground will take care of what slops over.

With all due deference to the ideas of the track man, whose greatest glory is in a perfect roadbed, and to those of the electrical engineers whose hobby is a complete trolley feeder system with a theoretical loss of five per cent., I must yet insist on the importance of the rail return. Down in Syracuse we use the soldered bond with no track feeders on the permanent way. The bonding is of four per cent. capacity and double throughout. The congested district of the city, the common centre, is not (as it should be) bonded to equal the capacity of the rail section. Our financial backing has not been educated to that extent as yet and would regard such an outlay as extravagance. The whole track, however, is in such a condition, where the above-named boud has been used, that a low reading voltmeter has failed at any time to detect a difference of potential between water pipes and rail, and the Western Union Telegraph Company, with its keen nose for electrolytic action, has been unable to locate a drop between their lead covered return and the iron of the rail, the attempt being made with an instrument reading to 1-100th of a volt.

The importance of a true metallic return cannot be overestimated. Where the chance for corrosion between band and rail is allowed to remain the certainty of an interrupted contact one day is assured. The jar produced at the joint by the impact of the car-wheels results in vibration enough to loosen fish-plate bolts, and in the natural course of events must loosen rivets as well.

The rail should be one mass of continuous metal throughout to give permanency of electrical contact. It must therefore be homogeneous. To make it so some process of brazing or soldering must be adopted. The former process has been found impracticable except in cases where it is possible to take advantage of wilding currents, or return currents of immense volume. These can be obtained ordinarily only at the power station, or by a large expenditure for special wilding apparatus.

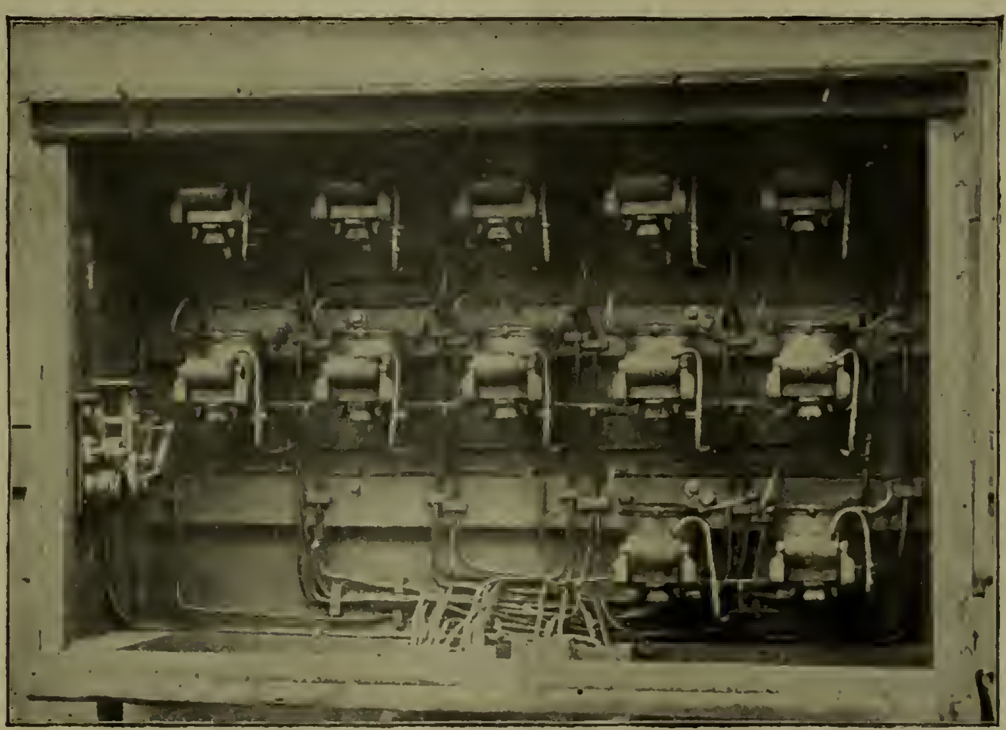
With these considerations in view the conclusion is forced upon us that the really practicable process is to solder the bond to the rail. Experience has proven it economical in first cost, and most desirable in the character of the results obtained.

The current carrying capacity or the number and section area of the bond conductors should depend upon the location of the track, many and large for the crowded districts and at the points where the great volume of return current flows before entering the return feeders to the power house, of smaller number and capacity in the outlying districts.

The Electrical Age.

VOL. XX—NO. 17 NEW YORK, OCTOBER 23, 1897 WHOLE NO. 545

G. E. Surface Contact System, Showing Stretch of Track in Yards of General Electric Company's Works at Schenectady, N. Y.



G. E. Surface Contact System, Showing Automatic Magnetic Switches in Temporary Manhole.

SURFACE CONTACT STREET RAILWAY SYSTEM.

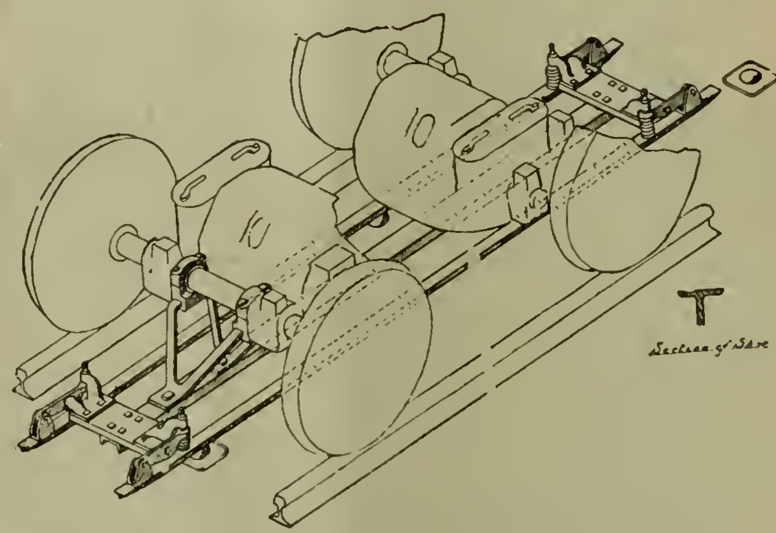
The introduction of a commercial electric traction system, involving the principle of surface contact, while eliminating the distinguishing features of the overhead and underground contact systems, is an event which street railway men have long been expecting and which is now an accomplished fact. Experiments stretching over many months have been carried on at Schenectady, N. Y., and the occasion of the visit of Lord Kelvin, was taken advantage of by the General Electric Company to make public their successful outcome.

The demand for a commercially practical system of surface contact electric traction has existed since electric traction was first introduced, but such a system had to come to its appointed place after the overhead and underground contact systems. Various schemes have been evolved in the past which have either been discarded as impracticable or have appeared before the demand for them has become acute enough to encourage their development. Today the demand for a surface contact system exists, and, peculiarly enough, this demand comes from Europe. In an European city the first practical surface contact electrical railway is already far advanced towards completion.

The experiments at Schenectady have been carried out upon a stretch of the track which forms part of the extensive factory tramway system of the General Electric Company's works. As the illustration shows, the addition to the roadbed between the rails of the track consists simply in two parallel rows of iron disks, convexed to a height of about one inch above the level of the rail. The car shown in the illustration is a simple factory tramway to which the controller, motor and storage battery equipment have been fitted. It may be said here that the General Electric Company is now engaged in changing over to the surface contact system the entire trolley tramway system in its yards.

The main requirements in a surface contact system are four: low cost of installation and maintenance; absolute absence of current from all disks not covered by the car; freedom from leakage of current, and reliability under all possible conditions of weather, service and location. It is the attempt to meet simultaneously all these requirements that has rendered the problem one of considerable difficulty, demanding long study and costly experiment to overcome.

In the G. E. surface contact system it is claimed that the requirements are adequately complied with, and from the description which follows this will probably be admitted.

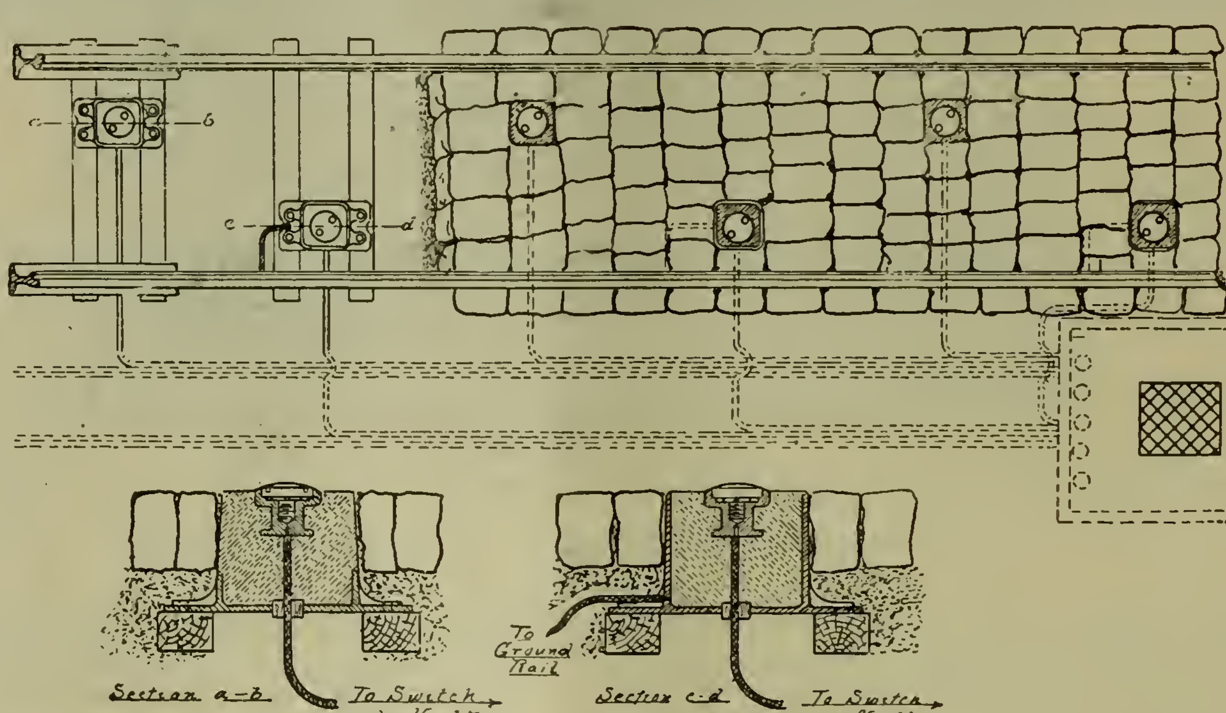


G. E. Surface Contact, Showing Shoes on Car Track.

The only live portions of the G. E. surface contact system on the street surface are the contact plates immediately beneath the car. This is true whatever the position of the car and whatever the speed—each plate in turn communicating current to the motors and becoming inert as the contact shoe on the car leaves its surface. These contact plates are placed in parallel rows between the two rails of the track and are set alternately. In the illustration the positive or communicating disks are on the right, the negative or discharging disks are on the left, one of each between two of the others. Each positive contact plate is made alive by the operation of an automatic magnetic switch which, instead of being placed in immediate juxtaposition with its plate or opposite it, outside the track, is placed in a manhole with a large number of others, each connected to its own respective plate. Through each negative plate is performed the double duty of closing the contact in the switch which "cuts in" the positive plate and of receiving the return current from the motors. Fig. 2 shows the arrangement of the plates on the street surface.

The operation of this system will be understood from the diagram, Fig. 3, A' A", and the negative plates B, B', and E', the positive contact plates, placed equal distances apart, a little less than one-half the over-all length of the shoe.

C, C', C" represent the automatic magnetic switches, and D, D' and D" their armature or contact makers. F is the positive or collecting shoe, E the negative or return shoe, and C the track return. H and K are switches which form part of the controller, the latter connecting in or cutting out the cells of a small storage battery, which is used only to energize the coil of the first switch, through the plate over which the car passes in starting. After the armature of the first switch has been raised into contact and the line current has completed its circuit, the battery is cut out by the forward movement of the controller handle. In the diagram the car is to move to the right and all the magnetic switches are open. The handle of the controller is turned to the first notch and switches H and K are closed. Current from the battery flows through a small portion of the motor resistance to the shoe, thence to contact plate A, and the coil C' completing the circuit to the ground. The coil C' thus energized raises the armature D', closes the circuit through the automatic switch, and the line circuit completes its path through the motors and through the greater part of the motor-starting resistances, shown by the arrows, through the positive plate B and shoe F. Part of the return circuit goes to the storage cells, which are kept constantly charged, and part through shoe E, negative contact plate A' and coil C' to ground, keeping the latter energized and the automatic switch closed so long as the shoe remains on contact plate A'. Moving the controller handle forward from the first notch to the second notch opens the switch K, cuts out the battery and sends a[illegible] the return current through the coil C'.



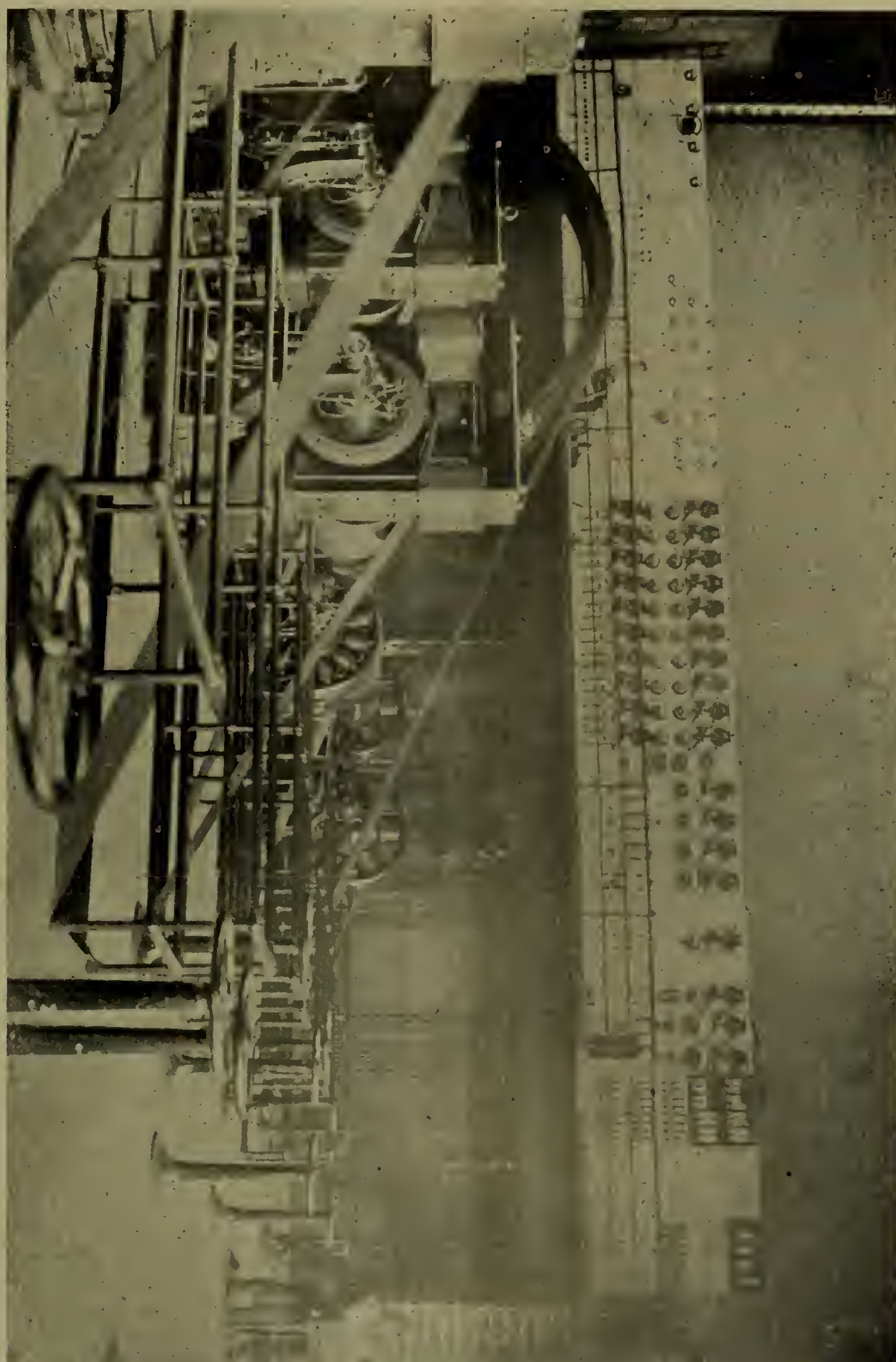
G. E. Surface Contact System, Showing Surface of Street and Sections Through Positive and Negative Plates.

The shoes E and F in the diagram are a little longer than the distance between contact plates. Thus when the car moves forward slightly the shoe will be in contact with the two contact plates A and A', and the return circuit will divide, half going through coil C and half through coil C', energizing both, and closing the armatures in the switches D and D'. The car moves forward and the shoe passes beyond the contact plate A'. The circuit in the coil C' is broken, the armature D' drops, cutting out entirely positive plate B', leaving it dead but allowing B' still to receive current through the closed switch at D. Shoe F, moving forward, then makes contact with plate B, before it leaves plate B' and the current is uninterrupted in its flow.

The automatic magnetic switch is the heart of this system. It has been designed to endure under the severest strains, and to act with such uninterrupted precision that the working of the system may not be impaired. The development of this automatic magnetic switch marks a decided step forward. Mechanically the switch is simple, strong and durable, with all chances of derangement reduced to a minimum. In the course of the experiments this switch has been subjected to the roughest possible usage and has withstood it unharmed.

If the leakage is great an arc is likely to form when the armature of the switch drops, and so long as this is held the contact plate in the street would remain alive, while the arc would burn the switch. It is not practicable to allow the armature to drop far enough to break the arc, and, to extinguish it, the magnetic blow-out principle is brought into play. By the use of this, retention of this arc is impossible ; but there is also the possibility of another arc forming in case of accidental ground on one of the leads to the positive contact plate, or if the forward switch fails to close when the handle of the controller is on the first notch, giving a path to ground through the battery. This is also taken care of by the magnetic blowout. All surface contact systems have similar conditions to meet, but none have incorporated the magnetic blowout principle.

The form of the contact plates is shown in Figure 2. They are first set in iron boxes and then surrounded by



Power House of the Toledo Traction Company.

insulation. The contact plates consist of two parts, a wearing piece screwed into a support and held by a spring washer. This wearing piece can be removed readily without disturbing the support. The standard shoe is thirteen feet long. Its shape and suspension is shown in the sketch, Fig. 5, the ends being curved upward slightly to prevent catching. The shoes are supported from the axles and have a slight upward and downward movement to allow for any irregularities in the height of the contact plates. The amount of drop in the shoe is regulated by a set screw.

The automatic magnetic switches are grouped in manholes, where inspection can readily be effected. Fig. 4 shows a group of these temporarily arranged for exhibition. Each manhole will contain about twenty switches, and the wires from the contact plates to them will be protected in similar manner to underground wires for any other purpose.

The battery on a car consists of ten cells with normal capacity of fifty ampere hours at five amperes. It is equal to all emergencies, being called into requisition only momentarily, while being charged; the remainder of the time the controller handle is on the first notch.

A close examination of the design and operation of this system will show that it possesses many striking advantages. The operation of the automatic switches is perfect under all conditions, as the full line voltage can be secured to close them and they open by gravity. There is no possible chance of the contact remaining electrified after the car has passed, as by the use of the blow-out on the switch and the switch itself, which opens as soon as the current is shut off, all danger and trouble due to live contacts is eliminated.

Grouping the switches in manholes renders the working part of the system easily accessible for inspection.

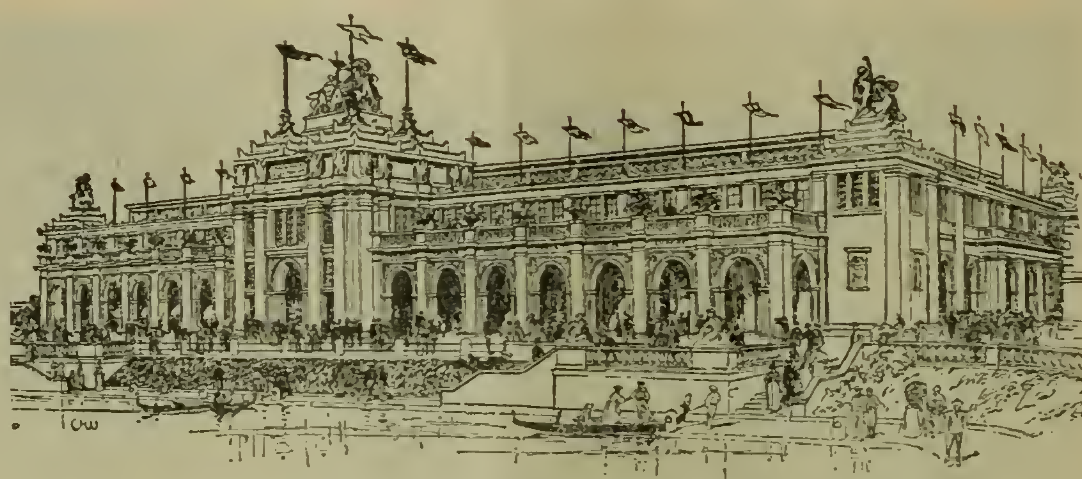
In the city of Monte Carlo, in the principality of Monaco, this system is being laid down by the Cie Francaise Thomson-Houston over a distance of about three miles. It is expected that this will be in operation very shortly.

A MODERN TRACTION CO.

The Toledo Traction Co., representing a combination of six street railways, have equipped a station with every modern appliance required for power and light. In the illustration the interior of the plant may be seen. Four 1000 K-W. generators for 3-wire system; seven Fort Wayne 150-light arc dynamos; four 500 K.-W. General Electric direct-connected generators, and engines ample in power and of first-class construction, complete the machinery comprising this entire plant. It is highly desirable to have mechanism that is neither faulty nor experimental in character form the elements of a good equipment. The first expense is necessarily high, but it is low compared with the ultimate cost if this fact is not appreciated. At present the features of electric light and power plants are of a most substantial character; being no longer doubtful of the issue, business men regulate disbursements as recommended by experienced electrical engineers. The conditions for earning high dividends are good from the start and as a consequence the plant becomes a paying investment to its organizers.

The Toledo Traction Company represents $2,000,000 in preferred and $4,000,000 in common stock, in addition to $5,000,000 in bonds.

Mr. N. B. Ream, of Chicago, is president. The road operates over 120 miles of track with 119 closed and 100 open cars. With the present management the people receive every satisfaction that a well conducted and enterprising traction company can give.



Trans-Mississippi and International Exposition Building.

TRANS-MISSISSIPPI AND INTERNATIONAL EXPOSITION.

The above-named exposition will be held in Omaha and cover a period extending from June to November, 1898.

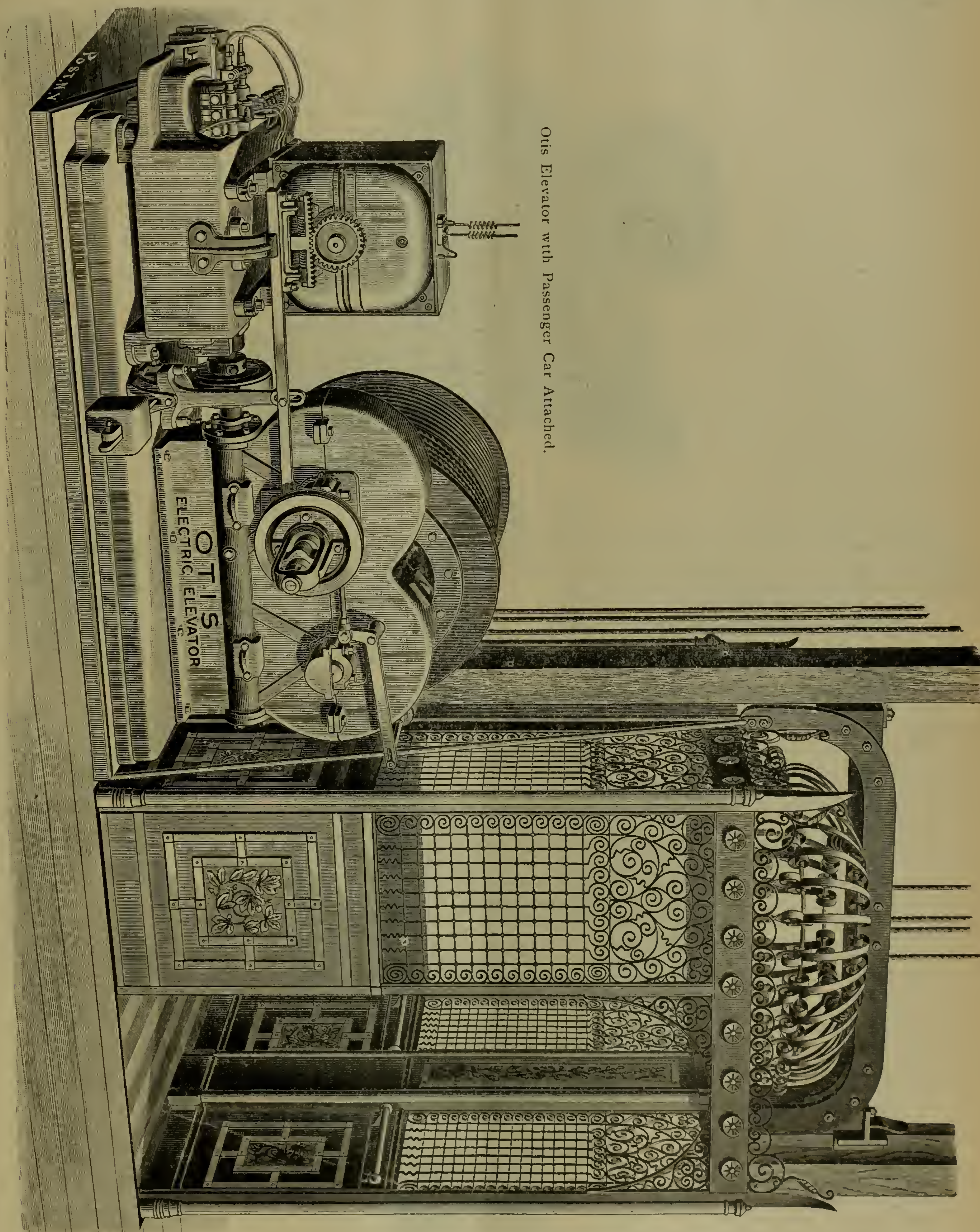
The building is 304 feet front by 144 feet in depth. There are triple entrances on the main floor level in the centre of the main front, and similar groups in the centres of the east and west fronts, with four emergency exits in the north wall. In front of the building, flanking both sides of the main entrance, is an open portico sixteen feet wide, running the entire front of the building. The centre entrance feature projects beyond the portico, thus forming the grand entrance vestibule. The main floor covers the entire area of the building. Above is a gallery thirty-two feet in width, extending around the four outer walls. The gallery is reached by spacious staircases located in the front corners of the building. In the rear corners are commodious toilet rooms. This leaves a high central court 248 feet long by 80 feet wide, lighted from the sky-lights and clere-story windows above the roof.

The entire building will be a series of yellow and ivory tones, growing more intense as they reach the top, culminating in the dull golden statuary, full of primitive vigor, which surmounts the building and symbolizes its use. The building was designed by Dwight H. Perkins, architect, Chicago.

OTIS ELECTRIC ELEVATORS.

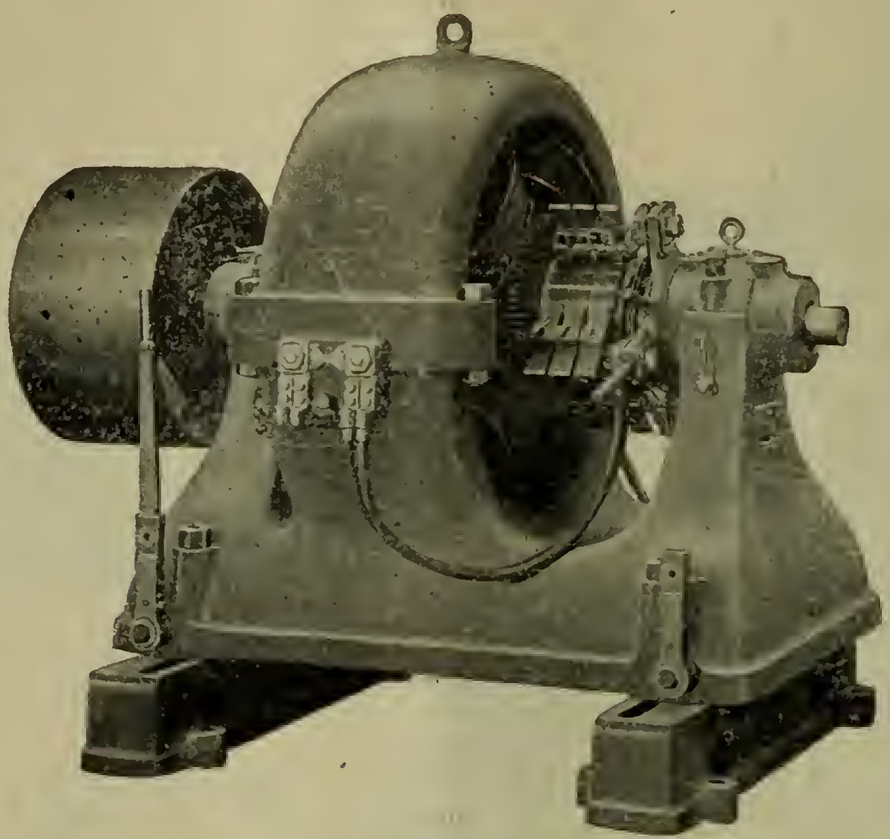
The Otis electric elevators for freight and passenger service may be regarded at present as indispensable adjuncts to the thorough equipment of a factory, business house or home. The illustration shows the general appearance of car and lifting device as designed by Otis Brothers & Co., 38 Park Row, N. Y. The freight and passenger car outfits differ from each other merely in car construction; the driving mechanism being exactly similar in either case.

The engine is of the drum gear type, with worm and screw driving mechanism. The worm wheel is made of phosphor bronze, and the screw of solid steel forging. For heavy duty and high car speed double worm and screws are used to minimize the friction. The machine is provided with both mechanical and electrical brakes.



Otis Elevator wtth Passenger Car Attached.

The automatic electric brake operates so as to stop the car gradually and easily, in case the current should from any cause be cut off or interrupted. There is also attached to the elevator engine a limit switch, which absolutely fixes and determines the amount of current which can flow into the motor. A safety device is placed in the supply line to the machine to guard against the burning out of the motor, by reason of any sudden increase in the quantity of current flowing through the lines. An automatic safety stop motion of mechanical operation is attached to the drum shaft of the elevator engine; so arranged as to stop the car at the upper or lower landing, independent of the operating device. A slack cable safety device is attached to the engine to prevent the cables from unwinding should the car meet with an obstruction in its descent. The operation of this device automatically and gradually brings the car to a stop in case the lifting cables shall from any cause whatsoever become slackened.



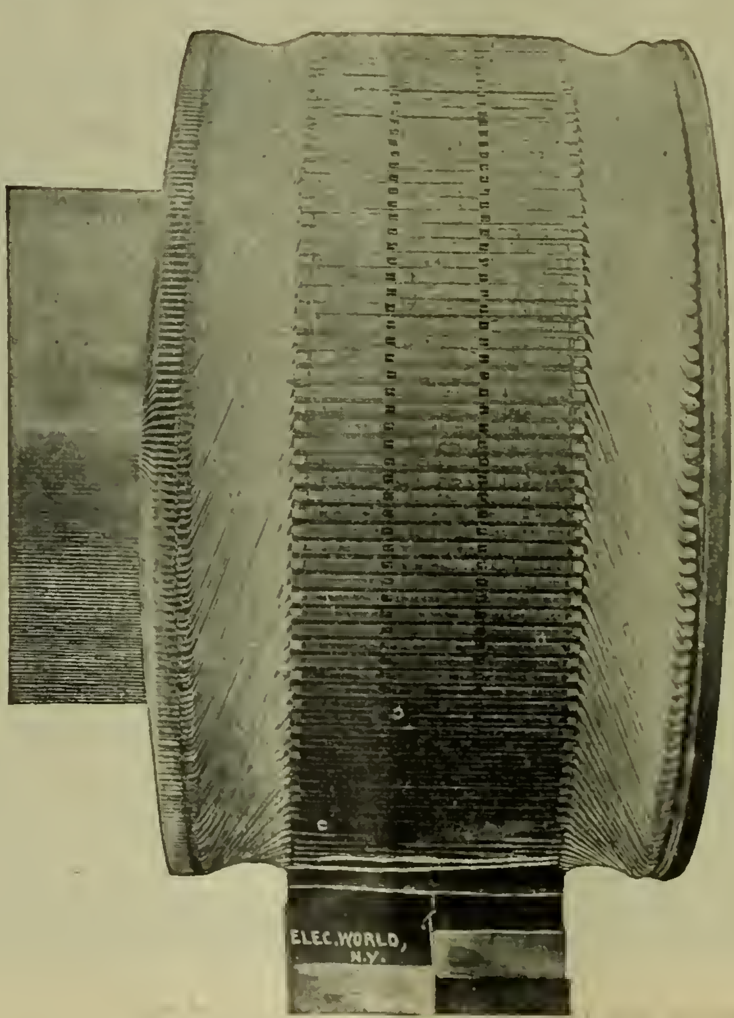
The Walker Generator.

Circulars supplied upon application, and references from the proprietors of the largest buildings, apartment houses, etc., in New York and other large cities.

WALKER RAILWAY GENERATOR.

The Walker Mfg. Co. have long since realized the value of a reliable, efficient and well constructed railway generator to traction companies. The departure they have made from conventional methods and the perfect system of assembling they have adopted place their apparatus far above the general run of mediocre machinery. Slowness of speed, perfect radiation and well-wearing brushes and commutators have secured for the generators a reputation from practical engineers that is exceedingly valuable.

Electrical engineers know of the Walker machines through their fineness of regulation and popularity among station men. The general public hear of them when a new building is to be equipped with the latest and best machinery; the Walker lighting plants being on a par with the best the market affords. Communications sent to the Walker Mfg. Co., of Cleveland, Ohio, will be promptly answered.



Walker Armature Complete.

Winfield, Iowa.—Telephones and electric lights will probably be established here.

The Electrical Age.

Established 1883.

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NEW YORK, OCTOBER 23, 1897.

CONTENTS.

THE FUTURE OF THE OVERHEAD SYSTEM OF ELECTRIC TRACTION.

It seems to be a generally accepted belief that electric traction has come to stay, and that the present overhead system will continue to be used unless a radical departure takes place. This departure may be either in the form of an underground open conduit system, third rail system or automatic block system. The vast progress made in electric railway work is such that we need feel no fear or doubt regarding its ultimate adoption to the exclusion of steam, cable or compressed air. But in spite of this sense of surety there is at present a feeling of concern among traction companies because they know that a change is bound to occur from the present overhead system to one which meets the exigencies of street traffic with all the efficiency of the overhead system but having no pole, no wire, or other unsightly appendages. The past agitation which existed in a great many of our large cities has died away to such an extent that traction companies need not anticipate any further disturbances due to a highly developed public sense of æstheticism. The question at present is one which proceeds from themselves, has been considered and will be solved in the near future by those connected with street railway enterprises. There are three systems in vogue at present, two of them operating to the entire satisfaction of the public and, in a financial sense, the proprietors also; the third, however, the automatic block system referred to above, has not been adopted or given a real practical opportunity to exhibit its strong points or deficiencies.

It would have been a good idea for one of the members of the American Street Railway Association attending the convention at Niagara Falls to have read a paper treating of the future of electric traction in the light of the overhead, open conduit, third rail or automatic block systems. A very large, well known and wealthy corporation has been conducting some very important experiments with an automatic block system of electric traction. The erection of a road of the open conduit type, stretching from one end of New York City to the other, indicates the practical success and absolute confidence capitalists have in what was once deemed an unreliable and difficult system to erect. The New Haven & Hartford R. R., in their experiments with a third rail system of electric traction, have shown that they regard this as the most positive of the lot and possibly the most practical. Is it strange, therefore, that the future history of electric traction is still an undiscovered country when so many possible systems may be employed and are being advocated by the representatives of wealth, enterprise and progress? The present overhead system has practically reached its limit. From the chaos that once presented itself a healthy outcome has resulted; the details of trolley and track construction are carried out with every attention; the motor, car and feeder systems have now reached a high point of perfection. There is but little left in that field of work to improve, and, from all the possible systems which have been experimented with or installed, a conclusion may be reached as follows: long distance suburban roads are best equipped with an overhead system; city roads running through crowded streets will necessitate the employment of either an open conduit or an automatic block system; for long stretches of road reaching to points hundreds of miles away either the overhead or the third rail are undoubtedly the best. These final conclusions may at least show the trend of modern opinion. They may illustrate the peculiar fitness of a certain method of traction to circumstances and surroundings which will guide an investor to that system worthy of adoption and development.

THE ELECTRIC TORPEDO BOAT.

The American, French, English and Spanish navies have been experimenting for some time with torpedo boats. A great many curious types have been built in consequence. The Americans with their highly developed sense of the mechanic arts have approached closer to the solution of this interesting problem than the rest. Two important torpedo boats have been produced—one by Nordenfeldt, the other by Holland. No torpedo boat of a purely electrical character is at present being tested or seriously considered. A hybrid type, one in which both steam and electricity are employed, has met with some consideration. In this case, while the vessel is above water, the steam-engine operates and drives the dynamo and charges storage batteries. When the boat is about to descend, the man-hole is closed, the engine shut down and the accumulators send their energy into the dynamo, operating it as a motor, and thus propelling the boat. It would seem as though a well-made vessel with large enough accumulators would be perfectly capable of executing all the manœuvres required without recourse to steam-power. This question seems to be one of ampere hours entirely, and it would surely seem as though the weight of a boiler, engine, storage batteries and motor would be greater than that of a set of accumulators and motor alone. The convenience and compactness of an electric equipment are certainly the factors required in any case touching upon torpedo boat outfitting.

One of the dangers arising from the use of the horseless carriages is the employment of petroleum as a motive power. Attention has been called to the inflammable nature of the vapor given off by some of the more volatile forms of petroleum and has called for special care handling and storing them. The danger is small in electrical carriages, and in both forms it will undoubtedly be greatly reduced in course of time.

PAPER ON "LOW JOINTS—HOW TO PREVENT THEM."

By C. Loomis Allen, Syracuse Rapid Transit Co., Syracuse, N. Y.

Nearly every street railway company has a stretch of poor track, which for good reasons it is trying to use for a term of years or until such a time as it is possible to rebuild with what is now called "permanent construction," and the greatest of the trackman's troubles in keeping this track in a condition for the operation of cars is the joint. In the majority of cases if the joints that were placed on the rail at the time of the construction of this track remain in use the bolts will become loosened and at a great many joints shear off. The supporting ties may be tamped solid, yet the joint will hold its proper place for only a short time.

In Syracuse, last fall, during our reconstruction, we had a street 4500 ft. long, in which were double tracks. The structure was a 47 lb. stringer rail upon 5 in. x 7 in. pine stringers, the ties supporting the stringers every 5 ft. It was our aim to save as much of this structure as possible and yet have a track structure in the street which would survive a period of five years' traffic. At the end of that time it is hoped that all the sewers, water, gas and conduits will be in the street, so that permanent construction can be built without being ruined during the process of construction of these underground structures.

The paving was removed and the stringer rails consigned to the scrap heap, the stringers and ties lowered 2½ ins. below the original grade. Ties were introduced between those under the stringers so that the spacing under the stringers was 2½ ft. between centres. To the stringers were spiked the Johnson Company's 66½ lb. girder rail which had been removed from track by reason of failure at joint. This rail had been laid on chairs and had become so worn at the joints that it was doubtful whether it could be used; but, aside from the deflected ends the rail was in good condition and not worn out. The ends of a great many of these rails were tested for deflection previous to laying and in many cases $\frac{3}{16}$ in. deflection was found. What effect traffic would have upon the ends of the rail after placing upon them the Weber joint was a result that was awaited with much interest. This joint was purchased with the idea of benefiting the rails, bringing them up to grade and in proper line. The rails were laid with broken joints with rail ends butted tight. No trouble was encountered in placing the joint, and the track structure was completed and paved in. It was our intention at the time of construction to operate on the track a day or two previous to replacing the pavement, and then to tighten the bolts once more firmly. The conditions of traffic would not allow this and the structure was paved in without this second tightening.

At first the cars which were operated upon this track pounded considerably at every joint. As the construction of this track was completed just before the final freeze-up last fall the pounding was made more prominent by reason of the frost holding the track structure firmly.

In the spring, after the frost had left the ground, the rails were examined and although no metal was restored to the head of the rail the ends of the rail had been brought up to grade and line. The bolts of some of these joints had become loosened, so the paving blocks were removed at the joint and the bolts thoroughly tightened. This track is not as good a track as our standard 9-in. construction, but we have saved from the scrap heap rails that, without the use of these joints, could not have been used as relaying rails. This construction, we believe, will do the work we expected of it, i. e., the carrying of traffic for a period of five years.

During the past four years girder rails 9 ins. in height, with brace plates and with joint plates of varying dimensions as to thickness and length, have been considered standard material for permanent construction, but the joint is still the weakest portion of the track structure.

Three things that are important in the solution of the joint question are as follows:

1st. Materials used in track construction.

2d. Manner of supporting the rails.

3d. The location of the joints in relation to each other.

In the purchase of track material for 9-in. construction, if the rails are all that are considered and the selection of a suitable joint for the rail is passed upon lightly, one would naturally buy that which would give to him track material at the lowest cost per foot of single track, i. e., the joint would be the cheapest joint purchasable. The other appurtenances aside from the rail would receive like treatment. But if, on the other hand, a good track structure throughout is desired with a minimum cost of maintenance after the track coustruction has been turned over for operation, due consideration will be given to all track appurtenances before final decision is made to purchase cheap material. Good material throughout is necessary to good construction and without it permanent construction cannot be had. The best material purchasable today will be poor enough after ten years of operation under electric traction.

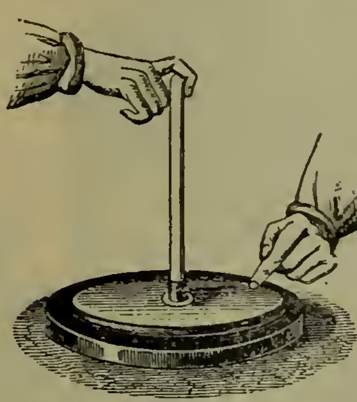
Considering that good materials are economical, we will now turn our attention to the support of the rails. The support of the rails along the entire length is just as important as for the rail to be well supported at the joints. The greater the number of lineal inches of tie-bearing supporting the rails when the ties are well ballasted and tamped, the longer the life of the track structure. To give good support to the rails, ties should be placed as close together as it is possible to do so and yet give room to properly tamp with the tamping bars the ballast supporting the ties.

The manner of fastening the rails to the ties should be carefully considered. Spikes that will give good holding power and not split or cut the ties so as to injure them should be selected. The joints in the rails upon either side of the track should not be opposite each other.

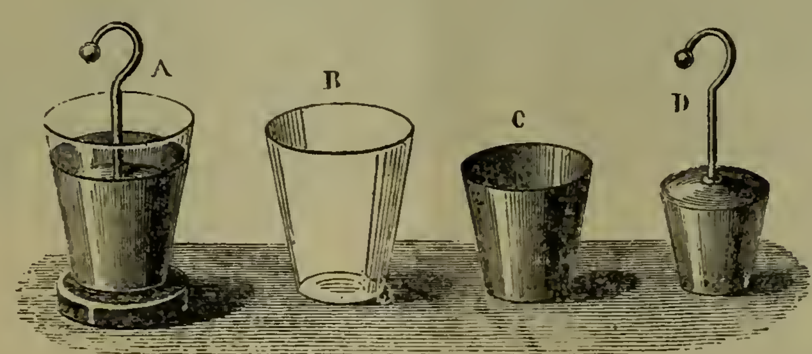
Rail ends of the same section very frequently show, upon being calipered, that there is a difference in their height, and when two ends like this are united bv the joint a pound or blow will result at this joint, causing a weakness upon that rail of the track. If another joint is laid immediately opposite upon the same ties supporting the poor joint, no matter with what care or in what condition the joint when laid may be, this pound or blow will have its effects upon the good joint, and it will not be long before two weak spots will appear in the track where, if the joints had not been laid opposite each other, there would have been but one; on the other hand, if the joints be laid broken the pounding is transferred by the axle of the car, not to the weakest spot on the opposite rail, i. e., the joint, but to the solid portion of the rail. The cost of maintaining to proper grade and line track laid with broken joints is not so great as track having joints laid opposite, as when once repairs are needed the latter will require attention a greater number of times. In the construction of permanent track today street railroads have the joint question to face only half as many times as they did three years ago. Sixty foot rails have cut the joint question in two.

We are laying in Syracuse the following construction at the joint, and from it have had no trouble: the joints are laid broken with rails butted tight. Corrugated joint plates, $\frac{9}{16}$ in. thick and 36 ins. in length, are bolted tight by means of twelve 1 in. bolts, the nuts of which are held in place by the Young gravity nut lock. The ties at the joint are laid to form what is known as the three tie joint; the centre tie supports the rail ends equally, and the other ties are laid so that the ends of the joint plates are supported upon the centre of the ties, thus giving three ties supporting the rail underneath the joint plate. The spacing under the rails, aside from the joint, is $\frac{23}{100}$ ft. between centres of ties, giving thirty-two ties to every 60 ft. of track. The ties used are Southern yellow pine, 6 ins. x 8 ins. x 8 ft., and they are supported by 8 ins. of broken stone ballast.

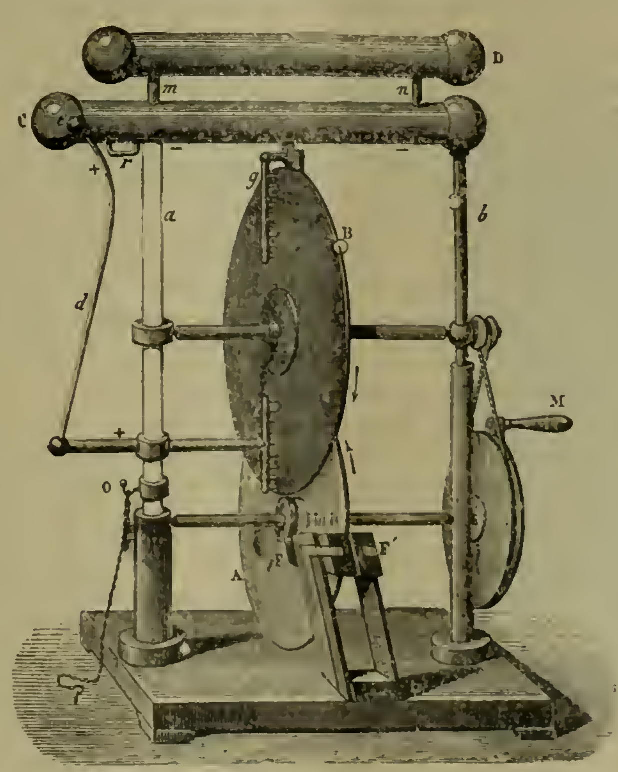
The question of low joints cannot be solved by simply considering the joint alone, nor by considering everything else and omitting the joint. The whole track structure must be considered. The subgrade upon which the ballast is placed must be made perfectly firm. The ballast must be of good thickness to give proper subdrainage and thoroughly rolled to give firm support. The ties should be the best obtainable, and as stated before, the closer spaced the better the track structure. The steel rails and their appurtenances used should be of the best material that money can buy, and when this track material is properly assembled the question of low joints should not arise for some time.



Removing the Free Electricity. Removing the Charge Previously Bound.



Leyden Jars with Movable Coatings.



Carre Frictional Induction Machine.

FRICTIONAL AND INDUCTION MACHINES.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

When a pith-ball is brought near a charged body, such as a rubbed glass rod or sealing-wax, etc., the attraction which occurs must be due to some change going on within the pith-ball; otherwise it would not move.

Before the glass rod or sealing-wax is rubbed it has no attraction for the pith-ball whatever, but after friction has been applied and a charge excited it seems that the presence of that charge stimulates the pith-ball to move.

There is no magnetic attraction existing between the two, and no unknown influence other than that spoken of which is affecting the pith-ball, that is, the presence of a static charge. In the last lesson, the final conclusion reached was that only unlike charges attract each other. Yet the pith-ball has not touched or been in communication with an opposite charge There must be one present or the glass rod would not affect it. A pith-ball would not move towards a positive or negative charge unless it possessed a negative or positive charge; and, as we have seen, since no communication has occurred between the pith-ball and any other body, something extraordinary must have occurred by which the pith-ball without contact becomes electrified. A new principle is therefore evident, which is, that a charged body across empty space will excite an opposite charge in an unelectrified or neutral body. The name given to this remarkable effect is induction. Not only will a neutral body have an opposite charge excited in it, but also on that part of the body furthest away from the original charge develop a like charge. For instance, a glass rod held near a pith-ball attracts it. The side of the ball nearest to the rod is negative; the side furthest away, positive. The pith-ball, therefore, possesses at the same time opposite charges. Whenever a charged body is brought near an object two kinds of electricity are developed in it, and the two kinds are equal in quantity. Heavy objects that are suspended will not demonstrate the influence of induction, but a light pith-ball responds immediately. The law that opposite charges attract each other, causes the negative charge in the pith-ball to move to the side of the ball nearest to the glass rod, and the law that like charges repel each other keeps the positive charge away from the glass rod.

The Electrophorus. This principle of induction is illustrated in the electrophorus. A rubber plate is excited with cat's fur and develops a negative charge. A brass plate, with an insulating handle, is placed upon it. The finger is rested on the brass plate for an instant, then removed. If the plate is now raised by the handle and the knuckle brought near, a bright spark will be seen. The process may now be repeated without touching the rubber plate—the brass plate put down again, touched, lifted again and discharged. The supply of electricity seems endless, yet the limit is reached when the rubber plate has lost its charge.

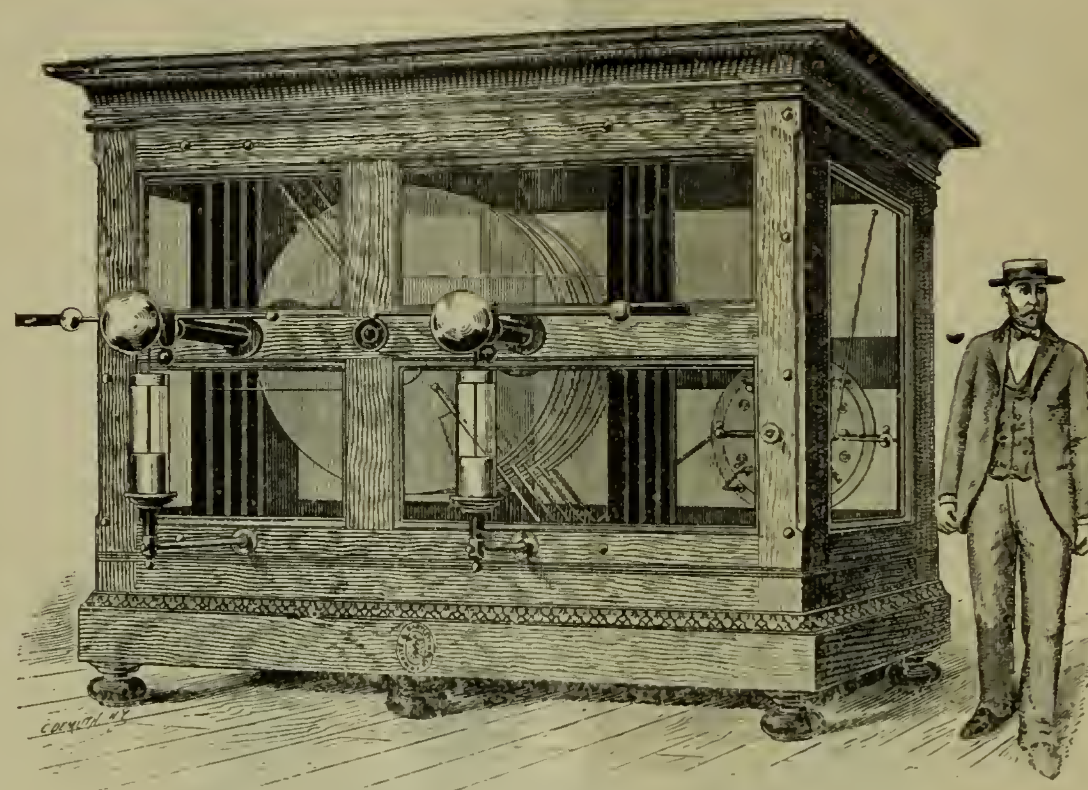
The explanation is this: The rubber plate has a negative charge; the brass plate resting upon it touches it only at a few points, the inequalities of the surfaces separating them by a film of air. Induction occurs and positive electricity is attracted to the lower surface of the brass plate; negative repelled to the upper. By touching the plate the negative is removed, but the positive still held. When the plate is lifted the positive, no longer bound by the negative of the rubber, is free to leave. The brass plate develops two kinds of electricity, positive below and negative above; this negative being repelled will leave at once if possible; it is called free electricity. the positive is held, and is called while in bondage bound electricity; it afterwards becomes free when the plate is lifted away. The action of like and unlike charges, of induction and of free and bound charges is illustrated in the electrophorus.

The Leyden Jar, or condenser, merely represents an electrical tank into which electricity is poured until it is full and then discharged. The parts are shown in B, C and D; a glass jar, an inside and an outside metal coating.

Action. The inside coating is supplied with positive electricity; the outside coating is affected by induction. The inner surface of the outside coating becomes negative; the outer surface, positive. This positive is free and may be taken away by touch; it is being repelled by the positive charge of the inside coating. The negative of the outer coating remains bound, until we connect it with the inner coating; the jar is then discharged.

Frictional Machines usually consist of a cylinder, or plate of sulphur, glass, or hard rubber. A cushion presses upon it and a row of metallic points, nearly touching, supplies the charge as required. The modern form of static machines is based upon the work of Holtz and Toepler; the machine best suited to illustrate the past principles of static electricity is shown in the sketch as constructed by Carré. It combines the frictional with the induction machine.

The Carré Frictional-Induction Machine consists of two plates turning in opposite directions and nearly touching. The lower plate produces a positive charge, because it moves past cushions. The lower comb of the upper plate is made of metal, and is affected by induction. Negative electricity appears at the comb, and positive at the brass knob. The comb, being made of sharp points, blows all its negative electricity upon the plate. When the upper plate turns, this negative passes under the upper comb. The comb is affected by induction and develops positive; the knob connecting to it becoming negative. The upper comb blows positive on the plate and neutralizes the film of negative electricity spread upon it by the lower comb. The lower knob is always positive; the upper, always negative. This type of machine, therefore, combines the purely frictional with the inductive.

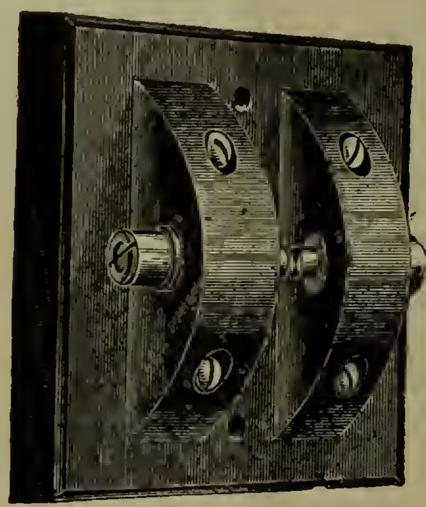


The Greatest Tœpler-Holtz Machine in the World

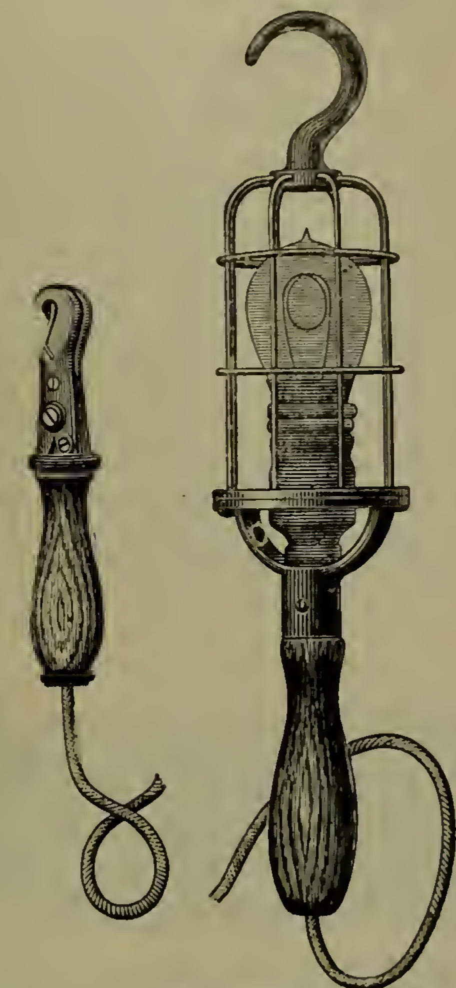
The lower plate continuously supplying a positive static charge, the lower comb, by induction, blowing negative; the upper comb, positive, thus leaving both above and below on each knob respectively, negative and positive electricity. The upper comb, in addition, serves to clean the plate of any charge that may remain.

of a charge has for its neighbor may account for this phenomenon. In certain cases a dynamic current will act similarly, but under such circumstances its nature has been greatly changed and the speed with which it moves back and forth in the circuit approximates 20,000 a second.

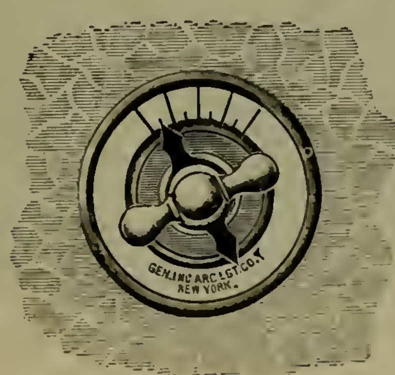
Hook in Position.



Receptacle.



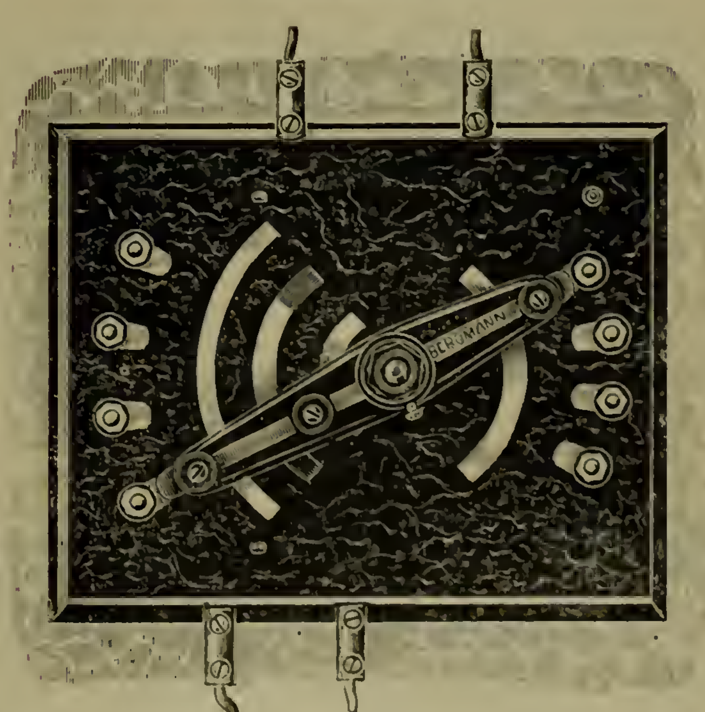
Attaching Hook.



GENERAL INCANDESCENT ARC LICHT COMPANY SPECIALTIES.

Bergmann Radial Voltmeter and Ground Detector.

Front and Back.



Bergmann Radial Differential Voltmeter Switch.

An electro-static charge remains on the outer surface of bodies. The Faraday cylinder is an example of this, and the charge always found on the outer surface of a hollow metal sphere. The repulsion that each increment

QUESTIONS FOR REVIEW.

(1) What is induction?

(2) What is meant by free and bound electricity?

(3) How does the electrophorus operate?
(4) Outline the operations of a frictional machine?
(5) Why is no friction necessary in a Holtz machine?
(6) How does a Holtz machine operate?

THE GENERAL INCANDESCENT ARC LIGHT COMPANY.

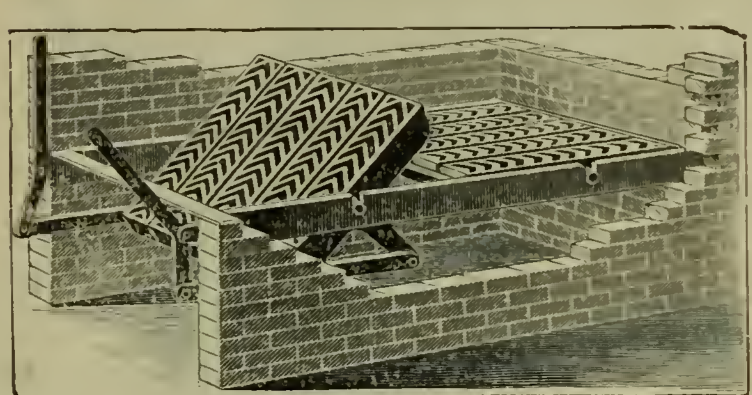
Among the many useful specialties manufactured by the General Incandescent Arc Light Company may be mentioned their Fire and Water-proof Attaching Hook and Receptacle, of which they are sole licensees and manufacturers under the right of the Molendo patent. It is used for connecting portable electric lights to stationary circuits, being very useful in breweries, distilleries, dye houses, mines, tunnels, etc. The handle, with flexible cord attached, is hooked into the receptacle shown with and without hook inserted. Secure contacts result, short circuits are impossible, and even in the dark the device is safe and reliable. A current of fifteen amperes may be carried without heating the contacts.

THE TUPPER SECTIONAL GRATE AND GRATE BARS.

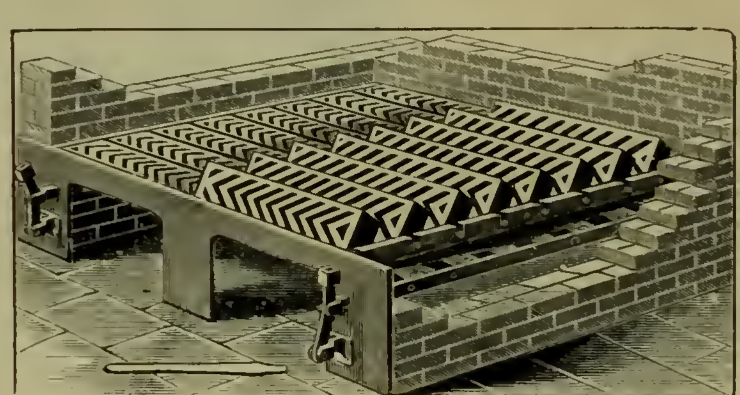
The Tupper grates and grate bars are manufactured by W. W. Tupper & Co., 39–41 Cortlandt street, N. Y. They are specially adapted to burn tan, sawdust, coal dust, pea coal, as well as large coal. The sectional grate averages sixty pounds per square foot, including bearers, all complete, and saves twenty-seven per cent. of the grate surface. The grates manufactured under the Tupper patents have met with great success for over a period of eleven years. They are used by more than eight thousand steamers, factories, etc., and have given satisfaction in every respect—being economical to use, simple to handle and convenient to adjust. Warping and breaking are not the characteristlcs of these grates, free expansion and contraction being allowed for and strength in construction removes all risks from blows or weight that may befall the grate.

The following illustrations show the appearance of the Tupper rocking and dumping grate and long bar respectively, adapted for all kinds of fuel. A great many references from first-class people have been received by W. W. Tupper & Co., certifying to the durability and economy of the Tupper grates.

Top View of Tupper Grate Bar.



Tupper Dumping Grate.



Tupper Rocking Grate.

The Bergmann Radial Voltmeter and Ground Detector Switches for direct mounting on switchboards are shown in the illustrations. The handle, indicator and dial only show on the face of the board. The back of the switch is mounted on a solid slate base. The visible parts of the switch are copper and nickel-plated. Both sides are shown, the back and front of board, in views.

The Bergmann Radial Differential Voltmeter Switch, for direct mounting on switchboard, connected on the same lines as the last, supplies a great convenience to those seeking appliances of simple construction to overcome well-known deficiencies in a system.

As in the above, only the handle, indicator and dial show on the face of the board. Both views are shown of back and front when mounted. This switch is specially designed for use with differential galvanometers in obtaining uniform voltage where several dynamos are run in multiple on the same system. Two incandescent dynamos used together in a private plant will never cause trouble or invite risk if started in conjunction with this switch.

The General Incandescent Arc Light Company, S. Bergmann, president, have factory and offices at 572–578 First avenue, New York.

The Electrical Age.

VOL. XX—NO. 18 NEW YORK, OCTOBER 30, 1897 WHOLE NO. 546

Albion E. Lang, President-elect A. S. R. A.

THE AMERICAN STREET-RAILWAY CONVENTION.

Albion E. Lang, the newly-elected president of the American Street-Railway Association, was born in the year 1849, at Huntington, Lorain County, Ohio. He entered the street-railway business as owner of the Monroe and Dorr street railroad, in Toledo, Ohio, in 1881. At that time there were five other street railroads in the city, and in 1885 he succeeded in uniting these roads into one company under the name of the Toledo Consolidated Street Railroad Company, of which company he became successively the secretary, vice-president and general manager, and president. Later on, the Consolidated Company acquired two other companies, and a second consolidation ensued, under the name of the Toledo Traction Company, of which Mr. Lang has been president since its organization. Mr. Lang was president of the Ohio State Tramway Association in the year 1893. He is also the president of the Toledo Consolidated Electric Company, and that company and the Traction Company control all the street railway and electric light properties of Toledo, a city of 135,000 inhabitants. Mr. Lang has been an interested attendant at the conventions of the association since the Washington meeting, in 1888, except the Atlanta and Montreal meetings.

The sixteenth annual meeting of the American Street-Railway Association was held at the Armory, Niagara Falls, N. Y., October 19–22, 1897.

President Robert McCulloch, of St. Louis, called the meeting to order at 11 o'clock Tuesday morning.

On the platform were seated ex-presidents H. H. Littell, Henry M. Watson, H. M. Littell and George B. Kerper. The officers and members of the Executive Committee were also seated on the platform, as follows: Messrs. Charles S. Sergeant, D. B. Dyer, C. F. Holmes, H. P. Bradford, Charles H. Smith and the secretary, Mr. T. C. Penington, of Chicago.

The President.—I now have the pleasure of introducing Hon. A. C. Hastings, Mayor of Niagara Falls, in which city we are so royally being welcomed at the present time.

Mayor Hastings then addressed the meeting.

Mr. President and Gentlemen of the American Street-Railway Association: It hardly seems necessary for me, representing the City of Niagara Falls, to extend a welcome to an association of such a wide reputation that all cities are anxious and happy to entertain you. It seems fitting that we should have you within our gates only long enough to show you the power we generate and send out for manufacturing. We have two large companies; one delivers current to our Buffalo neighbors, some 20 miles distant, and the other runs electric cars 14 miles in another direction.

While the last few years have seen great strides in the commercial use of the great cataract, as long ago as 1725 the French sawed lumber here with power from Niagara River to build old Fort Niagara. From that time forward more or less use has been made of this wonderful fall of water.

With some 200,000 horse-power being developed by the two companies we will have enough power to run a great many factories and we expect that you, gentlemen, in the near future will be knocking at our doors to obtain power to operate your roads for hundreds of miles about us. The roar of Niagara was heard in New York on a telephone; why not the same energy in larger quantities and commercially? We are generous and trust you will call on us for all you want.

I have this week seen a report of the New York State Railroad Commissioners of 1893 and find that our local road, the Niagara Falls & Suspension Bridge Street Railway Company, was chartered October 20, 1882, this being their 15th anniversary, or crystal wedding, as it were. They have a chance to give thanks that they are alive and healthy. From the same report I find the capital invested in '93 was something over $100,000,000, with some $20,000,000 gross income in New York State alone, but I also find your business was not very much better as to net profits than a great many others in that year. From the general air of prosperity, as shown in your faces, they must have improved and I trust they will keep on improving until you will not find it necessary to have your men mention about there being more room up front. We will not crowd you while in our beautiful city.

A few words of advice as to how to see the Falls may not be amiss, as you are here for a few days only, and most of your time will be taken up by your business. The park is free to all parts and comprises over one hundred acres that are accessible by walks and roadways. The electric car service is such that you can ride for miles with only a change of car from one road to another at two or three different points. The carriage hire is very reasonable—all reports to the contrary—only have it understood when you start, what the rate shall be per hour, which is regulated by ordinance. Don't think because you have driven or walked about for an hour or so you have seen it all. Take time and view the falls and parks from different points.

We appreciate the honor of your visit and want you to leave with such an impression that the memory will always be pleasant. Remember the latch-string is always out for you and we trust you will come again, individually and collectively. We wish you all success in your deliberations. May your association grow and flourish like a green bay tree. The gates of the city are wide open to you and the only restriction made is, that if you find anything bolted down, please leave it.

Personally it is a pleasure for me to meet and welcome you and I trust to have that pleasure again. (Applause.)

The President:—Gentlemen, we are obliged to his Honor, the Mayor, for his words of welcome, and we hope that he will preside at the police court if any of us are unfortunate enough to stay out and be captured. (Applause.)

The President ordered the roll to be called.

The President:—The next order of business is in the nature of an opportunity for those who may be present, representing companies, to make known their desire to join, that the Secretary may enter the names of their companies upon the membership roll.

The following companies then acquired membership in the association:

Nassau Electric Railway Company, Brooklyn, N. Y.

Binghamton Railroad Company, Binghamton, N. Y.

Buffalo Traction Company, Buffalo, N. Y.

Roxborough, Chestnut Hill and Norristown Railway Company, Philadelphia, Pa.

Chester Traction Company, Chester, Pa.

Colorado Springs Rapid Transit Company, Colorado Springs, Col.

South-West Missouri Electric Railway Company, Webb City, Mo.

Union Traction Company, Anderson, Indiana.

Atlanta Railway Company, Atlanta, Ga.

Wakefield and Stoneham Street Railway Company, Boston, Mass.

Mystic Valley Railway Company, Boston, Mass.

The next order of business was the approval of the minutes of the last meeting.

President McCulloch then read his address to the A. S. R. A.

Abstract of Address of President McCullough:—

Gentlemen of the American Street Railway Association: Our convention assembly for the sixteenth annual period is within the sound of nature's greatest wonder, but the wonders that are wrought in our own immediate application and appropriation of nature's resources are even more startling and awe-inspiring than the great Niagara Cataract. If our ancestors of two centuries ago could sit in judgment on our doings of to-day we would unquestionably be required to involuntarily undertake the feat of the gallant Captain Webb, and if, perchance, we survived the perils of the raging torrent, the bonfires of our aboriginal predecessors would be rekindled on the cliffs below, and a fat-frying would take the place of our discussions and merry-making, as there could be no escape on our part from the charge of witchcraft. These great falls were worshipped by our red brother; the venturesome explorer and historian dipped his pen in consecrated fluid as he wrote reverentially of their grandeur; the poet and the maiden everywhere have sung of them in enchanting praise; reverence and poetry and romance have characterized the stories which tell us of them; but the matter-of-fact Yankee of to-day, casting reverence and poetry and romance to the winds, has harnessed them like an old horse, and compelled them, just as subserviently, to do his bidding; they make heat and light and power for all purposes; they revolutionize the processes of the manufacturer and the chemist, and ere we meet here again they will, without doubt, have been saddled with the menial duties of cooking and washing and tilling the soil of all the country around. The enabling element for the utilization of this wasted energy of the past is electricity, in the development and search for uses of which the scientist and manufacturer sleep not, neither do they rest. They furnish us with their best and latest devices and appliances today, and tomorrow these devices and appliances are obsolete. To keep our place in the procession we must join in the cry of "The King is Dead, Long Live the King."

Our local brethren, with a hospitality as abounding and exhaustless as the never-ceaasing flow of their great river, have provided for our physical comfort and entertainment. We beseech them not to seduce us from a proper contemplation of the business before us.

Our noble ally, our helper in all the good work we accomplish, our always alert, jovial and genial friend, the supply man, has contributed, as usual, his share to our entertainment and enlightenment. He is here to show us the best of everything he has. He is not, in one sense, a member of our association; he does not participate in our deliberations; but he stands at our threshold, and the vigilance which he exercises, that none may escape, is worthy of our emulation in the conduct of our business. Let us show our apprecion of his efforts by inspecting his wares, by loading him with orders and by fraternizing with him, that his enjoyment of the occasion may be equal with ours.

The questions to be discussed in our convention have been selected with reference to newer developments and applications. The gentlemen honored by selection (and the honor should be much coveted) to prepare papers have all been urged to be present and personally present their efforts, thus giving them a force that can only be imparted by the enthusiasm of the author. Time will be given for the presentation and discussion of each paper, and it is hoped the discussions will be free and exhaustive.

I wish that my successor in office may have a secretary and executive committee who so thoroughly realize and faithfully perform their duties as have the secretary and executive committee who have assisted me in the performance of my very pleasant work.

And now, my friends and brethren, thanking you with more earnestness than my language can express for the unexpected honor with which you crowned me a year ago, and promising an impartial ruling on all questions presented, we will proceed with the business of the convention.

The next business was the reading of the minutes of the executive committee and the report of the secretary and treasurer.

The President: If there is no further business in connection with the opening exercises of the meeting, we will now proceed to the reading of the papers. The first paper is that on "Municipal Ownership of Street Railways," by Mr. P. F. Sullivan, general manager of the Lowell & Suburban Railway Company, Lowell, Mass. This is a subject to which Mr. Sullivan has given considerable personal attention, and he has gone to great trouble and expense to procure information on this subject, and his paper will be very interesting. The secretary read the paper, which with others, if space permits, will be printed in subsequent issues of the Electrical Age.

Boston was selected as the next meeting-place of the association.

In the evening the members sat down to a banquet at the International Hotel.

After the meeting adjourned many of the members walked across the upper Suspension Bridge on the Canadian side, where the cars of the Niagara Falls Park & River Railroad conveyed them to Chippewa and Queenston; from there they crossed to Lewiston and thence by the Great Gorge Route to Niagara Falls.

Wednesday's Session.

President McCulloch called the meeting to order at 10:30 a. m.

The Saginaw Street-Railway Company, of Saginaw, Mich., acquired membership in the association and the report of the auditing committee was submitted.

Mr. Charles Hewitt then read a paper entitled, "Application of Storage Battery to Electric Traction."

Mr. Hewitt, in reply to questions, said that he had in mind the cities of New York and Washington, as cities where storage-battery cars would be applicable. From his observation he believed that all small stations would be benefited in a large measure in their economy if they had a storage battery.

Mr. Patterson, of Salt Lake City, stated that his company's plant, consisting of a water-power, had been shut down on several occasions by accident, and inquired whether a storage battery would be of benefit to his plant, and where it should be placed. Mr. Hewitt replied that it would probably take a very large battery to take the whole load of Mr. Patterson's station, as the battery was usually intended to take care of the fluctuations in load only. The place for the battery would be at the distributing end of his transmission line.

Mr. MacFadden, of Chester, Pa., inquired whether it would be economical to have a booster and storage battery combined, as a booster line, where one would only want the power at certain times, during heavy loads, and on heavy grades. Mr. Hewitt thought that in the case of Chester a battery would not be of much benefit.

The local conditions of every case must be conidered in all such installations.

Mr. Mundy, of Lowell, Mass., asked about the application of the battery, particularly in suburban work, such, for instance, as race-track travel, without the use of the booster. If the battery were mounted in cars, would it be practicable to run these cars out in cases of special loads to the end of the route, when you will have the load, and then, during the race or other intermission charge the battery from the line. Mr. Hewitt replied that that was one of the variations of the scheme used abroad, which was perfectly possible.

Mr. H. H. Littell, of Buffalo, stated that it had been shown to him that he could save $75,000 yearly in their operation by the use of the storage battery, and he was almost led to believe that they could do it, but they had not made any contracts yet. As regards the use of compound direct-connected units in stations generating from 300 to 1,000 amperes, he cited the case of Easton, where before the use of storage batteries it required four engines to operate the road, whereas now only three were required. He estimated the economy to be twenty per cent.

Mr. Ely, of Niagara Falls, agreed with Mr. Littell, that this was probably the most important question coming before them, as it meant, if successful, the saving of thousands of dollars. His company is taking power from the Buffalo & Niagara Falls Railway and the other street railways of Buffalo as well, from the Niagara Falls Power Company, and the Niagara Falls Hydraulic Power and Manufacturing Company. They generate the power and sell it to the street-railway companies at so much per electrical horse-power per annum.

The street railway company has to pay for the power whether it is used or not, and for eight hours of the day, on an average, but a small quantity of the power will be used and for a certain number of hours, on their line particularly, for four or five hours, no power whatever is being used. If the accumulator could be used to store the current, and they could use it at times when they might not take it from the power companies direct, it would be a saving to his companions of thousands of dollars per annum. In Mr. Littell's case it would be a great saving. His Company was taking 1,000 h, p. daily, per annum, from the transmission line, and they were going to take more. Mr. Ely inquired of Mr. Hewitt whether, in his judgment, the state of the art had advanced to that degree that storage batteries or accumulators might not be safely, practically and economically installed to meet such cases. Mr. Hewitt replied that the batteries could undoubtedly be installed in such cases with economy. It was merely a question ot size. A hearty vote of thanks and commendation was tendered to Mr. Hewitt.

The paper on "Power Distribution and Use of Multiphase Current Transmission for Ordinary Street Railways," by Mr. Maurice Hoopes, electrical engineer, Lynn & Boston Railroad Company, Lynn, Mass., was then read by the secretary, Mr. Hoopes being prevented from being present by illness. A vote of thanks was tendered to Mr. Hoopes.

Mr. Hewitt stated that as far as the problems had come up in ordinary street railway work, with such distances as ordinary roads handle, he had been unable to figure any economy in the multiphase transmission, as compared with the direct using the booster. When one got to distances beyond, possibly fifteen miles, the problem then became more favorable to the alternating current. There are several things to be considered. In the first place, if one had a long line already running one has copper which is one already using on that line. The first thing to consider is whether this copper can be used in alternating transmission; and, in the second place, can the cables be used economically in an alternating current transmission. Very frequently they cannot. In Philadelphia they figured very carefully the question of alternating tri-phase transmission, in place of the battery, and found the battery more economical; and the results had shown conclusively that such was the case. It was a question in Mr. Hewitt's mind whether we are not on the eve of a very successful tri-phase motor, and instead of using the rotary transformers we will use the static transformers with a tri-phase motor on the car. He felt sanguine of the future possibility of this motor and had seen such motors work experimentally, and they bid fair to give very good results.

The president then appointed a Nominating Committee to nominate officers and select the place for the next meeting, and the meeting then adjourned until Thursday morning.

Thursday's Session.

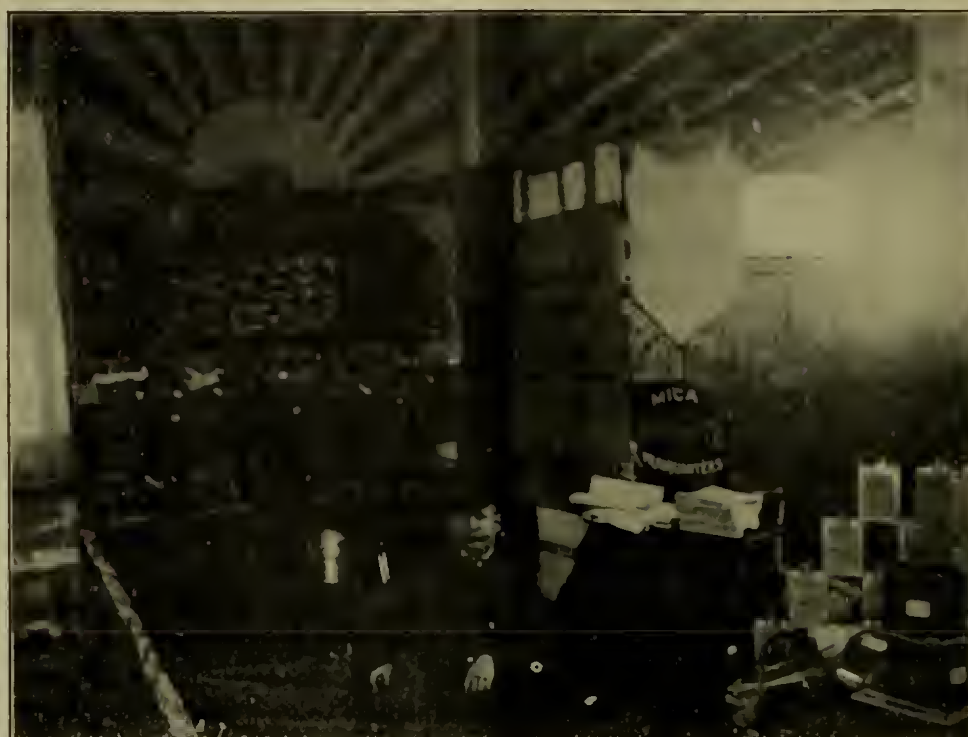
President McCulloch called the meeting to order at 11 a. m.

Mr. Bacon, in the absence of Mr. Ford, chairman, read the report of the Committee on Standard Electrical Rules for Construction and Installation of Electric Wires. The report earnestly recommended the adoption of the National Electrical Code. The report was adopted.

The matter of proper compensation for carrying the United States mails was then taken up and discussed by several members.

The afternoon session was occupied with the reading and discussion of the following papers: "Discipline of Employes," by Geo. H. Davis. "The Application of Electricity to Railroads now Operated by Steam Power," by Colonel H. N. Heft. "Best Method of Settling Damage Cases and Prevention of Accidents by Use of Fenders or Otherwise," by W. J. Hield. There was very little discussion.

Mr. Davis, in his paper, stated that a road has good discipline when all employes respect and kindly regard each other; when the officers do their best for the men, and vice versa; and when both officers and men sacrifice everything in the interests of the company. The railway manager must gain the implicit confidence of his officers and men. Complete organization is the first requisite for discipline. All orders should be issued in printed form, clearly stated. Employes in all ranks must be worked to their full natural capacity and physical strength. Nothing good or bad in a man's service should be passed without the manager's recognition; praise is a strong incentive to good work. An unusually large day's work should be followed by extra compensation.



Eugene Munsell & Co.'s Exhibit.

Closing routine business followed, with the election of officers for the ensuing year. The following were elected:

President, Albert E. Lang, Toledo, Ohio; first vice-president, W. Caryl Ely, Niagara Falls; second vice-president, J. A. Riggs, Reading, Pa.; third vice-president, E. G. Connette, Nashville, Tenn.; secretary and treasurer, T. C. Pennington, Chicago. Executive Committee: Robert McCulloch, St. Louis; C. D. Wyman, New Orleans; H. C. Moore, Trenton, N. J.; John Roach, Chicago; R. S. Goff, Fall River, Mass.

Peckham Motor Truck & Wheel Co.'s Exhibit. Messrs. Livingston, McLaughlin, Jr., and Ghegan, of Standard Thermometer Co., and J. H. Bunnell & Co., shown in left of picture.

HUSTLERS AT THE AMERICAN STREET-RAILWAY CONVENTION HELD AT NIAGARA FALLS, OCTOBER 19–22.

It was well that the attractions at Convention and Exhibition Hall were magnetic enough to draw a constant stream of blue-badged delegates. The executive committee are to be congratulated on their foresight in placing Convention Hall at a point requiring every delegate to pass through all the main exhibits to reach it. There were so many fine exhibits that it would be impossible to pick out a first prize. The General Electric, Walker, Westinghouse, Peckham Truck, Murphy Manufacturing Co., all vied with each other in having a first-class exhibit.

Edgar Peckham, president of the Peckam Truck Co., was in constant demand for the black leather-covered memoranda books, bill wallets and transparencies of the Falls; these souvenirs were among the most useful mementoes. The souvenirs were given out in their parlor at the International Hotel, where they exhibited their beautiful aluminum trucks in model forms and photos of all their various styles of trucks for every kind of light and heavy traction.

Messrs. Hanna and Lang assisted Mr. Peckham, and Mr. Ackley did himself credit at the hotel exhibit. Wednesday evening they gave away transparencies of the Falls; the rush was so great they had to chain down the models of trucks; they were so beautiful people believed they were to be given away as souvenirs.

The Sterling Supply & Manufacturing Co., of New York, had a parlor on the second floor of the hotel and kept open house. A constant stream migrated to this parlor to see the new passenger register, sand boxes, brakes and trolley supplies. The writer knows they received some nice orders for all their goods, and delegates went away with one of their souvenir clocks formed into a beautiful paper-weight.

Walter Chur represented the American Railway Supply Co., 24 Park Place, N. Y., and provided the delegates and guests with fine aluminum game counters.

Mr. Gerry had a room at the hotel and brought on a big trunkful of pocket-size books full of useful information for business men, mechanics and engineers, all prepared by his firm, Messrs. Jones & Laughlin, of Pittsburg, Pa., manufacturers of cold-rolled shaftings, couplings, car axles, etc. The demand for souvenirs kept Mr. Gerry busy.

Mr. Sackett, a practical steam locomotive engineer, showed his valuable time and trolley saver, Sackett's automatic trolley catcher. If the trolley jumps off the wire the Sackett catcher will hold it from flying in the air, striking cross wires, etc. Write O. R. Sackett & Co., Niagara Falls, N. Y., to send you a sample trolley catcher; they are worth $100 on every car; they will save their cost fifty times a week.

Charles Blizard, manager of New York office of the Electric Storage Battery Co., of Philadelphia, Pa., was kept busy explaining the virtues of their batteries. They had a small plant in operation at the Hall.

John Stephenson Company, of New York, gave away handsome booklets containing views in silver prints of the various styles of cars built for various roads, also valuable tables, memoranda, etc.

Geo. F. Porter, manager, and F. G. Fuller, the hustler, kept Kerite to the front and gave away souvenirs in the shape of a fine memoranda book, leather cover, the pad of which can be replaced by writing to Kerite, 203 Broadway, N. Y. The name of Geo. F. Porter is too familiar to our readers to require a further introduction; he still retains the secretaryship of the National Electric Light Association, and everybody is pleased to know that he will continue to guide both.

The Kleanit Company of Akron, O., gave away cakes of Kleanit, and the names of street-railway companies who clean their cars with the same.

The Meaker Manufacturing Company, Chicago, showed its various styles of car registers. Mr. J. W. Meaker was on hand to furnish information to callers concerning his well-known register.

Harry Kirkland, of the Cutter Electric & Manufacturing Company of Philadelphia, showed a fine collection of I-T-E circuit breakers.

The Bibber-White Company, Boston, Mass., was represented by Mr. C. E. Bibber.

Elmer P. Morris brought together a big array of exhibits at the Cataract House, and gave away brush holders. His brass band did the rest.

Mr. F. H. Newcomb, of New York, was present with handsome samples of uniform caps, etc.

The American Electrical Works, Providence, was represented by Mr. P. C. Ackerman.

The Chicago Insulated Wire Company, Chicago, had present Mr. William M. Smith as its representative.

Samuel L. Glover represented the Post-Glover Electric Company, of Cincinnati.

The Heminwray Glass Company, Covington, Ky., showed numerous styles of glass insulators, its exhibit being in charge of Mr. D. C. Heminwray.

The American Car Company, St. Louis, had its interests well taken care of by Mr. E. J. Lawless, its New York representative.

The Neal Headlight Company, Boston, was represented by Mr. George G. Ewing, the secretary of the company, and Mr. F. E. Huntress.

Michigan Electric Company, Detroit, Mich., was represented by Mr. J. E. Lockwood, one of the best-known members of the electrical fraternity.

The Pittsburg Reduction Company, of Niagara Falls, placed on exhibition a number of ingots of pure aluminum, which were greatly admired.

The Solar Carbon & Manufacturing Company, Pittsburg, had its interests well looked after by Mr. F. M. Laughlin, who made many friends at the convention.

The Washington Carbon Company, Pittsburg, was represented by Mr. J. S. Crider. This company does considerable business in the line of motor and generator brushes.

Adam Cook's Sons, New York, whose Albany lubricating compounds are extensively used by electric street-railway companies, were represented at the convention by Mr. J. Hernandez.

William Wharton, Jr. & Co., Incorporated, of Philadelphia, had an interesting exhibit of their switches, crossings, frogs, tongues and other heavy rail specialties, in a corner of the hall.

The Hope Electric Appliance Company, Providence, had on exhibition its instantaneous make-and-break safety switches, the merits of which were explained by Mr. John A. Drake.

Messrs. J. H. Bunnell & Co., New York, one of the oldest firms in the electrical-supply business, was represented by Mr. John J. Ghegan, who has long been a familiar figure at conventions, assisted by Mr. McLaughlin, Jr.

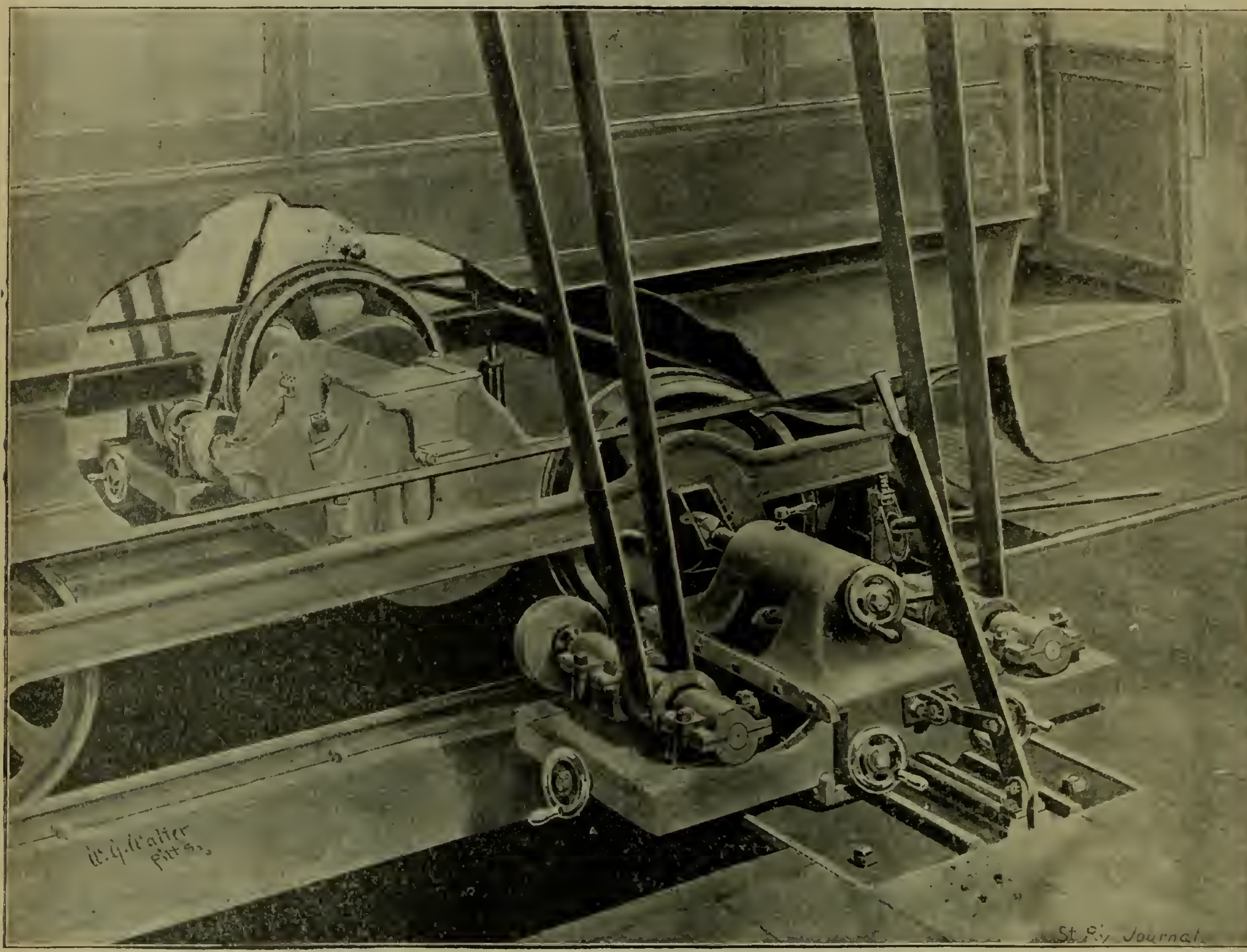
The Weston Electrical Instrument Company, Newark, N. J., was conspicuous in many parts of the exhibition building; all switchboard equipments had instruments of the Weston make.

The D. & W. Fuse Company, Providence, attracted attention by its fuse tests and excellent samples of fuses and appliances for street-railway work. Mr. L. W. Downes and Mr. A. W. Hutchins were the representatives.

THE MURPHY CAR WHEEL TRUING MACHINE.

For many years a great difficulty presented itself to traction companies, because of their inability to readily true car wheels which had become flattened, indented or otherwise affected, so as to be no longer true and round. A very ingenious, practical and comparatively cheap device has been put upon the market for the use of traction companies by the Murphy Manufacturing Company, of Pittsburgh, Pa. The inventor, Mr. John Murphy, exhibited the machine in actual operation at the late convention of the American Street Railway Association. Of all the contrivances appearing there, Mr. Murphy's represented the greatest originality in this particular field of work. The above sketch will show the method of applying the Murphy Car Wheel Truing Machine to an ordinary car wheel. The truck is raised from the ground and the truing machine looking like the tail stock of a lathe pushes forward a centre pin against the car wheel axle. The emery wheel is fed forward to the periphery of the car wheel and being driven at a very high speed, removes all metal, evenly and uniformly, which has prevented the rim from being perfectly round and true. The entire apparatus can be moved back and forth upon metal ways, and represents so solid and substantial a structure that the centring of the car axle and application of the emery wheel absolutely forces the car rim to become a perfect circle. It is not necessary to remove the entire car from the track but only that end to which the wheel is attached. When the emery wheel is applied, the car motor is likewise started, thus securing friction sufficient to round the wheel in a period of from fifteen to forty five-minutes. The great advantage of this method over any other known process is so obvious that the reader will fully realize that a great field of work is awaiting its immediate application. The amount of money saved by a traction company using this device, the ease with which they can remedy faults in their wheels, and the comfort to passengers travelling on cars are among its great benefits.

The Murphy Manufacturing Company own broad patents on other machines used for the same purpose as well as the one above described. If readers care to investigate further or desire more particulars, they may write to the Murphy Manufacturing Company, City Savings Bank Building, Pittsburgh, Pa.



Murphy Manufacturing Co.'s Exhibit of Wheel Truing Machine.

INFRINGEMENTS OF PATENTS ON ELECTRIC CABLES AND ACCESSORIES.

Buyers and users of underground and aerial electric cables will be interested to learn that the Standard Underground Cable Company, of Pittsburg, Pa., has entered suit against the National Conduit and Cable Company of New York for infringement of a number of its patents on cables, terminals, "T" joints, etc. The Standard Underground Cable Company was the earliest in the field in this country as a manufacturer of electric cables and contractor for their installation, and its reputation for extensive and successful cable installations is very high.

The following patents are involved in the suit:

No. 342,894, relating in general to a duplex or two-

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CONTENTS.

THE AMERICAN STREET-RAILWAY CONVENTION.

It is surprising to realize the extent to which street-railway interests have grown. At the recent Niagara convention, some of the most familiar faces of those associated with such interests were to be seen. It is a satisfaction to realize that the men making money out of street-railway enterprises have sufficient regard for those likewise interested to attend the meetings of their colleagues. It is a pleasure to see social ties tightening and friendships renewed which, without the American Street-Railway Association, would never have existed. There is more or less of the social element to be found among the delegates of a convention, particularly if its period of existence dates back as far as that covered by this particular consolidation of interests. At the convention many engineers, whose interests run closely parallel, were present, ready to make use of new improvements, methods or changes worthy of practical consideration. Possibly the majority were gratified in this respect by attending the meeting held in Convention Hall, where many important papers bearing upon the subject of electric traction, and matters connected with it, were read and discussed. The growth of street-railway interests and the scientific and practical aspect that has been given it due to its healthy growth and development, has made these convention meetings of the greatest importance. They enable engineers to come to quick decisions concerning changes in the road or station, the use of storage batteries and the distribution of cars and general operation of street-railway lines.

It may be said that these meetings are dollars and cents in the pockets of those attending them, and those staying away cannot afford to lose that which their fellow members gain and miss an opportunity only afforded once a year. We may say that the present condition of street-railroading represents but the first promising bud on the tree of electric traction. The field is so extensive, so broad and so capable of development in hundreds of ways that it would be foolish to express its limits or say that the present systems will not be changed. It is not due to any unhealthy enthusiasm that these opinions are advanced, but because of the fact that certain changes are imminent. The entire overhead system may disappear and in the next fifty years we may be gliding along on roads stretching across the contiuent entirely innocent of external wires or other familiar appendages. What will the American Street-Railway Association then discuss? Its present members will look back, if they are alive to do so, upon the subject matter of modern discussions as they would now recollect the time when it was almost forbidden to consider electricity as a subject of traction, and the old car horse wended its painful and laborious way along the roadbed like a phantom of unutterable despair.

THE RIGIDITY OF THE INVISIBLE.

Mankind in general is of the opinion that the invisible needs no consideration, that the so-called immaterial does not exist, and the play and influence of impelling and directive forces need not occupy a moment of their time. Perhaps they are right. The busy and practical world is so much occupied with questions of commercial importance, that their time for the survey of problems more or less abstract is too limited to be of any service.

The electrician is one who deals with peculiar conditions, which, in the majority of cases, are only interesting to him in so far as they affect the achievement he has in mind, but the thoughtful worker is forced at times to consider the strangeness and, in fact, marvellous effects he is frequently brought to witness He takes an iron bar in his hand and upon inserting it within the magnetic field of a large dynamo, feels the bar violently wrenched and forced to occupy a definite position. The space is empty as far as the eye and other senses are concerned. Upon inserting the hand into this magnetic atmosphere, absolutely no influence is felt. The interior is as yielding as the air and seemingly free from the play of forces, but within there is stretched an unseen medium of infinite electricity. It is the rigidity of the invisible that we have to deal with, and the iron bar inserted into this mysterious space is clutched and gripped as tightly as though bands of flexible steel were operating, affecting the position of and drawing the bar of iron towards the poles. Trolley cars would not operate—could not stir from place to place, if it were not for the fact that the empty space between the armature surface and field grasped the revolving mass with the hand of a giant and sent it whirling forward with its human freight above to take care of. There is certainly nothing stranger than the influence a magnetic field has upon a mass of iron—nothing more wonderful than to realize that huge Corliss engines are required to drive the armatures of great generators through empty space, and that the blazing fires and huge boilers and mighty engines are laboring away to overcome this grip of the invisible, this hard and all but unyielding grasp of a transparent, empty and apparently unoccupied void.

The Electric Storage Battery Company, Philadelphia, had an interesting plant of storage batteries for railway service. The representatives of the company present were Mr. Herbert Lloyd, general manager; Mr. J. B. Entz, Mr. F. J. Clark, Mr. Charles Blizard and Mr. J. Y. Bradbury. These gentlemen answered many questions regarding accumulators for street railway service.

conductor flat form of cable for telephone, telegraph, or electric-light service, this form of cable being especially economical in manufacture and installation, and especially well adapted, owing to its practical elimination of self-induction for alternating-current transmission.

No. 388,477, relating to what might be termed a "semi-concentric cable," composed of a central conductor or core, and a number of insulated conductors arranged spirally around the same, and having a cross section greater in breadth than thickness, and composed of a number of smaller wires or strands, the purpose being to produce a flexible cable of the smallest dimensions, and also, by the position of the wires with respect to each other, and by including them under one lead cover, to reduce self-induction to a minimum, all of which are desirable and valuable features in electric-light service.

No. 371,808, which is believed to cover generally the so-called "T-joint," or a metallic case or protecting shield secured around the insulated conductor joints between the main and branch cables. It would seem that a device of this kind is practically indispensable wherever branches or loops are to be taken from a lead-covered main or trunk-line cable.

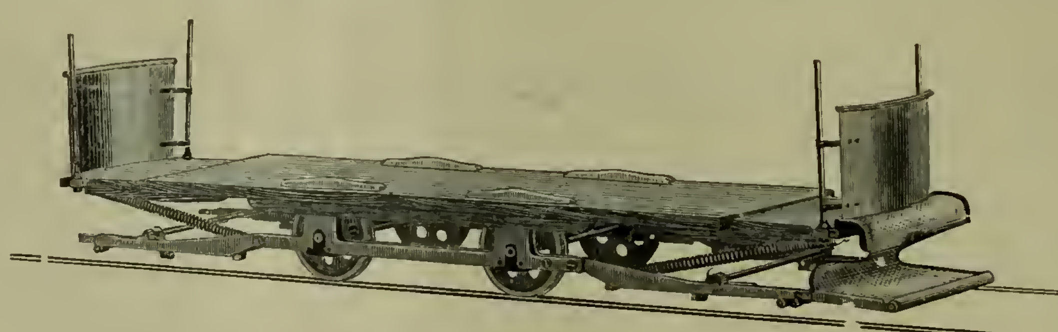
No. 395,546, is for a coating of tin or alloy thereof, or other material more durable than lead, as a protection against mechanical injury to the softer lead cover of the cable, and to resist the oxidizing action of acids, alkalies, and similar agents that might work the destruction of a plain lead covering.

No. 574,343 relates to the well-known cable-terminal head, tubular in form and split in two longitudinal sections for convenience of joining the cable conductors to their respective binding posts, the sections being made of substantially uniform cross-sectional shape throughout their entire length and of such internal dimension as to make a tight joint with the cover of the cable when applied thereto and provided with binding posts for connection with the cable conductors and the exterior distributing wires.

The suit has been entered in the U. S. Circuit Court for the Southern District Court of New York by Kerr, Curtis & Page of New York City, as solicitors, and Geo. H. Christy, of Pittsburg, Pa., and Thomas B. Kerr of New York City, of counsel, and it is expected that these suits will be pushed to a speedy trial and decision.

THE CULLISON AUTOMATIC CAR FENDER.

Safety devices for the prevention of accidents are absolutely required on trolley cars. Many car fenders have been invented for this purpose, some of which have very good features to recommend them; others, and the large majority, are perfectly useless, in fact dangerous to employ. A car fender must fulfil certain requirements before it can be considered perfectly reliable. It must be safe to human life, simple in construction, certain in operation, securely attached to the *wheel truck*, and should not project so far forward as to be a constant menace to vehicles or pedestrians. The Cullison Automatic Car Fender, invented by Obe. Cullison, meets the above requirements in every respect. It is not dangerous to life, because it is flexible and constitutes a finely meshed netting, into which a person would fall without injury. It can be readily attached to any car, being held underneath by two coil springs (see sketch), only a contact roller in front extending. The automatic action is such that when the fender strikes an object it releases the springs and shoots forward at least three feet, scooping up whatever is in front without hesitation. The car wheel, truck and fender being connected together, prevents the swaying of the fender so common in other similar devices and enables the roller to be run within two inches of the track. When turning curves other fenders sweep around several feet beyond the track, but this fender, tucked beneath, only appears a foot beyond, and thus removes the peril to passing obstacles.



Fender in Rearward Position.

Fender in Action.

LITERARY NOTES.

The November Home Magazine (Binghamton, N. Y.) is a Thanksgiving number. First there is a Thanksgiving frontispiece, and a Thanksgiving poem by Frank H Sweet; the illustrations drawn by W. B. Green.

Then there is an illustrated Thanksgiving story, "A Wolfville Thanksgiving," by Alfred Henry Lewis, of how they celebrated the day out West. The illustrations are by Frederic Remington.

Other fiction in this number include stories by Richard Henry Savage, the far famed teller of tales of adventure Albert S. Klinck, Arthur Howard Noll, and a particularly impressive sketch by Prof. Guy Carleton Lee, of John Hopkins University. There is also the first part of a short serial, "Dr. Alterius, a Tale of the Occult," which promises to be of extraordinary interest.

In more serious vein are an unusually interesting article on Madame Lafayette, by Haryot Holt Cahoon, which is illustrated with reproductions from rare miniatures and engravings; a profusely illustrated article on the Sketch Club of New York, and Miss Minna Irving, the well known writer on naval topics, tells about the need of better docking facilities for the new navy; of strict literary interest George Newell Lovejoy describes certain interesting conversations had with William Cullen Bryant

William Dean Howells, and Editor Vance in his department of book reviews holds forth on the new books of the day in an even more than usual interesting manner.

Of sociological and economic interest are papers describing the system of co-operation inaugurated by Alfred Dolge at Dolgeville, N. Y., and one on "State vs. Private Ownership of Our Railroads," by Leonard Darbyshire. Mr. Darbyshire gives many reasons why the state should not own the railroads.

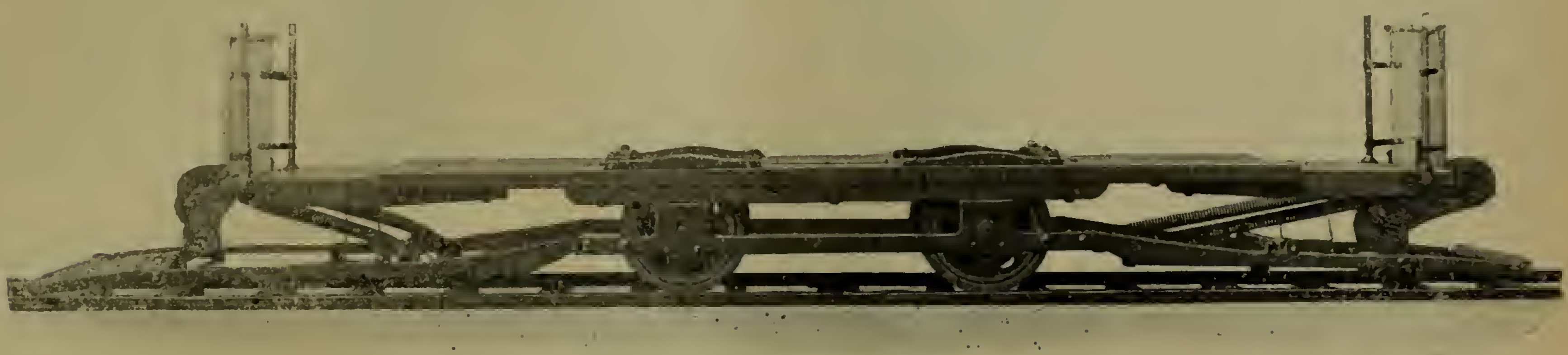
Then there is a full and detailed report of the recent meeting of the Commercial Travellers' Home Association of America, the publishers of the Magazine, and many other topics of special interest to commercial travellers. The November number is fully up to the standard set by its enterprising publishers.

Subscription price, $1 per year; single numbers, 10 cents. Every dollar of profit realized from this magazine is devoted to the building of the national home for worthy indigent commercial travellers, at Binghamton, N. Y.

such a case. A current may be produced by combinations of Liquids, Metals.

Two liquids may act upon each other like two dissimilar metals and originate a current of electricity, but it is well known that two metals are the most familiar means of producing a current direct from chemical energy.

It is to be observed that one metal is generally consumed or dissolved in even the simplest form of battery. A metal like zinc, for instance, which dissolves in dilute sulphuric acid, generates electricity. It will give up all, as quickly as it is produced, to certain other metals or elements placed in the same liquid with it. This electricity will not flow unless the zinc and other element, which may be copper, carbon, platinum, are connected by a wire. The zinc, as it were, gives its electrical energy through the liquid to the other element, and it *flows* from this other element outward through the wire to the zinc again.



Fender in Action. The Cullison Automatic Car Fender. Fender Ready for Action.

ELECTRIC BATTERIES, OR CHEMICAL GENERATORS.

LESSON LEAVES FOR THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

Science has its traditions as well as history; the most startling developments have followed frequently in the path of an accidental discovery. It would seem strange to say that so trivial an incident as the kick of a frog's leg would be the beginning of a vast series of experiments which finally culminated in the invention of apparatus that today seems indispensable.

Italy has given to us the foundation and starting-point of all that relates to batteries. In the city of Bologna, Galvani, a demonstrator in anatomy, while determining the effect of static charges upon the nerves of a newly-dissected frog, accidentally touched its body and leg with a metal instrument. The leg instantly doubled up and twitched violently. All of Europe was aroused at the news and the majority of scientists attributed this activity to the passage of a current from the frog's nerves to the metal; it was called the vital fluid and led to a supposed relationship between life and electricity.

Professor Alexander Volta, whose attention was drawn to the experiments and discovery of Galvani, concluded that the *contact* only of flesh and metal caused the spasm. He eventually showed that a similar effect could be produced by two metal pieces moistened at the point of contact; that is to say, a weak electrical effect proceeded from such a combination. On examination he found that one piece of metal becomes positive and the other negative under such circumstances.

It was but a step from this point to discover the traces of chemical action on one of the two pieces of metal—to shape them so that the more convenient form of voltaic pile and battery eventually came into use and settled forever any doubt as to the real origin of the current in

The simplest battery may be constructed of a succession of copper and zinc plates, round in shape and separated from each other in pairs by blotting-paper dipped in salt and water, or vinegar and water. The arrangement is as follows: zinc, copper, blotting-paper; zinc, copper, blotting-paper, etc.

The moistened metal, that is to say, the zinc plates, are affected chemically.

The two metals are respectively positive and negative to each other when arranged in this manner; the copper being positive, the zinc negative. The list below shows the action of one metal upon another, the one above being always negative to the one below. The metals were immersed in different liquids becanse it has been found that the attitude of one toward the other is immediately affected by the nature of the liquid in which they are placed.

In a solution of caustic potash and water.	In a solution of hydrochloric acid and water.
Zinc,	Zinc,
Tin,	Cadmium,
Cadmium,	Tin,
Antimony,	Lead,
Lead,	Iron,
Bismuth,	Copper,
Iron,	Bismuth,
Copper,	Nickel,
Nickel,	Silver,
Silver.	Antimony.

For instance, zinc will dissolve in a caustic potash solution and give up its positive electricity to any other metal in the list, such as copper or silver, immersed in the same liquid.

This brings us to a practical point, which is, that a metal dissolving in an acid develops the electrical energy, which passes through the liquid to the other plate and makes it positive. In other words, of the two materials composing a battery one is generally inactive, and acts merely as a receiver for the charge generated by the other.

It may at once be known that a current cannot flow unless there exists pressure to make it flow. This pressure is greater or less according to the materials composing the battery: the amount of current produced merely depends upon its size.

That is to say, a battery having copper, zinc and weak acid for its constituents, will, though no larger than a thimble, produce as much pressure as a battery similarly made of the size of a hogshead. The difference between them would only be that of the quantity of current produced.

Metals, therefore, bear a peculiar relation to each other in this respect. Zinc dissolved in dilute sulphuric acid, will in combination with copper, develop a pressure of one volt; the same metal in the same acid, with carbon instead, develops twice the pressure, or two volts.

The pressure developed by two given materials sometimes depends upon the liquid they are in as much as themselves.

Polarization.—The simple cell of Volta consists of a sheet of zinc and copper and dilute sulphuric acid. When the wires are connected to a bell it will ring loudly for a while and then slowly subside, possibly ceasing altogether. On looking in the jars all the evidences of intense chemical action are apparent, and it would seem that enough electricity is being produced to ring the bell as at the beginning. If the liquid is well stirred the bell may begin again, or, by dropping certain chemicals into the jar, the same result may follow. In either case we simply dislodge the bubbles of hydrogen gas which cling to the copper plate and cover it. This gas is reactive and the current cannot pass it. It must be *dislodged* or *absorbed.* It may be treated in three ways:

Mechanically,
Chemically,
Electro-chemically.

A battery is *polarized* when affected by gas bubbles on the receiving plate. The zinc is the *positive plate* but the *negative pole;* the copper, the *negative plate* and *positive pole.*

An arrangement to stir the liquid or force the bubbles of gas from the copper plate would illustrate the *mechanical method* employed as the Smee battery.

As this gas is hydrogen, a chemical which contains lots of oxygen would, when placed in the liquid, allow the two to combine and effect its removal by the *chemical method* as in the Bunsen or Grove battery.

A battery like the gravity or bluestone cell, which by its ingenious arrangement *substitutes* for the hydrogen bubble a particle of copper and allows that to be deposited instead, represents a type covering those employing *electro-chemical means* of depolarization.

Local action —When zinc is placed in sulphuric acid it will not be dissolved if pure. Commercial zinc is impure and eats away on all occasions, whether the battery is in use or not. We cannot buy pure zinc cheap enough, and therefore have to adopt another expedient.

Amalgamation.—When commercial zinc is covered by a coating of mercury pure zinc passes to its surface. The acid will only attack pure zinc when the battery is being *used.* A coating of mercury on commercial zinc gives it all the advantages of pure zinc and prevents local action.

Cause of local action.—The particles of iron or other foreign material contained in commercial zinc act in combination with the zinc surrounding them like little independent cells, and eat away the zinc in furrows and pit-marks when it is placed in an acid solution. Local action means local electric circuits within the zinc, the electricity being wasted there instead of passing to the positive pole. Amalgamation prevents local action. The use of the three methods described prevents polarization.

QUESTIONS FOR REVIEW.

(1) What did Galvani discover?

(2) How was Galvani's discovery interpreted by Volta?

(3) Upon what principle does the primary battery depend?

(4) (a) What governs the amount of current a battery gives?

(b) What governs the amount of pressure a battery gives?

(5) What is polarization and how is it remedied?

(6) What is local action and how prevented?

CONVENTION NOTES.

Mr. Morrell was on hand and always ready to explain the great advantages of the Morrell improved hydraulic pressed motor commutator. These commutators are made by the Miller-Knoblock Co., of South Bend, Ind. They guarantee these commutators to be absolutely perfect, and use only the highest grade hard-drawn lake copper and India mica. The Miller-Knoblock Co. make the best line of street car railway track sprinklers. The sprinkling of the tracks and streets is controlled from the platform; you can spread the water over the surface to any degree you desire, and you can throw it clear to the curb or limit it to the tracks. Write for descriptive circular.

Bailey Whipple looked after the exhibit of the Jandus Electric Co., of Cleveland, Ohio, the makers of the Jandus enclosed arc lamps, the first enclosed arc lamps that were the first of their class put into successful operation throughout the United States; thousands are now in use. Mr. Whipple was assisted by H. I. Sackett, Buffalo agent, and G. R. Scrugham, of Cincinnati.

Captain Willard L. Candee, of Okonite wire fame, received his friends at the International Hotel. The captain is a good entertainer and with his military suavity did battle for Okonite wires and cables in good old, ancient form. Not necessary to write details of Okonite insulation; it can talk for itself; it is strong enough and will resist everything, even its competitors.

J. W. Gadam, of Wm. Gadam & Son, 45 Rose street, N. Y., makers of models and special machinery, was at the convention, and prided himself on the fine exhibit of Peckham trucks and models made in aluminum of their construction.

Mr. Stillman, of the Watson-Stillman Co., 204 East 43d street, N. Y., looked after their exhibit of hydraulic rail benders, motor repair lifts, presses, etc., shown in a finely displayed exhibit.

Dr. Habirshaw and Frank Harrington, of the India Rubber and Gutta Percha Insulating Co. of New York, spread a veritable halo about the convention with their presence.

Gold Car, Office and House Heaters took the palm. They are said to have the only perfect system of radiation and need only to be examined before you buy an electrical heater. They are made of all sizes and can be placed in any position desired. Write the Gold Car Heater Co., New York, for catalogue. They exhibited in Convention Hall and gave away handsome walking-canes.

Mr. J. S. Bradley, of the New Haven Car Register Co. of New Haven, Conn., was proud of his exhibit at Convention Hall, and still more proud of the handsome paper-knife made of Gold Bronze they gave away. The demand was greater than the supply. This booth was one of the neatest and most attractive in Exhibition Hall. Mr. Bradley was assisted by Messrs. William Anthony, F. C. Boyd, A. W. Chappell and A. M. Loper.

The Standard Thermometer & Electric Company, of Peabody, Mass., had a nice display of inclosed arc lamps.

Their Upton Midget lamp for street railway circuits is so constructed that it will operate successfully five in series on circuits varying from 475 to 550 volts. Each lamp is provided with resistance and automatic cut-out, enabling one or more lamps of the series to be thrown out of circuit without affecting the light of the rest of the lamps.

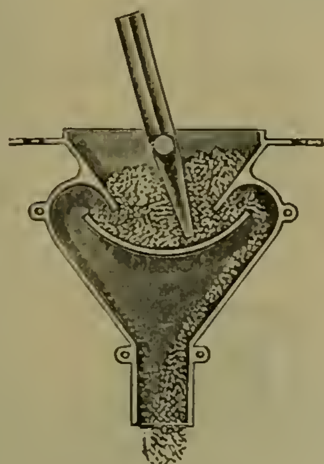
A catalogue of electrical supplies has been issued by J. H. Bunnell & Co., 76 Cortlandt street, New York. An important and interesting feature of the catalogue is that the number of the pages is constantly increasing. Messrs. J. H. Bunnell & Co. carry a full stock of apparatus for electric lighting, telegraph and telephone, railway and bell work, electric light fixtures, plating machines, etc., etc. The new catalogue contains 224 pages inside of the cover, on the front page of which is given a fac-simile of the award received by the firm at the World's Fair.

A reliable and well established firm like J. H. Bunnell & Co. have every facility for quickly supplying electrical goods at the lowest price, with quick delivery. They are one of the oldest electrical concerns in the country.

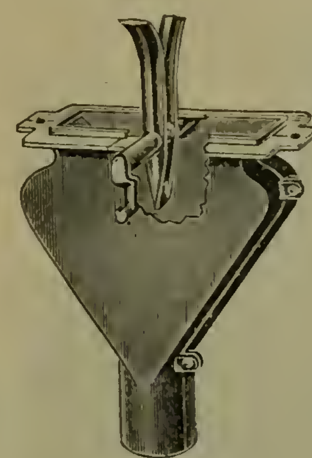
THE HAM SAND BOX.

The Ham Sand Box illustrated by sketch, is manufactured by the Trojan Button Fastener Co., Inc., 378 River St., Troy, N. Y. It is used by trolley and cable roads, and is regarded by them as the acme of improvement in this particular direction.

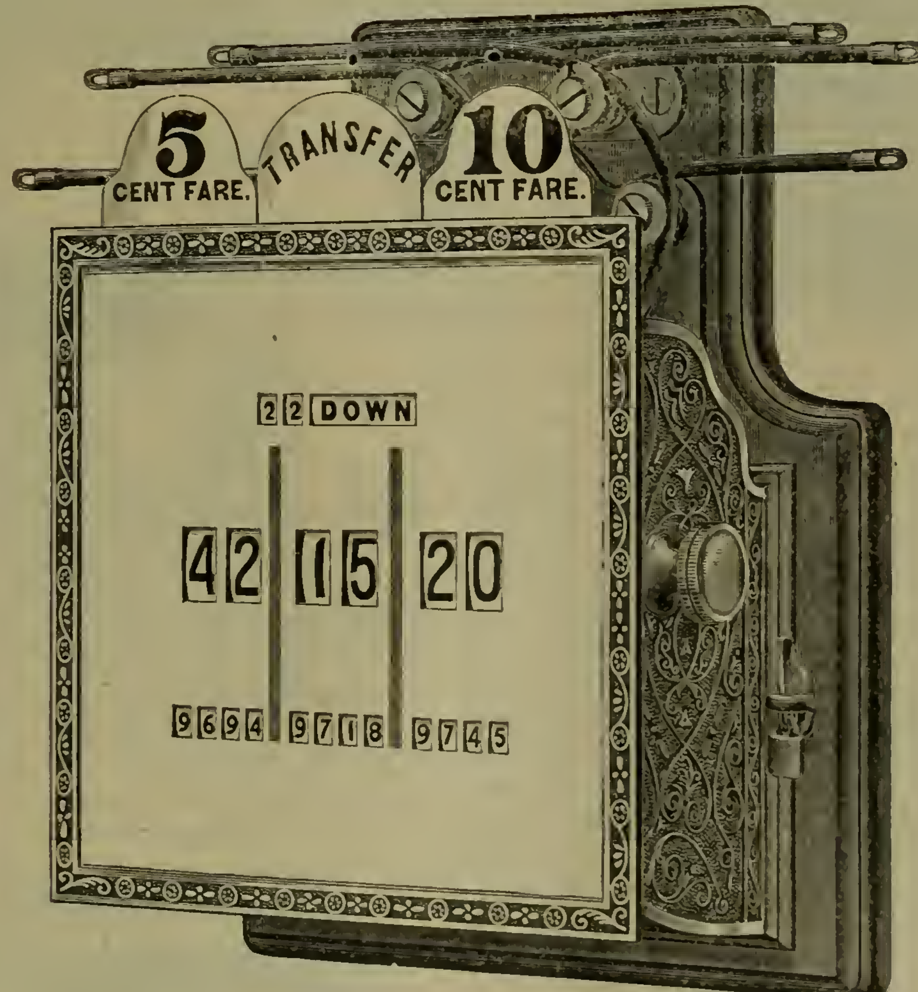
The Ham sand box in all parts is made of bronze metal. It has an opening in the box, under which is a curved shelf. The ends of the shelf extend beyond and above the opening in the box, so the sand cannot escape by gravity. A paddle is reciprocated above the shelf, and the movement of the paddle forces the sand over the ends of the shelf to the feed spout which leads to the car track. Above the paddle are two fingers which stir the sand. The connecting rod passes forward to the car platform, and is operated by a pin and bell crank lever, or by a hand lever. The working parts are extremely simple and the motions direct. The strokes of the foot or hand may follow each other so rapidly as to practically secure a continuous, but small stream of sand, a decided advantage in hill climbing. It can be easily seen that waste is impossible in this box, as the sand flows only when the lever is in motion, and the quantity of sand is regulated.



Ham Sand Box.



Ham Sand Box.

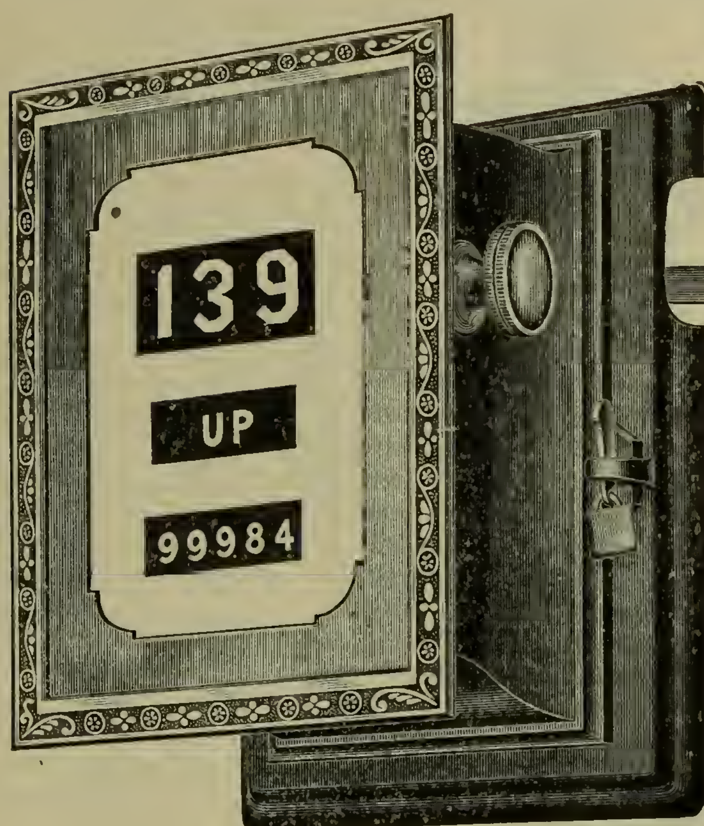


New Haven Car Register.

The sand hopper inside of the car and directly over the sand box, may be made of any form desired. It might be said that "one ounce of sand is worth a pound of cure," because wear and tear of the driving machinery, car wheels and brakes is greatly reduced by the use of a reliable sand box on tap, so to speak, when required. Any road can have a trial pair of sand boxes sent them on application.

THE NEW HAVEN FARE REGISTER.

The New Haven Fare Register, exhibited at the convention at Niagara Falls, has been adopted by the officers of many of the greatest and best equipped roads in the United States. The New Haven Car Register Company, of New Haven, Conn., have made it their object to manufacture fare registers whose accuracy, scope aud convenience would make them the superior of all others on the market. They have succeeded in interesting those concerns and corporations to whom the use of an accurate, reliable and durable, compact and complete register would be an actual saving of money and a source of satisfaction to their employees and themselves. These registers are made single, double or triple, and after instalment give absolutely no trouble and require no care.



'97 Model. New Haven Fare Registers. "Philadelphia" Dial.

The illustrations show three styles of fare registers generally used by traction and car roads. At the Niagara exhibit the different styles were shown to and inspected by thousands of visitors and convention delegates. These registers are not only serviceable but highly ornamental, being finished in enamelled iron cases, imitation mahogany, some with polished sycamore bases, the triple registers for instance) and otherwise oramented to please the eye as well as the conscience. At the Columbian Exposition, at Chicago, 1893, the highest award was given to the New Haven Car Register Company, and at the Cotton States and International Exposition, in Atlanta, 1895.

Eugene Munsell & Co., New York and Chicago, had a fine exhibit of "India and amber mica," in the sheet, as it comes from the mines, and in the form of segments for railway motors. Several sets of segments of various sizes were displayed beneath a large sign board on which was shown a full line of drop-forged copper segments made by the Van Wagoner & Williams Hardware Company, for whom Eugene Munsell & Co. are general Western selling agents. A souvenir in the form of a "mica mine" puzzle was given, and was probably sought for as much as any one souvenir at the convention. Parties not in attendance can secure these souvenirs by writing the company at either New York or Chicago. The exhibit was in the charge of Messrs. Brooks, of New York, and Charles E. Coleman, of the Chicago house.

The Mica Insulator Company, exhibiting in collaboration with Eugene Munsell & Co., of New York, Chicago and London, had a fine display of commutator rings, segments, tubes, plates and various forms of insulation. The company's new product, known as M. I. C. compound, was exhibited. Some ten different grades and styles of Micanite and Empire cloths and papers were shown. This was probably one of the largest exhibitions of insulating materials ever seen, and shows the progress the company has made the past four years in this branch of electrical industry. Mr. Charles E. Coleman, of the Chicago house, had charge of the exhibit. Mr. Franklin Brooks, vice-president of the company, was present one or two days.

American Exposition to be held in 1899 at Niagara Falls was well advertised at the Street Railway Convention with pasteboard medals containing invitations to call and visit the exposition at that time. A little newspaper advertising among the trades papers representing the various industries will do the exposition some good.

HUSTLERS AT THE CONVENTION.

Mr. Charles Y. Flanders, New York, represented Messrs. Morris, Tasker & Co., of Philadelphia, and the National Water Tube Boiler Company, of New Brunswick, N. J.

The John A. Roebling's Sons Company, Trenton, N. J., the well-known manufacturers of bare and insulated wire and wire rope, was represented at the convention by Messrs. H. L. Shippy, G. C. Bailey, M. R. Cockey and W. L. Doyle.

L. E. Frorup, of Schiff, Jordan & Co., 232 Greenwich street, New York, importers of special enclosed arc light Carbons, and manufacturers' agents, stopped at the Convention on Friday, on his way to Toronto and Montreal.

The Pettingell-Andrews Company, Boston, had on exhibition the Trojan leverage jack, which is used for emergency work and lifting car bodies without blocking. Mr. J. E. Wilson explained the advantages of this jack and interested many of the visitors.

The Garl Electric Company, Akron, Ohio, displayed its telephone system for street railways in operation. Mr. M. Garl, president, looked after the interest of his company, aud reported a large number of orders from railways for equipment with his telephone system.

The H. B. Camp Company, Aultman, Ohio, made an exhibition of the Camp underground and Camp insulating conduit. This conduit, which is now being extensively used, is steel armored and lined with vitrified clay or other vitreous material. Mr. A. L. Daniels represented the company.

Mr. F. Brooks, of Eugene Munsell & Co., of N. Y., was on hand and made a big show of micanite and mica in all conceivable shapes for electrical purposes. M. I. C. compound, their new production, was shown in a practical way; a strip of copper treated with the compound was riveted to a large card containing a full description of the great virtues of the new compound which they gave away to all visitors.

Messrs. Herrick & Burke, New York, showed a controlling electrical inspection system, for discovering any trouble arising in car equipments. This system is now being introduced. Mr. A. B. Hertick personally showed its workings.

The R. D. Nuttall Company, of Allegheny, Pa., showed a fine collection of gears, pinions, trolleys and brass goods. The new material, "steelite," from which it is now making electric-railway gearing, attracted much attention. The company was represented at the convention by Messrs. F. A. Estep, president; C. N. Wood, George W. Provost, Garson Myers, Scott R. Hayes, Charles Bartlett and A. S. Partridge.

The Consolidated Car-Heating Company, of Albany, N. Y., made a display of its electric car heaters, also electric heaters for general purposes. Mr. J. F. McElroy, consulting engineer; Mr. H. F. Ransom, Eastern agent and Mr. W. P. Casper, Western agent, represented the company at the convention.

The Storey Motor and Tool Company, Philadelphia, who make the popular enclosed motors and dynamos, was represented by its president, Mr. L. E. Storey.

The Central Electric Company, of Chicago, exhibited a fine collection of specialties—Garton lightning arresters, Bound Brook bushings, Pittsburg drawn trolley tubes, and a full line of overhead constructed materials. Messrs. W. R. Garton, manager of the railway department, H. E. Adams, Eastern agent, represented the company at the convention.

Peckham Trucks were to be seen all over Convention Hall and in use by the roads at Niagara Falls.

The William Scott Spring Co., of Philadelphia, showed all styles of car springs in their pretty booth in Exhibition Hall.

O. R. Sackett & Company, of Niagara Falls, had their automatic trolley catcher on exhibition, Mr. O. R. Sackett being in charge. Their device attracted universal attention on account of its many valuable features.

J. G. White, of New York, gave a dinner to his friends during the convention. He built the power line between Buffalo and Niagara Falls. Mr. White is an electrical contractor of considerable eminence.

Mr. D. C. Sweet, of Springfield, Mass., exhibited his car-wheel grinding machine, which has met with great success among street railway companies throughout the country.

Ed. G. Fisher represented the McMillin Woven Wire Fence Co., of Chicago, showed how to fence in trolley lines and gave away fine leather card cases.

The Hauffman-Conkell Co., of Canton, Ohio, had one of their automatic cut-offs and other devices for rendering falling trolley wires harmless on exhibition.

Geo. H. Buehler and W. R. Kerschner, of Columbia Machine Works, Brooklyn, N. Y., were at Exhibition Hall showing their superior trolley wheels, brakes and controller handles and special devices.

Frank Granger was on hand with his Corning brake shoe and aluminum nuggets of silver whiteness for delegates and friends. Frank is a popular boy and seems to have the knack of getting home with business.

Mr. D. F. McIntosh, president, and J. Partridge, of the Partridge Carbon Co., Sandusky, Ohio., were seen everywhere at the convention. They only needed to show themselves, as the Partridge carbon brush is used on every road of prominence. It cannot be surpassed for solidity, strength, lubrication and long life. Many have tried to compete but always failed for want of the necessary requirements and experience.

Mr. E. A. Lavens, of General Incandescent Arc Light Co., showed all styles of enclosed and plain low-tension and street railway arc lamps at the Cataract House during the convention.

John T. McRoy, 253 Broadway, N. Y., showed two styles of vitrified clay conduits such as are being installed along all the new tracks of the new electric roads of New York City.

The Ohio Brass Company, of Mansfield, Ohio, had a finely arranged exhibit. A fence formed of strain insulators was around the exhibit. A full line of headlights, track brushes, gongs, etc. A very neat souvenir pin, on which a little thermometer was coiled, was lavishly distributed. The representatives of the company present were Messrs. C. C. King, secretary, and A. L. Wilkinson, special salesman.

The Joseph Dixon Crucible Company, Jersey City, showed their new graphite wood-gear grease for trolley-car use. It reduces the noise from gears to a minimum, does not drip or ooze from the gear case. Messrs. J. H. Baird and A. L. Haasis distributed a variety of souvenir pencils.

Mr. Harold P. Brown, New York, had his E. C. A. rail bond for rebonding rails on paved streets, the plastic rail bond, the socket bond, and also various tools and appliances for use in the application. Mr. Harold P. Brown, of New York, and Mr. Franklin Sheble, of Philadelphia, were in charge.

The Mehling portable car safe and register was shown by Mr. Mehling, the inventor. Write for a circular illustrating how you can save 15 to 20 per cent. of the receipts that are lost daily on the cars by the use of this safe collector system.

The Electrical Age.

VOL. XX—No. 19 NEW YORK, NOVEMBER 6, 1897 WHOLE No. 547

Fig. 2.—"Finow" Canal Motor.

THE DEVELOPMENT OF ELECTRIC CABLEWAYS.

BY RICHARD LAMB.

Large expenditures of thought and money have been made to devise means of transportation that can disregard the insurmountable difficulties of some surface roads, such as excessive grades, too much bridging, or too great a cost for roadway. The natural suggestion has been to make the roadway through the air, and air-ships, flying machines and suspended cableways have been sought for to solve the problem.

Macaulay wrote, "Of all inventions, the alphabet and printing press excepted, those inventions which abridge distance have done most for civilization."

The most baffling problems we have before us today are those of abridging distances. With all the expenditure of life and money that has been put into the endeavor man has not as yet even been able to traverse this orb of the universe upon which we are living, and with untold riches as the goal; thousands stop within a few hundred miles of the Klondike, at the first short pass, to await a less hazardous season to risk the journey.

There are millions of feet of valuable timber in swamps standing within rifle-shot distance of convenient points of navigation that have been p actically unobtainable. The miry soil makes regular roadbeds too expensive, and it has been as impossible to get the teams into the swamps as to get the logs out. It was to solve this particular problem of abridging distances that my electric cableway was built.

I first built a cableway having portable iron bracket supports to attach to the trees, and an endless cable supported by sheaves upon the brackets. The cable was passed around a sheave which was driven by a steam-engine at one end of the line. This cableway worked well, and could haul logs for a distance of half a mile, which is farther than by any other method previously tried. I found that steam cableways are limited to straight lines, and as trees do not always grow in long, straight lines, I devised a means by which the car would replace the traction-cable in its sheave if it was dislodged in passing a bracket on account of the cable line not being straight. But this did not obviate the difficulty of having to select the route with reference to a straight line.

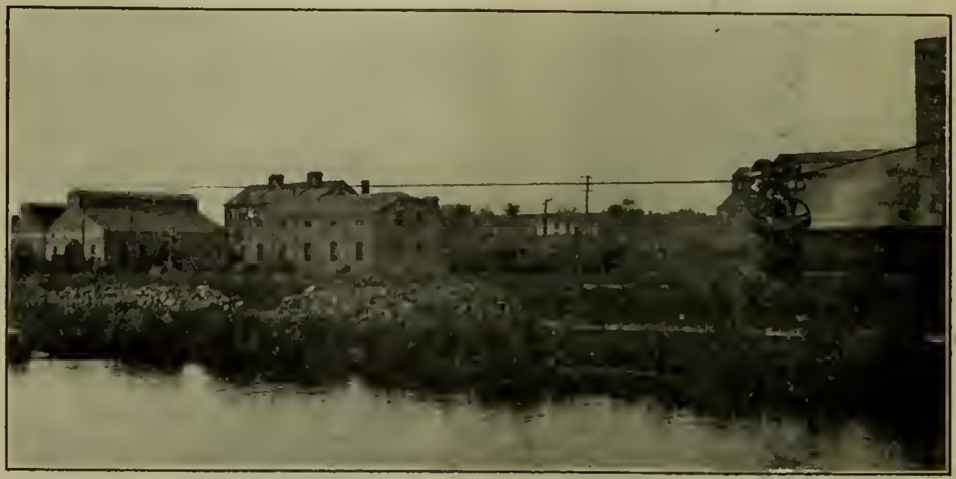


Fig. 3.—"Finow" Canal Motor on Cable Line.

Fig. 1.—First Test of Logging Motor.

In the excellent article on "Railways in the Air," published in a recent number of "The Strand," the writer states: "Two stout wire-carrying ropes are laid parallel on standards of wood or iron and then stretched tightly *in a straight line*. (These words are in italics.) Aerial rope-ways cannot run around corners." This condition is due to the fact that a moving cable has a tendency to work itself out of its carrying sheave, unless the line of the pull of the cable is straight. This fact suggested to me the necessity of the traction cable being stationary. It was a natural advance in the line of thought to note that if a sheave would transmit sufficient power to haul logs a distance of half a mile from the same, that it would be even more efficient if the power applied to the sheave was near by and accompanied the load on its travel. As

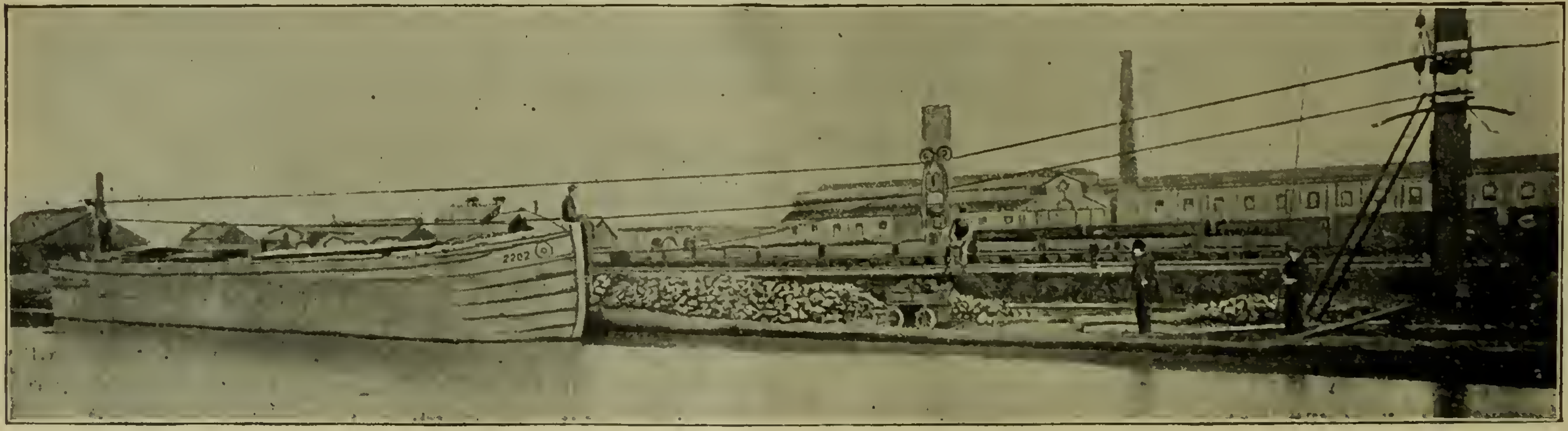


Fig. 4.—Hauling Canal-boat at Trenton, N. J.

an electrician, the cables of the steam rig naturally suggested to me conductors for an electric motor that would operate the sheave. Such a motor admits of the traction cable being stationary by passing it about the sheave several times and anchoring it at both ends; thus the motor winds in and pays out the cable on the principle of a capstan. The fact that the traction cable is stationary, and that the lower bracket catches the cable as the motor

Fig. 7.—Loaded Crane on Cable.

Fig. 5.—Test on Erie Canal ot Tonawanda, N. Y.

passes, makes a system of this kind the only one that can be operated upon concave and convex curved lines.

One of the essential features of the steam cableway is having the traction rope always parallel with the bearing the power is applied in a horizontal direction, the resultant force will neutralize the pull, and the carriage will stop. Cableways operated by horses upon the ground, pulling the carriage on the cable, have accordingly been

Fig. 6.—Motor used at Tonawanda.

Fig. 9.—Logging Motor Working in Swamp.

cable. The disregard of the direction of forces in other cable systems has been one of the main causes of their failure. On approaching a support the cable naturally sags and the carriage has to be propelled up an incline. If the grade of a cable is steep, as it is in practice, and inoperative. It was important, therefore, in the electric cableway to have the traction cable always parallel with the bearing cable. Supposing the incline of the cable is raised until it is vertical, we would then have an elevator; the bearing cable being the guide and the traction rope the hauling rope, the motor being on the elevator car instead of at the top or bottom of the shaft. It is this feaure that enables this system to operate on grades that would be impracticable by other methods.

This system consists of a carriage with grooved wheels in tandem that move upon a cable or suspended trackway. From this carriage is hung a frame, pivoted to the carriage so that it can maintain a vertical position regardless of the grade of the track. This frame holds an electric motor, preferably of an ironclad cylindrical type. The motor is geared to an elliptically grooved sheave. A steel cable is wrapped around this sheave two or more times and is anchored at both ends. For the sake of economy in conductors, the upper or bearing cable is insulated from the lower or traction cable and is used to carry the electric current. The carriage is insulated from the suspended frame and motor. An insulated wire is attached to the carriage and conveys the current to the rheostat. The other pole of the rheostat is connected with a convenient part of the suspended frame. The rheostat is designed to control the speed and reverse the current. A circuit breaker is put in circuit. Tracing the current from the generator, it passes along the bearing cable to the carriage, thence through the insulated wire, through the rheostat, to the frame of the motor, thence through the traction cable back to the generator. At intervals along the line, connection is made between the traction cable and the ground. A bar of copper-coated iron is buried at the foot of a tree or post to which the cable brackets are attached. A well bonded copper wire extends from this ground plate to the lower bracket, upon which the traction cable rests. In swamp and canal service the plate is buried well into the moist earth. A most marked difference in the resistance is noted when the ground connections are disconnected. When connected, the resistance is the same as if the traction cable was the same size as the bearing cable.

In making the first saddles to support the cable they were designed for movable brackets, which can be easily put upon trees and removed to other trees when the line is changed to a different location. These saddles have a U-shaped clamp that goes over the cable and is bolted down with wedge-shaped bolts. Under the saddle is a petticoated recess, designed to shed rain water from the insulation placed between the saddle and the bracket to keep the current from grounding or short-circuiting.

This develops a new feature in insulation. It appeared that many of the materials ordinarily serviceable for insulating were not available, owing to the fact that often a rolling load of 10,000 lbs. or more passes over the brackets, producing a grinding and crushing effect.

Lava, hard rubber, micanite, shellac, mica and its products, glass, porcelain, ozite and all products of resin, proved to be too brittle. Vulcanized fibre was finally used and proved quite satisfactory for a time. As only 220 volts are used in logging plants, and as it is an advantage from a construction standpoint to have the insulation as thin as possible, sheets of fibre one-eighth of an inch thick were used. It was found that, although this insulation was protected from the rain, by being shelaced and covered by a petticoat, after being exposed for some time, it would lose considerable of its resistance, and while some of the brackets could be passed by the electric motor, the heavy load on others would cause a short circuit through the insulation. This was averted by painting the saddles, brackets and fibre with insulating paint, and by increasing the thickness of the insulation to one-quarter inch, and using fibre that had been solidified under unusual pressure. This was found to work all right.

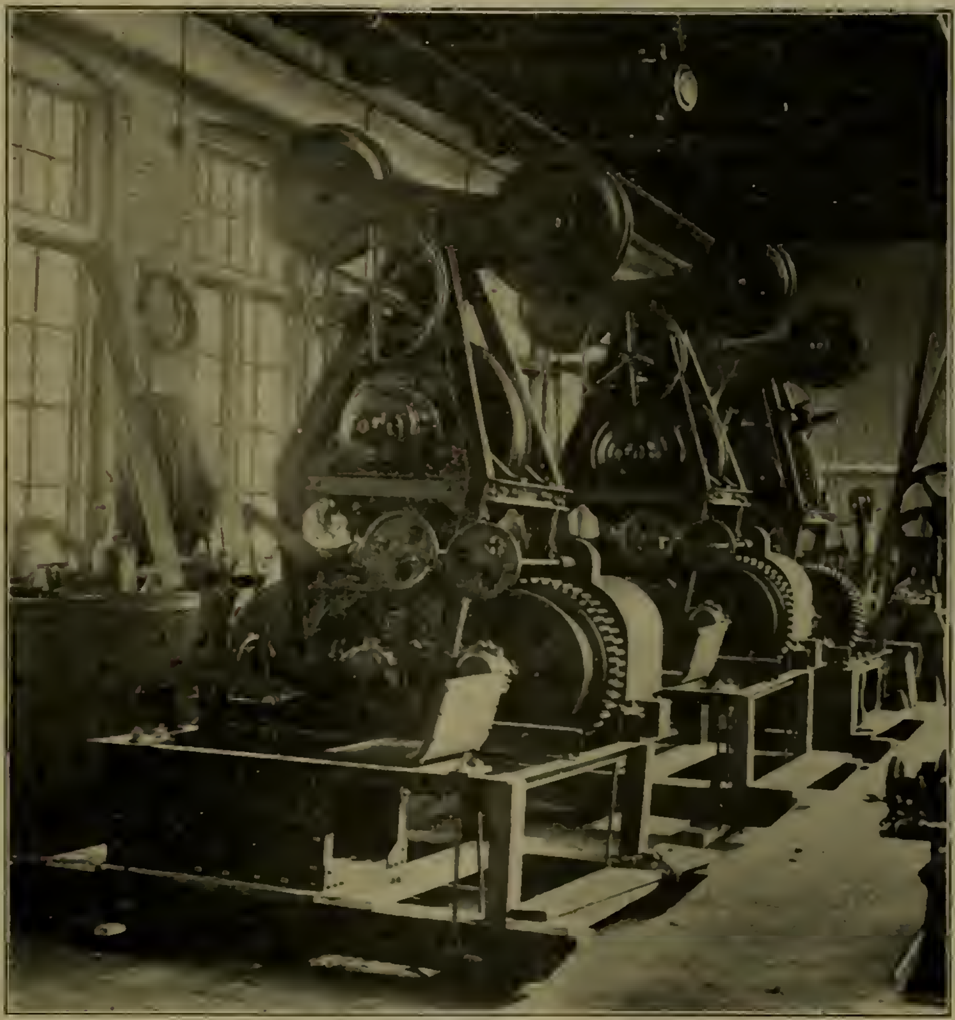


Fig. 8.—Crane Motors in Shop.

The saddles for the plant for the Erie Canal towing test, referred to hereafter, were made so that the tread of the bearing wheels would leave the rope, and the wheels would pass over the saddles on their rims, guided by flanges cast upon the saddles. On curves these flanges were made concave or convex as required. These saddles worked excellently, and the motor passed over them easily and satisfactorily. These brackets were insulated with ozite and vulcanized fibre, and painted with insulating paint.

Work in swamp logging demonstrated that small, short saddles are all that are needed, even for deflections in the line of from 20 to 25 degrees. The saddle was much simplified by attaching to the brackets an insulated cone-shaped pin, over which the saddle is placed, by having a cone-shaped recess in the under part of the needle to fit the pin. This recess also acts as a petticoat to protect the insulation. The question of insulating the cone-shaped pin was an important one. Vulcanized fibre could not be moulded upon the pin. A material was needed that, while having a high resistance, would adhere to the pin, and that would stand a great crushing strain. It should be preferably non-hygroscopic, and show a minimum absorption of water.

Insulated trolley hangers were secured, that showed an insulation resistance measured under 150 lbs. vertical stress above 300,000 megohms, and after sprinkling with water one-half hour, measuring immediately above 300,000 megohms. After again sprinkling with water twenty minutes, they measured immediately above 300,000 megohms.

Tested for absorption after soaking in the water four days showed weight of 312.9 grammes; weight as received 312.7 grammes; absorbed 000.2 grammes. (These tests by Stone and Webster.)

In the insulated stud made for the saddles, the breaking strain measured over 35,000 lbs. At that point the insulation showed no signs of giving way, and the same stud was subsequently used for regular work. The instrument used for measuring the crushing strain measures only 50,000 lbs. It was thought best not to test above 35,000 lbs., which was more than needed in any service it would be required to perform. The pressure was put upon the top of the saddle and the bottom of the stud. As the thickness of the insulation is over twice as great on these saddle pins as was used on the trolley studs tested, the resistance should be at least over twice as great. (This test by Pope Mfg. Co.)

The best steel cables for cableways are the interlocked and patent locked wire rope. These are almost as compact as solid bars of steel, and yet can be easily coiled by hand in coils four feet in diameter. A simple coupling is used to connect the cables. The wheels of the car pass over these couplings so smoothly that the rider on the motor scarcely notices the fact. These points of connection are as strong as any section of the cable. An advantage in these interlocked cables is that they present a smooth surface of comparatively flat steel, which wears a great many times longer than the ordinary cables whose surfaces present round wires that wear through and unravel. These cables are made to bear much greater strains than the ordinary cables, and being so nearly solid they make much better electrical conductors.

CONVENTION NOTES.

The Newspaper Vending Machine Co. attracted considerable attention. This novel vender was kept in constant motion showing the ease with which papers can be sold in street cars without the use of attendants and the annoyance of boys walking over your feet.

Morrin Climax boilers, made by the Clambrock Steam Boiler Co., Brooklyn, N. Y., were shown in photo views of their largest plants and explained by Mr. Chas. H. Sammans and T. F. Morroa, at Exhibition Hall. Their souvenirs were in great demand.

Leonhardt Wagon Manufacturing Co. of Baltimore, Md., showed their popular style of Trolley Repair Wagon, which attracted great attention from delegates.

Messrs. McCardell, West & Co., Trenton, N. J., had on exhibition the Trenton trolley wagon. Mr. J. R. McCardell represented the company and interested many of the railroad men by illustrating the various uses to which the wagon could be put.

The John Stephenson Company, New York, pioneer builders of street cars, was represented by Messrs. D. W. Pugh and J. A. Tackaberry, two of the best known and most popular men in the business. The Stephenson Company distributed a neat memorandum book as a souvenir, containing illustrations of the earliest and latest styles of street cars.

The H. W. Johns Manufacturing Company, New York, displayed a line of electric heaters in operation for both panel and cross-seat cars. The regulating switch for these heaters attracted much attention, three degrees of temperature being obtainable. A number of appliances for electric-railway work were also shown, together with the new toggle-clamp pole insulation, and the Luscomb clips for figure-8 trolley wire. Mr. J. Emery Meek and Mr. H. H. Luscomb represented the company.

Pocket-books were distributed by Messrs. G. H. Hale and A. C. Woodruff, representatives of the Consolidated Car Fender Company, of Providence, R. I. The car fenders manufactured by this company are in use in more than fifty cities.

J. C. Dolph & Company, of New York, had on exhibition samples of their copper and mica segments for railway motor commutators, favorably known among the street railway fraternity. Mr. Dolph, the genial head of the firm, was in attendance.

Mr. F. A. Estep, president, and G. W. Provost, the Pittsburg agent and representative, were in charge of the exhibit of the R. D. Nuttall Company, of Allegheny, Pa. This company are the manufacturers of "steelite," used in the making of their celebrated electric railway trolleys, gears, etc. This article is a special composition, having all the properties of steel, both from its appearance and also from physical tests.

The Garl Street Car Telephone, exhibited by the Garl Electric Company of Akron, Ohio, is a novel electric railway adjunct and was the subject of much favorable criticism by those in attendance. It is manufactured under patents owned by the above company, and by its means communication from the car direct to headquarters is effected.

Herbert I. Sackett, 820 Main street, Buffalo, N. Y., general construction supplies, has been constructing electrical engineer for all kinds of electrical work for some years. He was connected with the old firm of F. P. Jones & Co., and associated in the installing of the plant in the Brisbane Building, Buffalo, Pitts Works, and other large isolated plants. Mr. Sackett is sole agent for the Buckeye lamps, and Jandus long-burning arc lamps, for Buffalo and vicinity. Mr. Sackett intends to hustle with all the energy a young, expert electrical engineer can put into a growing business.

Mr. W. C. Wood, of the New York Switch & Crossing Co., Hoboken, N. J., exhibited one of their Electric Switches in operation, on one of the Niagara electric roads, and it was no doubt the most novel exhibit at the convention. Mr. Wood took orders for a number of the switches; every electric railway man who saw it was greatly pleased and a foundation was laid for some big orders.

The Standard Air-Brake Company, of New York, exhibited a No. 27 Brill truck equipped with the company's duplex compressor, direct axle-driven, and on another truck of the same make was shown the geared compressor. The Standard Company's hollow spindle brake cylinder, with fulcrum on the back head for equalizing double-track brake rigging, was also shown; as also the automatic current controller and their water and dust-proof electric compressor. The company was represented by Messrs. E. J. Wessels, E. H. Dewson, Jr., George E. Pratt, C. B. Fairchild, H. B. Taylor and E. E. Robinson.

Messrs. Matlock and Harrington, of Harrington Rail Bond Co., of N. Y., were hustling about for business; they showed by models how they bonded rails and referred to a model of the same in Exhibition Hall.

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CONTENTS.

AERIAL ELECTRIC CARS.

The transition from primitive methods of traction to those of a more complex character, is the result of a series of well blended efforts which reach back to the days of Rameses and his war chariots and forward to the glorious civilization of the nineteenth century. The evolution of all forms of vehicles spans the known history of mankind and finds its present termination in such modern contrivances as the automobile or recently improved cableway. It is this last which interests us and brings before our notice certain possibilities in its use and future development. Steam-railroad corporations have found that in the construction of their tracks a great item of expense is swallowed up, particularly when tunnelling and winding mountain ascents are made. All traction companies, whether steam, cable or electric, whether reaching across the continent from ocean to ocean or limited to a certain and well defined locality, must meet the expenses due to the laying of a roadbed, their rolling stock and the care which must be given to each. Were it possible to carry passengers or convey freight from New York to Chicago, St. Louis or San Francisco, without it being necessary to lay tracks, the expense of transportation would be so greatly reduced that roads could well afford to divide the present price into one-half.

In the construction of cable ways or telpher lines, it is necessary to erect substantial posts or supports and string the cable and electrical conductors along from one to the other. Prof. Fleming Jenkins seems to have been the originator of the telpherage system. It practically consists of a steel wire cable upon which are supported vehicles driven by electric motors, the current operating the same received from an additional conductor acting in conjunction with the cable proper. A system of this kind is in use at Glynde, England, which ttansports cement from pits to a railway shunt previous to its being carried to the cement works. The great saving of expense in the erection and operation of telpherage systems has recommended them to the attention of engineers.

The avoidance of track laying is a noteworthy feature and becomes a great advantage in cases where it is found impossible or too expensive to lay a track, as for instance over a rugged mountain road, down a somewhat abrupt declivity or over a long stretch of loose and shifting earth. According to certain authorities the construction of a telpher line or cable way is most successfully carried out when only one cable and no additional conductor is used. The Glynde telpher line, above mentioned, makes use of a single conductor which represents sections of an electrical conductor which alternate from side to side, the contacts of the car always touching both a positive and a negative pole. By means of this arrangement a single pair of cables can be used for operating aerial cars running in opposite directions. In past years, Mr. Daft and Mr. Vandepoele constructed short roads of this kind which met with but very little attention from practical men.

With the exception of these two and possibly a few others very little has been done in cable ways in America. An article in this issue on that subject will probably revive interest and show the practical possibilities and direct use to which it has and can be put. High speed is possible and practical on a cable way if light weights are carried, but it is necessary to reduce the speed or use a rail instead of a cable if the velocity is maintained. This axiom must be remembered in all cases where quick transit is desired. It is impossible to transport a vehicle at a high speed from one point to another unless a perfect rail or line is provided. It will be found upon investigation that th e expense of following out this precept is a great veto to the attempt. With the high speed of a hundred or a hundred and fifty miles an hour it is almost impossible to stop a car with any degree of abruptness and not wreck a section of the road or line. For passenger purposes it seems rather a risky undertaking to build an aerial road running at a high speed. With a well constructed miniature system it might be possible to whirl our mail across the continent at enormous speed, but before this is seriously attempted very careful experiments would have to be made to make such a novel method of transportation certain and effective. At present the matter contained in the article on cable ways presents the subject in a definite and interesting manner to the reader and is worthy of great commendation.

The return trip from Brighton to London in a recent contest resulted in another victory for the winner of the Paris-Marseilles race, a phaeton of the British Motor Syndicate being second, and the "Present Times" car third. The Panhard-Levassor carriage accomplished the journey in three hours and fifteen minutes, deducting stoppages, thus averaging a speed of 16 miles an hour. There was no accident of any kind to mar the success of the trip. The second carriage arrived only five minutes after the first and the third half an hour later.

The much-vexed question of what name they should bear in England seems to have been decided in favor of "motor cars."

An electric landau caused some sensation on the London streets this week. It demonstrated the fact that the horselees carriages can be steered through the crowded thoroughfares with facility. This vehicle was fitted with the Bersey system—the same adopted by the London Electrical Cab Company.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.) LIQUEFIED AIR.

Newark, Sept. 24, 1897.

Dear Sir: As a member of the American School of Electricity, I would like some figures showing how much is saved by the use of liquefied air in or around conductors. I am of the opinion that considerable power is wasted, but have not seen any data showing the facts.

Thanking you in advance I remain,

Yours respectfully, Member of A. S. E.

(A.) The saving can be shown by a consideration of any large transmission plant. In a line stretching ten miles allow a ten per cent. loss:

If 1,000 H. P. is transmitted, 100 is wasted.
If 10,000 " " " 1,000 "
If 100,000 " " " 10,000 "

Liquefied air would reduce this loss to at least five per cent, giving us instead of—

100 H. P. wasted, only 50
1,000 " " " 500
10,000 " " " 5,000

The cost of one H. P. per annum is about $25.00 to the producer; with water power possibly less. With a large plant, then—

50 H. P. cost $1,250, which is saved.
500 " " 12,500 " "
5,000 " " 125,000 " "

In large plants the cost of a liquefied air equipment would probably be less than the cost of the power saved; the balance would show its practical value in dollars and cents.

(Q.) SWELLING OF COMMUTATORS.

Baltimore, Sept. 25, 1897.

Dear Sir: The commutator of the dynamo I have in charge is sparking of late to such an extent that I have been forced to shut down. It seems to have changed its shape and to have become irregular in surface. The segments project and the mica sticks out. Kindly let me know what to do and why this has occurred.

Yours truly, G. Rasmusen.

The commutator has swollen because the insulation was not properly put on; the segments were not placed under pressure, and the baking, if there was any, was too short. You will have to apply all these remedies:

Place the commutator in a clamp and press the segments into place. The clamp referred to is an iron ring with bolts pointing inward arranged around it.

Bake the commutator while in the clamp for a day; then turn it down in the lathe: it will probably be all right after this and give no trouble.

NOVEL ELECTRIC EFFECTS AT THE EXPOSITION.

Omaha, Oct. 11.—The electric exhibit at the Trans-Mississippi and International Exposition will reveal many interesting features. Recent discoveries in the field of electricity by Lord Kelvin, the undisputed leader in the field of applied and theoretical electrical science; Edison, the "Wizard;" Professor Elihu Thomson, Steinmetz, Trask, Peabody and others will be illustrated. Mr. Louther Stieringer, of Schenectary, N. Y., who designed the electrical fountains at the World's Fair, has been engaged as consulting electrical engineer of the Trans-Mississippi Exposition.

The illumination feature of the exposition will reveal some magnificent effects, arranged by Mr. Stieringer, whose recent experiments in the illumination of the whirlpool rapids at Niagara Falls, by the aid of powerful searchlights, proved so interesting and successful to the members attending the convention of the Edison Electric Illuminating Companies. Mr. Stieringer contemplates further experiments along this line in the night illuminations at the Trans-Mississippi Exposition, principal among which will be an electric garden, showing the various hues and tints of the flowers by means of colored screens and powerful searchlights, and demonstrations with searchlight effects on moving waters; the Missouri river for a long distance. and also the bluffs on both sides, showing strange and wonderful effects developed by the aid of electrical science.

The interests and co-operation of the American Institute of Electrical Engineers, and the National Electric Light Association, the most important bodies of electricians in this country, who will hold their meetings in Omaha during the exposition season, will be a strong incentive for a complete demonstration of all the applications of electricity and its branches. Special features will enbrace electricity in agricultural work, long-distance power transmission, recent applications of electricity for cooking, ironing and heating pnrposes, and the transmission of intelligence by herzen waves.

Professor R. B. Owens, of the University of Nebraska, commissioner for the electrical section of the exposition, has secured the following exhibits: Direct current, single and multiphase motors for stationary use, railway apparatus, electric mining apparatus, high-frequency and high-potential apparatus, telephone and telegraph apparatus, electric wire making machinery, electro-chemical processes for the reduction of metals, searchlights, electric supplies and specialties. Professor Owens was a member of the jury of awards at the Columbian Exposition, and his relations with electrical manufacturing interests and electrical engineering have served to make his efforts and wide acquaintance of much usefulness in securing exhibits and enlisting the attention of manufacturers and inventors in all parts of the country.

Application has been made and space assigned to the following electrical firms: The Walker Company, the Fort Wayne Company, the General Electric Company, the Western Electric Company, the Wagner Electric and Manufacturing Company, the Crocker-Wheeler Electric Company, the Okonite Company, Ltd., the Cutter Electric and Manufacturing Company, the Keystone Electrical Implement Company, the Cutter-Hammer Company, Elmer G. Willyoung and Company.

The field of electricity insures a first-class exhibition, the new electrical iuventions and improvements developed of late in America and in Europe indicating a far greater knowledge of electrical science than the world has ever before known. The Trans-Mississippi Exposition in its electric exhibit is intended to bring together the finest demonstrations ever assembled at any exposition.

PERFECTED STEREOPTICONS.

J. Lathrop Allen, dealer in stereopticon supplies, 217 Centrè street, New York City, handles a very fine line of apparatus, including electric lanterns, hand feed and automatic arc lamps for theatrical lantern slide effects, dissolving keys, regulators, etc. Mr. Allen has been manufacturing these various lines of goods for many years and is a thorough mechanical and electrical engineer. The use of stereopticons has become so wide. spread that no institution of instruction can afford to be without a modern, fully equipped lantern. Mr. Allen has spent a great many years and considerable money in gaining a thorough knowledge and practical experience in this particular line of work.

His stereopticons are simple in construction and easily operated, rarely giving cause for complaint. We may mention in addition that Mr. Allen makes rheostats of all capacities for electric lamps.

CONVENTION NOTES—Continued.

Milo G. Kellogg, of Chicago, took out 124 patents on multiple telephone switchboard appliances, issued Oct. 26. In the history of the patent office this effort stands first in that particular line.

F. H. Newcomb, 1 Washington place, N. Y., had a show-case full of fine uniform caps.

Samuel Barnes, the original circuit breaker inventor, was at the convention. He has travelled throughout Europe and disposed of some valuable patents. The great Lindell Street Railway of St. Louis have him as their electrical engineer.

E. I. Richards, manager Hudson River Power Transmission Co., of Mechanicsville, N. Y. A large water power plant is to be installed by this company.

Wm. H. Tenbroeck, with his diamond trucks, was always to be found on duty and watching for delegates with orders in their pockets.

The Forest City Electric Co., of Cleveland, Ohio, distributed a handsomely cloth bound book containing full descriptions and illustrations of their well-known rail bond. We cannot go into details here, but advise our readers to get one of these books, as they are full of information useful for every one interested in electric railway work.

W. H. Delaney represented a new car company up the Hudson. We wish him success.

The Puritan Electric Company, formerly of No. 150 Nassau street, New York, has removed their office to the Bowling Green Building, No. 11 Broadway, New York, where they have increased facilities for handling the Alternating-Enclosed Arc Lamp which they manufacture. This change was rendered necessary by the large increase in business which they have received since the fall season commenced, and which has taxed their facilities of production to the utmost.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of the Institute, held October 27, a paper was presented by Mr. Richard Lamb on the "Development of Electric Cableways," describing the use of the electric motor for logging and canal-boat haulage. It was fully illustrated by lantern slides. The paper was discussed by Messrs. Bijur, Henshaw, Keith, Leonard, Mailloux, Martin, Sachs and Wolcott. About seventy-five members and guests were present.

At the meeting of the executive committee in the afternoon the following Associate Members were elected :

Balsley, Abe, chief electrician, Terre Haute Electric Railway Co., 514, 6½ street, Terre Haute, Ind.

Balcome, Herbert A., with The Eddy Elec. Mfg. Co., Windsor, Conn.

Child, Chas. T., editor, The Electrical World, 253 Broadway, New York.

Goltz, William, Hathaway Building, Milwaukee, Wis.

Jones, M. E., contractor and student in senior class, Cornell University, Ithaca, N. Y.

Le Clear, Gifford, electrical and mechanical engineer, Partner Densmore & LeClear, 7 Exchange place, Boston, Mass.; residence, Cambridge, Mass.

Thompson, Sylvanus P., Morland, Chislett Road, West Hampstead, London, N. W., England.

Williams, Geo. Henry, district superintendent The Edison & Swan United Electric Co., Ltd., 134 Royal avenue; residence, Culmore, Glenburn Park, Belfast, Ireland.

Wotton, James A., electrician, Southern Bell Tel. & Tel. Co., P. O. Box, 218 Atlanta, Ga.

The following Associate Members were transferred to Full Membership :

Sampson, F. D., manager, Charlotte Electric Light and Power Co., Charlotte, N. C.

Davidson, A., cable engineer and electrician, Central and South American Telegraph Co., Lima, Peru.

Decker, Edward P., electrical engineer, New York Telephone Co., 18 Cortlandt street, New York.

Ralph W. Pope, Secretary.

STORAGE BATTERIES.

LESSON LEAVES FOR THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The subject of storage batteries is of as much commercial as scientific interest. Not only have millions of dollars been spent in their introduction, but a like sum has found its way to the laboratory, in which many have sought to improve it to a point of commercial excellence.

What a Storage Battery is.—The storage battery, or, as it was called in earlier days, the Planté or Faure cell, is not a cell in which strictly speaking, electricity is stored ; but it is a means by which electricity causes certain chemical changes in lead elements that produce all the phenomena of a primary cell upon discharge.

Electricity is not stored, but chemical energy is stored, and therefore the problem of the perfection of the storage battery is almost exclusively a chemical one. Let us review the incidents connected with the development of the storage battery.

Discovery of the Principle.—When a pair of platinum electrodes are allowed to dip into acidulated water and small tubes are arranged to collect the gas they dispel by decomposition, a galvanometer connected in circnit will show a return current when the current from the battery or dynamo is stopped.

The platinum electrodes dipping into the liquid accumulate two gases, respectively oxygen and hydrogen. It seems that these two gases act towards each other as copper and zinc, or the electrodes of any primary battery. The return current observed is therefore due to the gradual recombination of these two gases into water, and the chemical union creates a reverse current which flows through the wires and affects the galvanometer.

Polarization, which is practically the accumulation of a gas or gases that oppose the passage of a current in a primary cell, is therefore the cause of the secondary or return current in a storage battery.

With two platinum plates in dilute sulphuric acid the current of polarization gradually increases up to a pressure of 2.6 volts.

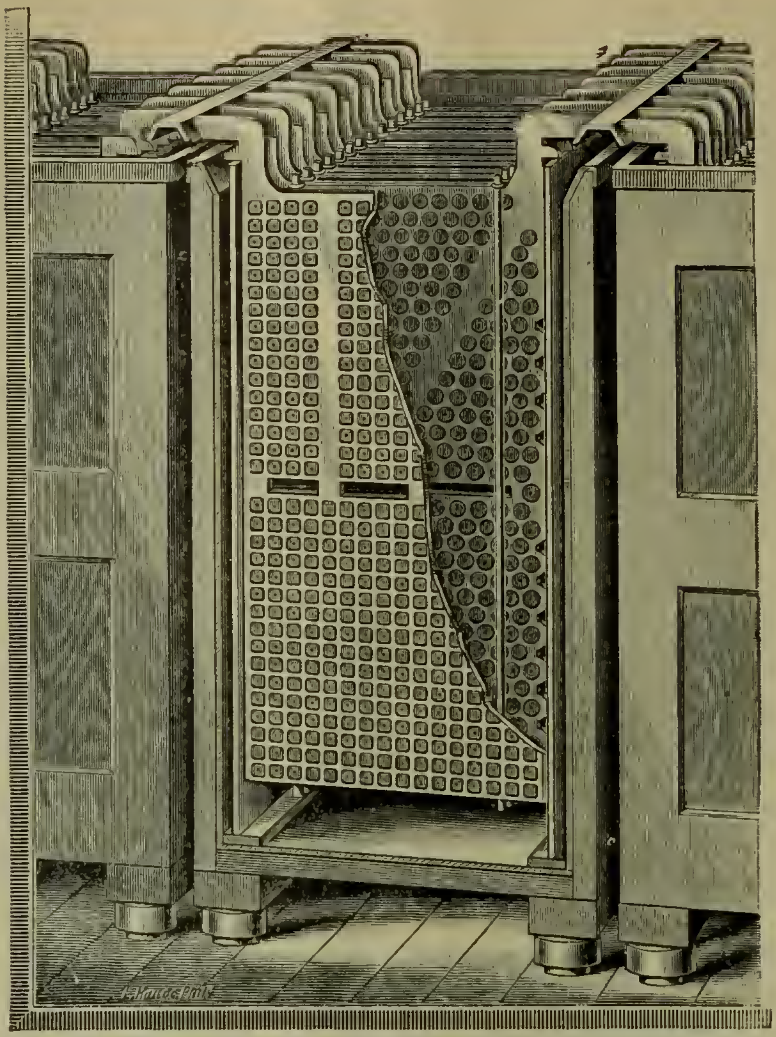
It is therefore a back electrical pressure which opposes the original current, and manifests itself when the first current is discontinued and the second allowed to circulate freely.

Size of Plate.—It is very evident that the larger the platinum plate the greater the amount of gas given off and the greater the capacity of the plate for current. The size of the plate, therefore, limits the amount of gas that is given off and the capacity of the cell.

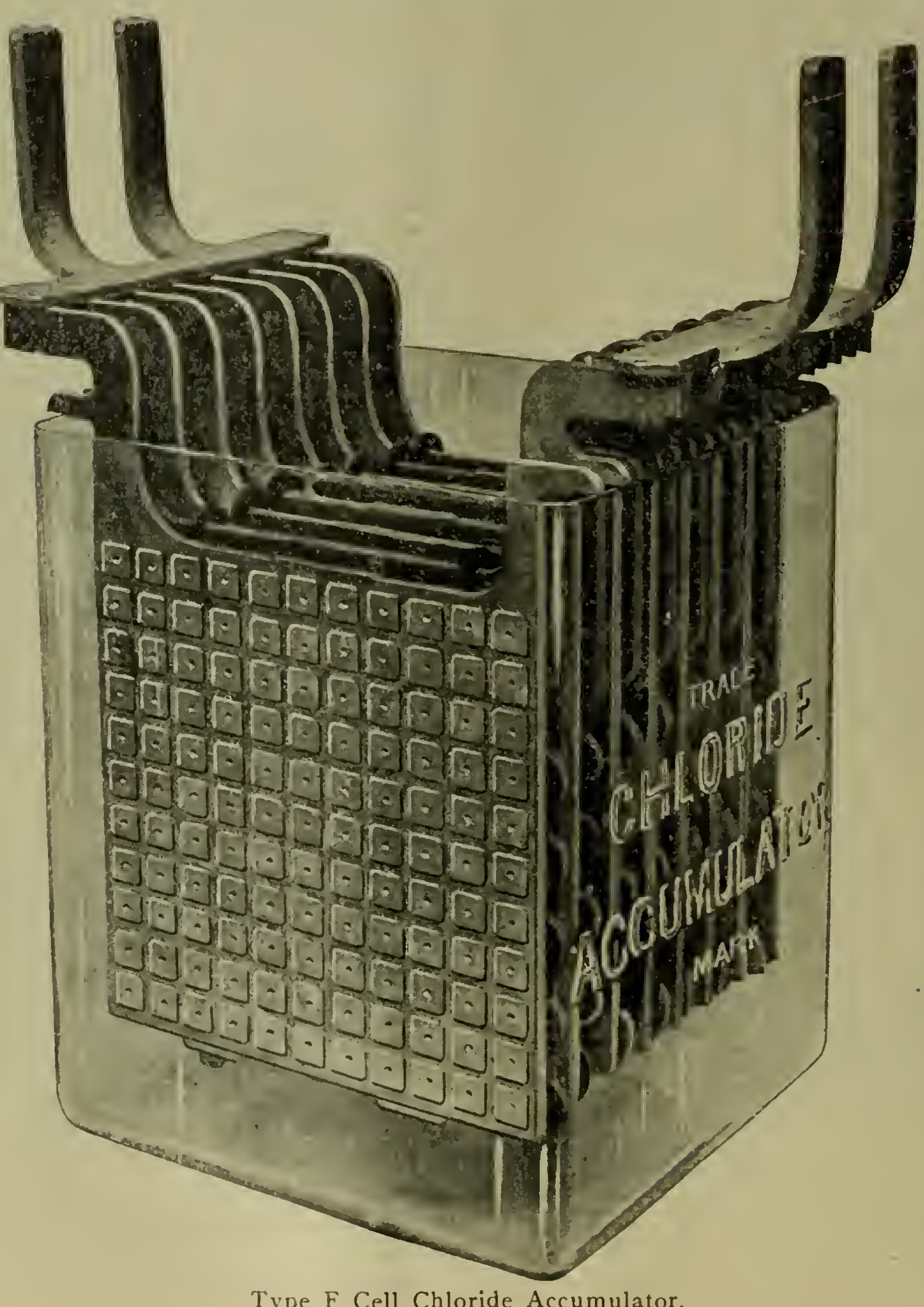
Ritter discovered that any two pieces of metal would accumulate chemical energy by this means, which they would afterward give out in the form of electrial energy. The two pieces of metal become independent sources of current after being disconected, and act to all intents and purposes like a voltaic cell.

Planté made a series of experiments, the result of which showed that of all the metals experimented upon, lead had the greatest capacity for polarizing effects, and therefore made the best form of secondary cell.

The Planté cell is made by taking two lead plates, im-

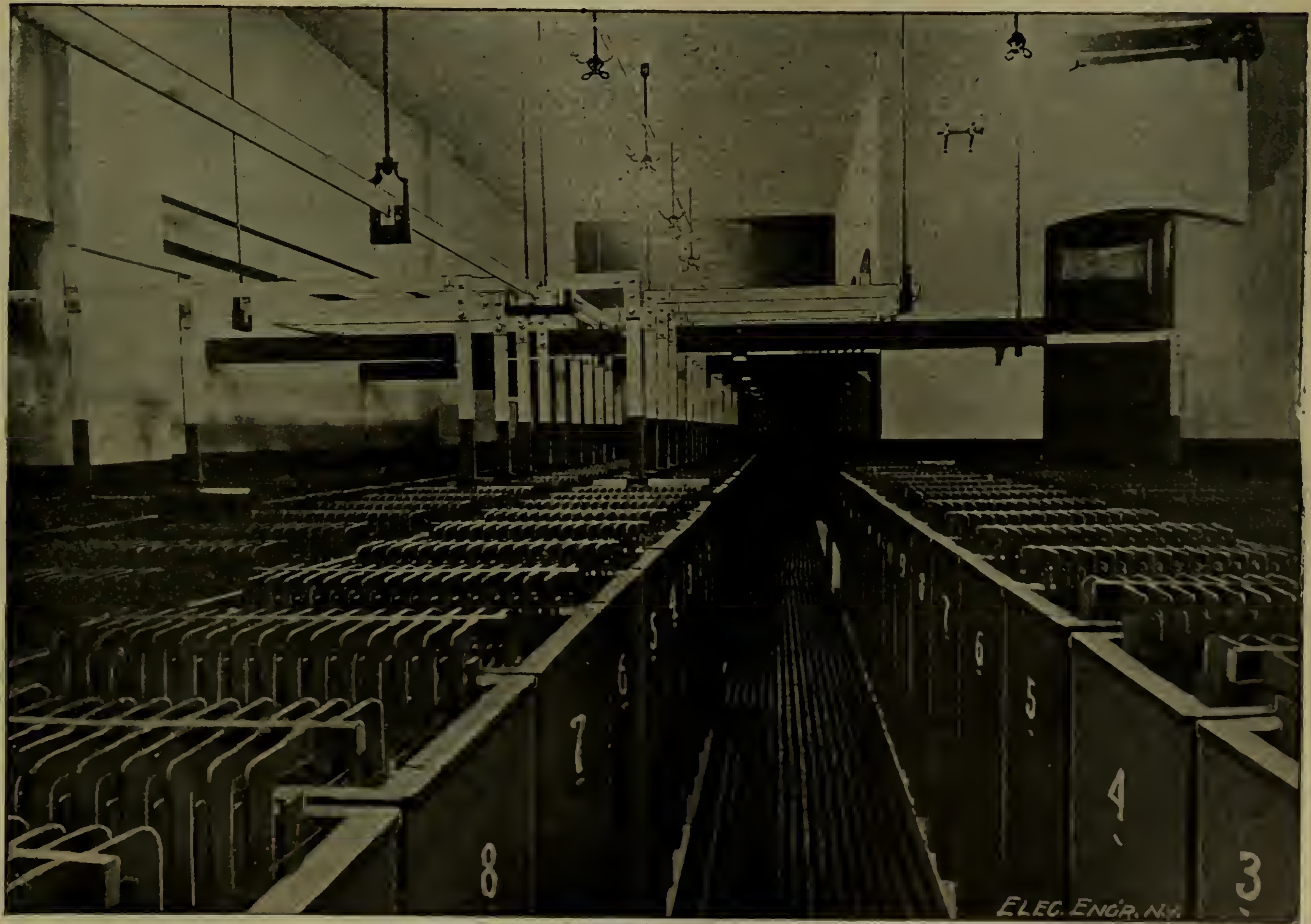


Central Station Cell Chloride Accumulator.



Type F Cell Chloride Accumulator.

Boston Edison Station. The First Independent Battery Station in America of Chloride Accumulators.



Bowling Green, N. Y., Edison Station of the Electric Storage Battery Company, mersing them in dilute sulphuric acid and applying a strong current.

Eventually a thick deposit of lead oxide of a reddish color forms on one plate and a grayish deposit on the other. In the course of time, by continued charging, these deposits become deeper and deeper; the reddish deposit penetrates to the very core of the plate and transforms it entirely, increasing its capacity for continued discharge and volume of current.

The positive plate is the reddish plate, upon which has formed an oxide of lead. This deposit is called peroxide of lead and is of a spongy nature. The more spongy it becomes, the better its qualities as a reservoir for chemical energy but the poorer it becomes mechanically, as it disintegrates and eventually becomes difficult to handle.

The negative plate is of grayish color, and likewise becomes an oxide of lead; the positive plate, a higher oxide than the negative. In fact, the negative is covered with a coating of dioxide of lead.

Forming.—It is necessary in order to get the cell into full working operation to have the cell *formed*, as the expression goes.

The plates must respond chemically to the influence of the current and absorb as much electrical energy as possible of that supplied to them. The thicker the oxide in each plate, the more able do they become to perform this function. It takes a very long time to get *lead* plates into this condition, but this has been overcome by Faure.

The Fauré battery is merely a modification of the Planté cell. Faure very carefully considered the question of forming the plates and concluded to try the effect of oxides applied artificially to them.

It seemed to him that time would be saved and all the long period of forming (which covered an interval of several months) reduced down to a few weeks. By experiment he found his reasoning to be true, and storage batteries became one of the most popular inventions of the age.

Red lead was applied to the positive plate, so called because when being charged the positive current was sent into it, and when discharged, the positive current left it. This was pasted to the plate by means of glycerine or some other liquid capable of forming it into a paste.

When the current was applied to this and the negative plate, the red lead gradually changed into peroxide of lead, became spongy and absorbed electrical energy to a great extent.

Litharge was applied to the negative plate, or that intended to be such, and, as above, a chemical reduction took place, the applied oxide becoming active as dioxide of lead.

Grids were formed of lead moulded into shape, and the lead oxide was applied to them in the form of paste.

A great patent suit was instituted against infringers by those claiming the exclusive right to apply paste to grids. One of those attacked were the Julian Company, who exercised considerable ingenuity by compressing powder into the grids, which was the most effective way to apply the oxide, instead of using paste—the main point at issue.

Inoxidizable grids were a valuable addition to the art, because the ordinary plate became mechanically weak by oxidation. The use of an alloy of antimony, lead and mercury gave the Julian Company a grid of the greatest value.

The Chloride Accumulator is practically a Planté cell. Pastiles of lead in a very spongy state are formed by pressing together chloride of zinc and lead; afterwards dissolving the zinc and leaving a spongy mass of lead in its place.

The Chloride Accumulator Co. use a grid with circular holes, in which in their latest form of plate they compress spirals of corrugated lead; this is their positive plate.

The objects to be kept in view in the manufacture of accumulators are, with regard to the plates—

Large surface,
Mechanical strength,
Long life,

by which means a great storage capacity may be obtained as well as commercial success in their introduction.

Buckling, which formerly was caused by the weakness of the plates, is due to a sudden discharge of great volume. The gases occluded by the oxides expand or escape so quickly that the plates become distorted or bent. Plugs are driven out and the battery may be either ruined or temporarily disorganized.

Sulphating is caused by the plates remaining in the acid solution too long uncharged. A thick, whitish coating of sulphate of lead forms which is very difficult to get rid of, except by heavy charging.

The voltage of a cell when fully charged approximates 2.1 volts; it falls during discharge to about 1.9 volts, or less. It is not wise to let a cell fall below this in pressure as a heavier discharge will be apt to injure it or require a long period of recharging.

Buckling and sulphating are the two great evils—buckling, a mechanical, and sulphating, a chemical one. Either may be obviated by a little care and attention. Overcharging is not decidedly injurious, but undercharging with a leakage of current may bring on sulphating in time. A battery must be kept charged even when not in use. The plate which wears out quickly is the positive or peroxide plate.

QUESTIONS FOR REVIEW.

(1) State the experiment which led to the discovery of the storage battery?

(2) What form of cell did Planté invent?

(3) What process must lead plates pass through before being used in a storage battery?

(4) Describe Faure's improvement on the Planté cell?

(5) What materials are required in a pasted cell?

(6) What requirements must be observed in an accumulator?

(7) Mention the faults of storage batteries.

F. R. Chinnock, a hustler of the old General Electric Co., after being engaged in the building of an electric railroad between Hackensack and Union the past two years, has entered the electrical construction business for electric lighting. We are pleased to call our readers' attention to Mr. Chinnock, as he is one of the pioneers in the electrical field. He has opened offices in the Taylor Building, New York, and Arbuckle Building, Brooklyn. Telephone call, 3667 Cortlandt street.

Messrs. H. O. Keeler, L. A. Gray and W. S. Bartholomew represented the Adams & Westlake Company, of Chicago, manufacturers of street railway specialties; their car shades, headlights, etc., eliciting favorable comment from street railway men.

The Electrical Age.

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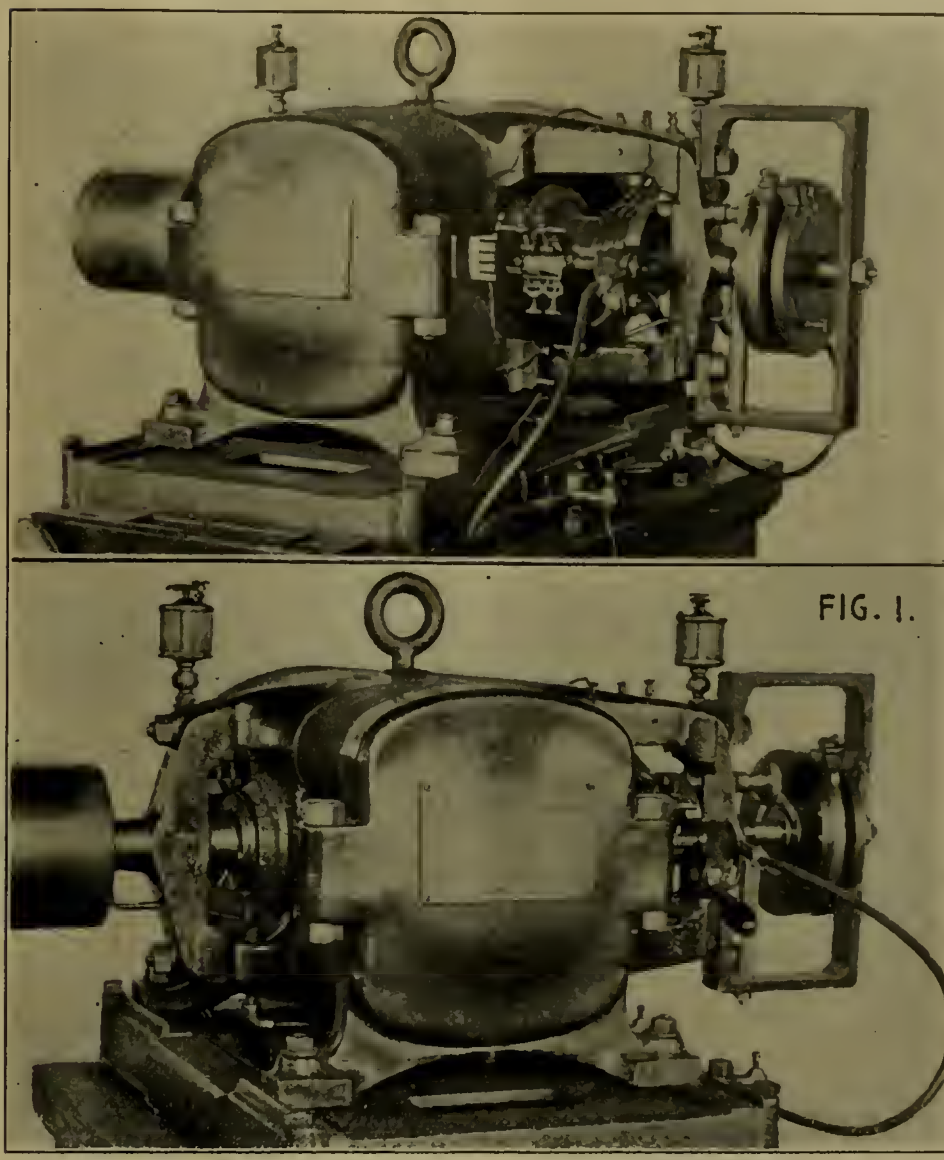


FIG. 1.

ARMATURE REACTIONS IN A ROTARY CONVERTER.

By Professor R. B. Owens, D. W. Hawksworth and H. W. Doubrava.*

It was primarily designed to obtain curves showing the instantaneous distribution of induction over the pole faces of a rotary converter for different armature positions and conditions of loading.

In general the method employed to effect this consisted in measuring the instantaneous electromotive forces under different conditions, generated in a series of small, equally even-spaced coils of fine wire wound over the armature surface. The electromotive forces in these coils in any position being of course proportional to the induction density in that part of pole opposite coil.

The machine experimented upon is of the well-known consequent pole type made by the old United States company. Its output is 3½ K. W. at 110 volts, normal speed 2,400 R. P. M.

Fig. 1 shows two views of machine. At the commutator end are seen three slip rings, connected to commutator; also the contact-maker at end of shaft. At the pulley end are two contact rings, to which the several test coils may in turn be connected. The armature is drum wound with smooth core. The commutator has 54 segments.

The machine originally designed for a continuous current generator was changed as shown into a 3-phase converter by placing slip rings on the armature shaft and connecting segments 1, 19 and 37 of the commutator respectively to rings 1, 2 and 3. No suitable 3-phase generator being available, it was used only to convert continuous into 3-phase currents. The applied voltage at the brushes was kept exactly at 110 volts, the energy being supplied by a 15 K. W. Edison generator.

Instantaneous electromotive forces were measured by the usual zero method using telephone.

The particular contact maker used may, however, be described. An iron ring was cast in the form indicated in Fig. 2, and attached to a hard rubber disk about half an inch thick; A, A' are glass wedges and B is a thin steel clock spring placed between them; C is a screw with insulated head by which the wedges are forced into a wedge-shaped slot in the rim and held firmly in place. The metallic strip B is connected to the contact ring E. The glass wedges and strip are ground even with the rim of the cast iron ring. The contact brush, which consists of two thin steel watch springs, coming only in contact with polished metal and glass surfaces, wears well, and the contact is always clean and good. No difficulty whatever was experienced in reading electromotive forces to less than one-fiftieth of a volt.

Since the object desired was to show the instantaneous induction distribution over the pole faces, and the variation in induction density at different points on the polar surface as the armature and armature currents varied in position and value, the ordinary single or two-brush method of exploring commutator potentials for continuous current machines would evidently be useless. First a single coil of fine wire was wound lengthwise around the armature and the ends connected to the contact rings

* A paper presented at the 14th General Meeting of the American Institute of Electrical Engineers, Eliot, Me., July 26–28, 1897.

at pulley end of machine. Fig. 3 represents the relative position of coil and three limbs of secondary circuit of converter; A B is the fine wire coil wound through the

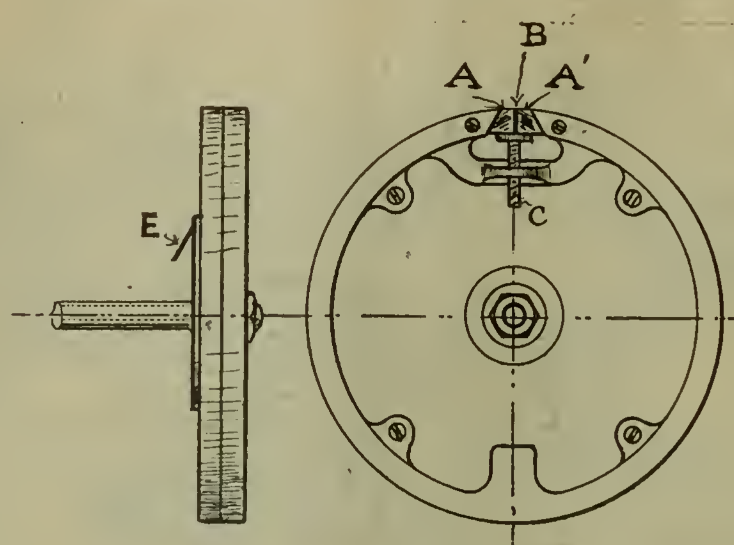


FIG. 2

point where one contact ring is tapped; I-II, II-III and III-I represent the three limbs of the secondary circuit.

The machine was first run as a motor with no load and

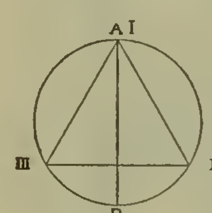


FIG. 3

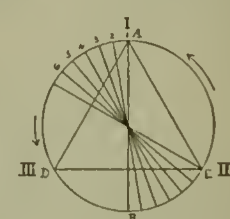


FIG. 4

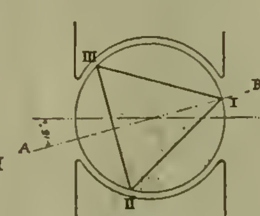


FIG. 5

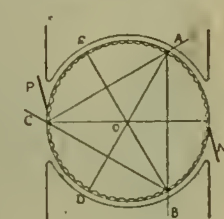


FIG. 6

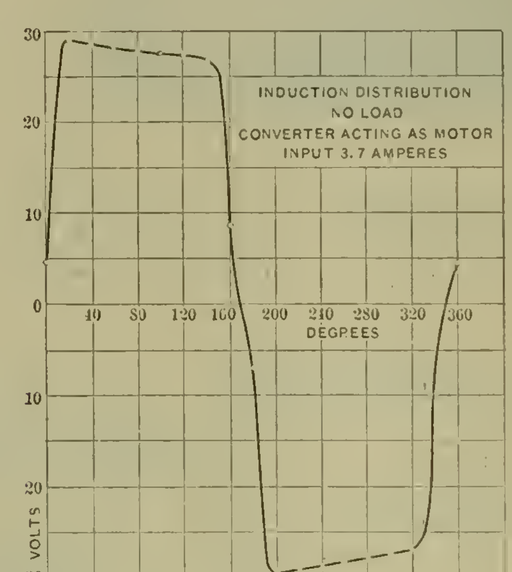


PLATE 1

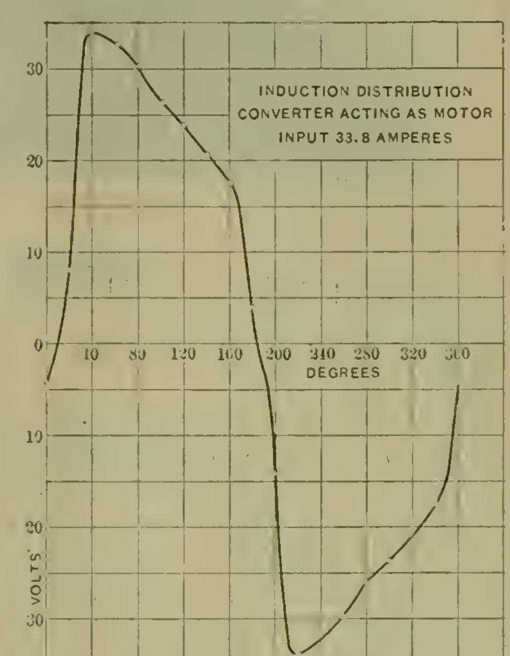


PLATE 2

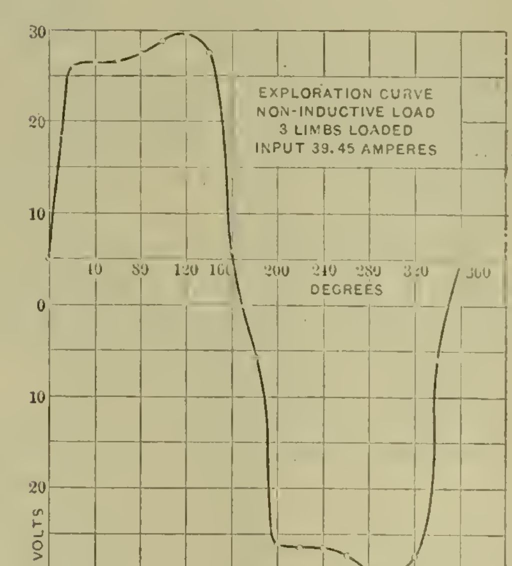


PLATE 3

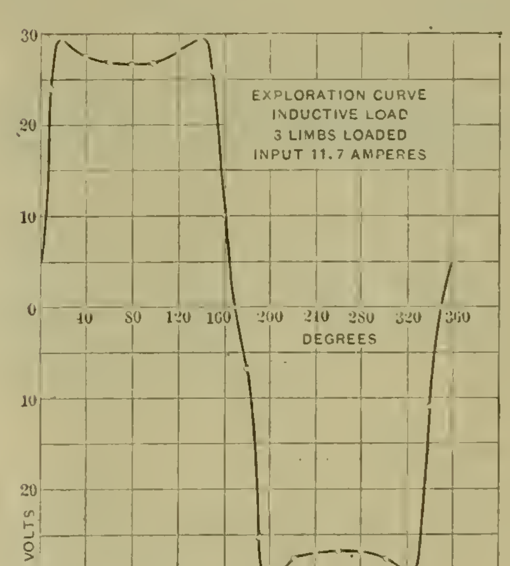


PLATE 4

curve plate I obtained. This shows the induction distribution to be quite uniform over polar surface, but slightly shifted in opposite direction to rotation. This would naturally be expected, as the armature reactions with so small an armature current would be but slight.

The machine was again run under steady load as a motor up to about its full capacity, the armature taking 32.6 amperes. In this case the distribution curve shows a very decided distortion of the field, as indicated by curve plate 2. Both of these curves are exactly like what would have been obtained by the ordinary two-brush method of exploring commutator.

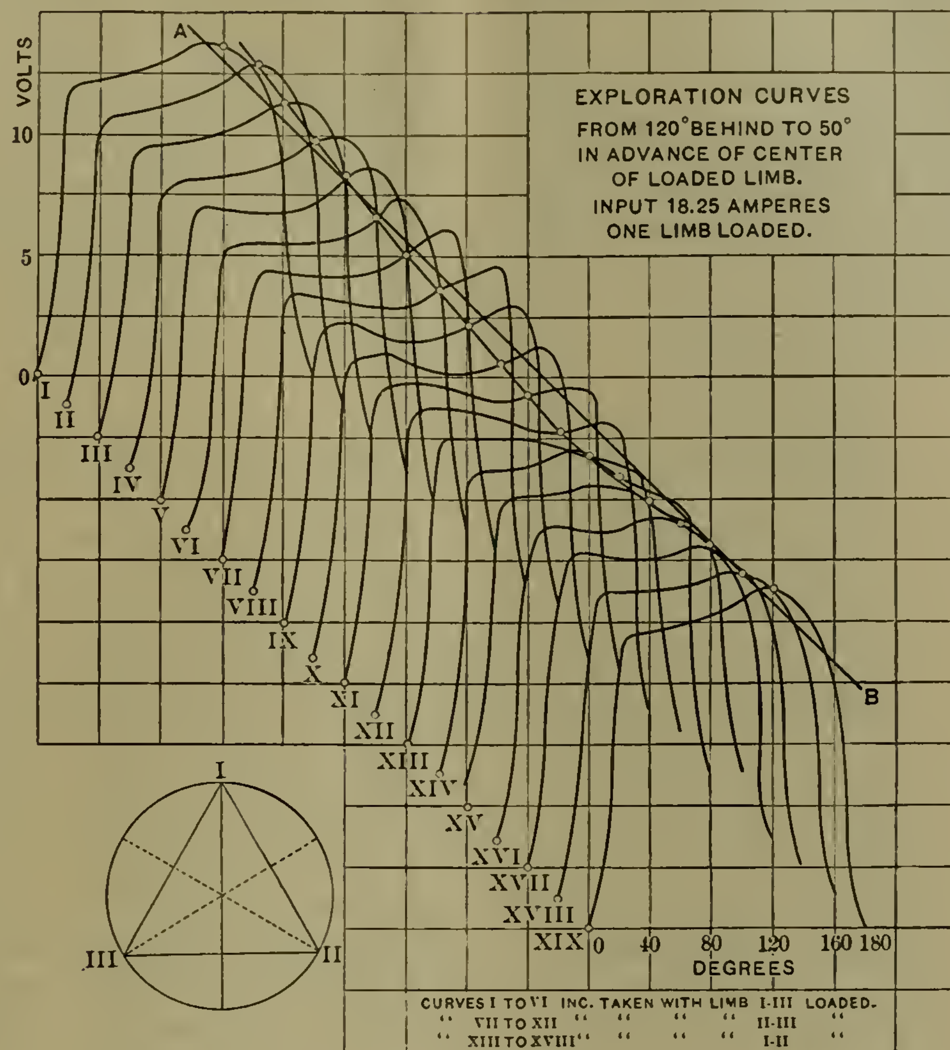


PLATE 5

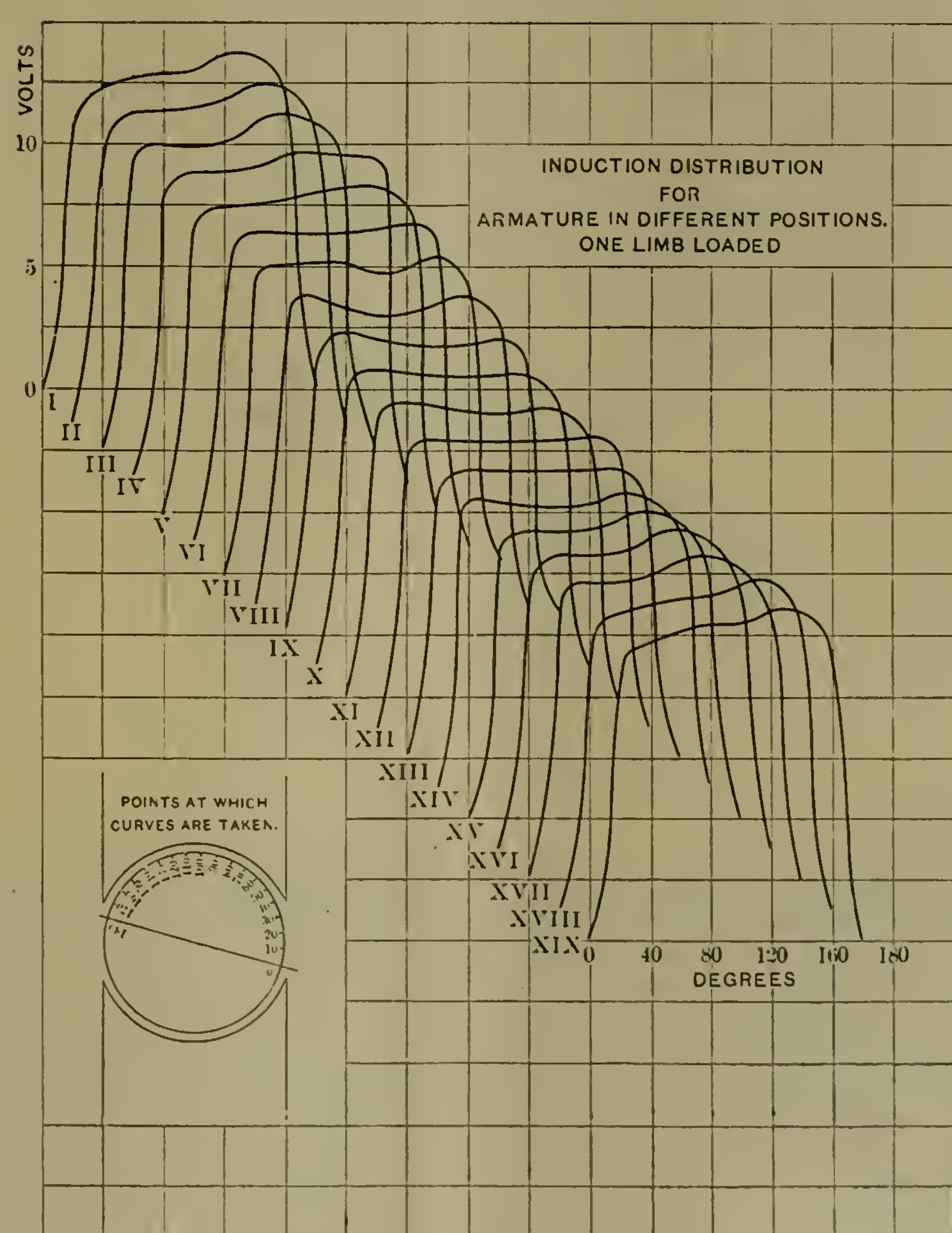
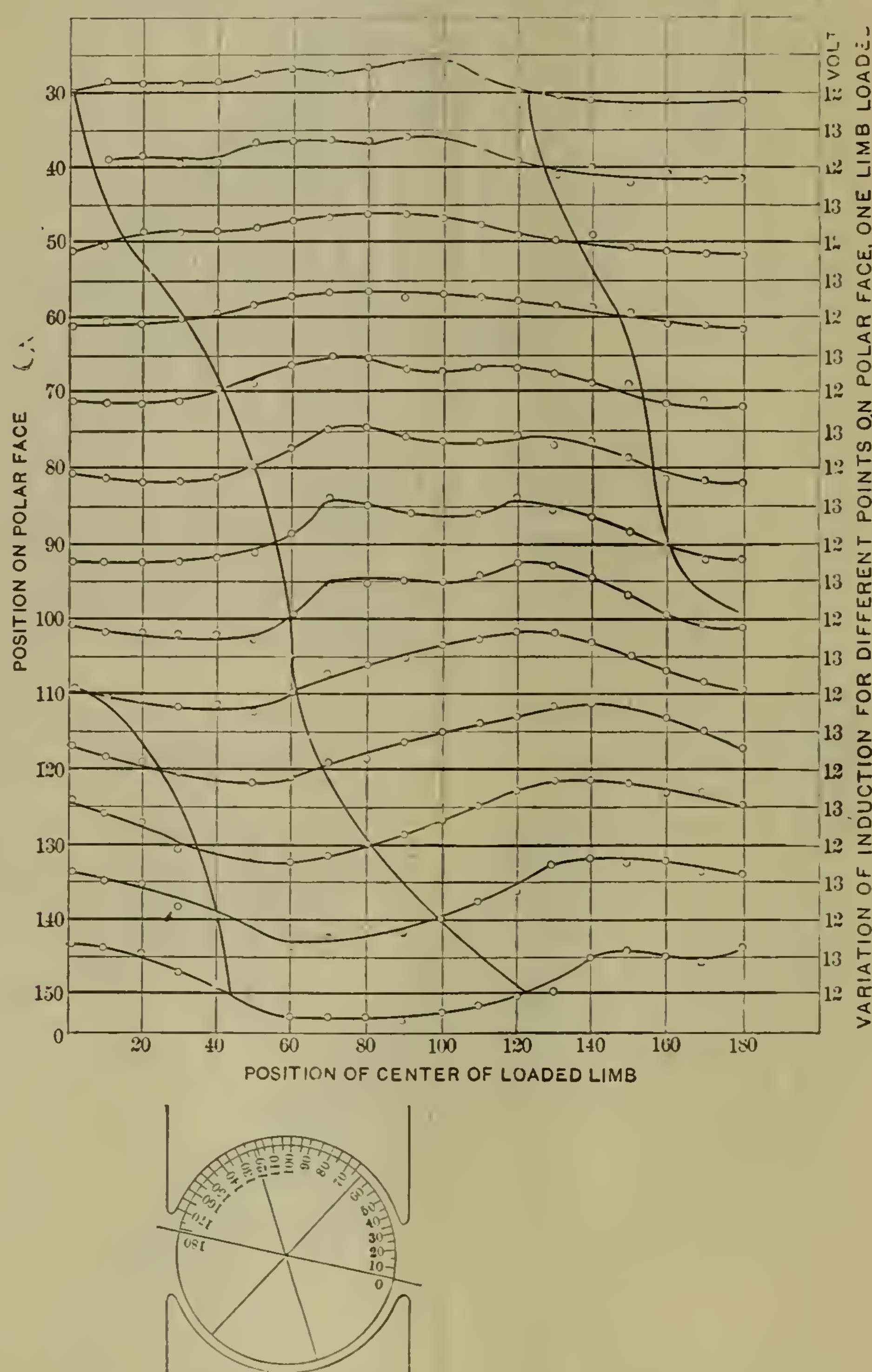


PLATE 6

The machine was next run as a converter, the three limbs being equally loaded with incandescent lamps. The armature took 39.45 amperes. Although in this case the armature current is much larger than when the machine was operated as a motor, no shifting of the brushes was necessary to avoid sparking, as was before the case, showing the small reactions in a rotary converter. Curve plate 3 is the exploration curve from the same test coil for this case, and curve plate 4 is the exploration curve from test coil when equal inductive loads were put on the three limbs, the armature taking 11.7 amperes. The last two curves must not be confused with curves which show the instantaneous distribution of induction for particular armature positions and loads. They merely show the induction at a fixed angular position from the loaded legs as the armature assumes different angular positions. From a series of such exploration curves the instantaneous induction distribution can, however, be easily obtained as follows: First, we will consider the case of a single limb loaded. It will be seen by an inspection of Figure 4 that placing test coils ten degrees apart at points 1, 2, 3, 4, 5 and 6 and taking readings from each separate coil with limbs I-II, II-III and III-I loaded separately, is the same as having but one limb loaded and coils placed ten degrees apart entirely around the armature. The three armature windings being known to be practically identical when the limb I-III is loaded, test coil 1 will give the induction 60 degrees behind the centre of loaded limb, coil 2 50 degrees, coil 3 40 degrees, and so on to coil 6. When limb II-III is loaded, the curve from coil 1 shows the variation of induction at the centre of the loaded limb, coil 2 shows the variation of induction ten degrees in advance of the centre, and so on up to coil 6.

When limb I-III is loaded, test coil 1 gives the variation of induction 120 degrees behind the centre of the loaded limb, test coil 2, 110 degrees behind, and so on up to coil 6. Thus are obtained a series of eighteen curves, showing the instantaneous induction for every 10 degrees from 120 degrees behind the centre of the loaded limb to 50 degrees in advance of the centre as the armature rotates. The eighteen curves numbered I to XVIII are shown on plate 5. The origin of each curve is shifted 20 degrees to the right and 1¼ volts below that of the preceding curve for clearness.

From these exploration curves the instantaneous induction distribution for particular positions of the armature is easily found. Suppose that the centre of the loaded limb is on the line of commutation, which in all cases is 15 degrees from the point midway between the pole tips, as



POINTS AT WHICH CURVES ARE TAKEN

PLATE 7

shown by line A B in Fig. 5, and that the distribution was desired for the limb in this position; the line of commutation is taken as reference line. It will be seen by reference to Fig. 4 that taking the zero point of curve VII gives the induction at the point where the centre of the loaded limb is at zero degrees; then if the reading is taken at 10 degrees on curve VIII, the amount of induction for 10 degrees in advance of the centre of the limb, which is still in same position, is obtained. The induction for 10 degrees further will be represented by the reading for 20 degrees on curve IX and so on.

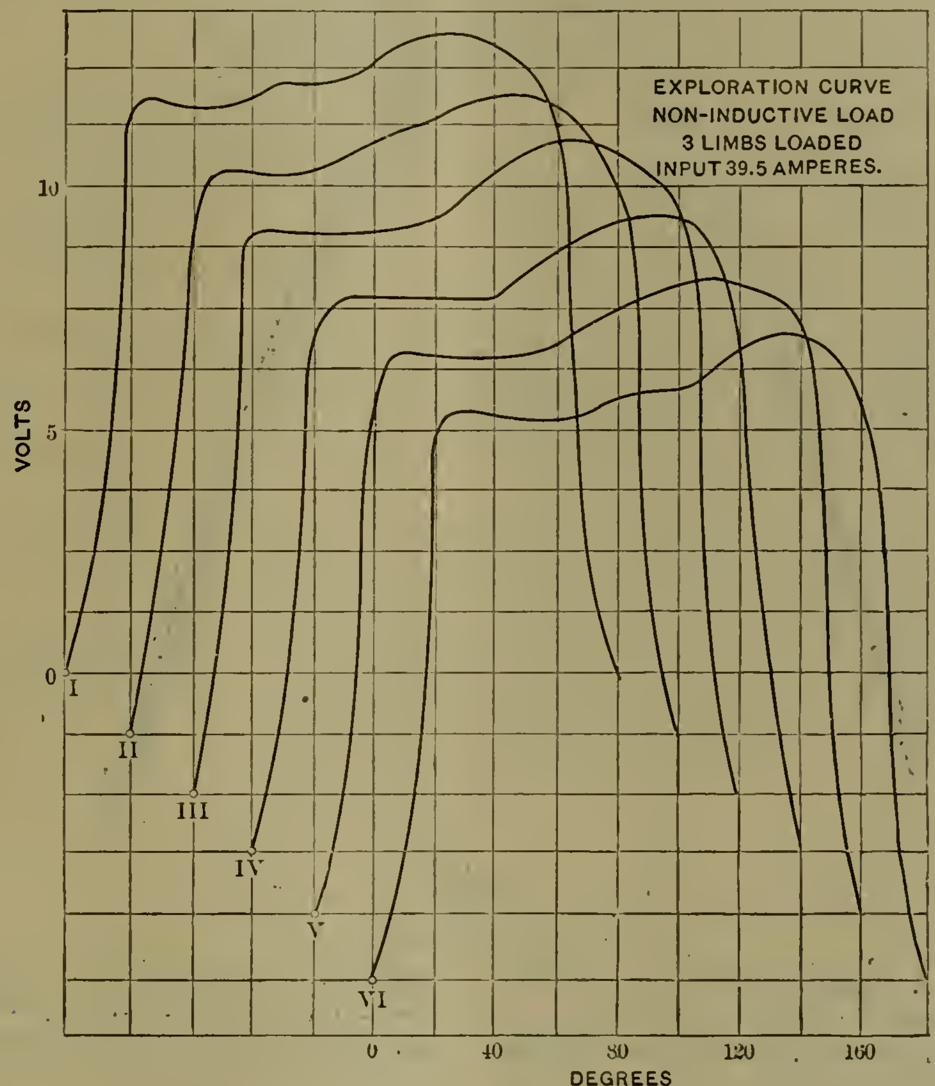
The series of readings for curves, plate 6, were obtained in this manner, and show the instantaneous distribution of induction over the pole faces with one limb loaded in different angular positions.

Of course the same curves might have been obtained directly by measuring successively the electromotive force in each of a series of test coils evenly spaced for one particular position of the loaded limb or armature, but the above indirect method is easier of manipulation.

The curves, plate 7, show the variation of induction through particular points in the polar face as the loaded limb asumes different positions. These curves are obtained directly from the curves, plate 5. Suppose it is desired to draw a curve representing the variation of induction at 140 degrees from the zero point. Connect the points where a vertical through the 100-degree point of each curve intersects the curve. The new curve so found, when compared with the right line A B, drawn through points representing 140 degrees and 12 volts for each curve, shows the variation above or below the induction corresponding to 12 volts.

Taking points from 30 degrees to 150 degrees, inclusive, and changing the axes, gives the series of curves, plate 7. It will be noted that the variation of induction at some points is greater than at others, and that the waves of variation differ in phase as of course would be expected. Connecting the points where these curves cross the 12-volt line shows the variation of induction at successive points in time and amount very nicely.

The exploration curves, plate 8, were taken with all three limbs equally loaded with incandescent lamps. When one limb is loaded, any particular distribution of induction occurs twice in every revolution of the armature, but with three limbs loaded, this happens six times per revolution. In plate 8, curve VI is exactly similar to curve I, and referring to Fig. 6, it will be seen that the distribution of currents in the armature will be the same when A B and C are either at N or P The curves showing instantaneous distribution of induction with armature position can be obtained from the exploration curves in plate 8 in the same way that curves, plate 6, were obfrom curves, plate 5.



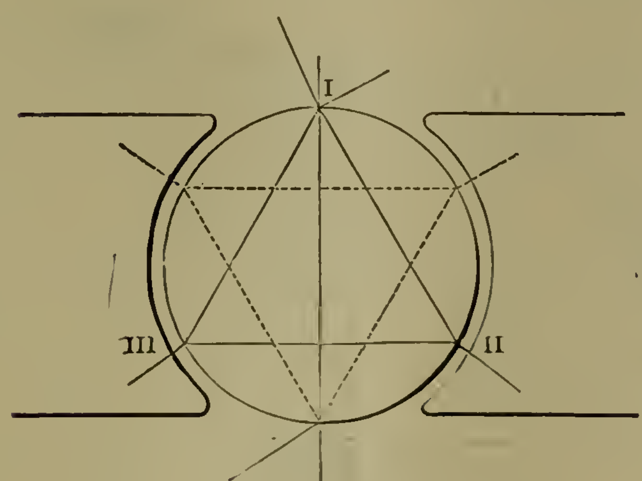


PLATE 8

The shape of the electromotive-force curves taken from a rotary converter depends on the induction distribution. If the lines of force through the poles, air gap, and armature were uniform and parallel, the electromotive force in each turn of wire on the armature would be sinusoidal, and the electromotive force as measured between any leg being the sum of sine waves would also be sinusoidal, but the electromotive-force curves we acually get is the sum of a series of electromotive-force curves similar to curves plate 5, differing in phase by the conductor angle. On plate 9 are shown electromotive-force curves between legs for different loads. Curve I is for full load, curve II for half load and curve III for no load. Curve IV is a sine wave whose R. M. S. value is 67.4 volts. Plate 10 shows the efficiency curves for the machine as a motor and as a converter. If the load on the machine as a converter had been increased until the losses equalled the losses of the motor at full load, then the ratio of the two outputs would be the relative capacities of the same machine working in the two ways. It is regretted that limited time prevented a more complete experimental study of this machine, but it is hoped that some of the results are not without interest. A detailed study of a more modern machine will be reported later.

Of course the results as found agree with what might have been anticipated, and are probably not new to the engineers of some of our manufacturing concerns, but as the experiments of a company's engineers form part of the company's assets, they do not always find their way into engineering literature.

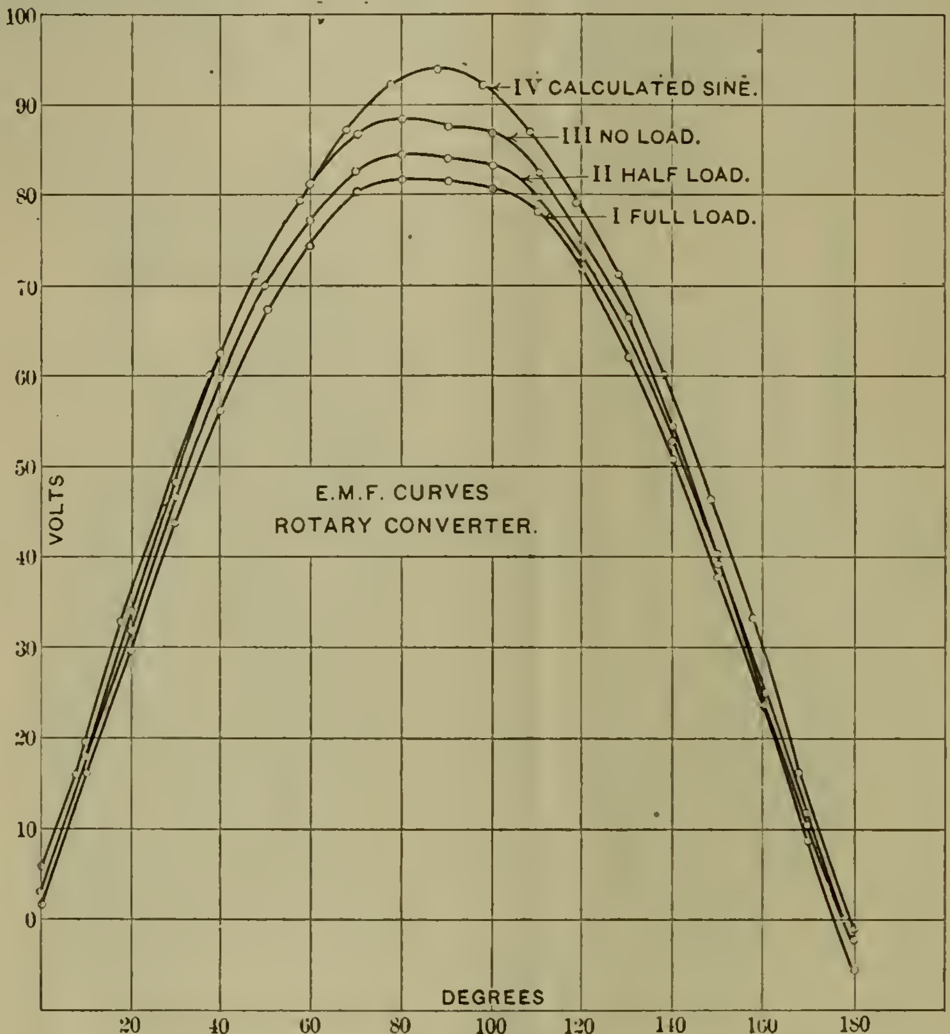


PLATE 9

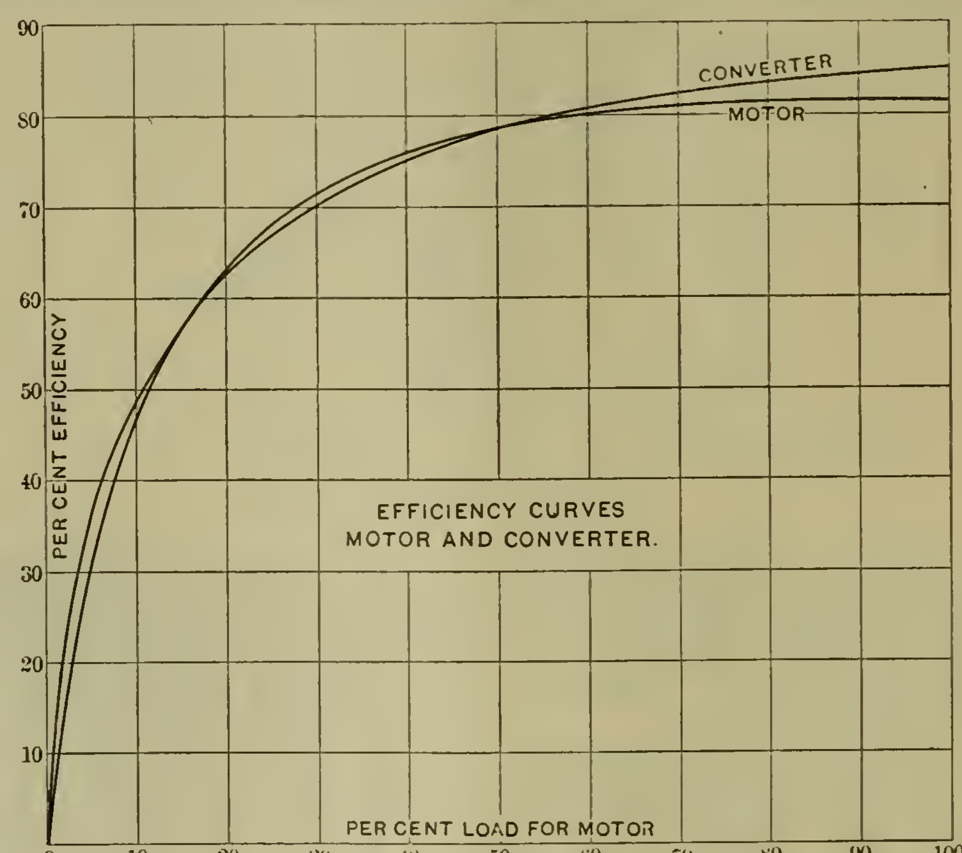


PLATE 10

Athena, Ala.—The Birminghan Railway and Electric Company have purchased the Powderly dummy road.

DEVELOPMENT OF ELECTRIC CABLEWAYS.

(Continued from page 278.)

The traction cable is made of ⅝-in. or ¾-in. specially strong "19 wire" steel rope, with a soft iron wire core, in place of hemp, which is ordinarily used. This increases the conductivity. One of the most remarkable results in practice in this system is the fact that the traction cable does not have to be pulled very taut; in fact, a sag in the cable seems to be of no disadvantage, as the motor does not tighten the line far ahead, even when doing considerable service. The sag adds to the weight of the cable and to the friction on the brackets, and these two resistances act as an anchor for the traction cable, independent of the terminal anchorages. For example in the case of a trial plant for a German canal the resistance to be overcome by a motor, or its "draw-bar

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CONTENTS.

THE FARMER AND THE OVERHEAD TROLLEY.

Since the overhead system of electric traction has been introduced, its application to other fields of work has been seriously considered and in certain cases actually tried. For instance, a trolley line running along the route of the Erie Canal or any narrow stream of considerable length might be used for the purpose of propelling a canal boat, scow or heavily freighted vessel, provided the same was equipped with an electric motor and screw propeller. The pensive mule, who has for years dragged its weary burden along time-honored and well-trodden paths, would then find its vocation gone and its occupation pursued by an abler and more active source of energy. It thus seems that in this field of work the trolley, in conjunction with an appropriate electrical equipment, has and will prove in the future to be of the utmost benefit as above described. But a newer, stranger, and somewhat astonishing departure has been proposed in which the trolley wire will likewise cut an important figure. It is proposed to erect an overhead line along the main country roads from city to city, or as far as convenience and rural commerce will advocate. The heavy country wagon, the farmer's phaeton, and in fact the carriages of city residents each equipped individually with a motor, will seek propulsion by running upward to this overhead line the equivalent of a trolley pole, an easily moving and flexible device which will convey power from the overhead line to the automobile below, whether horseless carriage, horseless wagon or other properly constructed arrangement for carrying heavy loads.

The general details of such a system would not be very difficult to work up. On one side of the road all vehicles going in one direction would move; on the other side those travelling oppositely. The erection of the line would not require any great skill for this particular purpose, and the operators of the plant connected therewith in order to keep trespassers away, that is, those owning horseless carriages and desiring a ride at the expense of the power company, the line would have to be under supervision, which in itself is not a difficult matter to do. Large farm houses could well afford branch lines running into their premises in the same manner as a track-siding might be brought to the doors or actually within a large factory. Provided sufficient traffic occurred, this would be a paying investment to capitalists desiring to inaugurate a new and feasible system of cross-country transportation without the expense of laying tracks or incurring the expenses necessarily due to the running of a trolley system with cost of cars, motor-men, conductors, etc.

Many large cities, as far as farmers are concerned, would practically be brought to their very doors, and a change thereby instituted which would more closely interweave the lives of city and suburban residents. There are many large and important towns in the United States between which may be found beautiful model farms. How much more complete would be the farm if thus connected to a large city and able at any moment to hitch up the electric country wagon and wheel along in good time to its very heart. Many dairy owners, florists and fruit raisers could be likewise accommodated and thus dispense with the care of horses and the time consumed in getting them ready for harness. With a movable trolley line stretched across large fields, ploughing would become a charming occupation, and in other ways too numerous to mention, benefits without end would be enjoyed by the lover of green grass, country air and bright sunshine.

THE USE OF STEAM TURBINES.

The recent improvements in steam turbines have given station managers considerable confidence in them and led a few to give them a trial. The economy of steam turbines is in many respects a matter of doubtful issue, so much depending upon their construction, the steam pressure and the condensing apparatus, yet the fact has not been lost sight of that steam turbines are above all the most appropriate piece of apparatus to couple to a dynamo that we know of. Vibration does not exist in one well constrected; direct connection between dynamo and turbine is a simple achievement, and the compactness of a plant of this kind has especially in large cities, where every square foot of space is expensive, caused them to be well received. There is a great possibility, and a very near one at that, of the steam turbine playing a very important part in the future of electric lighting. The time is near at hand for the reciprocating engine to pass away and make room for the next stage of mechanical development.

THE HUMAN ELECTRIC BATTERY.

The superstition that human beings should sleep with their heads to the north is believed by the French to have for its foundation a scientific fact. They affirm that each human system is in itself an electric battery, the head being one of the electrodes, the feet the other. Their proof was discovered from experiments which the Academy of Sciences was allowed to make on the body of a man who was guillotined.

This was taken the instant it fell and placed upon a pivot free to move as it might. The head part, after a little vacillation, turned to the north, and the body then remained stationary. It was turned half way round by one of the professors, and again the head end of the trunk moved slowly to the cardinal point due north, the same results being repeated until the final arrestation of organic movement.—Railroad Tel.

pull" was to be 645 lbs. Now at one pound per running foot of traction cable, the influence of the motor pull would only be felt 645 feet ahead of the motor. Therefore with motors distributed 645 feet apart, each one practically has its traction cable anchored from the motor ahead and, in consequence, the combined pull of all the motors is not exerted upon the terminal anchorage.

In the first plant, the clamps on each of the lower or traction cable brackets were made with steel jaws, with springs under them, such as are used on grip-pulleys. When the traction cable was pulled the clamps gripped the cable, and when the motor lifted the cable, on passing the bracket, the jaws released the cable. These clamps were found to be unnecessary.

In canal practice the terminals will be ten miles apart with tension stations every two miles. At the terminal stations rotary transformers will transform the high voltage alternating current to 500-volt direct current, and send the same each way a distance of five miles. Where the traffic justifies, a line will be placed on each side of the canal, when the insulated or bearing cables will be connected at intervals to feed each other. The anchorage of the traction cable will be made with a series of clamps, and the motors will be passed through them as canal boats through locks. At the end, the motor is released from its traction cable and is conveyed across the canal on a cable, or where masts are allowed on boats in the canal, by a hinged trussed track that can be opened like a gate, or raised out of the way. The handle of the rheostat is easily controlled from the boat by a cord attached to the handle. When the cord is pulled from the opposite direction to which the motor is to be run, the current is admitted in the proper direction, and the motor proceeds. When the cord is released, the handle flies back to a vertical or cut-off position, and the motor stops. When two boats pass they exchange motors by simply exchanging tow-lines and controller cords.

The first test of canal boat towing with this system was made on the Delaware and Raritan Canal at the Trenton Iron Works. The motor was made to go over concave and convex curves and up and down grades while towing the boat.

In reference to the test of canal boat towing on the Erie Canal, at Tonawanda, it is not necessary to make any apologies for the system. Superintendent of Public Works Aldridge, in his report to the Legislature, unqualifiedly indorsed the system and stated: "Early in the season of 1895 application was made to me to officially designate a part of the Erie Canal for the proposed test of the efficiency, economy and practicability of the so-called 'Lamb System' for improving the present system of towage on the canals of the State. The location selected was a piece of canal about one and one-quarter miles in length at Tonawanda, N. Y. The purpose was to select such a portion of canal as would embrace as many practical obstacles to the success of such a plan of towing as could be found anywhere in a section of the canal that length."

In the report of Chas. R. Barnes, electrical expert for the Public Works Department of the State of New York, he sums up by saying: "The electrical towing system appears to present so many meritorious features that I have no hesitation in endorsing it as the system deserving preference over any other hitherto experimented upon, or likely to be devised in the near future."

So short a time was given in which to construct the trial plant that existing models had to be copied. The motor was over 9 feet in length; it weighed 2,213 pounds. The elliptically grooved sheave was driven by a worm-gear. The voltage, which was gotten from a trolley line, fluctuated from nothing to 500 volts, but seldom equalled the latter amount. The bridges under which the motor had to go were very low, and had to be approached by reverse curves on a grade of about 20 degrees. Trenches had to be dug next to the abutments to give room for the motor to pass under the bridges. Both convex and concave curves had to be passed over, and at one point the deflection was about 30 degrees. In spite of the difficulties the trial showed that the system performed economically and efficiently all that it was designed to accomplish.

In the plant recently constructed for trial on a German canal, the motor has been shortened to less than five feet in length; its weight reduced to 1,300 pounds. The worm-gear has been avoided by a double reduction direct gear, gaining 50% in efficiency over the worm-gear, and the elliptically grooved sheave has been placed about the cylindrical electric motor, getting a large bearing surface and increasing the efficiency accordingly. At the test made at the Trenton Iron Works this motor, using a 5 horse-power Storey motor, wound for 500 volts, and going at the rate of 2.3 miles per hour, pulled 800 pounds when having the use of only 220 volts. This shows a remarkable efficiency, which is due to the mechanical principles utilized, viz., hauling the motor along by a fixed rope, attached to a capstan operated by practically a winch.

The uses to which this method of telpherage can be put are so numerous that I will not attempt to give descriptions of plans that have been, and are now, being made for various parties, for such services as fortification work, rice culture, mining plants, ship building and sewer excavating plants. I will confine my descriptions to completed work.

Possibly the most universally serviceable application that has been made of the system is traversing motors with double hoisting drums for quarry purposes. These motors are to go on 700 feet span cableways. Each of these cableways has one end stationary and the other is movable on a curved track. It is designed to lift 10,500 pound rocks at the rate of 100 feet per minute and traverse at the rate of 600 feet per minute. At a test at Trenton made upon a temporarily erected cableway we raised 6,600 pounds, and ran on the cable at the rate of ten miles per hour, part of the time going up a grade of over 30 degrees. There will be no difficulty in these motors raising over 10,500 pounds and running ten miles an hour. A 15 horse-power Storey motor is used. The rheostat reverses the motor and regulates the speed. A band brake also is used to regulate the stopping. This is controlled by a lever in front of the motorman. There is a safety brake to be used in case the band brake should fail. This is operated by a wheel. The shoe of this brake clamps the upper cable. It is attached to the car proper, and with the wheel handle oscillates with the carriage as it climbs or descends grades. A lever in front of the motorman is used to control the speed of the drums that raise and lower the skip. A friction clutch, controlled by a wheel handle, disconnects the traversing sheave gear and engages the hoisting drums or vice-versa.

In a place within reasonable distance of an electric plant having surplus power, these electric cable hoists can be erected and operated for a comparatively small cost. In contracting work, where electric lights are also used, these cable cranes can be used to great advantage. In other places the small generating plant necessary to operate these motors will add but little to the expense of an outfit.

Those who think that electrical machinery is of such a delicate nature that it is only serviceable for cities of advanced civilization, should go to the Dismal Swamp, and see a so-called dainty machine doing as rough and dirty work as any service to which a machine could be put. He would see the laborers, over their knees in mud, sawing down giant trees, and hear the woodsman sing: "Stand from under, she's saying good-by to her neighbors." With a crash that throws mud and water high into the air, a tree will fall and fill a space with broken limbs, embedding itself well into the mire. This means work for the motor. Logs are to be drawn from their beds, and when the ammeter in the generator room on the scow for an instant runs up, possibly to a point of overload, it is the motor overcoming the suction in drawing out a buried log. With the voltmeter standing at 220 volts, you would see the needle momentarily go to 35 amperes and then drop to about from 10 to 16, depending upon the size of the log. As the cone over the end of the log strikes a stump or a cypress knee, the needle flies to about 20 and then back, and as the log dives off of an obstruction it may be crossing, the current drops to zero momentarily. Finally when the log reaches the tail-tree about 20 amperes is recorded as the log rises from the ground and hangs suspended by the hauling cable. This cable is rived through a sheave, which is attached to the tail-tree fifty or more feet from the ground.

After a number of logs are drawn to the tail-tree, they are transported over the cableway to the terminal on the banks of the canal. Reading the ammeter as the log comes in we see it start at about 5, then go up to 12 or 14, as it crosses the bracket saddles, then go down to 5 again. In this process of transportation, one end of the log is suspended by a car on the cable. The end of the log is raised from the ground by holding fast the bight of the grip-block rope and going ahead with the motor. The block is attached to the car, when the same results are produced as if the power was applied to the rope direct. When the end of the log has been raised to the proper elevation, the grip holds it from falling, and the rope is coiled and placed on the tongs which holds the log, and after getting a couple of cars loaded you are ready to carry your valuable logs from one of nature's worst fastnesses to a point where they become valuable to mankind.

The question has been asked, "do you require expert help about these logging plants?" In answer, I would say that I am satisfied with my superintendent. He has spent his life in swamp logging, and has had no chance for education, much less scientific studies. When I assembled the generator, the first time that I put up that plant, he put on a pair of rubber gloves, not wishing to run any chances of getting a shock, even if there was no fire in the boiler. While testing the plant a fuse blew out on the generator, and one of my negro help started on a run in the swamp and never returned again to work. I afterwards heard that he stated: "Mr. Lamb can't fool dis nigger; I done worked on the government dredge boat, and knows what a dynamite machine is."

In spite of the lack of electrical information of the logging crew, no inconvenience has been occasioned on that account. All features of insulation are provided for before the plants are shipped. An ordinary steam engineer acquires quickly the necessary information for running the dynamo. The motor is shipped with all parts adjusted, and the extent of the motorman's duties is simply to push the handle of the rheostat according to the direction he wishes to go.

The light first cost, the high efficiency, the ease with which it can be operated by ordinary mechanics, portend for this system an important place among the useful applications of electricity of this century.

MAGNETISM AND MAGNETIC FIELDS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

Magnetism is a natural phenomenon. The recognition of its remarkable effects dates back to the earliest ages of history. On the one hand the annals of Chinese lore contain fragmentary remarks pertaining to the lodestone; on the other hand, in the Arabian nights, a work of unknown age, we hear in the travels of Sinbad of the wonderful mountain that no ship could attempt to pass without destruction.

But there is no doubt that the mystery of the lodestone, like that of amber, gave rise to a host of interesting traditions.

The Chinese, it seems, departed from the ancient marine practice of steering their vessels by the North Star as soon as they discovered the tendency of a magnet to point to the north. The use of the magnet or lodestone eventually became a familiar proceeding to the navigators of early days.

Poles.—Notice of its properties was made by so great a genius as Sir Isaac Newton, and because of the fact that the magnetic force was stronger at certain points of the lodestone than others, he called them poles.

Queen Elizabeth's reign marked the period in which science began to receive the proper attention, but it was necessarily harassed in its growth by the limited views of those who antagonized its progress. When the existence of poles became evident it was but a step to name them and examine into their properties.

North Pole.—It was decided to call the poles by names according to the position they took when the lodestone was suspended by a string. It was found by experiment that one end of the lodestone persisted in pointing northward, so the name north pole or north-seeking pole was given to it.

South Pole.—The other pole might just as well be considered as one always pointing southward, and it was considered just as appropriate to call it the south pole or south-seeking pole.

The magnetic force showed a tendency to discriminate between either one end of the earth or the other. It was but a step from this to experiment with magnetized bodies and show a very peculiar principle whose action was thus manifested.

Transmission of Magnetism.—It was discovered, whether by accident or intention it is difficult to say, that a piece of steel or iron could apparently absorb some of the magnetic qualities of the lodestone and possess in like manner all of its characteristics. It would then become

Magnetized,
Possess two poles,
Point North and South.

In other words, it was possible to impart magnetic qualities to steel or iron without in any way diminishing the original power of the lodestone.

Permanent Magnets.—When hard steel was thus rubbed with lodestone, the magnetism it received would not leave it except by

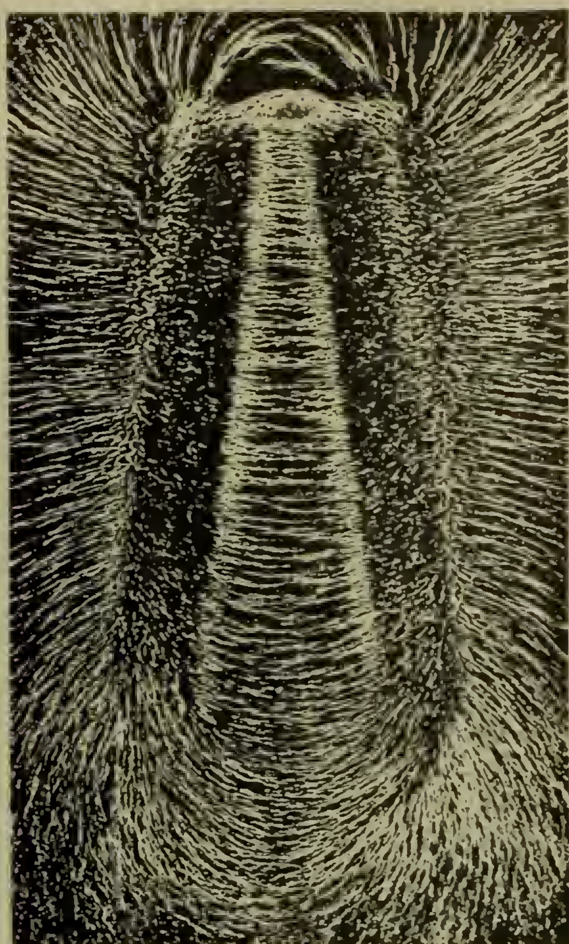
Hard and repeated blows,
A red heat,
An opposing magnetic force.

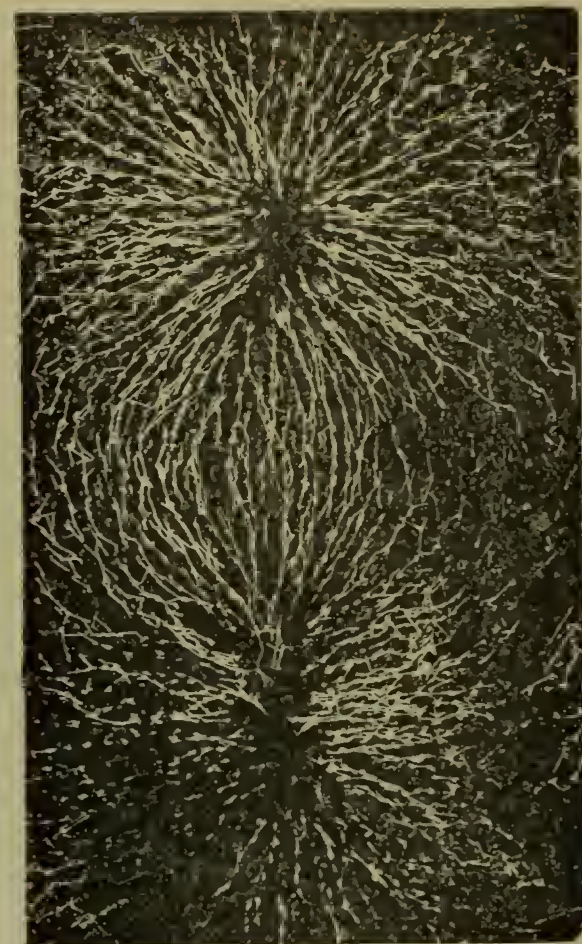
It was therefore decided to call such magnets permanent magnets.

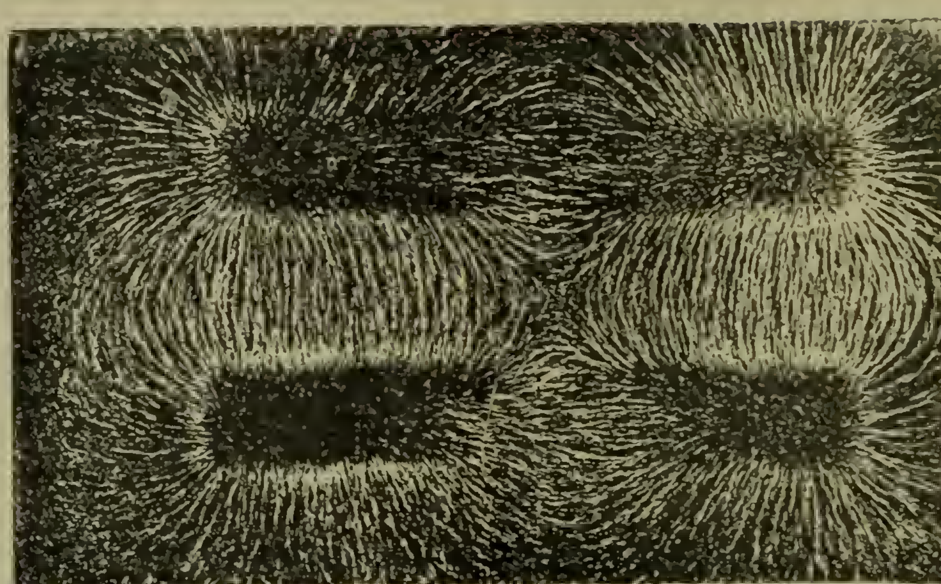
Temporary Magnets.—Soft iron or nickel was tried in the same manner, with the result that the magnetic force remained only as long as the lodestone was present and in near or intimate proximity. The magnetism was temporarily present, the iron being therefore called for the time being a temporary magnet.

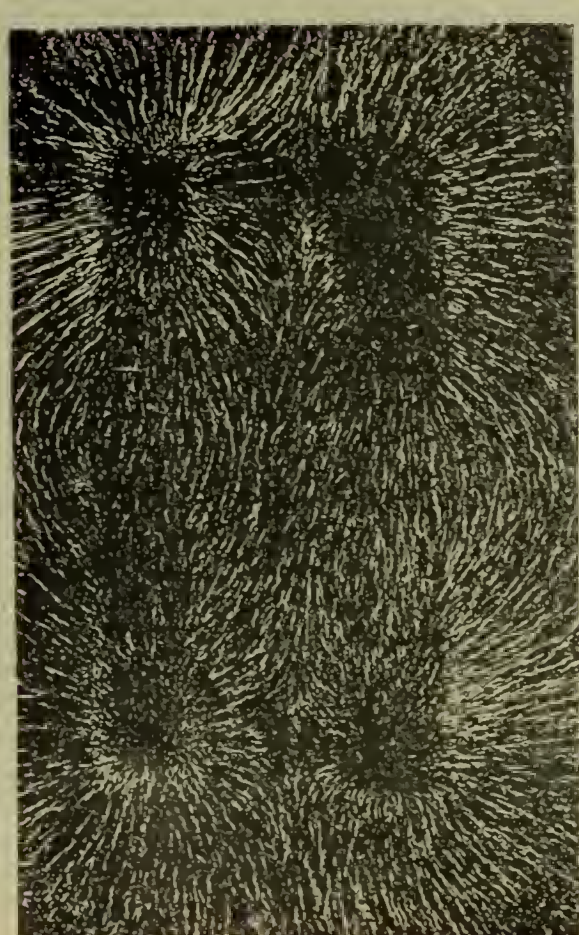
Law of Attraction.—The earth, as previously mentioned, always tried to make one end of a magnetized body point north. It was likewise found that with two magnetized bodies, one end of each unfailingly exhibits attraction for the other.

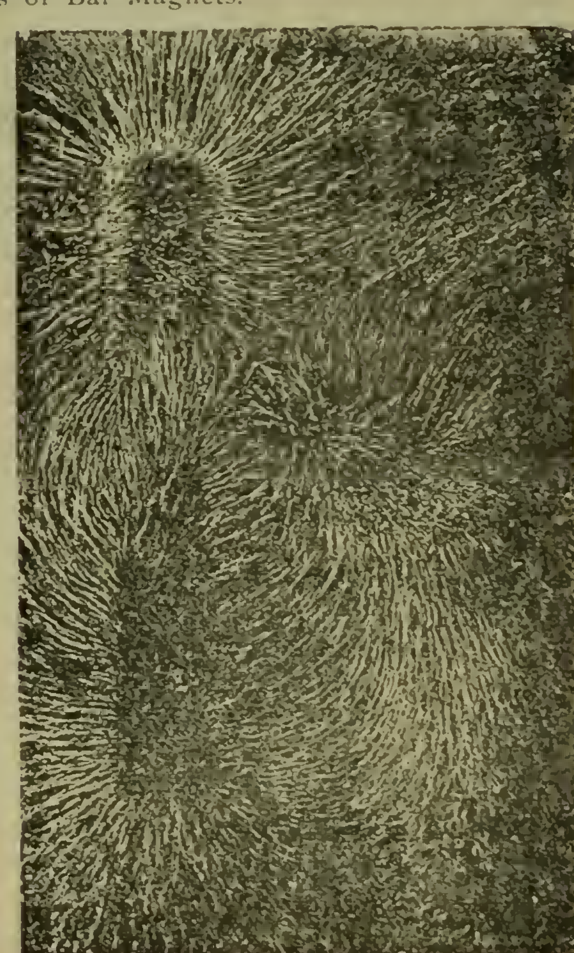
Law of Repulsion —On the other hand the magnets indivividually could be made to repel each other. Two north-seeking poles or two south-seeking poles would mutually repel each other, but a north-seeking and a south-seeking pole constantly maintained a tendency to meet. We then have—


Magnetic Field of Horseshoe Magnet.


Magnetic Field of Bar Magnet.


Attraction Between Unlike Poles of Bar Magnets.


Repulsion Between Like Poles of Two Bar Magnets.


Magnetic Field of a Bar Magnet and the End of Another Magnet, Showing Attraction and Repulsion.

Two north poles repel,
Two south poles repel,
A north and south pole attract.

The laws of attraction and repulsion of magnetic poles are—

Lik poles repel each other.
Unlike poles attract each other.

A Magnetic Field.—The space around a magnetized body is called a magnetic field. The presence of this field may be perceived by holding a piece of iron in the neighborhood of a strong magnet. The pull upon the iron will illustrate the force thus exercising its functions as magnetic energy.

It is possible to increase this pull to 200 pounds a square inch. In order to do so, however, the intensity of the field must be increased. More magnetism must be produced. The best way of obtaining a stronger field is to employ the electric current by sending it through coils of wire surrounding a horseshoe of soft iron.

Lines of Force.—If upon a bar magnet a sheet of white paper is placed and iron filings are placed over it, curious curves show themselves in the filings. They extend from one end of the magnet to the other in continuous lines. They appear broken and scattered at each extremity, but nevertheless they are complete from end to end in curves of increasing size. They illustrate the manner in which the magnetic force spreads from pole to pole, and the attraction that the lines of force of one pole have for those of the other. The streams of magnetic energy are called lines of force. Although the methods we use in our calculations cause us to look upon them in a more abstract manner, it may be remembered that a magnetic field consists of physical lines of force and depends for its effectiveness upon the strength of its field.

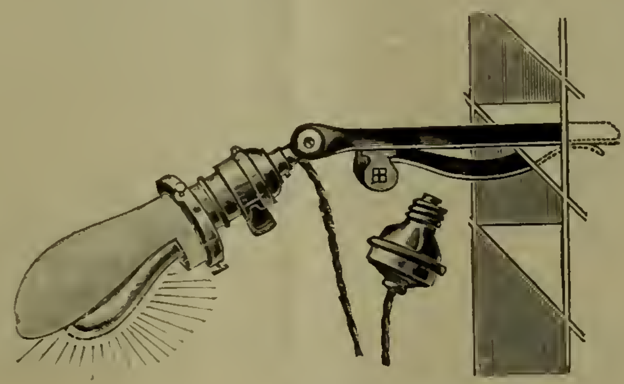
A magnet placed in a magnetic field will point in a direction parallel to the lines of force. If a magnetic needle is placed between the widely separated pole of a magnet, its north pole will lie nearest to the magnets south.

What a Magnet consists of.—It is supposed, and borne out by experiment, that a magnetic body consists of an infinite number of small magnetized particles, with their opposite poles in contact. It is not necessary for the body to be magnetized to be in this condition, but to be merely susceptible to the influence of magnetic force.

A piece of iron is always in this condition; its particles, however, being irregularly arranged. When the iron is magnetized the particles form strings of little magnets, north pole touching south pole; with the removal of the magnetic force the particles fly back to their irregular grouping, and the poles at each end disappear. A knitting needle magnetized may be broken into the smallest possible particles, and each will possess a north and south pole.

QUESTIONS FOR REVIEW.

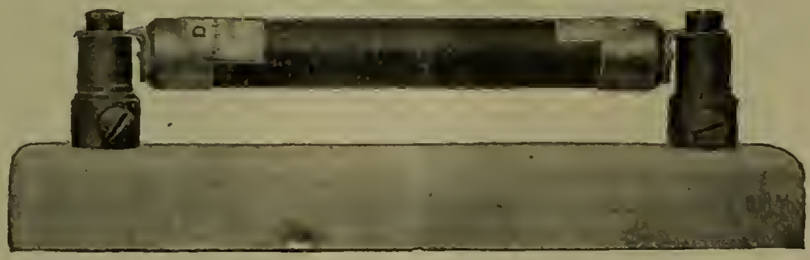
(1) What is magnetism ?
(2) (a) What is a pole ?
(b) What is a north pole ?
(c) What is a south pole ?
(3) (a) What is a permanent magnet ?
(b) What is a temporary magnet ?
(4) State the two great laws underlying magnetic phenomena ?
(5) (a) What is a magnetic field ?
(b) What is a line of force ?



The Jones Desk Clamp.

THE JONES DESK CLAMP.

Messrs. J. Jones & Son, wholesale dealers in Electrical Supplies, 67 Cortlandt St., N. Y., has placed upon the market an ingenious, cheap and useful desk clamp, to be used in a roll-top desk or attachment to a shelf, mantel piece, wall book-case, etc., as desired. The pressure secured by the clamp holds the lamp and socket attached to it firmly in place. After use, it may be slipped into a box, drawer, or pigeon-hole. The clamp is sold with and without lamp. It costs, without lamp, $2.50. Circulars mailed on application.



D. & W. Non-Arcing Fuse and Cut-Out.

NON-ARCING FUSES.

A 500 horse-power fuse blows in a man's hand without injury. The safety valves of an electric light, power or transmission plant are its fuses. Without them safety from short circuits, grounds, crossed wires, etc., is impossible, and in all cases the presence of bad fuses adds but little to that freedom from danger so absolutely essential in a modern plant. When fuses are used which will not blow at a certain point, the plant is unsafe, and when fuses are used which blow too soon, complications are bound to arise which will ultimately cause fear, and a lack of confidence to arise in the minds of consumers. In other words, a fuse must be reliable or it is useless There are many circumstances which affect the melting point of a fuse : strong draughts of hot or cold air, stretching, a change in the alloy of metals, an imperfect contact, etc.

The danger of a blowing fuse is obvious to even the lay mind. Fires and scorchings may result of a serious nature. To remove such possibilities and supply a fuse which will be reliable and serviceable the D. & W. Fuse Co., of 53 Aborn St., Providence, R. I., have placed a line of goods on the market which represents the result of their experience and scientific experiments.

The D. & W. fuses do not flash when they blow ; heat or cold does not affect their proper point of dissipation. They are so reliable, clean and safe that no station or private installation can afford to be without them.

A man may hold a 400 pilowatt fuse in his hand when the generator is short-circuited without danger. Fuses built to do this are the superior of all others. The sketch shows this remarkable fuse, which embodies the skill and science required to make it not one of the best but the very best in existence.

At the A. S. R. A. Convention at Niagara Falls, Mr. A. W. Hutchins had charge of the exhibit showing the D. & W. Non-arcing Fuse.

THE PIERCE & MILLER ENGINEERING CO. report a strongly-marked increase along all its lines of business, following the return of its President, F. M. Pierce, from his tour around the world, during which he made many valuahle connections.

From observations he made while abroad, he decided that America would do a large European business in furnishing equipments for electric tramways, and to accommodate this trade, and the rapidly increasing home trade, a large increase in this company's engineering and selling force has been drawn from England and Ireland.

Mr. Pierce has made strong financial connections in London and New York, which enables his company to "finance" electric railway and other first-class enterprises.

This company reports work in hand as follows: One 300, three 1200, three 800 horse-power, and several hundred horse-power in small engines, and one complete railway-power plant.

This company is now handling the Rice-Sargent engine for large work, and the "STANDARD" Ball of Erie for the smaller high and medium-speed electric purposes.

THE NEWTON APPLIANCE COMPANY, 120 Liberty street, city, supplied the switches and cut-outs used in the new Astoria Hotel. The reputation of their goods is so great that all new and important buildings must be equipped with them to be secure from faults and risks otherwise possible. The Newton Appliance Company have made a specialty of certain electrical lines of goods and intend to show on every occasion that no other concern can surpass their manufactures in either finish or serviceableness.

NEW CORPORATIONS.

The Sprague Electric Company, with a capital stock of $5,000,000.00, was incorporated October 11, at Trenton, N. J. This represents the combination of two great and well-known concerns, namely, the Sprague Electric Elevator Company and the Interior Conduit & Insulation Company. This co-operation of interests will make a noteworthy episode in the history of electrical engineering. Some of the most able electricians and business men will work in conjunction for the purpose of developing this great concern. The products or manufactures of the Sprague Electric Company will not differ from those formerly produced by each concern respectively, but in addition certain novel, useful and valuable inventions will be brought forward. The new multiple unit electric railway system of Frank J. Sprague, the new dynamos and rotary transformers of Lundell and the surface contact railway system of Johnson and Lundell will be pushed to the front. It is intended to sell the old factory of the Interior Conduit & Insulation Company at West Thirty-fourth street. All machinery and operations will be confined to the works of the Sprague Company at Watsessing, N. J. The New York office of the Sprague Electric Company will be found at 253 Broadway. The new company will have as its board of directors, Edward H. Johnson, Albert B. Chandler, Frank J. Sprague, Edward C. Platt, John E. Searles, John Markle, W. Murray Crane, Carl Schurz, Allan C. Bakewel, William H. Baker and John O. Stevens. The officers are A. B. Chandler, president and managing dlrector ; E. H. Johnson, first vice-president and general manager; F. J. Sprague, second vice-president and technical director, with E. C. Platt, secretary and treasurer. Mr. J. W. Mackay is connected with this concern to a large degree. Our readers may be acquainted with the fact that Mr. Chandler is well known as president of the Postal Telegraph Company, that Messrs. Johnson and Sprague were colleagues in the dawning days of electric railroading. To both these gentlemen great credit is due for their persistent efforts and business genius in developing individually large and important electrical interests. We wish the new company all kinds of success.

THOMAS A. EDISON JR.'S Improved Incandescent Lamps do honor to themselves by outshining all other lamps in the office of The Electric Age.

MR. TAYLOR, of Cleveland & Taylor, electrical contractors, 5 Dey street, N. Y., lately returned from a European trip looking well and hearty; he has got his land legs on again. He enjoyed his trip abroad and came home hearty and happy.

HATZEL & BUEHLER, the noted electrical engineers and contractors, of 114 Fifth avenue, N. Y., are the oldest and most succesful construction firm in this city and deserve the honors they have received in way of contracts for the leading buildings in this city, among which are the Surety Building, Broadway and Pine street; the Gerry and Vanderbilt residences, as well as others of prominence, can testify to the excellence of their work.

David A. Starr, electrical engineer and contractor, of Cornwall, Ontario, Canada, and vice-president and managing director of the Cornwall Electric Street Railway, was on hand at the A. S. R. A. convention looking out for all the new and good things. Mr. Starr was one of the original men who built up the Royal Electric Co. of Montreal.

The Electrical Age.

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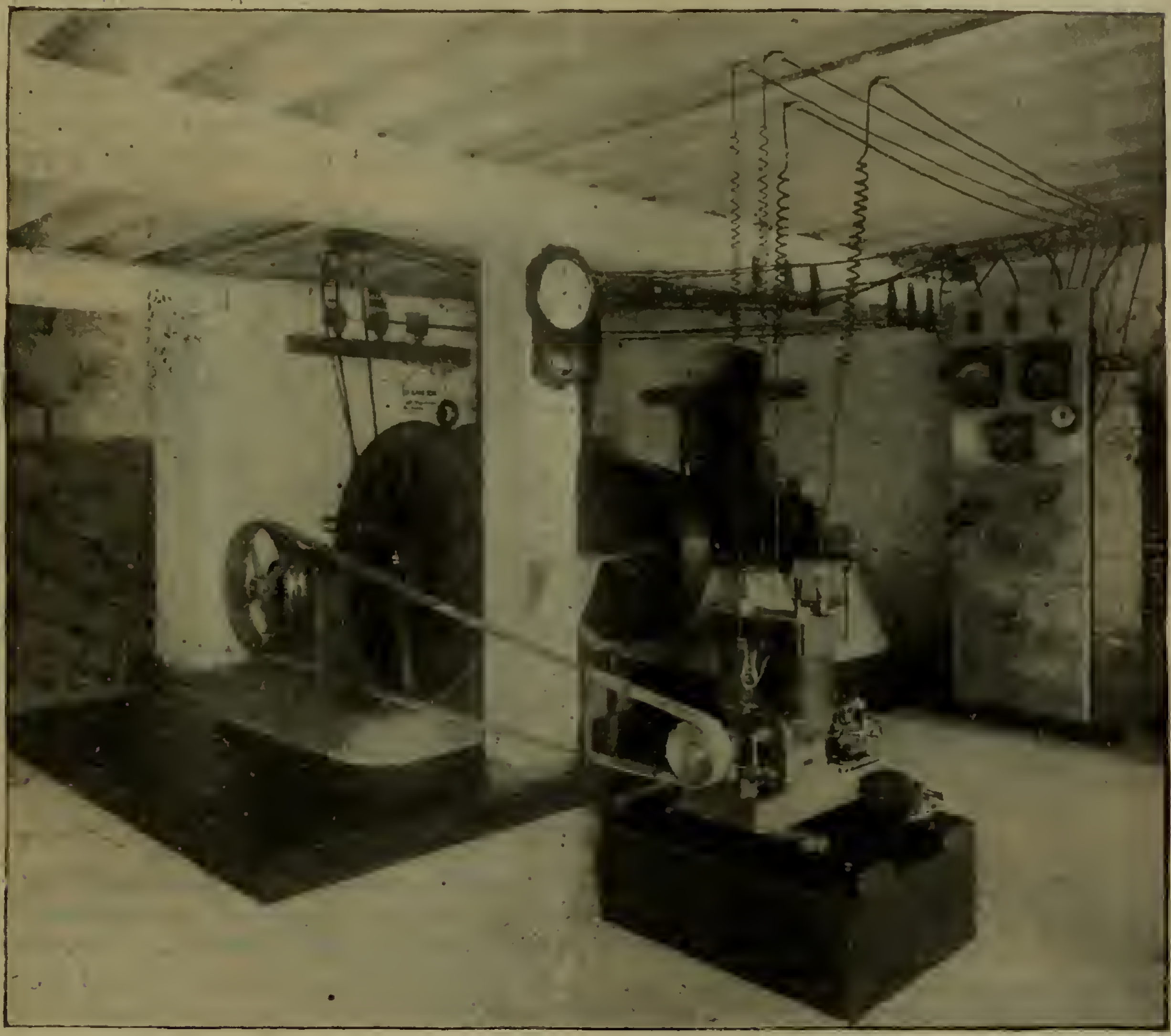


150-Horse Power Synchronous Motor in Sperry Flour Mill.

ELECTRICITY IN FLOUR MILLS.

Since the completion of the great three-phase electric power transmissions on the Pacific coast, between Folsom and Sacramento and the San Joaquin and Fresno, the use of electricity as a motive power has made great strides. Two of the most important flour mills are now added to the already long list of consumers.

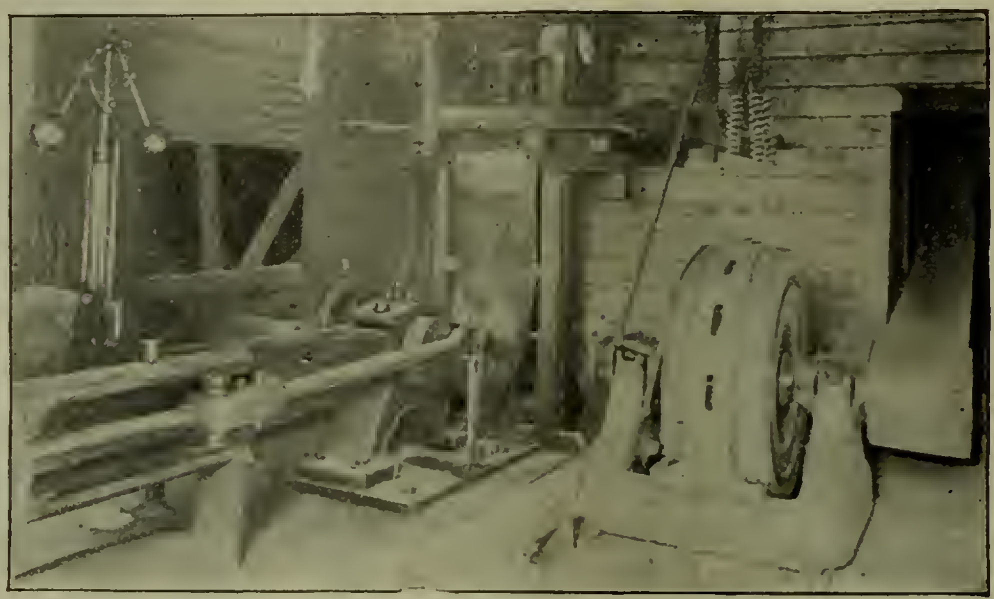
The first to place its dependence on electric motors instead of the steam-engine was the Sperry Flour Mill of Fresno. This is driven by a General Electric synchronous motor of 150-kilowatt capacity running at 600 revolutions. The illustration shows this motor with a small bi-polar motor to bring it up to speed, in the basement of the mill whence the main belt passes to the rolling and grinding machinery above.

The second mill is the second in importance on the Pacific coast and the largest flour mill in the United States using electricity instead of steam. Its electrical equipment consists of three General Electric three-phase alternating-current induction motors operating at a pressure of 500 volts. The largest of the three motors has a capacity of 75 H. P. This is belted to the main shaft of the mill and drives all the flour-making machinery. It runs continuously for twenty-four hours, and for three months without stop. The second largest motor is one of 30 H. P. This occupies a position on the second floor of the mill and drives all the cleaning machinery. It runs continuously for eighteen hours daily. The third is a 20-H. P. motor; and is placed in the basement near the 75-H. P. motor. This drives the roll for grinding the corn and the barley. Its work is intermittent and it runs from eight to ten hours per day only.

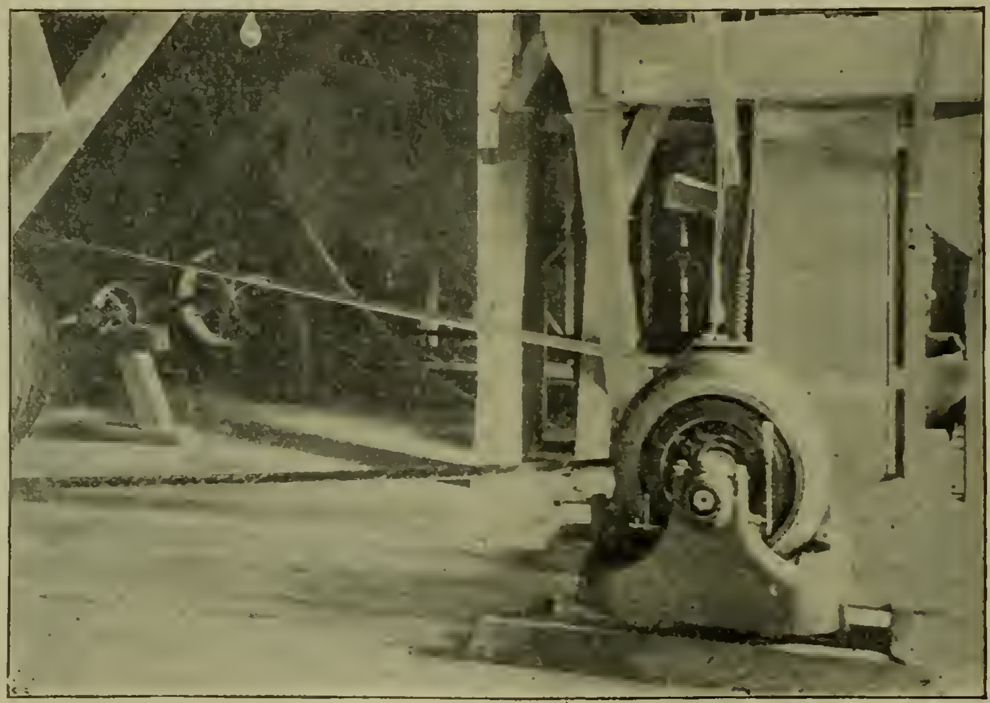
The power consumed by the motors is registered by means of recording meters which show the total horse-power of current consumed. These meters register exactly the power used and allow the company to keep a careful watch upon their machinery and obtain the highest economy in operation. For instance, when the cleaning for the day is completed and the 30-H. P. motor and all the cleaning machinery are shut down, all expenses for power in that department ceases at once. No power is wasted in running idle shafting and belting. The same is true in a still greater degree in the corn and barley crushing department, where the work is more intermittent.

Still another source of saving lies in the fact that neither engineer nor fireman is required to operate the mill electrically. The motors are so simple in their operation that any employee about the mill can handle them. To start the motor a simple switch is closed and a lever on the motor thrown over. In less than a minute the motor begins to perform its full load of work and continues without further attention from the operator. The stoppage of the motor is an equally simple process. No attention is required beyond this, except that entailed in keeping the motor lubricated. Power is always ready at call, but the mill is not put to one penny of expense for power after the machinery ceases to operate. In addition to this economy, the wear and tear on belts, bearings and machinery is reduced to a minimum by the system of subdivision of power which has been adopted. The cost of hauling coal from the river to the mill, which is in the centre of the city, is also saved. It is estimated that the economy in actual power consumed in the Phœnix Mill by the present method of driving is not less than fifteen per cent., and the total saving in the entire cost of operation will pay for the electric motors, their installation and adaptation in less than one year.

In addition to the economy in the operation of the mill by the introduction of electricity as the motive power a considerable amount of space has also been saved, as will readily be realized, and the room formerly occupied by the driving machinery can now be utilized for other machinery or for storage purposes. The present capacity of the Phœnix Mill is 275 barrels of flour and 20 tons of rolled barley and feed, every twenty-four hours, and the entire output of this mill is taken by local consumption, none of the product being shipped outside the State. It was due to the careful investigation of the subject by Mr. J. H. Arnold, the manager, that electricity was adopted as a motive power. He is already reaping his reward for himself and his company in benefits constantly accruing.



75-Horse Power Motor in Phoenix Flour Mills.



30-Horse Power Induction Motor in Phoenix Flour Mills.

TRAIN ACCELERATION TESTS.

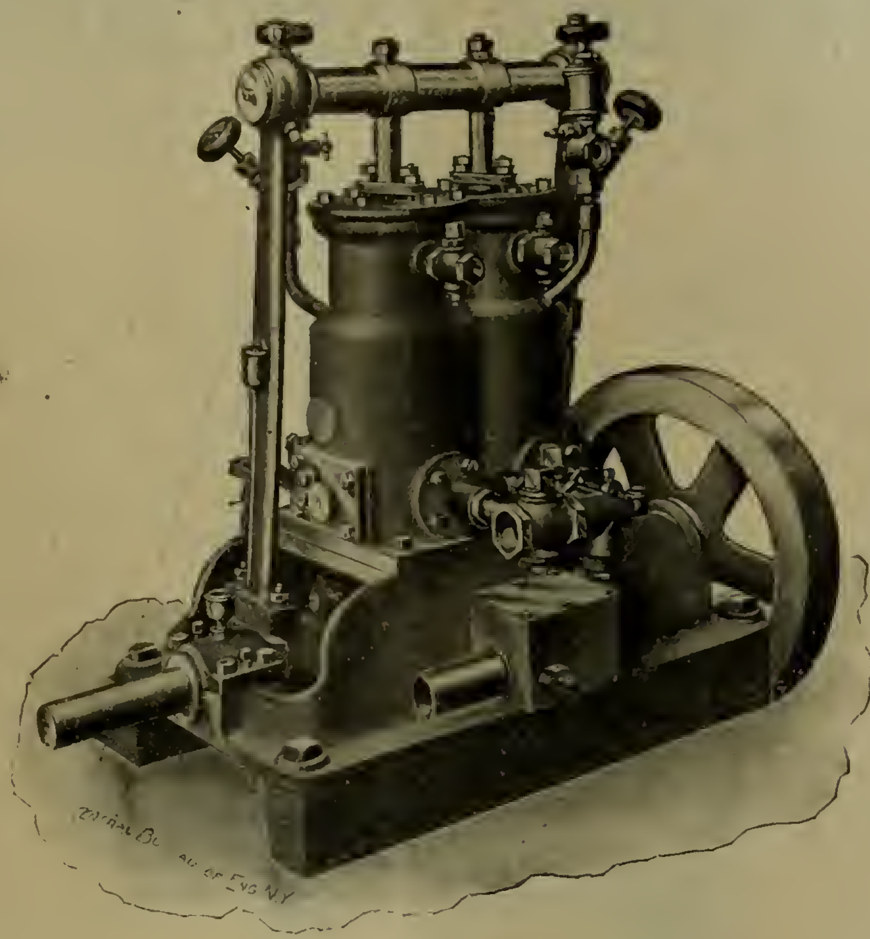
A series of additional train acceleration tests were made October 7 on the experimental track of the General Electric Co. at Schenectady, in the presence of A. W. Sullivan, general superintendent; W. Renshaw, superintendent of machinery, and John Lundie, consulting engineer of the Illinois Central Railroad, and E. C. Carter, principal assistant engineer of the Chicago and North-western Railroad. Although the weather was most unfavorable and the runs made in a heavy downpour of rain, the results recorded were pronounced very satisfactory.

Our readers will recall that the Illinois Central Railroad has contemplated the adoption of electric traction in its suburban service, between Van Buren Street Station and Woodlawn, a distance of about eight miles, using the tracks over which that company carried on the enormous World's Fair passenger traffic. The tests in train acceleration made by the General Electric Company recently have been urged forward for the purpose of giving a clearer comprehension of the adaptability of electric traction, and of securing that acceleration from rest, which would satisfy the demands of a congested suburban traffic such as that with which the Illinois Central Railroad has to cope.

The car used on the occasion of those tests was a standard elevated railroad car weighing empty about 25 tons. It was equipped with four 50-h. p. motors known as G. E. 57, one mounted on each axle, controlled by a standard series-parallel controller. In order that the officials present should be able to witness the actual performance of the car, the interior was equipped with voltmeter, ammeter, recording watt meter and compensated chronograph, with bell attachment sounding at 2-second intervals. Attached to one axle was a Beyer speed recorder, with the gauge on a level with the window.

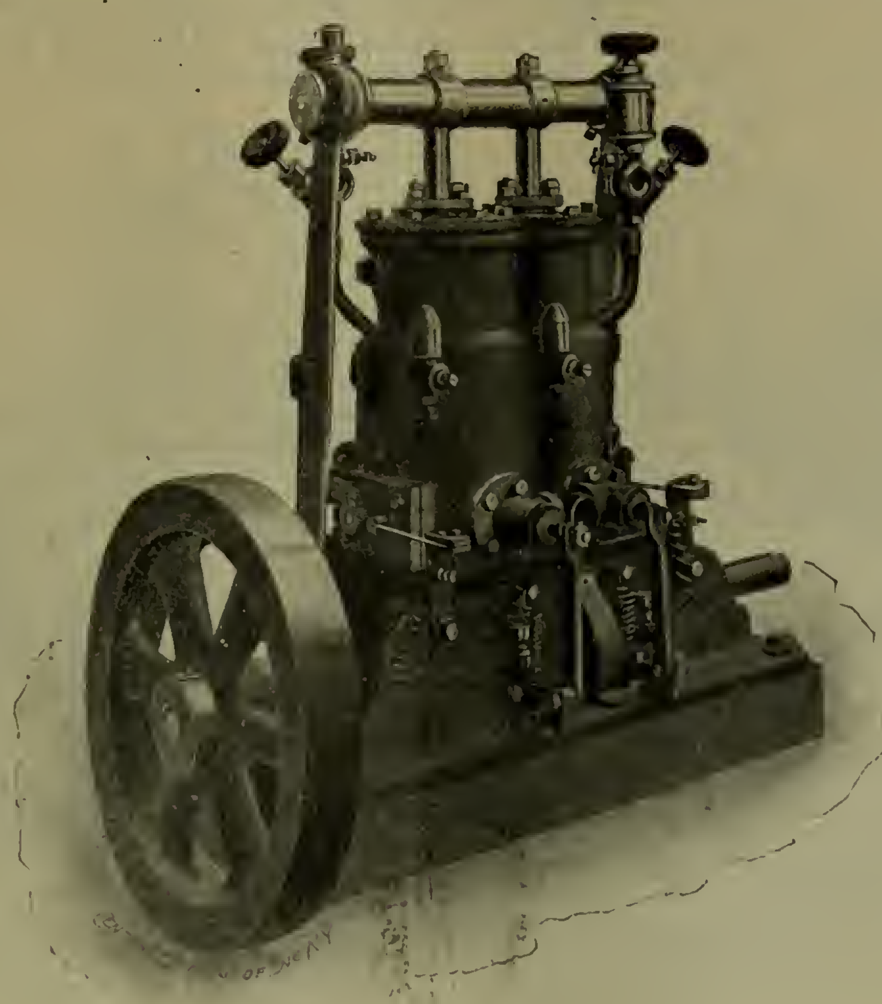
The car was driven by Mr. W. B. Potter, chief engineer of the railway department, and the tests were made under his direct supervision. A series of fourteen runs were made on the tangent of the experimental track—a stretch of 3,000 feet long—and the results on the wet track showed that in five seconds the car holding twenty people reached a speed of nineteen miles per hour; in ten seconds, thirty miles per hour; in fifteen seconds, thirty-five miles per hour, and forty-one miles an hour in twenty seconds.

This was with a wet and greasy track. During the latter half of the test the rain ceased, and a second series of tests was made with a dryer track. The results were more favorable, and a speed of about forty-one and a half miles an hour in twenty seconds was obtained.



Wing's Naptha or Gasolene Engine. (Double Cylinder.)

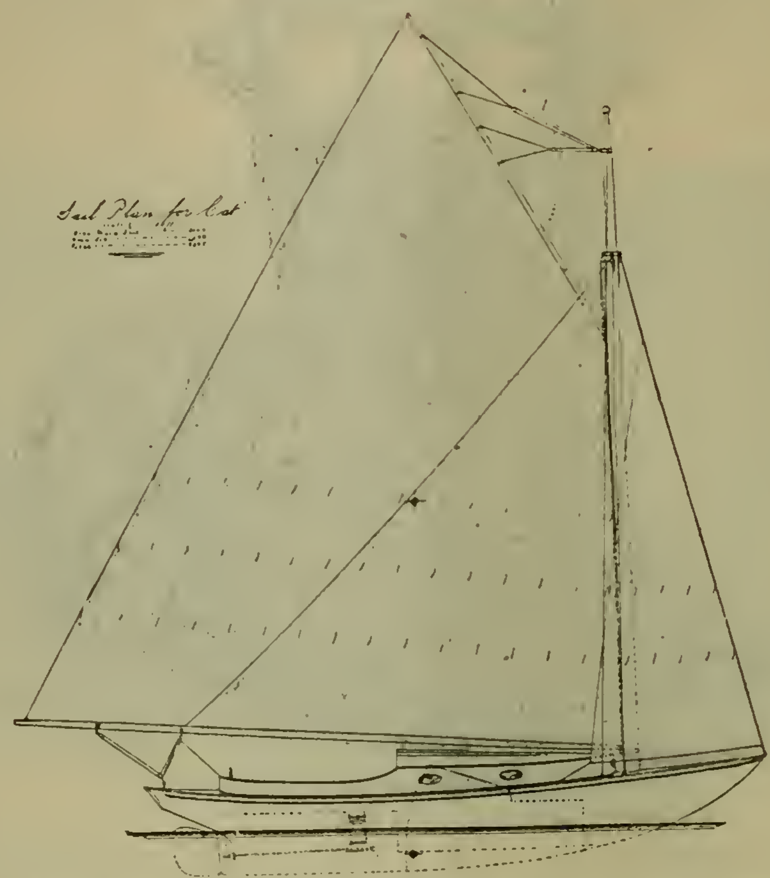
Perhaps a better idea of these results may be conveyed by saying that an ordinary elevated steam train would reach a speed of about fourteen miles an hour in the same lapse of time, while it would be only possible to accelerate it to the same speed in the same space of time by starting it on a down grade of about fifteen per cent. The significance of such acceleration may still better be grasped by the fact that it would mean a saving of not less than fifteen minutes in the running time over a distance of ten miles, with the same number of stops as in ordinary suburban or elevated service.



Wing's Naptha or Gasolene Engine. (Double Cylinder.)

The tests are to be continued at Schenectady under varying conditions, that is, with different weights of cars and different equipment.

The need of electricity on certain branches of the traction service of roads now operated by steam is becoming more urgent, and although it is perhaps premature to predict any immediate revolution in steam road methods, the



35-Foot Cabin Cat Boat, Built by L. J. Wing & Co. for F. L. Sheppard, Gen'l Sup't, Penn. Railroad, Carries a 6-H. P. Wing Gasolene Engine.

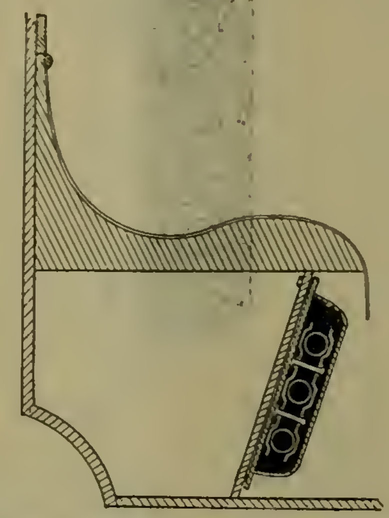
encroachments of electricity in that domain can no longer be denied.

GAS ENGINES FOR MARINE USE.

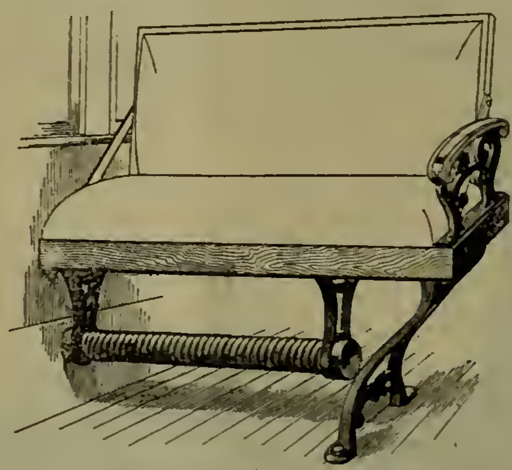
The time has arrived for gas-engines to receive the attention they have so long deserved. The many uses to

21-Foot Launch with 2-H. P. Wing Marine Engine.

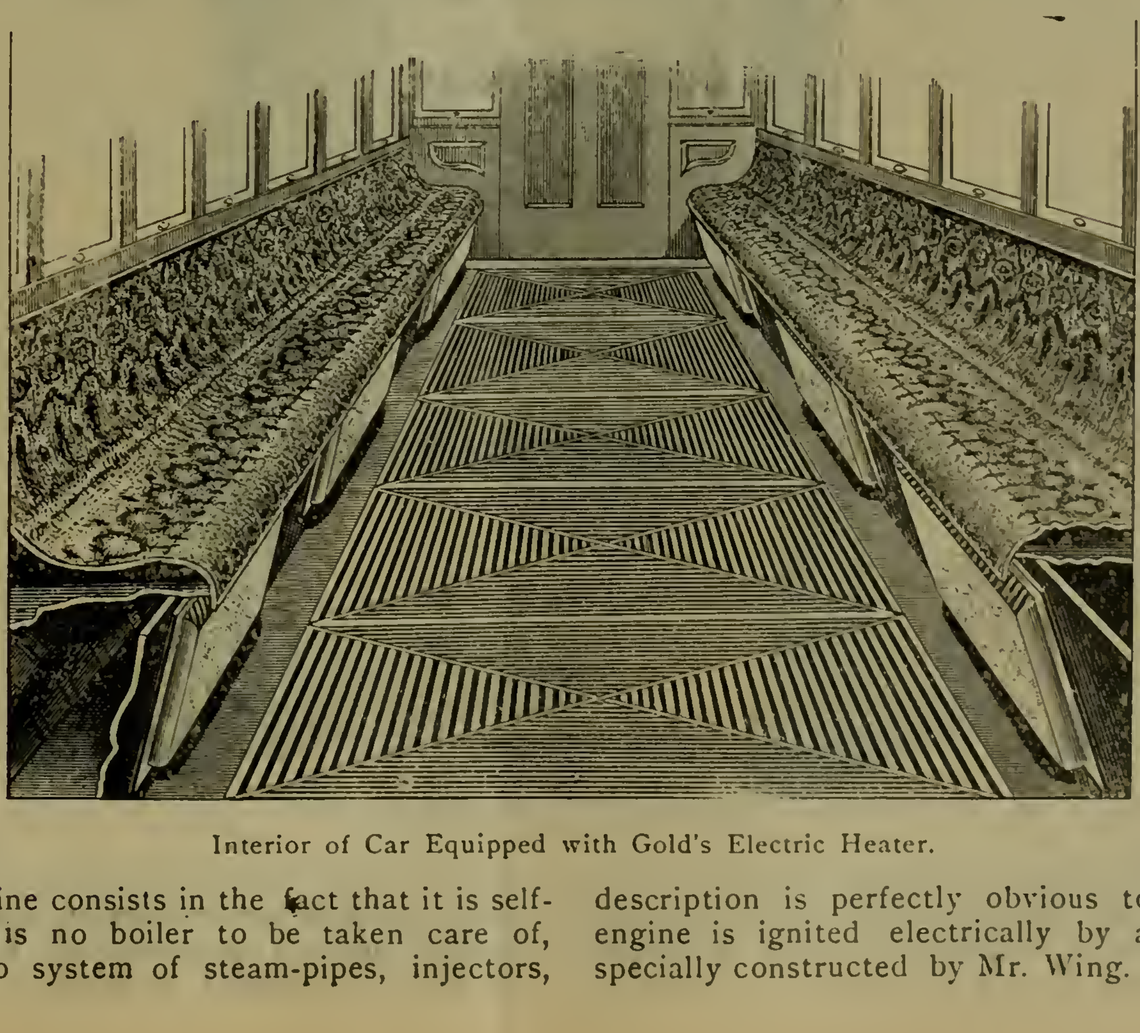
which gas-engines can be put are as numerous as the applications of a steam-engine, to countless fields of work. Of late, in Germany, England and America, gas-engines have been regarded as an economical power producer that could compete with any other class of machinery. The direct application of gas-engines to marine work has been carried out in a most successful manner by Mr. Wing, of L. J. Wing & Company, 109 Liberty street, New York. The great satisfaction derived from the use of a well-built, compact and efficient gas-engine is always present in a purchaser's mind. The marine gas-engines sold by the above concern combine in their construction the necessary features required to make them the most popular type of gas-engine associated with marine practice. The space they occupy is so small, their construction implies the most careful workmanship ; the economy with which they run constantly upholds the idea that Wing's marine gas-engines are the product of careful experiments directed towards a final and important end—high efficiency. The illustrations appended show a six-horse power Wing engine, in perspective, the port side of the engine showing. The Wing Company manufacture their four and two-horse power, single-cylinder engines on the same general lines. Two other sketches show Wing's naptha or gasolene engines. The illustrations will give the reader an idea of the appearance of these engines, fully assembled and ready for use. These double-cylinder engines are made in sizes of four, ten, fifteen and twenty horse-power. They are practically double engines and involve certain novel improvements of so valuable a nature that without doubt they lead all others from every engineering standpoint. The great beauty of a gas-engine consists in the fact that it is self-contained. There is no boiler to be taken care of, no fire or ashes, no system of steam-pipes, injectors, pumps, etc., no risks of any kind that might endanger life or limb; but, instead, an engine that will start at once without delay, require little or no attention and perform its functions as a piece of power-producing machinery ought to without expert care or additional expense. The cost of running Wing's Improved Marine Gas-Engine has been so reduced that cause for complaint on the part of the purchaser would certainly not exist on that score. The consumption of gasolene is one-tenth of a gallon per horse-power hour, or about five cents per hour for a thirty-foot launch with a six horse-power Wing Marine engine at present price of gasolene. The advantage of having auxiliary power on board a sailing vessel of any description is perfectly obvious to the reader. This engine is ignited electrically by an improved device specially constructed by Mr. Wing. Its action is abso-



Heater in Position Under Seat.

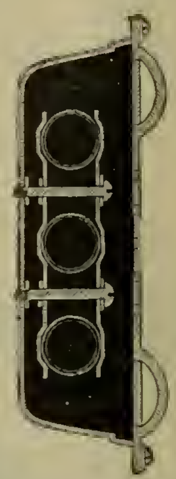


Use of Heater for Cross Seats.



Interior of Car Equipped with Gold's Electric Heater.

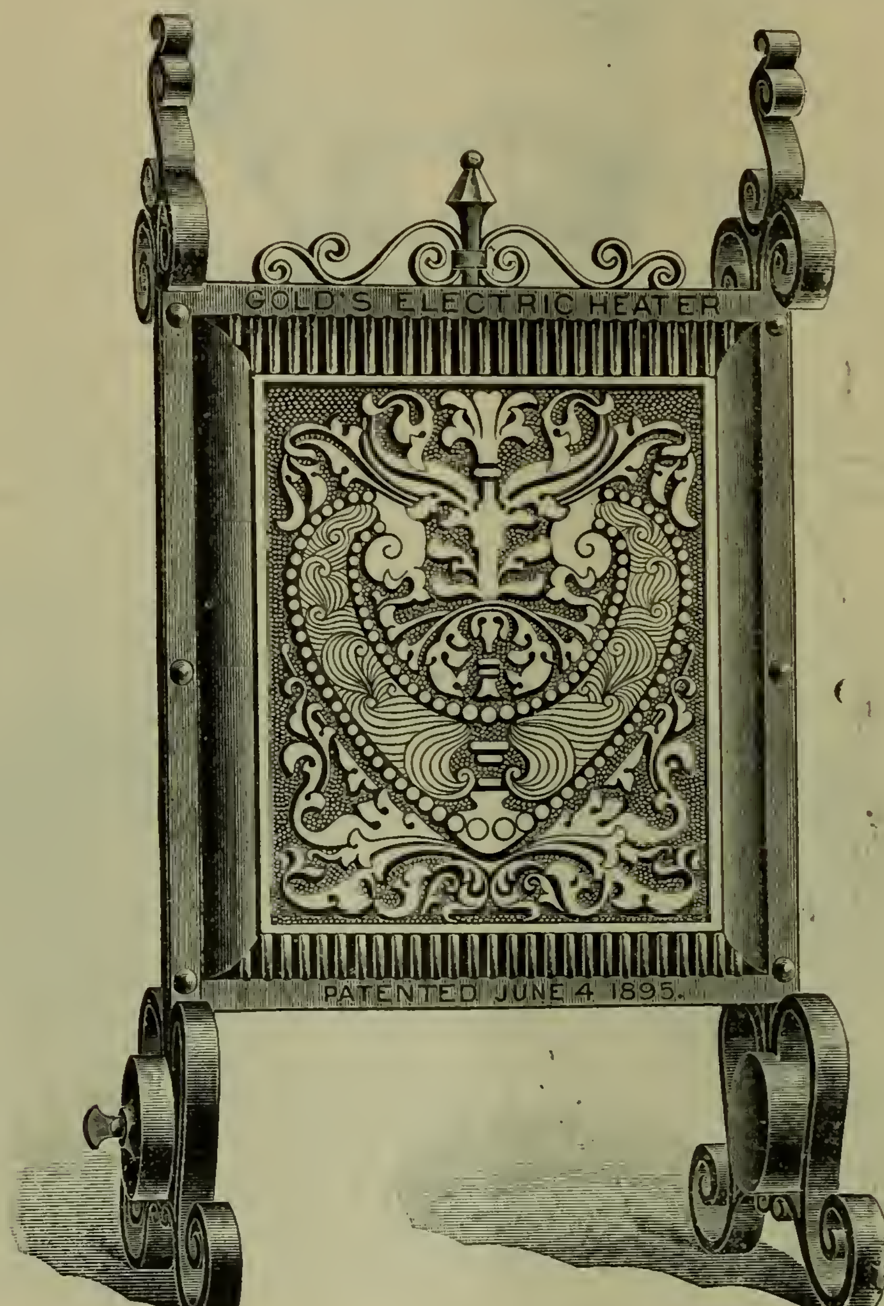
lutely certain, and an installation of this kind on board a pleasure yacht will be greatly appreciated by its purchasers, particularly when calms occur and the owner, instead of waiting for a breeze, can shoot ahead and leave other yachts behind. Mr. Wing will be pleased to send catalogues and descriptive matter to those desiring to correspond.



Cross-Section of Heater.

THE HEATING OF CARS BY ELECTRICITY.

The application of electricity has not been limited to merely light and power, but it has found other fields as broad and as interesting in which it will cause a radical change to occur. The use of electricity for purposes of heat has gradually come more and more into prominence in the last few years. The special branch of the profession which has come into existence and excited considerable comment is that which heats cars by electricity, and among the first to investigate so practical a problem was the Gold Street Car-Heating Company. A great many improvements which collectively make their heaters a success are controlled by this concern. The efficiency, convenience and cheapness of these heaters make them so far superior to the ordinary stove, commonly used in cars, that the change from the old to the new system of heating is inevitable. There is, besides, an element of safety to be found in connection with an electric-car heater which most eloquently proclaims its superiority to any other method of warming cars. The Gold Street Car-Heating Company have offices in New York at Frankfort and Cliff sts., and in Chicago at 658 Rookery. Illustrations are appended, showing the position of the heater under the seat, the interior of a car equipped with Gold heaters, and the appearance of a heater as seen with part of the front removed, showing the resistance coils in po-



Gold's Electric House Heater.

The Electrical Age.

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CONTENTS.

THE INCANDESCENT LAMP AND ITS ULTIMATE PERFECTION.

Since Edison invented a lamp which showed the practical application of a current to illuminating purposes and proved that a carbon filament in an exhausted glass globe could give light for hundreds of hours without failure, thousands of inventors following in the footsteps of their illustrious predecessor, have sought to further perfect it, get more light for less power and obtain a filament whose construction and nature would resist the fierce heat of blinding incandescence.

The incandescent lamp since its inception has made marvellous progress, and represents a grade of perfection that seems not only to leave little to be desired but still less to be anticipated. The question naturally arises, in what way can the incandescent lamp be improved so as to give more light for less power, and be durable enough to last, even though the temperature of its filament is that of molten metal. The answer may be framed in the following words: "a lamp that will give more light, though consuming less energy, is one whose filament can stand a higher temperature, and in conseqnence has been brought up to a high pitch of incandescence with very little additional power." All lamp filaments at present are just heated to a point beyond which there would be a great gain of light with slight additional power, below which there is a great loss of light for a slight decrease of power. In other words, lamps of today are burnt at a point bordering upon high economy, and in them all, the disintegration of the carbon is so rapid with the slight surplus of power mentioned that, commercially speaking, it does not pay to take advantage of this gain. A more refractory material must be chosen, as for instance, the oxide of some rare metal that will stand the tremendous heat produced by the passage of the current. There are upon the market at present lamps which consume the proper amouut of power, that is, about one-twelfth horse-power apiece; others that take but one-fourteenth horse-power, and finally another class but rarely used, except in special cases, that absorb only one-twentieth or one-thirtieth of a horse-power. In other words, lamp manufacturers are willing to supply you with makes that will take two-thirds, one-half and even one-quarter of the regular amount of power, but they will not guarantee the life of such lamps under any circumstances.

The further improvement of incandescent lamps, therefore, rests upon a basis which involves not only the perfection of the lamp itself but in addition the engineeriing situation, that is, the regulation of pressure supplied to such lamps. The more reduced the power a lamp takes, the more careful must be the consumer in regulating the pressure supplied to it. An opportunity to preserve the natural life of the lamp is thus gained, but its construction will inevitably limit its hours of life to a certain maximum value which falls and falls with its rating, that is, the energy it takes per candle-power. The reduced life, many inventors claim, can be increased, however, by the use of certain rare oxides whose resistance to high temperatures is extraordinary.

It has been suggested by some to build the filament in a tubular form, thus presenting a greater surface in proportion to the material it is composed of than would otherwise be exposed with it in a solid form. This idea is a valuable one. If a perfectly refractory cylinder were coated on the outside with a thin conducting film of light-giving material, a current sent into the same would produce light at a much higher rate of efficiency than if the material matter equivalent to that film were in a solid column. Although an ordinary carbon filament is very slight and delicate, it is highly evident that by spreading the same upon a flat surface so that the ultimate cross-section of carbon and length did not vary, although it covered a greater area, the incandescence of this mass would be more highly productive of light, and therefore in certain respects provide a solution to the above problem, but the difficulty of achieving these results is so great that at present unless a new discovery is made of a compound or element that heat but slowly affects, incandescent lamps will remain no more efficient, no longer lived than the present market affords.

The Japanese have been performing some interesting experiments with X rays. They have quickly appreciated the value of a modern scientific education, and one of their leading thinkers, Prof. H. Muraoka, in the University at Kioto, has been engaged in an attempt to discover Roentgen rays in the light of fire-flies. The flies were placed in a box, and separated from them was a photographic dry-plate, which was found to be slightly affected after a two days' exposure. It is strange to realize that the fire-fly, whose transient gleam might have flashed across the sight of primitive man, in forests and on marshes that have solidified into beds of coal and peat, contained within its little body the power to produce the wonderful X rays.

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sition. The construction of the Gold heater betrays considerable care and thought on the part of its designers. The coils are built so that the best possible distribution of heat occurs, for the amount of current received. The cold air percolates through the bottom and passing the resistance coils is heated and issues as a uniform current of warm air. There are no sirocco-like gusts of hot air, alternating with frigid draughts, but instead, all that a passenger can desire—a comfortable flow of pleasant and even temperature.

The aim in the construction of these heaters has always been to utilize all of the electrical energy consumed, to the very best advantage, that is, securing the most heat delivered into the car body for the least amount of current possible. This has been accomplished by placing the resistance coils of heaters in such a position that all of the cold air entering them at the bottom is thoroughly cut up and divided into the smallest particles by the hot-resistance wires. This produces a steady flow of evenly warmed air.

Gold's Electric Heater for Street Cars.

The resistance coils of these electric heaters are usually of an inch and a quarter diameter, and generally three coils high, one placed directly above the other, in a horizontal position, as shown in the view. These coils are held securely in position by slight grooves in the solid and specially prepared enamelled plates, so that, in the improbable event of a wire breaking, it would be impossible for it to leave its original position, thereby avoiding any short circuit or burning of wires and fuses.

The wire is likewise non-corrosive and will last for many years. Three gradations of heat are obtainable with this device. A switch turned to either point one, two or three gives the different degrees of heat. The Gold electric heater is particularly adapted to street-electric cars and is made for cross-seats as well as those arranged longitudinally. Illustrations are given showing heater in position under a cross-seat, and an artistic and finely finished heater for homes, apartments, halls, etc. This portable, represented in sketch, may be connected by means of a flexible cord and plug, to an ordinary lamp socket. The Gold Street-Car Heating Company build a special heater for boats, or the wall in a private house. Many of them are used in the transatlantic steamers, and the absence of noxious gases and danger for such purposes places them far above any other heating device in existence. At the American Institute Exhibition, last year, the Gold electric heater was given the highest award and pronounced the superior of all others.

The Gold electric heaters were exhibited at the American Street-Railway Convention at Niagara Falls, meeting with great favor there. Mr. E. E. Gold, president, W. E. Banks, treasurer, and John E. Ward, manager, were on hand looking after the company's interest. Mr. H. E. Beach, acted as representative.

E. W. Gold, Western representative.
H. E. Beach, Eastern "
Frederick Weston, electrician.

A NEW ILLUMINANT.*

I have the honor to report an important discovery which, it has been claimed, will in time do away with the present system of illuminating public places, etc., with the electric arc light. The details, briefly, are as follow:

Mr. Ernest Salzenberg, director of the gas works of the city of Crefeld, has invented an improvement in incandescent gas-burners, which relates to the production of incandescent gaslight, based upon the discovery that, when the pressure of the gas is considerably increased upon the incandescence body, the said body emits a golden-yellow light, very agreeable to the eye, displaying objects in their natural colors.

The gas is supplied to the burner at a pressure of about 3½ atmospheres, the burner, to withstand this high pressure, being of special construction. A single incandescent jet of the ordinary size can emit a light of much more than 1,000 candle-power. The light is of such intensity that a person is enabled to read the finest print at a distance of 100 to 150 feet.

The inventor claims that the cost of his incandescent light of 1,500 candle-power is only 4½ cents per hour, while that of the ordinary electric light of 400 candle-power is (in Germany) 14 cents per hour.

In the apparatus constructed by Salzenberg, a hydraulic pressure of 3.5 atmospheres, and even more, may be forced through the improved Auer burner.

The invention is, however, only applicable where water-works exist.

Mr. Salzenberg has already applied for letters-patent in the United States.

P. V. Deuster,
Crefeld, October 29, 1897. Consul.

THE ELECTRIC ARC-LIGHT COMPANY.

Few appreciate the actual cost of introducing successfully on the market an article embodying a new principle.

In most cases the cost of selling is found to exceed the cost of manufacturing the article.

The liberal policy of the Pioneer people has proven such to be their case in the past in forcing to the front and making a place in the electrical field for the enclosed arc lamp, and even at the old price of $30.00 they found the margin of profit small.

This preliminary work they consider has now been done, and the enclosed arc lamp is recognized to-day as the only lamp considered in arc-lamp work, and the business has grown to such magnitude that the Electric Arc-Light Co., of 150 Nassau street, formerly 687 and 689 Broadway, early in the season took steps to enlarge their manufacturing plant, and they are pleased to announce that this plant is now completed with a capacity of

*Department of State, Bureau of Foreign Commerce, Washington, November 13, 1897.

1,000 lamps per month, and with the new facilities thus secured, and with the large amount of business they are doing, they are enabled to effect a saving which it is their purpose to give to the consumer, and announce a reduction in price of their standard brass lamp from $30.00 to $25.00 each.

We are sure that this liberal policy will be responded to by the trade, and still further add to the call of the Electric Arc-Light Co. for Pioneer Lamps, and while they have always claimed this lamp to be the most perfect piece of mechanism in the market, the price has been placed at the same point by them as makers of lamps which they claim have had less experience, and who are in reality infringers on the broad basis Patents of Marks; and now that the commercial position of the Pioneer Lamp is assured, it is understood that the owners of the Marks Patents are beginning a most vigorous crusade against all infringers, which covers all types of enclosed arc lamps except those made by manufacturers as may have been licensed.

Size 22 C.-W. Mill Motor.

CROCKER-WHEELER ELECTRIC CO.

The Crocker-Wheeler Electric Co., of Ampere, N. J., have received recognition from many sources in consequence of the excellence of their equipments and the up-to-date enterprise that has led them to adopt new methods in the manufacture of their improved machinery. One of the above illustrations represents a New Haven Engine Lathe connected to a size 3 C.-W. motor. The speed changes are made through a nest of gears which transmit the power with certainty and dispatch.

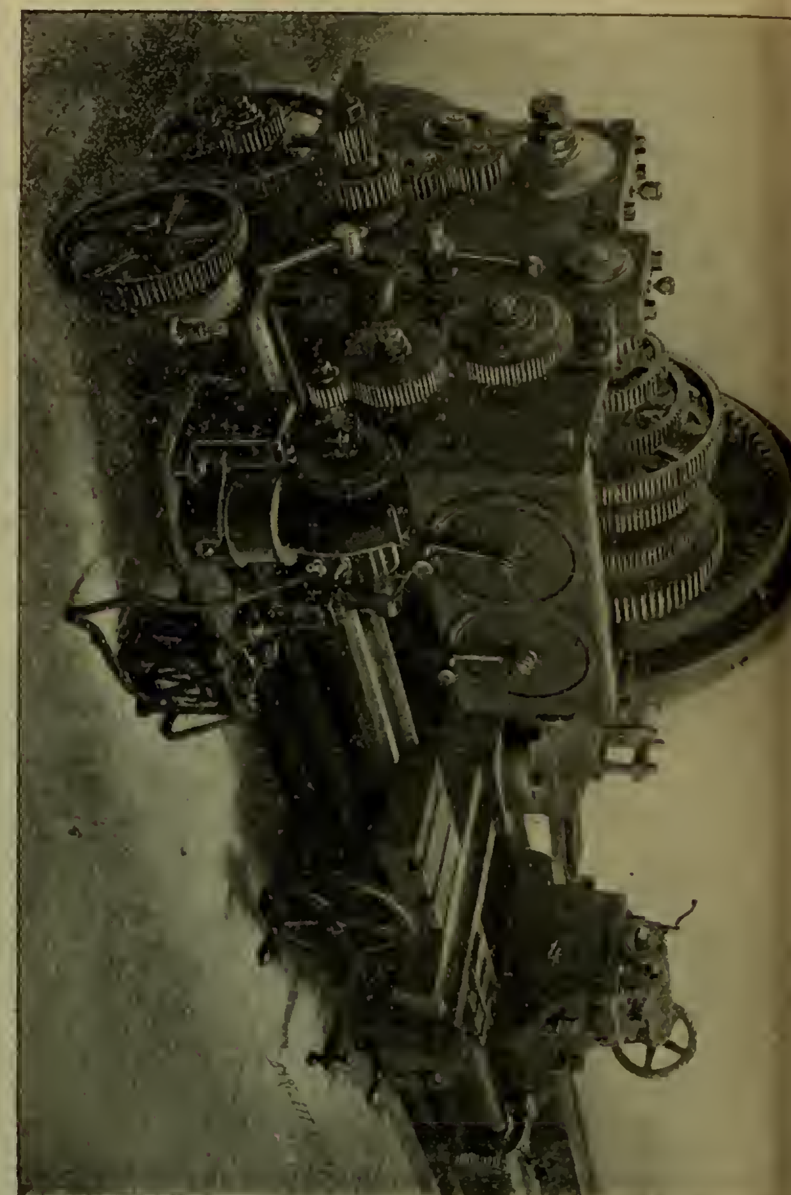
Belt losses and the inconveniences resulting therefrom cease to be with this arrangement. The Crocker-Wheeler Electric Co. were the pioneers in the use of direct-connected machinery; all the tools in their shops being operated by motors that only consume power when required.

The 200-K-W. railway generator made by the C.-W. Electric Co. runs at a speed of 500 revs. per minute. This handsomely designed machine is rated as follows: 225 K-W. motor at 115 to 230 volts, 400 revs. per minute; 200 K-W. at 450 revs.; at 500 volts as a motor 225 h.-p. at 450 revs. per minute; at 500 volts as a dynamo 200 K-W. at 500 revs. per minute.

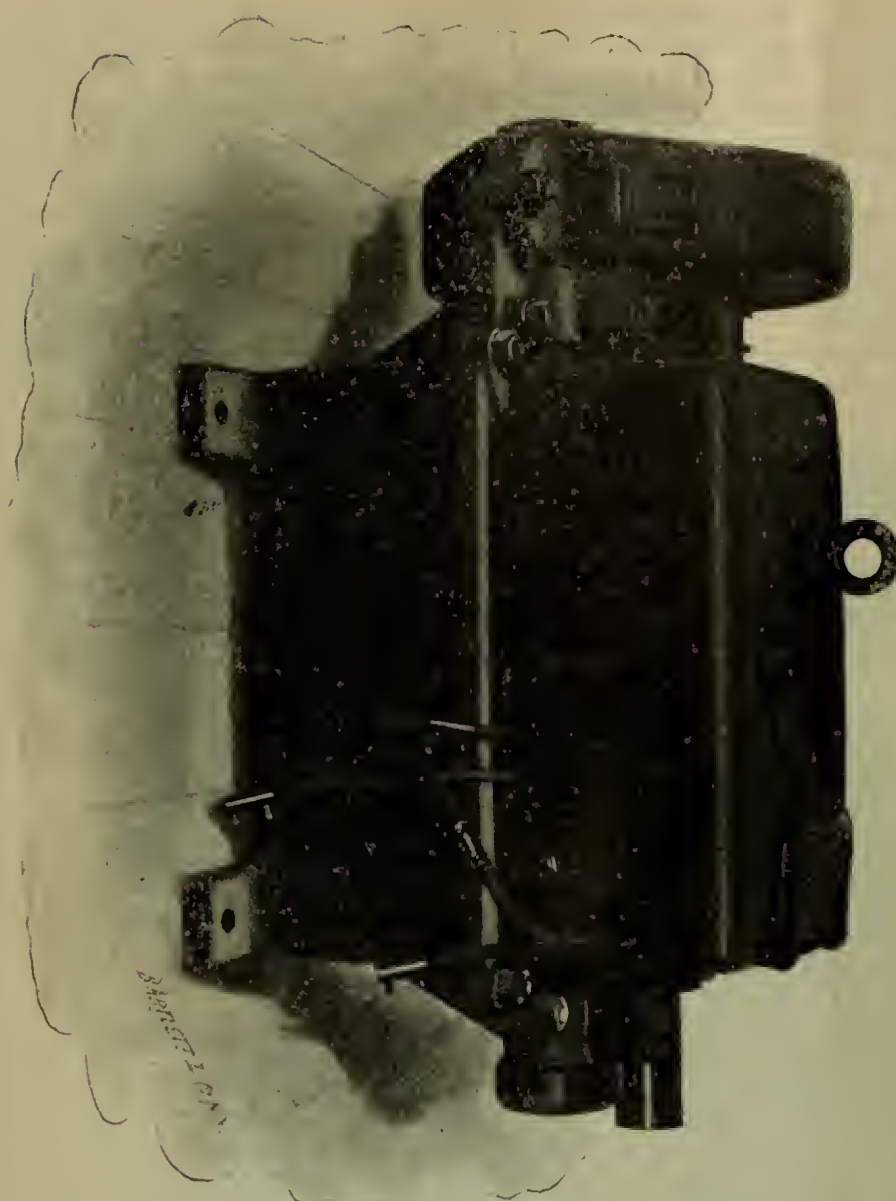
In addition to the above belt type machines, both motors and dynamos are being manufactured, which represent electrically and mechanically designs of a high order. In efficiency, the Crocker-Wheeler belt type machine cannot be surpassed, and certain diagrams illustrating the working conditions under which even small sizes of motors or dynamos run likewise testify to their high efficiency in all cases. The speed best suited to belt type machines varies from six hundred to twelve hundred revolutions per minute, and although the winding is necessarily modified to meet the above speed variations, the efficiency in total is not affected. The Crocker-Wheeler belt type machines are built both bi-polar and multipolar, with certain valuable mechanical features added which have given them a reputation for durability which will endure. Solidly constructed brush holders, self-oiling bearings, substantial belt-tightening apparatus and, electrically speaking, freedom from undue heat in winding on armature and field conclusively prove that Crocker-Wheeler machinery may be regarded as one of the finest products of American industry. It may be said that no manufacturer pays the same attention to the finish and assembling of machineyr or takes as much interest other than commercial in their completion than the Crocker-Wheeler Electric Company. In fact, the original basis on which they started was two-fold in its character—first, to design and construct a device that would answer to certain electrical and mechanical tests; secondly, to offer this machine to the public with a full consciousness and perfect confidence in its durability and efficiency.

In some of the illustrations types of machinery and their parts are shown. It is hardly necessary to speak of the precautions taken to secure ample copper conductors in the armature, sufficient cross-section and surface in the commutator and the proper brush areas, and other points of secondary design, because in actual practice the dynamos and motors of the above concern have always shown that they were capable of withstanding severer strains than their competitors. In matters of regulation, period of long run and smoothness of operation, the above apparatus stands unexcelled, and it is therefore advisable for plant owners, station proprietors, electrical contractors and capitalists to thoroughly investigate the quality and nature of Crocker-Wheeler machinery before undertaking to buy at hap-hazard.

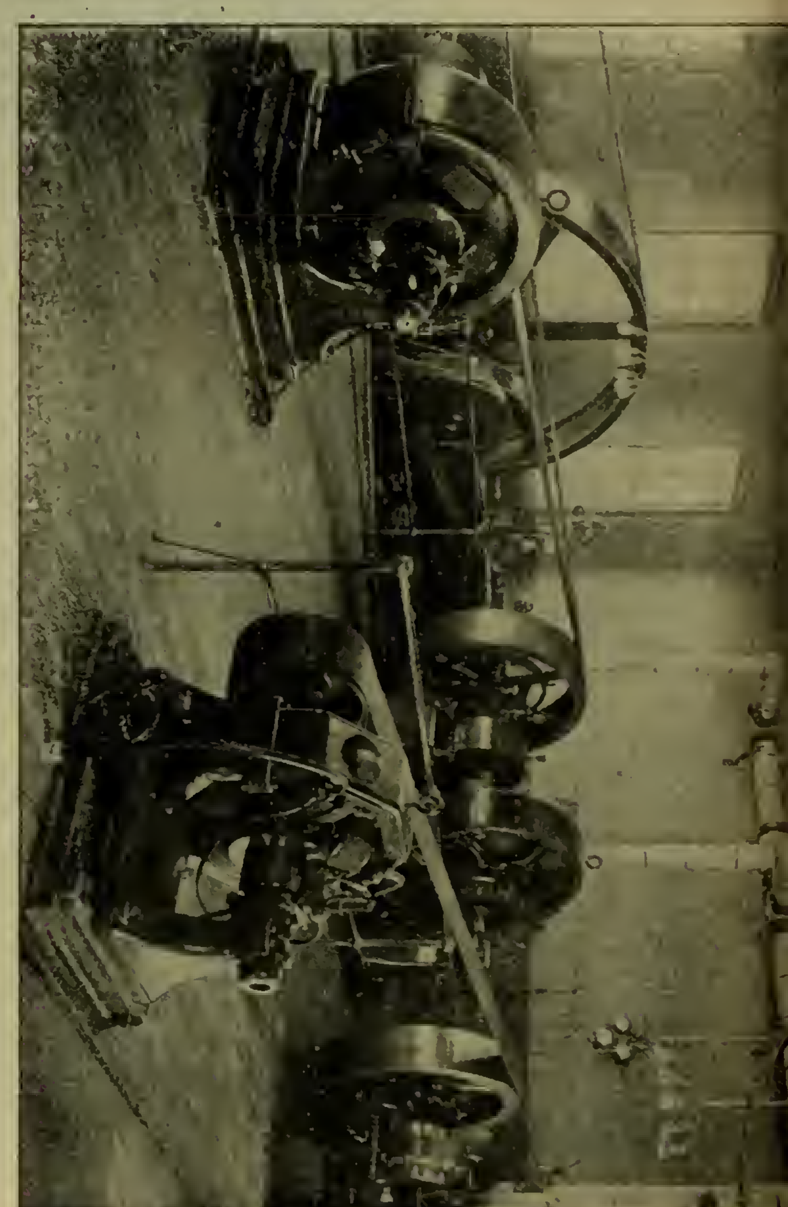
The New York office of this company is at 39 Cortlandt street, and their extensive works may be found at Ampere, N. J.



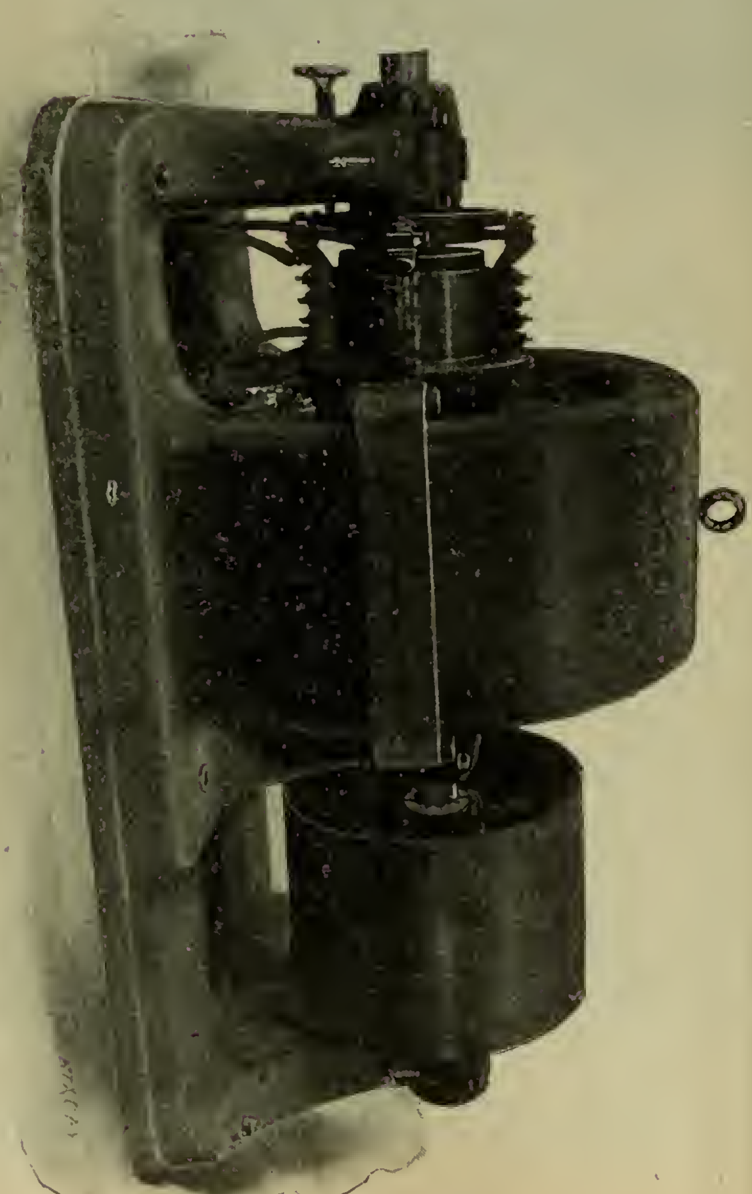
Direct-Connected Engine Lathe and Crocker-Wheeler Motor.



Size 22 Mill Motor, Connections Side.



Interior of Power House, Crocker-Wheeler Works, Ampere, N. J.



200-Kilowatt Dynamo at 450 Revolutions per Minute.

ELECTRO-MAGNETISM.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The magnet, whether natural or artificial, advances the idea that certain forms of energy, particularly magnetic energy, has the native quality of discrimination. Certain laws govern this tendency—the attraction or repulsion of poles; but further than this we cannot go except on theoretical lines. We find likewise that when magnetic effects are produced by means of an electric current, the action of unchangeable laws becomes evident and a host of interesting facts follow in consequence.

A magnetic field is the space in which magnetic force appears. It has often occurred that a given effect is the result of apparently different causes. In the case at hand attention is to be drawn to the principal means by which magnetism is produced.

The whirl of magnetic energy around the wire disappears when the current ceases, increases in intensity as its strength increases, and acts in perfect accord with it.

Iron placed in the coil makes it a powerful magnet, because the number of lines of force have been increased by it, and likewise the usefulness of the coil.

Permeability.—Different materials affect these lines of force when passing through them to various degrees.

Iron increases them.

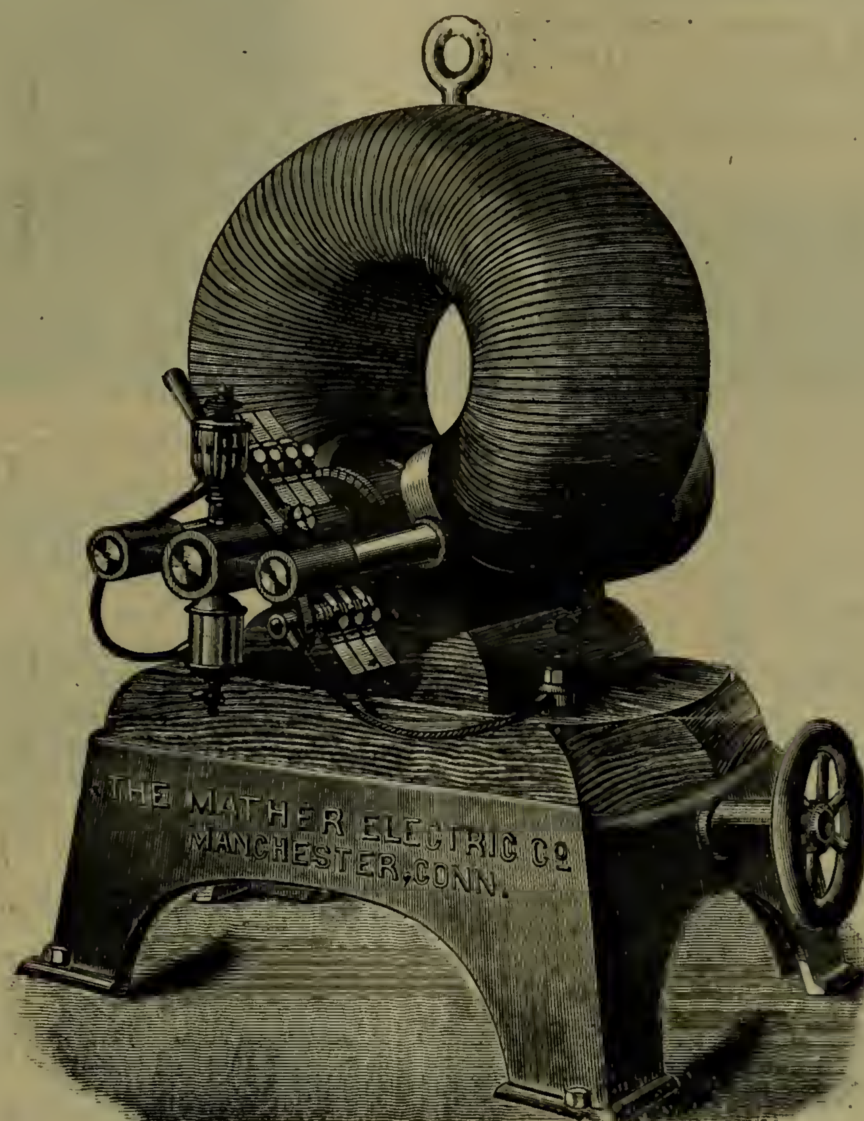
Nickel increases them.

Copper or air leaves them as before; acting alike.

It seems that iron conducts them, as it were, easier than anything else we know of; but air treats them with indifference, the number neither increasing nor diminishing with or without a vacuum.

This property of a body to carry the lines of magnetic force is measured by their permeability. The standard taken is—

Air = 1, a fixed value.
Steel = 800, a variable value.
Soft iron = 1000, a variable value.



An Ideal Magnetic Circuit.

(1) Due to natural causes—the lodestone.
(2) Due to contact—the steel magnet.
(3) Due to the electric current—a wire carrying a current.

A coil of wire carrying a current will be found to possess magnetic qualities and has, by investigation with a compass, both a north and a south pole.

The strength of the current will have an effect upon the magnetic field the coil produces, as likewise, upon the iron in its centre.

A wire in which a current passes becomes magnetic on the outside to such an extent that a delicate compass is at once affected when brought near.

The strength of the field produced by a coil of wire depends upon

The strength of the current.
The number of turns.

By coiling the wire all the magnetic energy is concentrated at the centre, and therefore manifests itself there most strongly.

The multiplying effect of soft iron in a coil is so great that its strength has been raised on occasions to a point where 200 pounds pressure per square inch was produced.

The greater the permeability of the iron, the better it is for the building of dynamos.

Wrought iron is best;
then follows Mild steel, and
Cast iron,
arranged according to their permeability.

The strength of the magnets, or rather of the iron within the coil, is measured by the number of lines of force it possesses to the square inch.

Approximately, Wrought iron takes 100,000.
Mild steel takes 80,000.
Cast iron takes 60,000.

Saturation.—When the iron is carrying as many lines of force as possible it is said to be saturated, in the same sense that water in which sugar is being dissolved will ultimately refuse to carry any more in solution. Actually this stage is never reached, but a condition bordering upon it is such, that enormous power is required to gain a slight increase in lines of force. It is economical in the manufacture of dynamos to keep well within this limit.

A north pole in a coil can be known without testing, because it is merely necessary to discover whether in the end of the coil facing you the current is circulating in a direction opposite to the hands of a clock.

A south pole in a coil is known if the current in that end of the coil circulates with the direction of the hands of a clock.

The number of lines of force a piece of iron produces with a coil grow very rapidly up to a certain point; then the increase becomes less and less, until ultimately saturation results.

The curve of saturation shows this very clearly; that is, the rapid increase of lines of force due to the turns and current. With a few turns and little current the number of lines of force grow rapidly within the iron; up to a certain point this continues, but even though the magnetizing force be doubled or tripled the lines of force increase but slowly.

Ampere turns is the name given to turns carrying a current. One turn carrying a unit of current (an ampere) is called an ampere turn.

The ampere turns acting in 1000 turns carrying $\frac{1}{10}$ of an ampere equals

$$1000 \times \tfrac{1}{10} = 100 \text{ ampere turns.}$$

The same magnetizing force would be produed by 100 turns and one ampere, or 200 turns and half an ampere, etc.

Turns and amperes are multiplied together to give ampere turns.

Magneto-motive force is the name given to the magnetic force derived from the ampere turns which excites lines of force in air, iron, steel, etc., in quantities depending upon the

Cross section,
Length,
Permeability of the same.

The magneto-motive force = $1.257 \times$ the ampere turns.

In any material the number of lines of force are found by the following rule:

$$\text{Lines of force} = \frac{\text{Magneto-motive force} \times \text{permeability} \times \text{cross-section.}}{\text{Length.}}$$

This rule as it stands is applicable at once, if the length and cross-section are given in the metric system; that is, in centimeters and square centimeters; otherwise it must be modified for English measure.

A NEW PATENT DRILL CASE.

A very important invention has been made which will be greatly appreciated by machinists, in the nature of a new drill case. This drill case combines within itself certain important features which will make it highly desirable and even essential to quick work in the machine shop. The disagreeable chase after a drill or drill gauge comes to an end when the drills are carried in this improved case. The Weiss drill case, such is its name, contains sixty round-bottomed receptacles, each carrying special-sized drills from number one to number sixty; the number sixty having a capacity of two hundred drills and the number one about sixteen drills. The case is practically a drill gauge, with finely ground bushings well hardened, opposite each receptacle. The exact size of each drill is given, particularly for use with standard-size taps. It represents one of the most convenient and practical additions to the machine shop, and is sold by Louis T. Weiss, successor to Weiss Brothers, 286, 288 and 290 Graham street, Brooklyn, N. Y. The Weiss drill case is

made of cast iron, highly finished in japan, and tastefully ornamented. For circulars or information address the above.

NEW YORK ELECTRICAL SOCIETY, 183D MEETING.

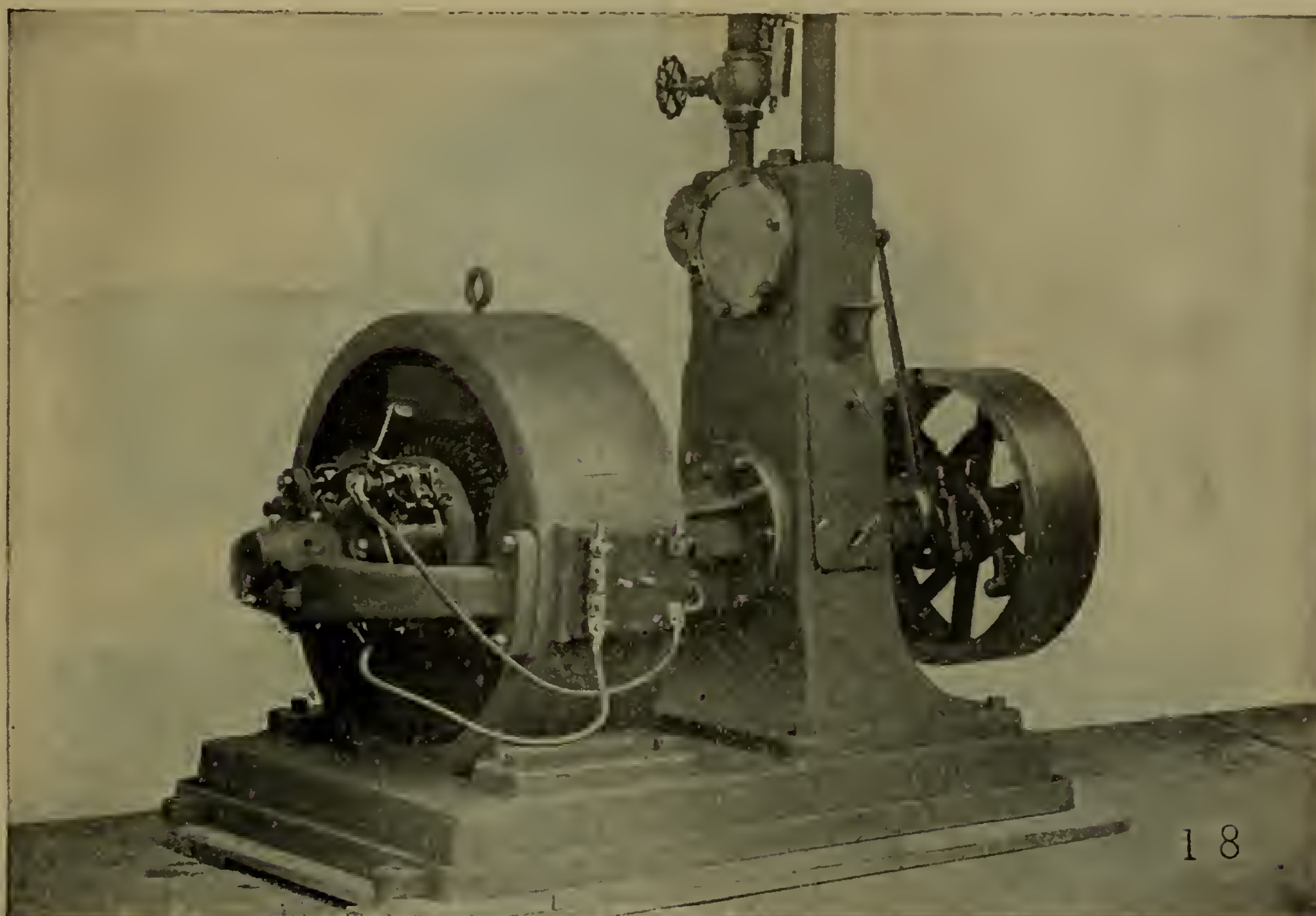
The 183d meeting of the society, postponed from the 8th instant, will be held at the new buildings of Columbia University, West 116th street and Western Boulevard, on Monday, November 22, at eight P. M.

The president, Doctor M. I. Pupin, will explain the scope of the programme arranged for the season, and give an informal address on "The Physics of the Ether." Downtown members will find it convenient either to take the Boulevard car all the way, which will land them at the University gates or the elevated to 66th street, or 104th street Station and thence by car.

C. O Reilly, chairman of committee of St. Patrick's Cathedral, N. Y., wants plans from electricians to ring the new set of chimes by electricity. Mr. O'Reilly can be seen at his Storage House, Forty-fourth street and Lexington avenue, N. Y.

The Electrical Age.

VOL. XX—NO. 22 NEW YORK, NOVEMBER 27, 1897 WHOLE NO. 550

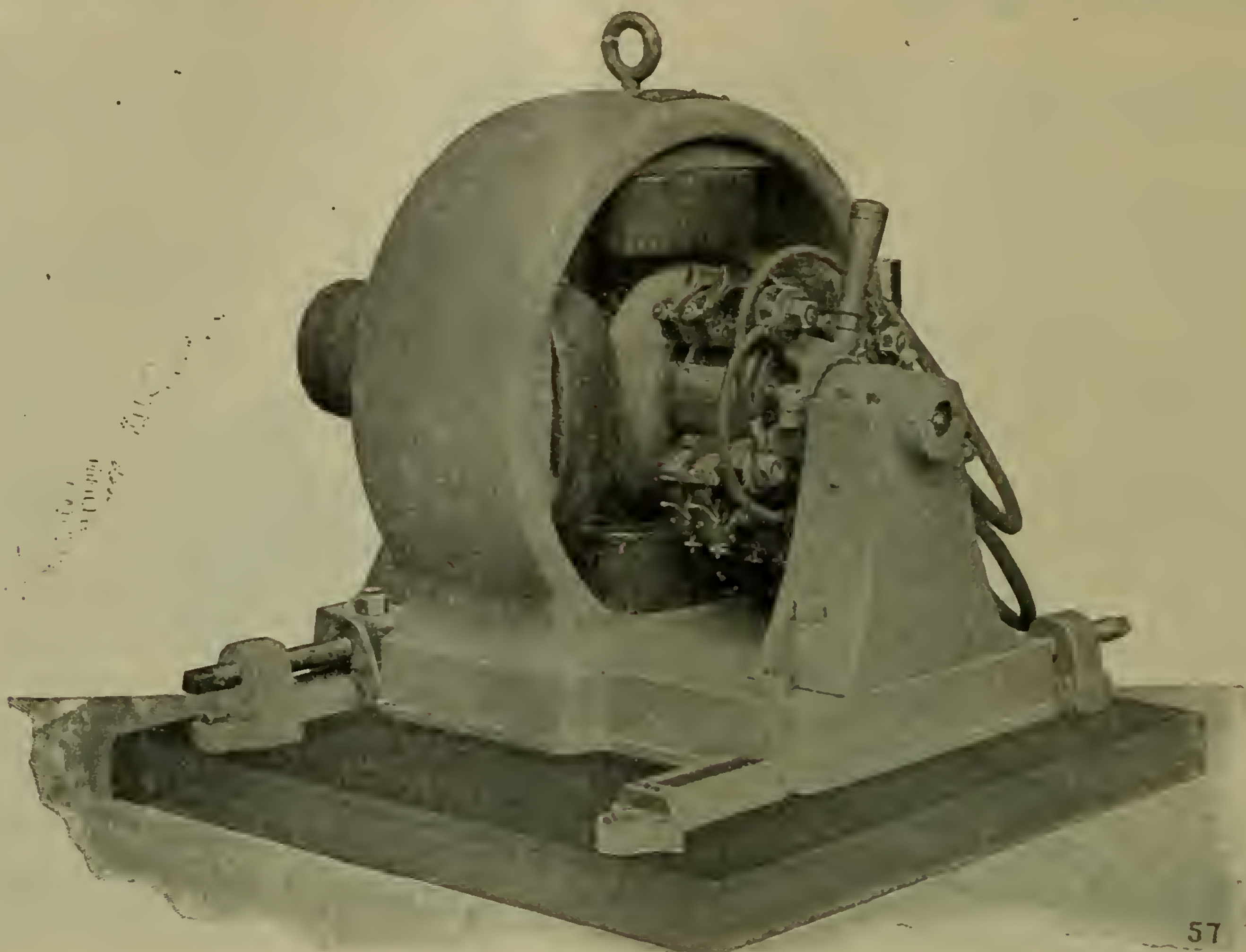


Case Engine Direct-Connected to Bullock Electric Mfg. Co.'s Dynamo.

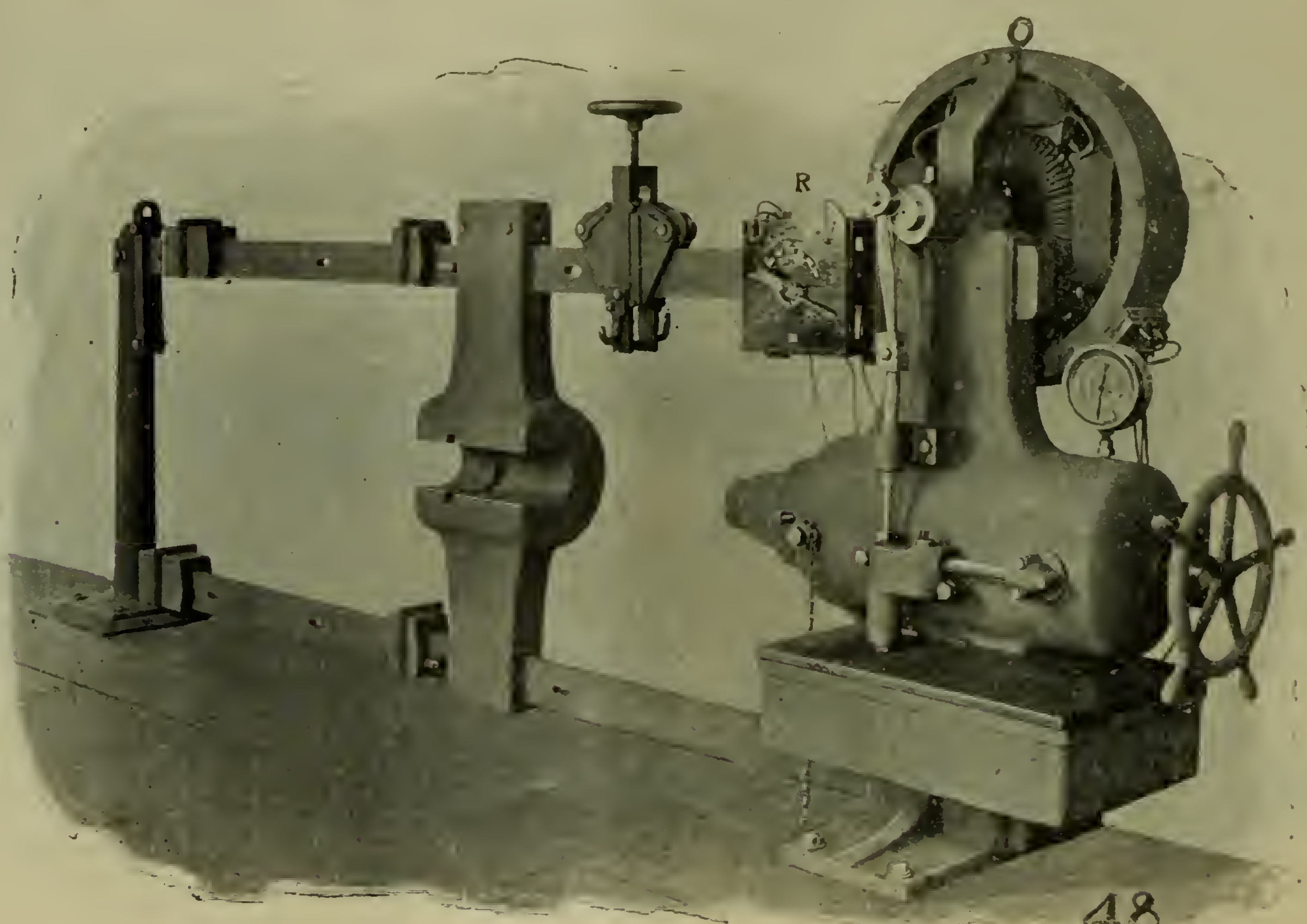
Munsey's Printing Room, Run by Bullock Electric Mfg. Co.'s Motors.

NOVEL APPLICATIONS OF ELECTRIC POWER.

It is wonderful to contemplate the advance made by electrical manufacturers in the last ten years. There are very few fields of work of an industrial nature that have not been entered and in many cases monopolized by them. The steam roads of this country are threatened by invasion from the trolley king. The cab systems are slowly giving way to the horseless carriage, and in the kitchen itself, the stronghold of the home, savory dishes are prepared through its agency. It is therefore evident at the close of this wonderful century, that we may be transported across the continent at a tremendous speed and enjoy, while on our way, the gastronomic products prepared in electric saucepans. Not alone have manufacturers improved these fields of work but they are paying particular attention to the printing shop. In the illustrations, the equipment of the Methodist Book Concern and Munsey's printing room is shown. The equipments installed are those of the Bullock Electric Manufacturing Company, of Cincinnati, O. The machinery they place upon the market for printers' use have found a widespread application. Such presses as the Cottrell, Campbell, Hoe, Huber, etc., are being operated successfully by these motors, which being of slow speed and direct-connected give every satisfaction. The saving in power in any case by the use of direct-connected machinery is so evident that a firm claiming to be unable to stand the expense is one expressing willingness to endure a constant financial leakage.



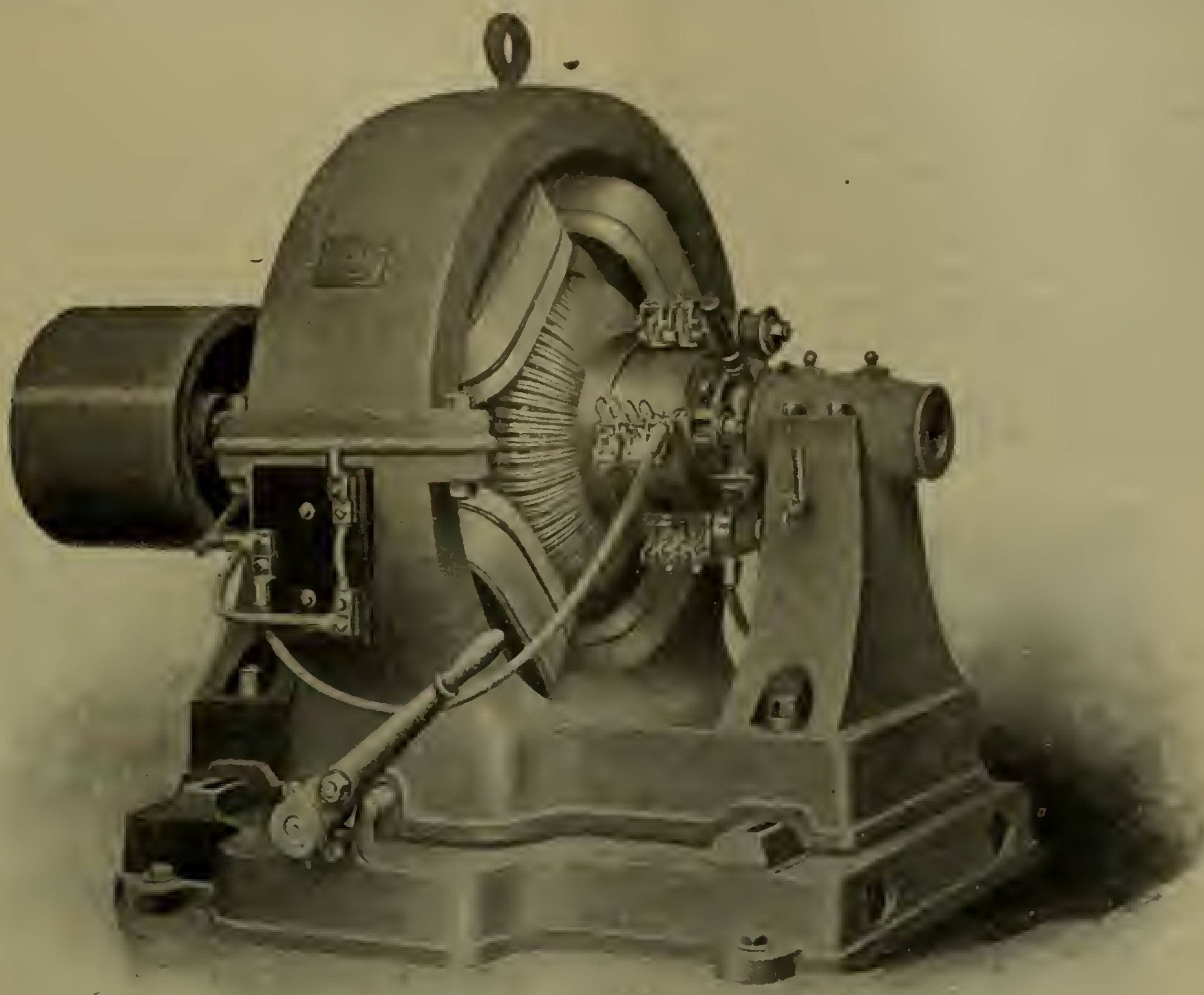
Type H, Generator or Motor, Belt Driven, 5 to 10 H. P,



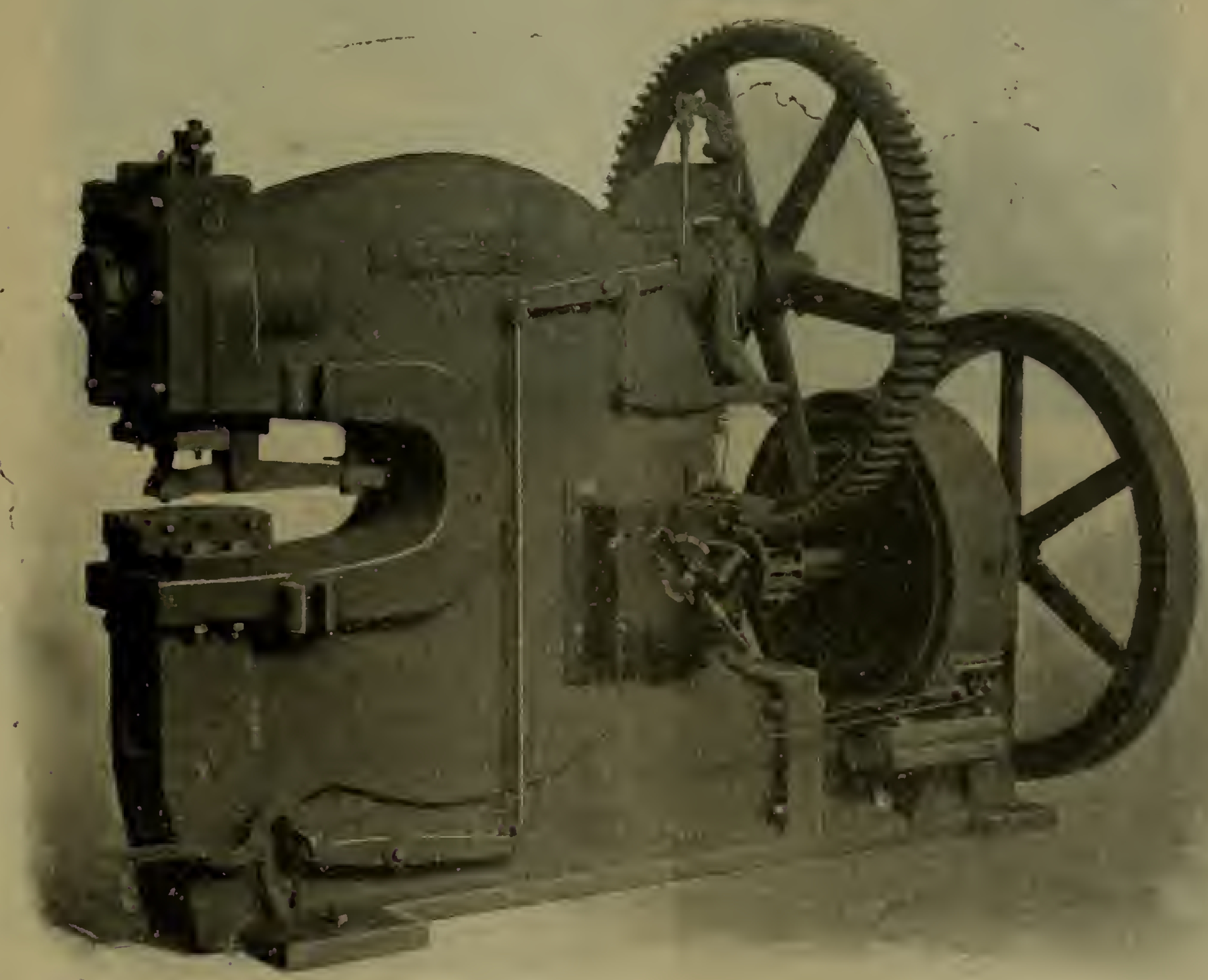
Hydraulic Machine for Pressing Wheels on Axles. Bullock Electric Mfg. Co.

The convenience of having each press independently controlled is so great that when once installed the proprietor soon realizes how superior his plant is—how much cheaper to run and how much more satisfactory in every respect than his neighbor's. The absence of belts, gears dirt and noise and the comparative cheapness plainly indicate the wonderful advantage an electrically driven press has over any other driven differently.

In addition to these equipments, the Bullock Electric Manufacturing Company connect their motors to machine tools, such as drill presses, punching machines, lathes, etc. Motors are supplied when required, perfectly en-



Type H, Generator, Belt Driven, 12.5 Kw. to 50 Kw. Bullock Electric Mfg. Co.



Punching Maching with Direct-Connected Motor. Bullock Electric Mfg. Co.

closed, for mounting on the ceiling, to be applied to the line shafting by means of a coupling. All of the motors manufactured by the above concern for direct connection are protected from outside injury by a complete covering.

It is surprising to realize how great a number of machine shops and great printing houses are now being operated by the Bullock Electric Manufacturing Company's slow speed motors. Some of the heaviest machines in the machinist's practice are driven by electric motors, and the benefits derived from their use are so pronounced that the manufacturer need seek no recommendation from those that once become his customers. Such recommendations as he requires come in unsolicited.

In the field of electric light and power, the Bullock Electric Manufacturing Company's multipolar generators and electric motors, for direct current lighting and power have gained an enviable reputation. The highest grade of electrical and mechanical design is evident upon inspecting these machines. The greatest art of the manufacturer is displayed in their construction and finish and the efficiency and smoothness of operation may be regarded as their chief characteristic.

Armature coils, field coils, commutators and brushes are built upon the basis of experience and scientific knowledge, thereby giving the consumer the double advantage gained by such a combination. The general run of their machines are multipolar. The frames have high permeability. Armatures and fields have the most perfect insulation, being baked in addition for thirty-six hours. The finest sheet iron is used for the armature cores; the field pieces being made of iron plates. Foucault currents and hysteresis are thereby reduced to a minimum in the field and armature respectively.

The ample dimensions of the commutator and brushes make them well able to stand overload without heating, and the relations established between the field, strength, pole-piece area and armature winding practically eliminates sparking. The regulation is automatic in the generator and when desired also in the motor.

The sales agency for the Bullock Electric Manufacturing Company in New York is in the St. Paul Building, No. 220 Broadway.

The largest press in the world will soon be built for the "New York World." It is called a sextuple color press, and the equipment adopted for its driving power after thorough investigation is that of the Bullock Electric Manufacturing Company. The leading papers of this city, "Journal," "Sun," "Herald" and "Times," are now being printed by the aid of Bullock machinery.

Printing Room of the New York Journal, run by Bullock Electric Apparatus.

THE PRODUCTION OF INCANDESCENT LAMPS.

The Incandescent Lamp, simple in appearance, is yet very complex in all its features. Probably in no other branch of the electrical industry does experience count for so much, nor any product in which the best results are absolutely dependent upon constant, careful, continued inspection and testing. To secure a perfect product at the present low prices of lamps, both extensive experience and heavy production are necessary. During the prevalence of the low prices of the past two years many lamp manufacturers have resorted to short cuts to reduce the cost of the lamps, frequently attaining poor results for which they are now compelled to sacrifice the very economies they previously made. This course the General Electric Company refrained from following, and during the hard times no relaxation in its efforts towards improvement in machinery, processes, inspection and testing, has been permitted. The result to-day is that this Company, with an output of over 6,500,000 lamps yearly, is manufacturing a better and more uniform lamp than formerly could have been procured for double the price.

So large a production and sale naturally allows of the adoption of improvements not possible with smaller manufacturers. The lamp works is provided with a very complete laboratory, with a staff of competent chemists and electricians constantly occupied in carrying on experiments and tests all tending to the betterment of the product.

Perhaps the most noteworthy improvement introduced during the past two years is the new exhaustion process. By the adoption of this process the quality of the Edison lamp is distinctly advanced beyond lamps exhausted by other methods. During recent years mechanical exhaust pumps, that is, pumps operated without mercury, have from time to time been presented, but in each case the size of the pump has been too great, the object having been to exhaust a large number of lamps at one time. This practice being considered injudicious, such pumps have not been adopted, but the lamp works have succeeded in obtaining a small mechanical pump, with a rate of exhaustion such that it can practically be employed to exhaust one lamp at a time. Experiments with this pump lasted nearly two years, and showed that the lamps could be exhausted more nearly the ideal lamp vacuum by this pump than by any other. It is now used to exhaust the Edison lamp, and the mercury pumps have been discarded. The final perfection of the vacuum, however, is not obtained by the pumps unaided.

In combination with these pumps a chemical process is introduced, exclusively used in this country by the lamp works, and as the various phenomena of exhaustion are clearly marked, a very definite rule of operation has been formulated.

The natural residual gases of an incandescent lamp may be considered conducting gases, since they allow current to pass from one leg of the filament to the other. The residual gases are, therefore, not only injurious to the filament, but their necessary removal has previously involved long and tedious processes. By the new method of chemical exhaustion, all the residual gases are thoroughly removed from the lamp by the introduction of a gas capable of combining with them. Previous to this introduction a blue glow fills the bulb when the filament is brought up to bright incandescence, but when the combination takes place between the residual gases and the new gas, the blue glow suddenly disappears and a lamp, "sealed off" at this moment, has a vacuum of perfect insulating properties.

The advantages of the chemical process of exhaustion are several. The combination of the gases in the bulb is a phenomenon so marked as to furnish an absolute proof that the proper vacuum has been obtained. The lamps are exhausted one at a time and the whole attention of the operator is concentrated on a single lamp. This insures a perfection of vacuum difficult to obtain in lamps exhausted in groups. The operator sits in a comfortable position and, not unduly wearied, can do as accurate work late in the day as in the morning.

The injurious effects of mercury upon the health of the operator being avoided, his uninterrupted service is secured and the very highest skill dependent upon continued practice is retained.

THE NORWEGIAN MICA COMPANY.

We beg to inform you that under this date we have started "The Norwegian Mica Company." The office is in Christiana, Norway. The company is working mines of mica in Norway. The board of directors consists of the professor of Mineralogy at the University of Christiana, Johan H. L. Vogt and the civil engineer in Christiana, Mr. Henry E. Mohn, the latter acting as president.

We will be very thankful to you if you will kindly note this in your journal.

Yours truly,

The Norwegian Mica Company.

Christiana, the 6th November, 1897.

PAPER ON "THE ADVANTAGES OF A CAR-MILEAGE RECORD.

BY T. J. NICHOLL, ROCHESTER, N. Y.

In the wonderful evolution which the application of electricity as a motive power has everywhere wrought, in urban and interurban transit, it is not surprising that street-car companies, in the creation of new, and adjustment of old departments, important to the new order of things, should possibly have failed to give some matters' the attention they demand.

We believe that in the radical and rapid developments which have taken place, the subject of mileage is one of the details of the street-railway business that has not received the attention or discussion which its importance merits. In fact, it is almost impossible to find an article in reference to the same in any of our railway magazines, and we rarely hear the matter brought up for discussion at railway conventions.

At one time all that was considered necessary was a record of the total mileage made per day on the entire road, and this was kept in a rough way and was only used in figuring earnings and expenses per mile at the end of a certain period. During the horse-car days an estimate, in many cases, sufficed, but the change to electric traction demands a most complete and accurate record not only of the total daily mileage for the roads but of each route, individual car, the various systems of equipment and trucks ; also for the different parts of an equipment, viz. : wheels, gears, pinions, armatures, brake-shoes, trolley wheels, etc. In fact, the mileage is the chief, and in most cases the best and only basis on which to figure statistics in reference to earnings, traffic, the various operating expenses, etc. In this way it brings every item down to a standard for comparison, and thus proves an almost indispensable guide to economy.

(To be continued.)

A notable change is about to be made at Omaha, Neb., where the new Omaha Thomson-Houston Electric Light Company is undertaking the concentration of its station. It has recently placed an order with the General Electric Company for three monocyclic alternators, each one to be directly connected to a compound condensing McIntosh & Seymour Engine. These alternators will be revolving armature, 48-pole machines, each of 300 kilowatts at 150 revolutions and will be separately executed. They will take the place of a considerable number of smaller machines and will be used to furnish current to an extensive system of 3-wire secondary mains fed from large transformers.

We are reliably informed that the American Electric Telephone Company, of 171–173 S. Canal street, Chicago, was the most successful competitor at the Tennessee Centennial Exposition which has just closed, receiving the highest award for meritorious apparatus in the way of telephones and switchboards. The American Company is to be congratulated on its success at Nashville, as it follows up in a most satisfactory manner to the company the previous successful competition at Atlanta, at which Exposition it also received the highest award.

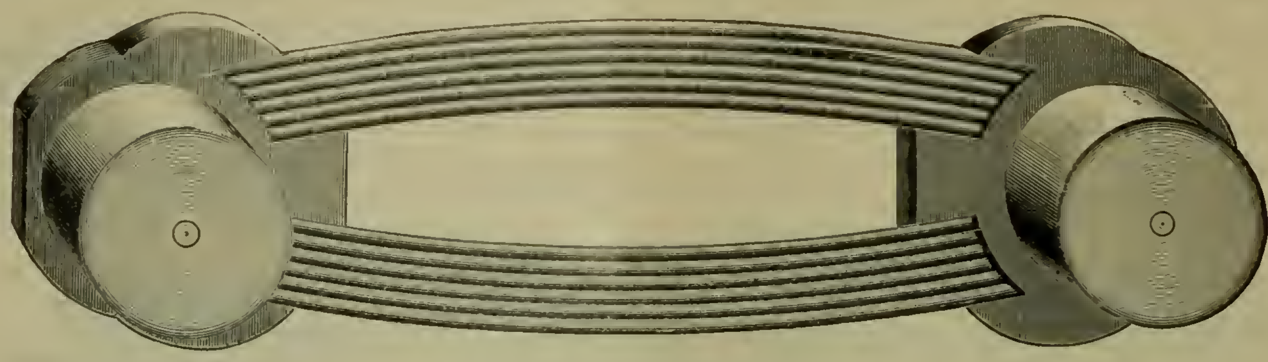
Stanberry, Mo.—The Stanberry Telephone Co. has been incorporated by L. M. Hale, A. C. Frisber, E. E. Aleshire and others. Capital stock, $10,000.

Portersville, Cal.—Mt. Whitney Telephone & Power Co., E. W. Beebe, elected assignee.

Dunn, N. C.—The Dunn & Lillington Telephone Co. has been incorporated by G. K. Grantham, F. M. McKay, J. A. Green, W. F. Pearson, E. F. Young and others. Capital stock, $5,000.

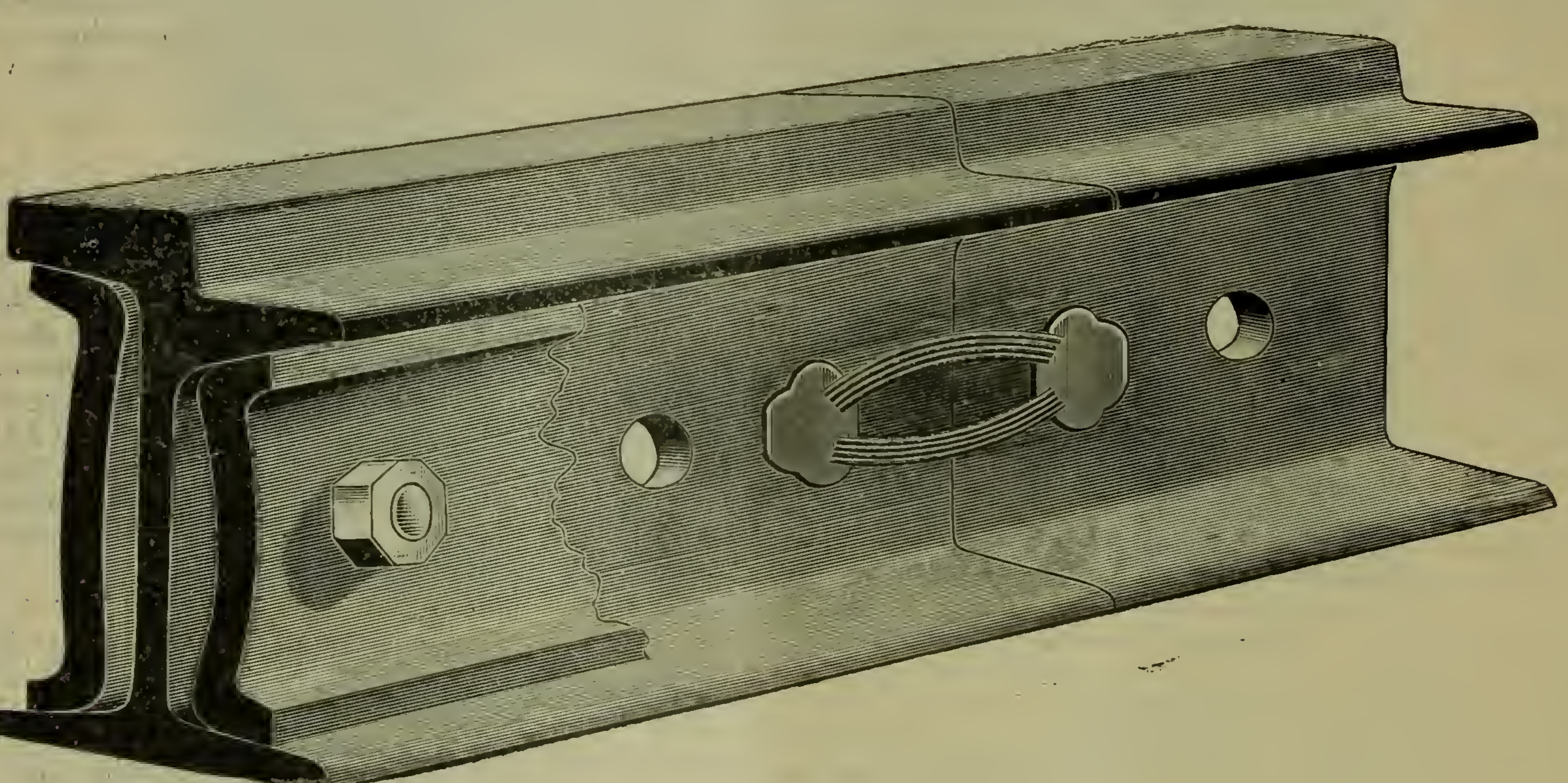
THE PROTECTED RAIL BOND.

It may be said that the losses in a power station are directly traceable to the track, particularly to poor rail bonds. An inproved rail bond is in fact so valuable a feature of a street-railway equipment that unless it be selected with considerable care, those installing it will find to their deep regret that it is a source of loss and a continual drain upon the power supply. The sketches supplied with this article represent protected rail bonds with



The Protected Rail Bond.

the copper connecting-pieces firmly joined. They may be placed under the fish plate and thereby be protected from all possible injury. The terminals of the bond are sufficiently large to make ample contact with the rail and they are secured to it either by means of the improved Cleveland bond welder or by hand riveting. From a mechanical standpoint the bond, in spite of its substantial construction and rigid adherence to the rail, is capable of expansion and contraction and can undergo consideration vibration without loosening or injury. The bond



Joint of Girder Rail Showing Bond in Place.

is constructed of flattened copper wires, with the ends cast-welded into copper terminals and drop-forged to size and finish. By means of the welder tremendous force is brought to play upon the copper terminals, making an absolutely perfect joint between them and the rail. Concerns using one thousand protected rail bonds will have a welder loaned to them free of expense. Some of the largest traction companies in the United States use the protected rail bond, sold by J. C. Dolph & Company, 126 Liberty street, New York. This company act as agents in the East for the Forest City Electric Company, who manufacture these improved rail bonds. Such concerns as the Consolidated Traction Company, of Jersey City, N. J., the Pasadena & Pacific Railway Company, of Los Angeles, Cal., Terre Haute Electric Railway Company, of Terre Haute, Ind., and many others too numerous to mention, use this bond and find that it gives perfect satisfaction. The agents desire correspondence and will undoubtedly satisfy all consumers.

DYNAMOS FOR DEPOSITING METAL.

The art of electro-plating is very old in comparison with other departments of electrical work, and it would seem for this reason that all apparatus used for electroplating purposes would be perfected to a high degree. But unfortunately many concerns do not gain by experience, and hence have not manufactured plating apparatus of a high order of excellence. The Eddy Electric Manufacturing Company, of Windsor, Conn., have been carefully studying the situation for sixteen years, and their improvements in apparatus used for electrolytic work such as electrotyping, electro-plating and galvanoplastic manipulations generally, have been so great that in all probability they represent the leaders in this field of work in the United States. The agents for the Eddy Electric Manufacturing Company are H. B. Coho & Company, in the St. Paul Building, New York. Mr. Coho has pushed the Eddy electro-plater very extensively, and has felt from the start every confidence in the machinery he sells. The design of these electro-platers, as represented in the illustrations, is such that they may be run with high efficiency—no sparking and cool armatures and fields. The standard plating and typing machines are built in five sizes. The ironclad type, represented by Nos. 0 and 1, do excellent service and represent an ideal construction. The dynamo is built of steel, the coils are wound on forms and the insulation throughout is above criticism. But very little power is required for the fields, and this fact alone shows careful design, particularly in the case of platers, which have always been regarded as wasteful in every respect. A multipolar steel frame is used in the

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NEW YORK, NOVEMBER 27, 1897.

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THE COOKING OF FOOD BY ELECTRICITY.

A novel and interesting sight may be witnessed by visiting the Pearl street station of the Edison Electric Illuminating Company, in New York City. Within this building, in full operation, may be found an electric kitchen, fully equipped with culinary apparatus, all of which is run by electricity. The officers of the company and important officials are allowed an opportunity each day to taste the most unique of meals—a dinner prepared entirely by electricity. Perhaps the first historical record of such an incident may be traced back to old continental days, when the ancestors of the American public rose in arms against their mother country. Benjamin Franklin records the fact in his quaint way by stating that a turkey was roasted on the bank of the Schuylkill River, the fire being procured by the discharge of a Leyden jar, igniting alcohol. This is the first instance known to mankind of a meal having been prepared by the aid of this all-powerful agent. But, whereas Franklin's turkey was exposed to the vulgar flames, the hot birds and other choice edibles enjoyed by the officials of the Edison station are cooked in an oven whose heat is graduated to a nicety and which represents entirely a C^2R loss. To encourage the use of electricity in the kitchens of large hotels, in apartment houses and private homes, the Edison Company have reduced prices to such an extent that the discounts offered consumers will enable them to use electricity at about one-half the price asked before. In order to realize how seriously considered electric heating is, we may state that the American Electric Heating Corporation is at present capitalized at $10,000-000.00. People looking at these figures will certainly realize the importance, at least business men, of electricity in the kitchen for culinary purposes. All kinds of imaginable dishes and pans are on the market that can only be used in connection with an electric current. It is an ideal way of cooking and is so clean, convenient and really inexpensive, that we can safely predict its general use in the near future to the practical exclusion of the cooking range. Great credit is deserved by those that have fathered this project and in spite of many objections have pushed electric heating apparatus so energetically that the day is not far off when the great emporiums of large cities will advertise, side by side with their Brussels carpets, rocking-horses and fashionable ties, the latest electric-heating apparatus. The efficiency of electric heaters of any description is so high that the return in heat is practically a full equivalent of the current sent in. It is merely necessary for the electric light and power stations to co-operate with the American Electric-Heating Corporation and the increased sale of electricity and heaters will grow to enormous proportions.

ONE HUNDRED AND FIFTY MILES PER HOUR.

The attention given to electric traction by Charles P. Clarke, president of the New York, New Haven & Hartford railroad, is of the greatest interest to electrical engineers and the general public because it heralds an effort that would not be the last of its kind to establish communication between widely separated points in a practical and highly commendable manner. Those dealing with steam power, and the machinery operated by it, have been accustomed to look upon traction machinery as something of a positive and substantial nature, that is to say, there is no uncertainty about the operation of a locomotive, whereas the use of an electric motor over a long stretch of country never having been attempted, is regarded by railroad magnates as a method that is merely feasible and at present not practicable. Many object entirely to any system which relies for its power upon an overhead conductor, which storms may throw to the ground or from which the pole connection may slip. They do not see their way clear from an economic standpoint, and are therefore waiting one for the other before any departure is made.

The New Haven & Hartford track operating the above mentioned electric cars, consists merely of three rails, the middle or third rail, as it is commonly called, acting in the capacity of an overhead trolley wire. Aside from the fact that perfect electric contact can be and has been established between adjacent rails, the difficulties to be overcome are two-fold, and yet as difficulties are more easily overcome than those that confronted locomotive engineers not twenty years ago.

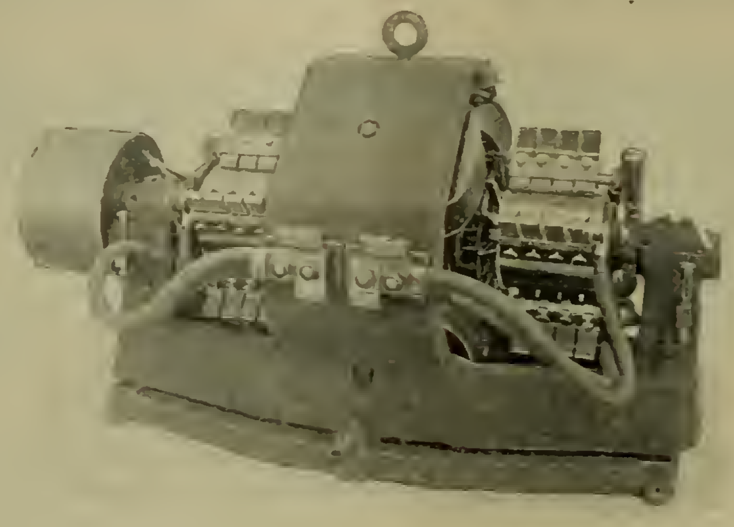
For the purpose of establishing a high speed railway on which cars can travel at the rate of one hundred and fifty miles an hour, contact between the third rail and the car would have to be absolute and the rails supporting the truck bodies of a construction adapted to meet this change in condition, that is, the swift moving of a heavy, though elastic mass. The rails would certainly be heavier, so as to avoid the peculiar waves that occur in them when supporting a body moving at a high rate of speed. A rigid rail, weighing two hundred and fifty pounds to the yard, well bonded to its neighbor, would certainly enable a train to move upon it without serious loss at the rate of more than two miles a minute.

The middle rail, considered to be so dangerous to straying country cows and farmers, could be elevated several feet above the roadbed and thus avoid in a marked degree many ominous possibilities. The shoes pressing upon it could be modified to stand the increased friction and thereby carry the current to the car without creating a melting heat. A system of this kind is so positive that the regular track inspector could go his rounds in the regular manner, possibly being trained so as to be able to quickly observe deterioration in the bonding or other mechanical defects that might arise.

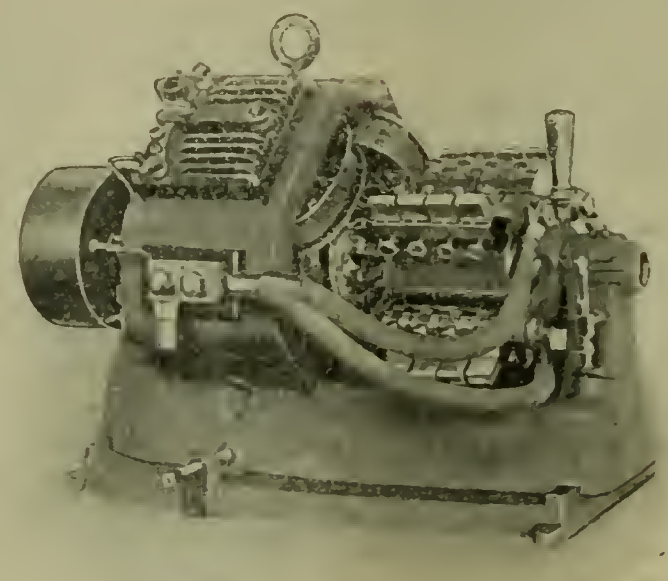
construction of sizes 2, 3 and 4. The field is so excellently distributed that a coil emerging from or entering under a pole-piece is subjected to the influence of a gradually increasing or decreasing magnetic spray, which destroys the hum and kills the sparks noticeable, not only in platers but in all dynamos of poor design. The field coils, bearings and armatures of these larger sizes are constructed with the greatest care. Ample commutator segments are provided and sufficient brush area to allow the conduction of even the heaviest current without undue heat. The number 3 and 4 machines are built so that a plating firm can get a high pressure for striking the work and a lower one for continuing the plating.

For information relative to the Eddy machinery customers may write to H. B. Coho & Co., and undoubtedly thorough satisfaction will be given.

H. B. Coho & Co., of the St. Paul Building, New York, have started up a new switchboard and repair department. This department is under the supervision of T. J. Murphy, well known to electrical workers. They will make all kinds of switchboards and repair or reconstruct any type of dynamo or motor.



Nos. 3 and 4, Type G, the Eddy Plater.



No. 2, Type G, the Eddy Plater.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION Committee on Convention held a meeting at the Holland House, New York, November 22. It was unanimously resolved to hold the next meeting of the N. E. L. A. in Chicago, the home of the president, either in May or in June, 1898. No meeting of the association has been held in the Central States for a number of years, and we believe this to be a good omen for the benefit of exhibitors to congregate all their exhibits in so central a section of the country, contiguous and convenient to every central station manager as well as the manufacturers and buyers.

The electrical exhibition, to be held at Madison Square Garden during the month of May, 1898, under the auspices of the Electrical Exhibition Company, 15 Cortlandt street, New York, will be a decided success; the high standing of the officers and directors and management of the company is a guarantee of the outcome of the enterprise. The large number of prominent electrical industries, manufacturers and inventors that have secured large spaces for exhibiting their apparatus is an encouraging sign that the electrical show will be one of the greatest attractions of the metropolis next May. A large number of inventors as well as manufacturers are already at work designing most interesting and novel exhibits for the coming great display for Greater New York. Electricians and others who are not already interested in this prospectively magnificent exhibition will do well by communicating with the manager, Mr. Marcus Nathan, who will give them courteous treatment and extend every encouragement to become exhibitors.

The installation of the People's Light and Power Co. of Newark, N. J., will shortly be increased by eighteen 125-light Brush arc dynamos, having a total capacity of 2,250 2,000-C. P. arc lamps.

Madison, Wis.—The Monroe County Telephone Co. has been incorporated by V. V. Willis, E. V. Benjamin and H. C. Hackner. Capital stock, $8,000.

Cheboygan, Mich.—The Michigan Telephone Co. has filed its $750,000 blanket mortgage.

St. Louis, Mo.—The Missouri Automatic Telephone Co. has been incorporated by Charles T. Farrar, William Dean, Henry A. Colt and others. Capital stock, $100,000.

New Brunswick, N. J.—The Home Telephone Co. has been refused a franchise.

COMMERCIAL TRAVELLERS FAIR.

Dapper and swagger gentlemen with gripsacks en route to the Grand Central Depot and the up-town ferries leading to the western trunk lines pause in their career these days to call at the Tower of the Madison Square Garden. They are travelling salesmen who stop to give pointers and report progress to the master mason of a structure which is rapidly being reared. The master mason is Mr. Alfred Chasseaud, and the structure, a metaphorical one, is the coming Commercial Travellers Fair, which is to be held February 28th to March 5th, at Madison Square Garden. Mr. Chesseaud is its general manager.

The Fair, in just the measure that it proves successful financially, will help to complete a real structure, the partly built National Home for Disabled Commercial Travellers and their dependent families, and the widows and orphans of commercial travellers. The incomplete building stands on South Mountain, near the city of Binghamton, N. Y.

The commercial travellers recently held a harmonious and enthusiastic convention in Binghamton and unanimously voted to make the Fair succeed. Mr. Chasseaud was appointed to manage the Fair and all the travellers agreed to back him up. The officers of the Association having the Home in its charge, made a financial report that aroused extra enthusiasm and inspired the Home builders with renewed courage.

The officers of the Commercial Travellers Fair are: President, Chauncey M. Depew; Vice-Presidents, Governor Frank S. Black and Mayor William L. Strong; Secretary, R. G. Dun, and Treasurer, Mayor George E. Green, of Binghamton. Mrs. T. C. Platt is the chairman of the Women's Committee and Van Schaik and Morton are the counsel.

Travellers in many parts of the country are sending in to Manager Chasseaud pledges of cash New Years' gifts, and in hotels everywhere are being placed glass collection boxes in the shape of miniature travellers' trunks. The Buffalo Hotel Men's Association has just pledged its hearty support to the Fair and other hotel organizations will aid.

The Fair will be made unusually picturesque and attractive to the public.

THOMAS A. EDISON, JR., AND HIS NEW INCANDESCENT LAMP.

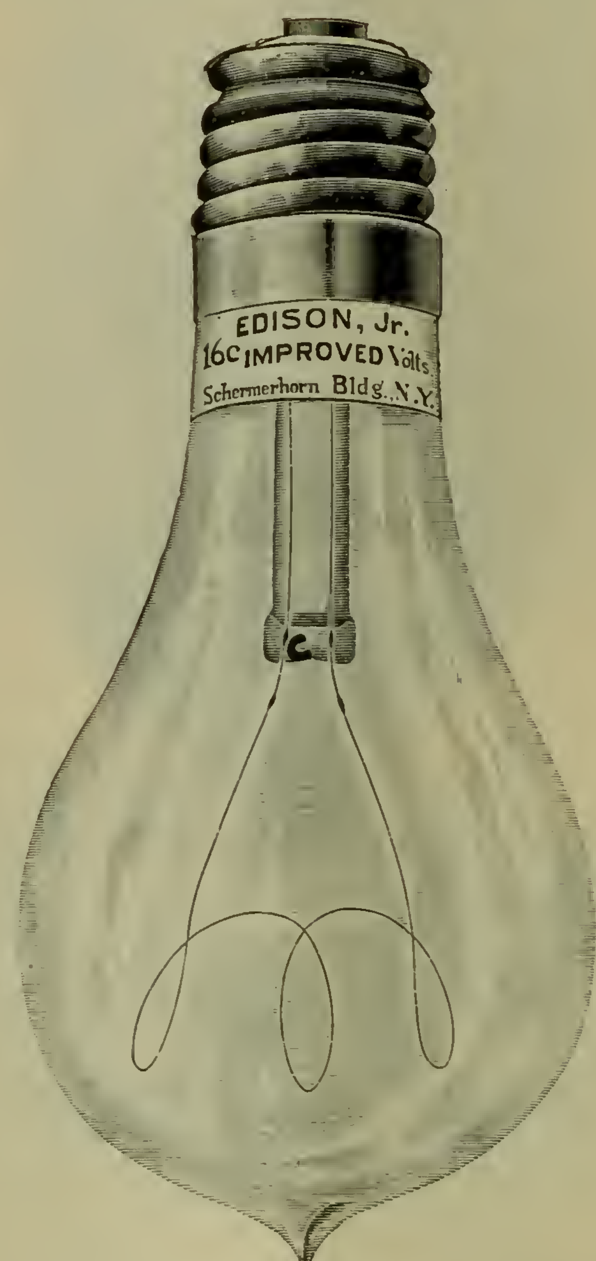
The improvements in incandescent lamps have been rather limited in their nature in the past few years. The lamp put upon the market by Thomaa A. Edison, Jr., son of the distinguished inventor, Thomas A. Edison, represents the result of a long series of careful experiments and may be regarded as the most economical and best constructed incandescent lamp upon the market today. The fact that prices have been cut has led a great many manufacturers to put lamps upon the market of an inferior quality, of short life and poor construction. In fact, it is almost impossible for those that compete to give the proper attention to the lamp from an electrical standpoint unless more time is devoted to its improvement instead of its sale. The Edison, Jr., improved lamp has been carefully studied in each particular detail. Its vacuum is practically perfect and the filament prepared with all the skill and art that an extensive experience can give. The filament is carbonized at a temperature of 4000° Fahrenheit and its resisting power is so great that deterioration is practically absent. The claim made that this lamp is fifty per cent. better than any other lamp upon the market is a very modest one; the inventor and manufacturer being so impressed and convinced of the superiority of his lamp to others that he is willing to offer samples for a thirty days' trial by any customer willing to investigate their merits for purposes of purchase.

Thomas A. Edison Jr

Thomas A. Edison, Jr., son of the famous inventor, Thomas A. Edison, was born in Newark in 1876. He received his instruction entirely under his father's care, and on every occasion took personal interest in his father's experiments. This atmosphere of practical laboratory life has prepared Thomas A. Edison, Jr., for the work he has laid out for himself. He recalls his father's endeavors to bring out the old tinfoil phonograph and his efforts to make the incandescent lamp a success.

As co-worker with his father he spent the greater part of two years on X-ray work. Mr. Edison, Jr.'s talents have manifested themselves in artistic as well as mechanical and electrical lines. The home of Thomas A. Edison, Sr., is full of paintings and watercolors, showing the son's powers as a colorist. Mr. Edison, Jr. is deeply interested in mining, and his special predeliction for this field of work has shown itself on many occasions, and it is his intention to extend his work in this line. The incandescent lamp that he is selling at present is the outcome of many years' careful work and required a thorough knowledge on Mr. Edison, Jr.'s part to clothe it with those features that it now possesses. This lamp is creating a great stir among the profession and, in fact, considerable jealousy in certain circles. Mr. Edison, Jr. started out about a year ago to learn the nature of business methods and the customs of business men. So far he has succeeded admirably, and his lamp, which still remains unpatented, is made in many respects by processes that he intends to keep secret. His reluctance to patent anything is the past experience of others which has been proved to him.

The demand for this new lamp has grown to such proportions that Mr. Edison is busily engaged filling orders and attending to his own immediate interests. The general offices are to be found in the Schermerhorn Building, 96 Broadway, New York City. We feel sure that customers desiring to patronize Mr. Edison will find the satisfaction derived from his lamps far beyond that experienced by the use of any other. He may be corresponded with at the above address in New York City.



The Thos. A. Edison, Jr., Improved Incandescent Lamp.

Charlestown, W. Va.—The Charlestown Electric Light, Heat & Power Co. has been incorporated by G. N. Horn, B. D. Gibson, John A. Livers. Capital stock, $15,000.

Charleston, Mo.—The Charleston Electric Light Co. has been incorporated by J. H. Moore, J. P. Bridges, E. G. Rolling and others. Capital stock, $20,000.

OHM'S LAW.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

Each branch of science seems to rest upon the foundation of some great law.

Mechanics has its Newtonian law of gravitation; astronomy, a derivative science, owes its existence to the laws of planetary motion, Kepler's laws; and in common with these we pass to the great science of the day, which depends for the explanation of its many phenomena upon Ohm's law.

A little pamphlet written by Dr. G. S. Ohm, in Berlin, in 1827, called "The Galvanic Circuit Mathematieally Investigated," came to light before the scientific societies of Germany and England. Previous to Ohm's work it was a very difficult matter to speak definitely of the qualities possessed by an electric current except in a manner that gave no valuation either to the current or pressure.

Let us return to the main subject and try to discover whether a current of electricity can be examined intelligently as to its changes in strength and pressure.

A current of electricity is a natural phenomenon. A blast of steam passing through a pipe, or a stream of water under the same conditions, takes the path offered—that is, the pipe—and moves through it delivering a quantity at the other end, dependent upon—

(1) The pressure of the steam or water.

(2) The diameter and length of the pipe.

This illustration serves to show that a fl d or gas is affected in a manner that can be considered as a matter of daily experience, when the dimensions of the pipe are increased or decreased, or when the pressure within the pipe is likewise changed.

A current of electricity seems to possess modes of action that corresponds somewhat to the passage of a fluid through a pipe. The difficulty in using this simile, however, is the false impression that may be conveyed, that electricity is itself a fluid. Electricity is no more a fluid than heat or light, or even magnetism. Its behavior under certain conditions, though, has been best understood by a comparison of this kind. Let us send a current of electricity through a wire. It is highly evident that the electrical impulse will not pass through the wire unless it is forced to do so. There must be some definite reason for its movement, otherwise it might happen, if there were not, that it would not pass on a given occasion. We find, therefore, that the current from abattery or any other source of electricity is brought into being and is, in fact, only able to manifest itself because it possessess a quality that enables it to pass from point to point and makes it an active source of power.

What is this quality without which the phenomenon of electricity could not exist, without which the current could not leave the battery, and without which it would remain immovable in a line of wire?

Electromotive force is the expression used to describe this quality. It is roughly comparable to the pressure in a boiler, which forces the steam along, or to the pressure in a hydrant, that forces the water out. The pressure of the water is due to a difference of level between the faucet and the water in the reservoir; the pressure is therefore a consequence of these two levels.

A current from a battery is originally started by the electromotive force within the cell.

This establishes a difference of pressure between the elements of the cell—the zinc and copper, or the zinc and carbon. They act towards each other like bodies of water at different levels. One element has a tendency to send its electricity into the other element simply because its electrical level is higher. The word level might be changed to the word potential, and the difference of electrical level between the elements in a cell spoken of as the difference of potential between the elements of a cell. The chemical action brings the electromotive force into existence, which in its turn causes, by its lack of balance between the elements, a difference of pressure, level or potential. A current flows because a difference of electrical pressure instantly transmits the electrical energy from point to point, only from a point of higher to one of lower potential.

If inequalities of potential cause a flow of electricity, how shall we know how much passes or how to regulate it? The current traverses a wire; it is forced along the wire because one end of the wire is at a lower potential than the other. If the wire is of such a metal that a current has difficulty in getting through it, only a little will pass; in order to get more through, the difference of pressure or potential between the ends must be increased.

The case would be like that of a narrow steam-pipe through which at one hundred pounds pressure an attempt is made to force a great quantity of steam. It will not pass through unless the pressure is doubled, tripled, or, as it may be, quadrupled.

The wire opposing the flow of current is said to possess resistance. All metals resist the passage of electricity to a greater or less degree. They all have resistance, and to send the same value of current through equal lengths and diameters of each would require different electric pressures.

The unit of electromotive force is called a volt.

The unit of resistance is called an ohm.

A gravity battery produces about one volt; a cell of this general description having given the original value, since then slightly changed.

The resistance of a column of mercury 106.3 centimeters long (41.85 inches), whose weight equals 14.4521 grammes (223.025 grains), and of equal cross-section throughout, is exactly one standard ohm.

A pressure of one volt will force through a column of mercury like the above — that is, one ohm—a current whose strength would be one ampere.

An ampere is the current delivered through a resistance of one ohm by a pressure of one volt.

Ohm's law merely states this fact as follows:

$$\text{Current in amperes} = \frac{\text{Pressure in volts.}}{\text{Resistance in ohms.}}$$

For example, with 100 volts
at 10 ohms,
what current is delivered?

$$\text{Current} = \frac{100}{10} = 10 \text{ amperes.}$$

Another way of stating Ohm's law is as follows:

Ohm's Law.—The current is directly proportional to the electromotive force and inversely proportional to the resistance.

QUESTIONS FOR REVIEW*

IN ELECTRO-MAGNETISM.

(1) What kinds of magnets are there?
(2) What is a magnetic field?
(3) Upon what does the strength of field depend?
(4) What is permeability?
(5) Of what metal are dynamos made?
(6) Explain the meaning of saturation.
(7) What is an ampere turn?
What is magneto-motive force?

QUESTIONS FOR REVIEW.

OHM'S LAW.

(1) Upon what does the flow of water in a pipe depend?
(2) What is electromotive force?
(3) What is meant by difference of potential?
(4) What is resistance?
(5) Give the names of the units of E. M. F. resistance and current.
(6) What is the standard of resistance?
(7) State Ohm's law.

The behavior during flood times of an electric street-railway, operated on the General Electric open-conduit system, such as the Metropolitan Traction Co. of New York is so extensively laying down, is of interest to the public. Ignorance of it has formed one of the principal motives for decrying it. While no flooding of the conduit has ever occurred on the Lenox Avenue line, it has been averred that, if it were flooded, traffic would necessarily stop, owing to short circuit, until the water had been run off. That this is not the case is shown by an interesting experience on the line of the Metropolitan Traction Co. in Washington, D. C.

October 9, 1897, as the result of a heavy rain storm, a stretch of track, some 150 feet long on the F Street line, became completely flooded, the water filling and overflowing the conduit, as it was unable to run off by the usual sewer connection which was cut off. According to the statement of Mr. Weaver, president of the road, although the conduit was filled completely with water for nearly two hours, the station was not short-circuited, nor were the water rheostats called into requisition. The

* Left out of last issue.

normal load of the feeder for the section is 300 amperes; the load during the time the conduit was flooded was 600 amperes, and the cars were also operated on the sections on both sides of that which was under water. The water was practically pure and this partially accounts for the small additional load.

The Washington electrical-conduit system, although its conduit has been several times flooded, has never yet been tied up, except once when the water almost covered the floors of the cars and flooded the motors. At other times the line has been operated by means of a reducing rheostat. The present instance is the only one in which the flooded section has been operated directly from the generators without reducing medium. It was estimated that the pressure of the current on the cars in the centre of the flooded portion was about 250 volts.

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POSSIBLE CONTRACTS.

Pittsfield, Mass.—The Pittsfield Electric Street-Railway Co. will extend its street railway.

Augusta, Ga.—The Augusta Street Railway Co. will expend $25,000 in improvements to its electric plant, etc.

Savannah, Ga.—The Savannah, Thunderbolt & Isle of Hope Company will expend $50,000 in improving its trolley system.

Ford City, Pa.—A company is being formed for the purpose of building an electric railway from Kittaning to Ford City, Pa.

Gas City, Ind.—Plans are being prepared for an electric-light plant to be constructed here.

Ocean View, Va.—The Ocean View Electric Railway Co. has been granted permission to extend its line to Brambleton, Va.

Vernon, B. C.—An appropriation of $12,000 has been given for the construction of an electric light plant.

Saginaw, Mich.—Efforts are being made to secure a street-railway franchise.

Appleton, Wis.—M. K. Gochnauer, city clerk, may be addressed concerning electric-light service.

Madison, Ga.—Mr. Thomas may be addressed concerning contemplated construction of electric-light plant.

NEW CORPORATIONS.

Washington, D. C.—The H. P. Hill Lighting Co. has been incorporated by H. P. Hill, F. J. Whitehead and A. L. Bogan, to furnish electric light and power. Capital stock, $10,000. The principal place of business is to be at Ninth and F streets, N. W.

Kalamazoo, Mich.—The Kalamazoo Heat, Light & Power Co. has been succeeded by the Kalamazoo Gas & Electric Co. with a capital stock of $200,000.

San Francisco, Cal.—Pacific Coast Electric Co. has been incorporated by Tacitus M. Crane, Jacob J. Gottlob, Melville Marx, Ralph E. Marx, James Maloney. Capital stock, $25,000; stock actually subscribed, $3,600.

De Lassus, Mich.—The De Lassus and Farmington Railway Co. has been formed for the purpose of constructing an electric railway from De Lassus to Farmington, a distance of three miles.

Parkersburg, W. Va.—The Parkersburg and Marietta Traction Co. has been formed to construct an electric railway from this city to Marietta, Ohio.

Scottville, N. Y.—A company is being organized to construct an electric-light plant.

McKeesport, Pa.—The East McKeesport Railroad Co. has been incorporated with a capital stock of $35,000. The company will build an electric line from McKeesport through Versailles, North Versailies, and McKeesport to Wilmerding.

Stamford, Conn.—National Electric Co. has been incorporated by Walter Ferguson, Anthony N. Brady, A. M. Young. Capital stock, $100,000.

The Ward Electric Supply and Construction Company, 39-41 Ann street, N. Y., represent the elements of a young and vigorous industry. Messrs. Green & Levy, the heads of this thriving firm, are too well known to make it necessary to outline their virtues. They have installed complete electric-light plants and wired for thousands of incandescent and arc lamps all over the Eastern States. They lately secured the contract to install the wiring, etc., of the fine new Singer building, Broadway and Liberty street, N. Y., for several thousand lamps. Among a few prominent buildings in which they have installed plants is the St. Patrick's Cathedral, Elizabethport, N. J., St. James Church, F. H. Betts' residence, Sixty-fifth street and Madison avenue, New York, etc. They carry a large line of electric-light supplies, motors, all styles of enclosed and open arc lamps, etc.

TELEPHONE NOTES.

Franklin, Mich.—The new State Telephone Co. has an exchange.

Kalamazoo, Mich.—The Kalamazoo Mutual Telephone Co. has been organized with a capital stock of $25,000.

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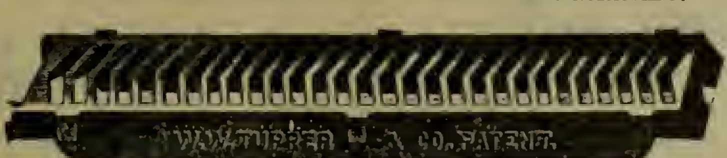

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The Electrical Age.

VOL. XX—NO. 23 NEW YORK, DECEMBER 4, 1897 WHOLE NO. 551

Fig. 1. Gear Plant of General Electric Co. at Lynn.

Fig. 2. Interior of Gear Plant Showing Gears Ready for Shipment.

A MODERN GEAR PLANT.

The astonishing growth during recent years of the electric street railway industry, has led to an equally rapid development in the manufacture of gears for use with railway motors. Railway motor and motor gear and pinion of the coeval, but during the life of the motor many sets of gears and pinions are necessary. Today when the number of motors in use reaches well toward the hundred thousand, the demand for gears and pinions is enormous and at no time in the past has it reached its present proportions. A mild estimate places the number of electric railway motor gears in daily use in the United States alone at 50,000, at least, and as the average life of the gear is about two years, a yearly output of from twenty thousand to thirty thousand is necessary for renewals alone, exclusive of those required for new motors.

In the pioneer days of the electric street railway, the cast iron gear and pinion of gun-metal were used exclusively. Experience and time necessarily brought about improvements and changes. Today the standard motor gears are of cast steel and the pinions of hammered steel, while the teeth are accurately cut from the solid stock by machines as perfect in their adjustment and performance for their work as those which cut the more delicate gears of higher class machinery. The change from cast iron to steel has resulted in a reduction of some sixty to seventy pounds in the weight of the gears, while their life has been very materially increased. A steel gear will wear more than twice as long as a cast iron gear, and while with the latter type breakage was a common occurrence, with the steel gear breakage is practically unknown.

To supply gears which would carry in themselves a guarantee of perfection, the General Electric Company established some time ago at its River Works, Lynn, Mass., a plant for the manufacture of gears and pinions. This plant is a model of its kind. The cutting machinery is of the most modern character, and the entire plant is laid out on a comprehensive scale. The exterior of the establishment is shown in Fig. 1. In this building is an extensive foundry for the gear blanks, as well as the gear-cutting shop. The former is equipped with overhead travelling cranes, driven by electric motors, furnaces for the molten metal, core ovens, and modern appliances of all kinds for the manufacture of steel castings of the highest grade. The great difficulty encountered in making steel castings —the tendency to secure blow holes, draws and cracks— has been overcome in this foundry.

After a long series of experiments, the General Electric Company perfected a process which now enables the foundryman to produce steel castings which are as practically perfect as if of hammered steel. Indeed, it may be said that in this gear foundry the manufacture of sound steel castings has reached an extremely high state of development, for not only has the question of soundness secured practical perfection, but the strength and wearing qualities have been the subject of long experiment until the steel produced possesses both in a striking degree.

Fig. 2 shows an interior view of the shop, that side devoted to the milling machines, gear cutters, key seating machines, special drill presses for drilling the bolt-holes in the gears and others. Some idea of the extent of the industry may be gathered from the number of gears in the foreground standing ready for shipment on order or removal to the stock room. Fig. 3 is a nearer view of some of the special drill presses, milling machines, etc., with a lot of gears in course of preparation for the tooth-cutting machines.

The process of manufacture of a pinion is illustrated in Fig. 4, showing the pinion forging, the pinion blank, milled, bored and seated, ready for the teeth to be cut, and the finished pinion ready to ship. Fig. 5 shows a steel gear bolted together and machined, with part of the teeth cut. These teeth are cut from the solid stock by specially made cutters, themselves designed after exhaustive experiment. The machines used are both elaborate and expensive, and are of unusually heavy design and accurate workmanship. They are all fitted with ingenious devices for producing uniform teeth. The pinions are cut from the best hammered steel forgings, and the teeth are cut with the same care as is taken in the cutting of the gears. All, that is both pinions and gears, undergo a rigid inspection before shipment.

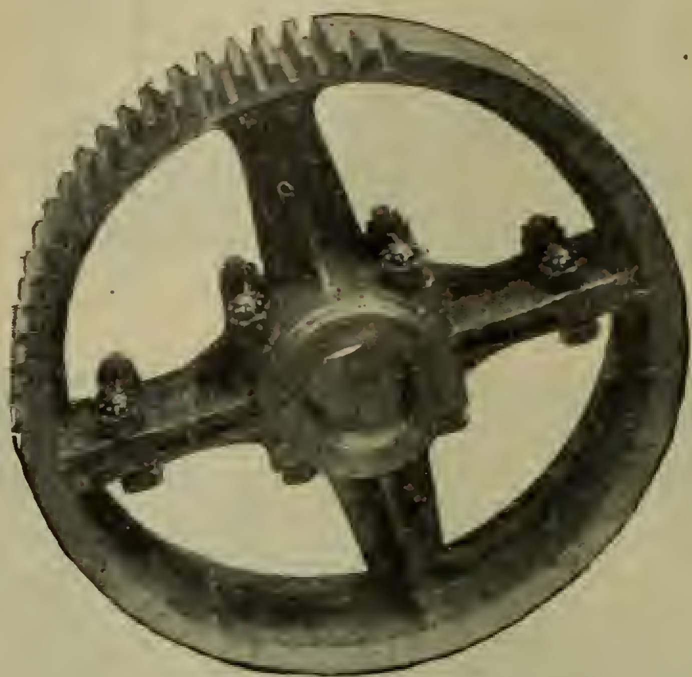


Fig. 5. A Gear Under Way.

The question of age of gears has not, perhaps, received from street railway managers the attention it deserves. In the life of gears there is a distinct difference between the extreme life and the proper economical life. There is a point in the age of gear and pinion a which it becomes more economical to consign them to the scrap heap and to use a new gear and pinion, than to retain them in service. The question is a nice one and a series of efficiency tests have recently been carried out. While the results are not yet collated, it may be

Fig. 3. Drill Presses, Milling Machines, etc., in Gear Plant.

said that a worn gear and pinion require some 400 watts more energy than a new gear and pinion. This is a statement made authoritatively, and one which will give food for profitable thought to managers of electric railways.

THE GREAT RUBBER WIRE TRUST.

Sometimes rumors become facts, but in this present instance it seems as if the rumor regarding the proposed wire trust has no actual foundation. At any rate, the manufacturers of Kerite wire have not the slightest intention of combining with the promoters of such a monopolistic enterprise. This concern has been in business for thirty-eight years, and as the oldest, most important and most conservative of wire concerns realizes in the light of a broad experience that no good can come from such a consolidation. They can stand alone and feel with the continued aid of their trusted employees they can continue as in the past to carry on their business without the assistance of others. Day's Kerite insulated wires and cables are known far and wide, and intend to enjoy those benefits derived from an established business—confidence between themselves and their customers and a reputation for honest dealing that will never fail. Mr. W. R. Brixey, the proprietor of the above business, has always found it to his interest to employ men of ability and integrity. He has more than that in the person of Mr. Geo. F. Porter, the general manager. The trade knew Mr. Porter before he was associated with the above concern and have always held him in the highest regard. The trust the Kerite Company believe in may be better expressed by the word "trustworthiness," as exemplified by internal relations and dealings with customers.

NOTICE OF REMOVAL.

On and after Monday, December 6th, 1897, the offices of this company will be located at 18 and 20 Broad Street, New York, where all communications should be addressed

INTERIOR CONDUIT & INSULATION CO.
November 29th, 1897.

Mr. J. C. Moulton, formerly with the Sawyer-Man Electric Company, also the A, B, C Company, has recently severed his connection with the Rochester Lamp Company to re-enter the electrical field. He is now with the Columbian Electrical Supply Company at 329 Fourth avenue, where he will be pleased to receive his friends.

PAPER ON "THE ADVANTAGES OF A CAR-MILEAGE RECORD.

(Continued from page 319.)

Although, as before stated, the subject has not received sufficient attention, progressive and economical managers are, with the ever-increasing development of electric railroading, realizing more and more the importance attached to a correct mileage record. The tendency is toward greater accuracy in this department in future. We must admit that if a record is worth keeping at all it is worth keeping well, for should a manager make any calculations from statistics based upon an incorrect mileage, he would be liable to entail considerable loss.

With the object in view of having, as near as possible, an absolutely correct system of computing its mileage, this company has spared no effort, with the result that the system now in force works to perfection and answers our requirements in every detail.

Having been requested to furnish a paper on this subject, we will endeavor to give, as briefly as possible, the system adopted by this road, hoping the same may prove of some value and furnish some ideas and suggestions.

We operate 78.73 miles of track in the city, covering an area of about eighteen square miles. Some of our routes are quite intricate, and on part of them we have as many as six turning points where we can turn part of our cars, as the traffic on the balance of the line may not warrant the same service as nearer the city. In some instances our cars run on several different lines during one day.

Our average daily mileage is between 13,000 and 14,000 miles, or about 5,000,000 miles annually.

In the first place, our engineers made a very careful survey of each line, and mapped same out to the scale of 400 feet to one inch. These maps show all switches, cross-overs, junctions, cross-streets, etc., and the distances are given from commencement of the line to all points where it is possible to turn. From these maps we have figured tables for any specified number of trips or half trips in either direction on each route.

Each motorman makes report of the number of trips made by his car daily, on a card which answers a threefold purpose. In addition to giving the number of trips made, it answers as a time-card and also as a trouble-report. (Form No. 1.)

Any motorman taking out a car makes out one of these cards which he hands to his relief, and the man pulling the car into the barn drops this card into a box provided for the purpose. The night foreman has access to this box, and from the reports finds out all repairs necessary to be made, and anything he is unable to complete he reports to the day foreman.

Every motorman is advised of the importance of having

Fig. 4. The Growth of a Gear.

his trips, time, etc., correct, and is required to account for any trips lost and also to report any defect which he may notice about his car, and if he fails to do so is held strictly accountable.

The trip cards are checked with the starter's report so that no cards can be left out; also the time of leaving barn and pulling in must agree, and there is no chance of anyone getting more time than is actually put in, as the time a man leaves the car must agree with the time his relief takes it.

From these trip cards the mileage is figured by routes (Form No. 2), the mileage for each car being put down separately on the slip.

The individual car mileage is then posted daily to the credit of each car in a book provided for the purpose (Form No. 3), and the amounts are carried forward monthly, so that when we want the mileage of any article we have only to subtract the mileage at the time the same was put into service from the total mileage made by the car on which it is used at time it comes out.

The route mileage is posted up daily in a book provided for this purpose, (Form No. 4), and in this way we get the mileage of each for the month or year; the earnings are also shown on this book.

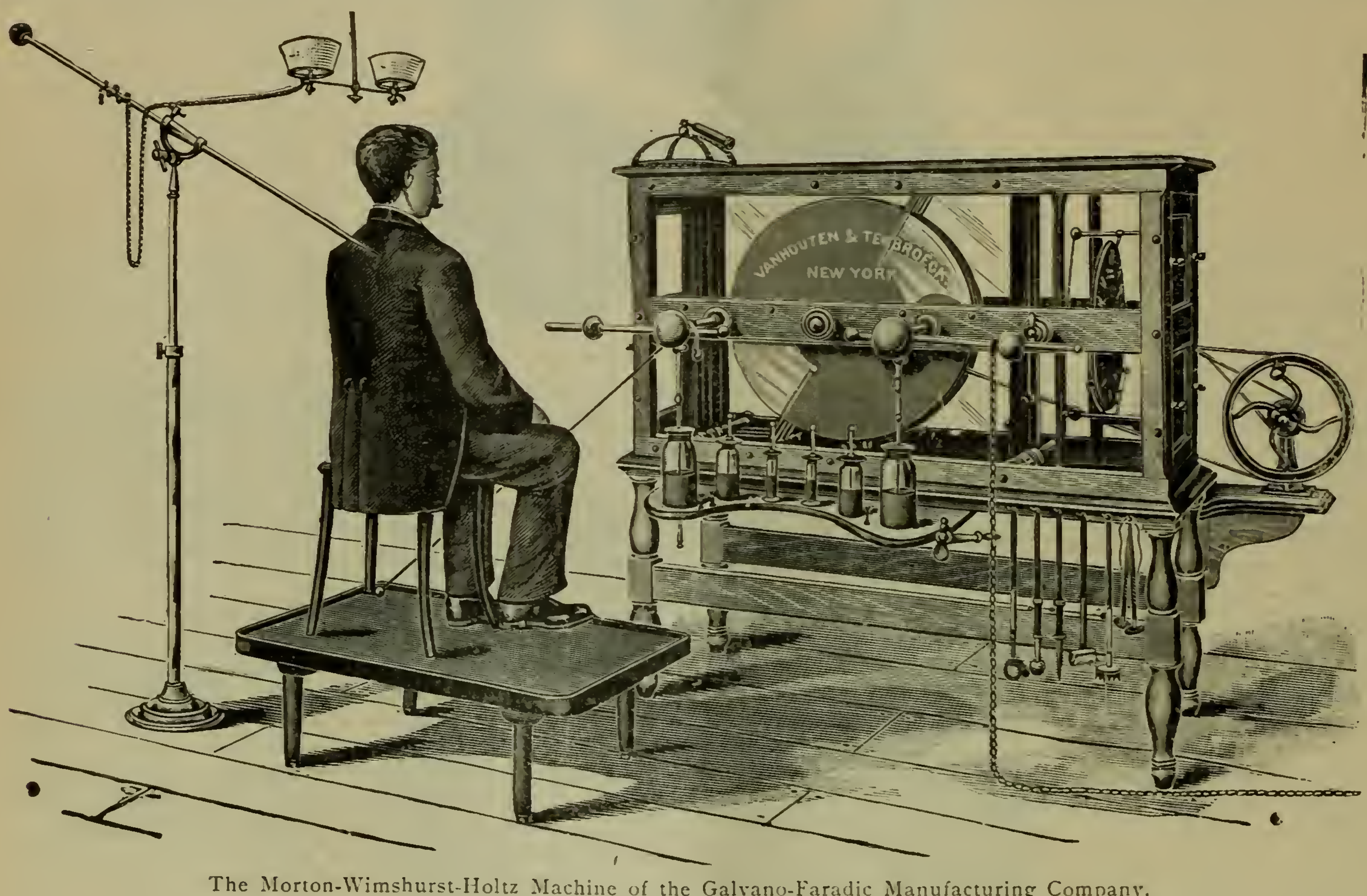
A daily report (Form No. 5) is made for the manager, which shows the mileage and earnings on each line; also, weather, etc. It also gives the corresponding figures for the previous year.

On our monthly mileage statement we figure all the various operating expenses per car mile, showing also the corresponding figures for the previous year, and thus we have a very good comparison of results. We also keep records of cost of repairs per mile on the various equipments in use ; also of the life of car wheels and other parts of an equipuent.

To close, we hope the above statement of our experience and system may prove interesting, and that if nothing more it may promote discussion, and bring forward views and suggestions from others, thus giving the subject of car mileage the position to which it is entitled as a most important factor in street-railway statistics.

ELECTRO-THERAPEUTICAL APPARATUS.

The profession of medicine has been greatly assisted in the last twenty years by the use of electro-therapeutic apparatus, which when properly applied by a physician of care and understanding, have greatly aided the patient's recovery, when his affliction was of a physical or physiological nature. The stimulation given to different organs of the body when an electric current is applied is one of the most remarkable of known phenomena. From a general standpoint it seems as if the molecular changes occurring in nerve tissues were either duplicated by the passage of a current or at least the nerve itself responds to its influence and creates the changes that bring about health and animation to the individual. A great physician once stated before his clinic the fact that the muscles do not become tired, but the delicate nerve plasm permeating them loses its vitality and the individual becomes tired because his nervous energy has diminished. In other words fatigue results, and for the purpose of overcoming such a condition, particularly when due to disease, galvano-faradic appliances have come into general use.

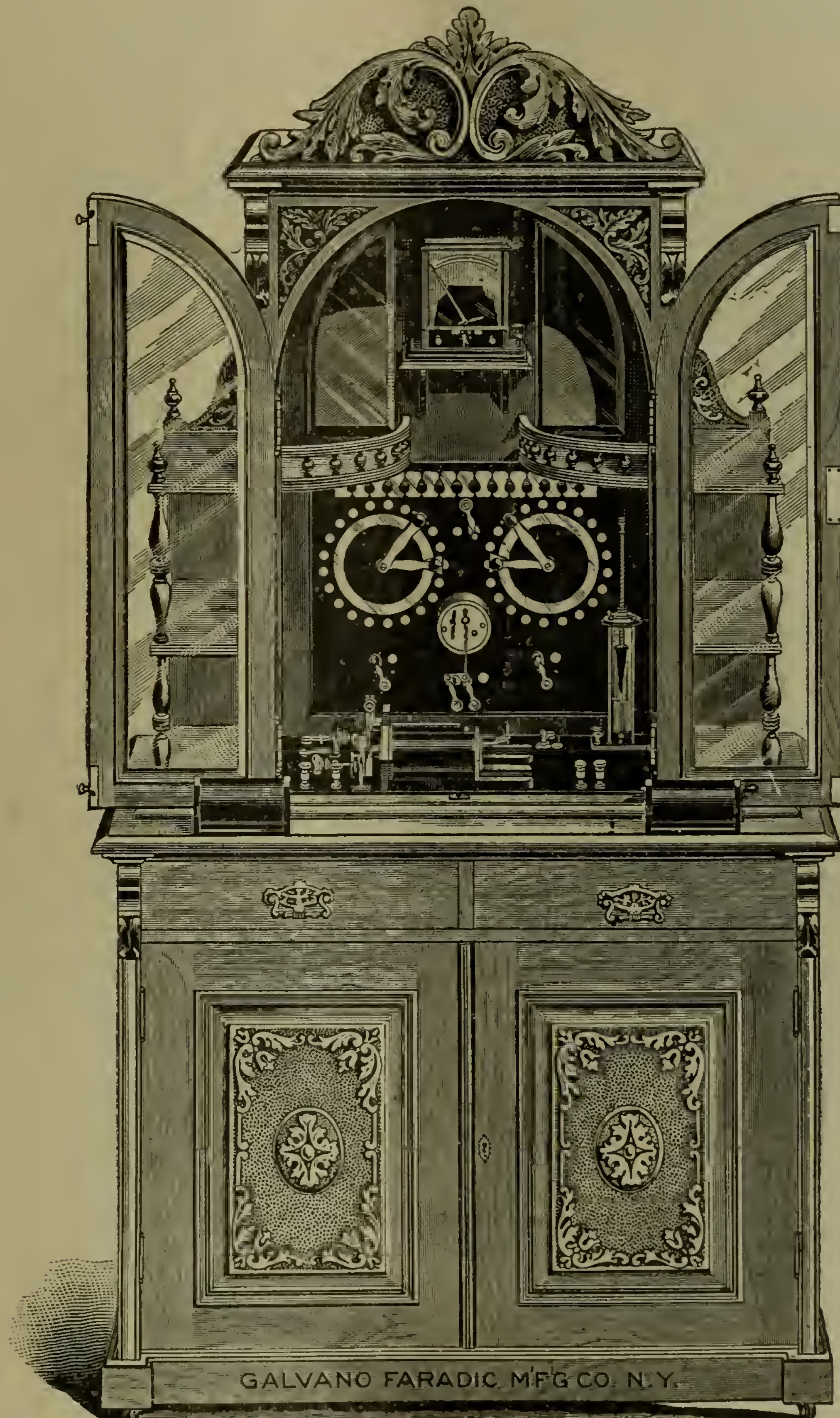


The Morton-Wimshurst-Holtz Machine of the Galvano-Faradic Manufacturing Company.

The static machine shown in the illustration was used Nov. 30th and Dec. 1st and 2d, at the office and salesrooms of the Galvano-Faradic Company, for the treatment of a patient, as shown in the sketch. A representative of the Electrical Age saw him come in, assisted to the chair by relatives, barely able to walk. He was treated by a prominent physician and was so benefitted that he left the place unassisted, saying his relief made him sure of a good night's rest.

The machine represented in the illustration is called the Morton-Wimshurst-Holtz Influence Machine. Two sizes are constructed, the first with eight thirty-inch plates, the second twenty-eight-inch plates. A small Wimshurst is used for charging and the mechanism operating the entire device is simple, practical and almost impossible to disarrange. A fifteen-inch spark can be obtained from the large machine. A complete outfit includes electrodes, insulated platform, Leyden jars, stand with crown for head breeze, ball point electrodes, etc.

The improved upright cabinet equipped with more than forty cells of the Fitch perfect battery, in addition to galvanic circles, double-cell sectors, wire-coil rheostat, pole-changer, automatic rheotone and water rheostat, represent one of the most convenient, ingenious and indispensable outfits a physician can have. The cabinet includes faradic coils and a water rheostat. The current can be varied and controlled to suit any particular case the medical adviser may have in charge. Being beautifully ornamented, the cabinet is a piece of fine-art furniture when closed. There is nothing better than the best and it is advisable for those that can afford it to always procure the best. The Galvano-Faradic Manufacturing Company have their show-rooms at 300 Fourth avenue, New York City. They are always pleased to show visitors the nature of their apparatus and feel confident that competition cannot excel their goods in either quality or price. The above company was established by W. B. Van Houten and T. R. Ten Broeck in 1870. They have already issued the twenty-seventh annual edition of their catalogue.



Improved Upright Cabinet Battery, Galvano-Faradic Manufacturing Company.

TELEPHONE POLE LORE.

It is possible that the science of wooden telephone poles may still be far from exhausted when metallic poles shall have completely displaced them.

The life of a cedar pole in this climate is about twenty years. Such a pole may rot in fifteen years, or be sound at the end of thirty years, but twenty years is the term reckoned on. Chestnut poles are not counted on for so long. Locust poles seldom rot, and they season into the hardness of iron, but that is against them, since it makes them difficult to climb.

In open country a forty-foot line serves well, but irregularities of surface sometimes call for much longer ones. It is a rule that there shall not be a greater variation in height than five feet between two successive poles, and whenever it is possible the line is made horizontal.

Some of the tallest telephone poles in the world are those on the Kingsbridge Road. They rise from eighty to one hundred feet above ground. Perhaps the tallest in the world is the mast that helps to carry the long distance lines across the Hudson at Troy. The mast is 155 feet tall, and is planted on an island in the river. Some of the biggest and costliest telephone poles are in Philadelphia. The tallest of them cost $190 each. Such poles measure three feet in diameter at the butt, and are planted ten or fifteen feet in the ground. The term mast is applied in the telephone business to poles made of several splicings.

The cost of building an ordinary telephone line is about $100 per mile for each wire carried. Forty men, with two horses and the usual appliances, can set up four of the great poles in a day. It is estimated that after a sleet storm a pole of one hundred wires bears a weight of nearly four tons. It is found that a familiar reddish brown paint is the most durable for use upon telegraph and telephone poles.

GREAT ELECTRICAL EXHIBITION.

Interest in the coming Electrical Exhibition is taking a very substantial shape. The demand for space is even larger than was looked for, and it comes from the leading representative firms in the electrical, steam and kindred trades. They are planning to spend money liberally in making their exhibits attractive.

Madison Square Garden will afford plenty of scope for this sort of work, and present indications point to a remarkably brilliant display.

FORTUNES FROM FRACTIONS.

There have been in recent years several instances of sudden wealth, says a writer in Leslie's Weekly. South Africa and Cripple Creek have produced millionaires over night, and a bicycle and patent medicine promoter in England made $10,000,000 in as many weeks. There are several thousand people who are each worth $1,000,000 or more, and there are several more thousands who are on the road to become millionaires. Most of these are persons who are getting their riches on small fractions of a cent. The street railway kings who are rising to millionaires are fully satisfied with a part of one cent of the nickel they collect, because there are so many of them.

The sugar kings have reduced the price and improved the quality of sugar, but as long as they get their fraction on each pound the Americans buy they can make a profit all the way from 20 to 50 per cent. The coal oil monopoly has not only reduced the price and improved the product, but its little fraction makes the greatest money-making enterprise in America. The man who invented the patent beer stopper is getting a bigger income than the President of the United States. A cheap headache remedy is allowing its proprietor to spend $100,000 a year, and still lay up another $100,000 for a rainy day. The first thing is to get control of some article of universal use, and the small fraction will do the rest.

ALL THE WAY FROM INDIA.

(Written by a Native.)

G. B. Naik & Co.
Poonah City, India, Oct. 16, 1897.

Dear Sirs: We shall feel extremely obliged for favoring us with a sample issue of The Electrical Age. If approved, will continue the same, please.

We have need of electric scientific working models by dry batteries. So please address one who deals in above electric novelties, etc., and oblige,

Yours faithfully, Cuenmils,
Per Manager.

WHAT ARE WE COMING TO?

The horseless carriage, we are told,
Is now the pressing need.
And still it seems some other things
Would better take the lead.

The drinkless drink, for instance,
Which ought to serve as one,
And as a fit companion
Is named the shotless gun.

And there's the dogless sausage,
Which must be coming near,
While loudly chalk and water
Say cowless milk is here.

The kissless mouth's another,
To keep away the men—
And, furthermore, to conquer
The microbe in his den.

The musicless piano
Is well up toward the van,
And likewise may be mentioned
The lieless fisherman.

The summer-girlless summer—
But no—we'll have to call
A halt right here, for this one
We do not need at all.

—New York Life.

TELEGRAPHING THROUGH THE EARTH WITHOUT WIRES.

In 1893 Mr. Nikola Tesla attended the St. Louis convention of the National Electric Light Association and gave an address that was quite startling, coming as it did from a man of such a reputation, who has always been extremely careful in his statements, especially with regard to his own discoveries and achievements. Mr. Tesla then declared his belief in the possibility of telegraphing over the entire earth without wires, if he could construct a machine that would enable him to disturb the static electricity of the earth.

Since that time Mr. Tesla has devoted much time to the solution of the problem and he now announces that he has produced a machine which will, in his opinion, attain the desired object.

"The machines which I have completed," Mr. Tesla said in a recent interview, "will carry messages through the earth for a distance of 20 miles or so. I have sent and received signals with them, and I feel confident that I am not mistaken in saying that the problem upon which I have spent many days and nights is solved. Of course, it is possible that I am mistaken. I have made mistakes before, but not many. I shall at once make machines which I expect will enable me to telegraph to any part of the earth as readily as I can within a limited distance by means of the ones I have.

"If I have a machine which will throw a stone from here to there," continued Mr. Tesla, pointing from the floor at his feet to the door of his laboratory, "then I do not need to doubt that I can make one which will throw the stone 50 miles, if I can control the necessary power.

"Suppose the whole earth," he said, "to be like a hollow rubber ball filled with water, and at one place I have a tube attached to this, with a plunger in the tube. If I press upon the plunger the water in the tube will be driven into the rubber ball, and as the water is practically incompressible, every part of the surface of the ball will be expanded. If I withdraw the plunger the water follows it and every part of the ball will contract. Now, if I pierce the surface of the ball several times and set

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NEW YORK, DECEMBER 4, 1897.

CONTENTS.

DAYLIGHT FROM DIRT.

When Dean Swift wrote his famous tale of "Gulliver's Travels" he did not realize how closely he anticipated modern scientific methods. Gulliver, the hero of the tale, was wrecked on the island of the Liliputians. He fell into the hands of the Brobdingnagians, a race of colossal giants; but the creator of this famous character little knew when he referred to a strange class of inventors who were trying to extract sunlight from cucumbers that at the close of the nineteenth century, daylight, or its nearest equivalent, would be obtained from the great garbage heaps of large cities. The age is full of wonders and, as history repeats itself, so sometimes do the satirical suggestions of defunct authors take shape and form and crystallize into a substantial something. The town of Shoreditch, England, practically a suburb of London, is entirely illuminated at night by electricity obtained directly from the combustion of refuse. Not only has this method of utilizing it proven a success but, commercially speaking, an amount of profit has accrued therefrom which will probably be effective in stimulating other municipalities to put their waste product to the same commendable purpose. In Shoreditch but thirty-four tons of coal were used in two months, and even that was due to the fact that on certain days no refuse was collected. The light obtained from the cremation of this valuable material in Shoreditch is that of 7,000 eight-candle power incandescent lamps and sixty arc lights. After five months' operation, the station managers find the demand for light beyond their capacity to supply it, and a further extension of the plant is contemplated at present. Why do we hesitate to employ a similar method in New York City, when success is so assured? With so self-contained a system of electric lighting, we begin to approach an economy equal to that of the French people. Waste is unknown in Paris. When our own city gleams at night with the light of myriads of arcs, let the wonder of that sight never depart, for perhaps some of it is indeed obtained from the ancient and honorable cucumber.

THE COMPETITION OF STEAM AND ELECTRICITY.

Recent discussions have been held in engineering circles regarding the position of steam and its cost, and some interesting facts have come to light, showing that steam-power, though universally used, is either losing ground or, through the cost of coal being reduced, has been cheapened to an extraordinary degree. At a meeting of the American Society of Mechanical Engineers the above subject was discussed and Mr. Dean read a paper in which he considered its cost through a period of twenty-seven years. There was a time when the Corliss simple condensing engine represented the most economical type in use, consuming from nineteen to twenty pounds of steam per horse-power hour. The compound engines of today, particularly among the finer make, consume but little more than eleven pounds per horse-power hour. In Germany a small machine, named the Schmidt motor, has only consumed 10.17 pounds of steam per horse-power hour. The conclusions of Mr. Dean are based upon figures illustrating the direct gain derived from the use of compound engines, steel reheaters, steam jackets, higher pressures and a greater rate of expense. Due to these improved methods and machines, thirty-seven per cent. is gained above the normal results. A saving of five per cent. may be considered as due to vertical and horizontal engines, and so on, by considering new style grates, boilers, economizers, etc., which, of course, have improved steam engineering so far beyond the practice of twenty-seven years ago that the above, in addition to the reduced cost of coal, shows a gain of fifty-eight per cent. above the cost of steam-power in the last three decades. The comparative figures now appear, as follows: in a thousand horse-power plant the yearly cost of a horse-power, in 1870, was $38.14; at present a plant of this size would only cost $16.31 a horse-power per annum.

The improvement in apparatus methods and the decreased cost of fuel has undoubtedly brought about this reduction in the price of steam-power. Competition has become so keen in large cities between the producers of steam and electric power that every year a reduction in the cost of each can be expected. It is difficult to state exactly what the cost of an electric horse-power per annum would be, even in the case of a plant of definite size. So much depends upon circumstances and so little time has expired since electric power may be truly said to have been sold to consumers, but the vast encroachments being made undoubtedly lead one to believe that another five years will be very effective in so reducing the cost of electric power in thickly settled centres that its price, with the wonderful convenience that its use implies, will absolutely defy any manner of competition from any source whatsoever. When we shall look back upon a period of twenty-seven years and compare the cost of electricity then with what it is now, we will assuredly find a pronounced decrease, not due, however, to direct improvement either in dynamos, motors or methods, but more to its general use in the factory and home, in the crowded thoroughfares and upon the water-ways that abound around our metropolis.

tubes and plungers at each place, the plungers in these will vibrate up and down in answer to every movement which I may produce in the plunger of the first tube. If I were to produce an explosion in the centre of the body of water in the ball, this would set up a series of vibrations in the whole body. If I could then set the plunger in one of the tubes to vibrating in consonance with the vibrations of the water, in a little while and with the use of a very little energy I could burst the whole thing asunder."

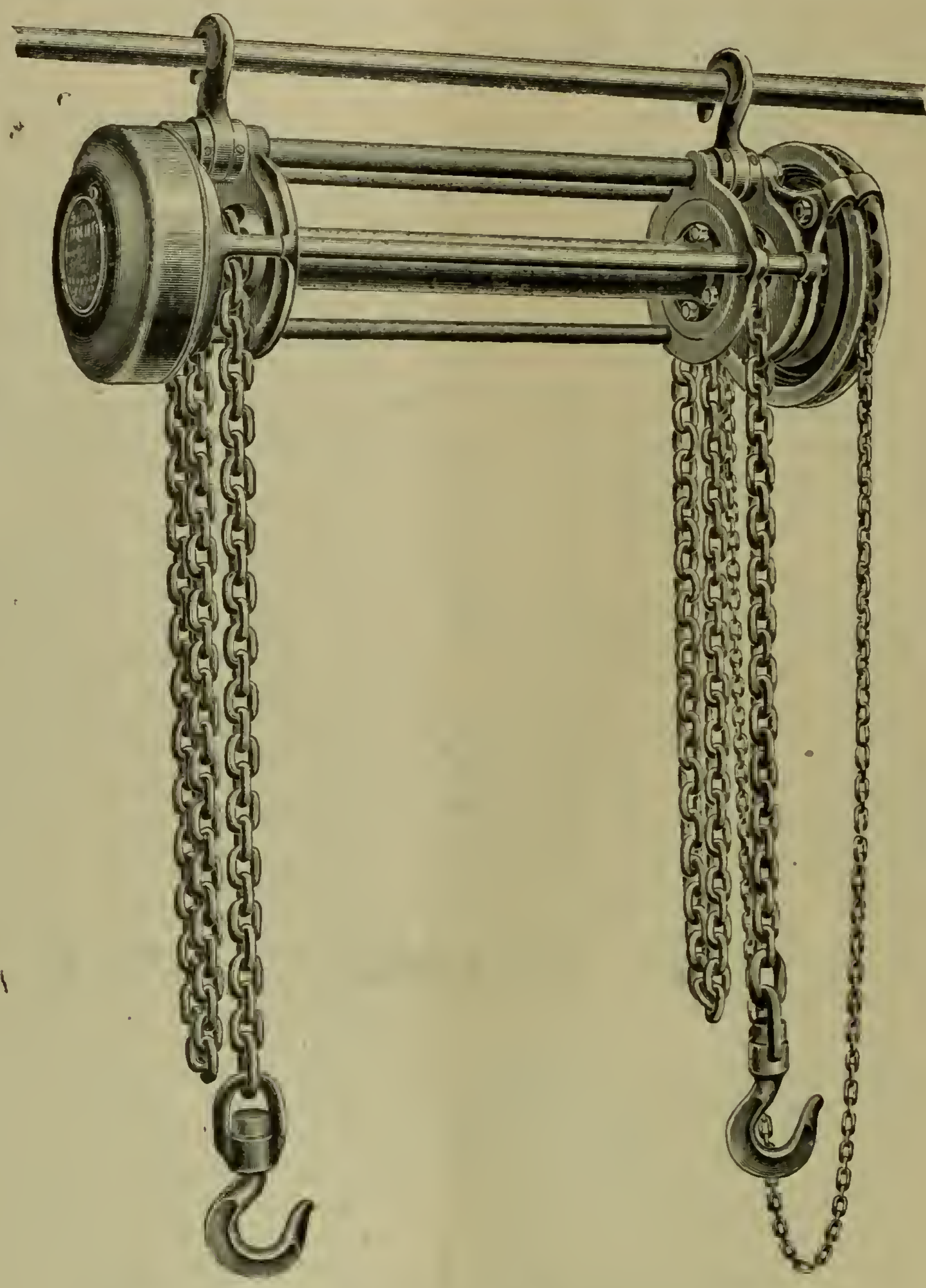
This, Mr. Tesla said, would explain in a rude way how he proposed to set the whole of the static electricity of the earth in motion, for telegraphic purposes, by taking advantage of the incompressibility and elasticity of the electric fluid. Then he told of some of the interesting results which he had accomplished in studying the theory and effect of vibrations. In one case he set a steel ring, 4 inches thick, vibrating, and by repeated but gentle continuations of the vibrations burst the ring. In another case he took a steel bar an inch in diameter, set it vibrating, and kept it going until its internal disturbance was so great that first a section of the rod broke loose from one end and flew off and then another section flew off from the other end.—Scientific Machinist.

Piedmont, W. Va.—The Gordon Telephone Co. has completed a telephone system at Piedmont, and is about to make long-distances connections with other points. Company's capital stock is $100,000, and 50,000 of this is fully subscribed.

SPECIAL TRIPLEX HOIST FOR HANDLING LONG MATERIAL.

The accompanying illustration shows a special form of the Weston Triplex Chain Block made by the Yale & Towne Manufacturing Company, of Stamford, Conn., and 84–86 Chambers street, New York, especially designed for handling long material such as bars, beams, lumber, etc.

It consists of a triplex block with its mechanism separated into two parts, coupled by means of shafts and separators, and provided with two hoisting chains, the combined strength of which is equal to the lifting power of the block. The hoist can be so built as to separate the two hooks any distance desired, according to the character of the material to be handled. The hoist may be hung from a fixed support, as in the illustration, or an overhead track or crane, as desired.



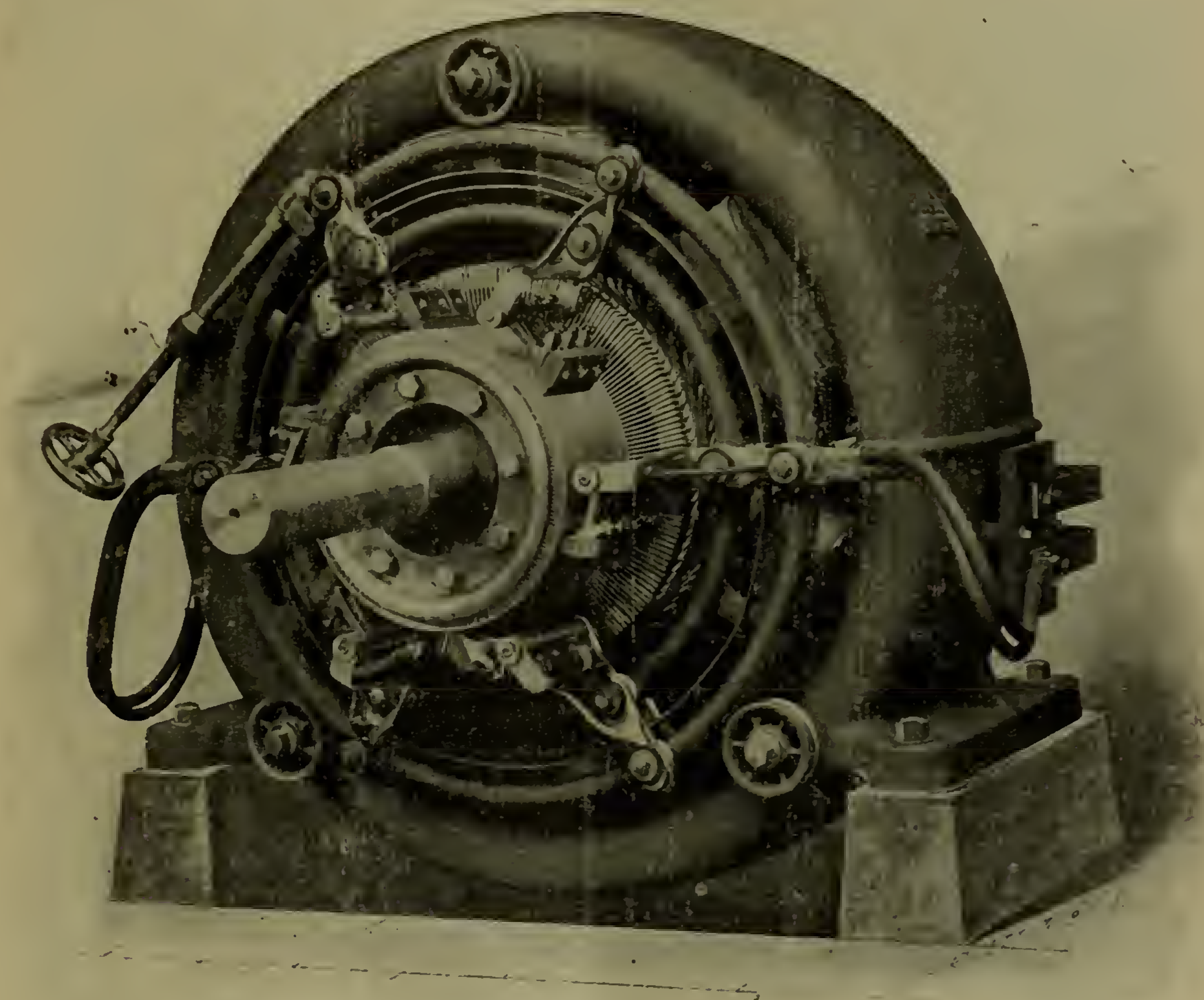
Spiral Triplex Hoist, Yale & Towne Mannfacturing Company.

The hoist thus provided with two lifting chains and hooks always moving together is adapted to a wide range of uses, and for the handling of long material is much better than a block with a single lifting chain. The latter is sometimes used with a yoke, having hooks at each end, but this arrangement is less steady than the one shown in the illustration and necessarily occupies much more head room. The triplex hoist with two lifting chains will doubtless commend itself for a wide variety of uses.

Do not fail to get a copy of the Christmas edition of The Electrical Age.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY.

In last week's issue of the Electrical Age a description was given of some of the machinery manufactured by the Bullock Electric Manufacturing Company, of Cincinnati, O., and special reference was made to direct-connected machinery, such as printing presses, punching machines, etc., operated by electric motors. The direct-connected multipolar generator of the concern presents from an engineering standpoint many valuable features to the observer's notice. Being substantially built a magnetic circuit is thereby provided which carries the lines of force without leakage from pole to pole and requires in consequence of its high permeability a minimum of magnetizing force, which of course means a minimum of copper.



Multipolar Generator for Direct Connection, Bullock Electric Manufacturing Company.

The pole pieces of laminated iron are held in place by the field frame, the metal of which is cast around them. When the armature, which is built of fine Swedish iron is in place, the magnetic circuit is so perfect that although the field is of great strength, no sign of external magnetic leakage is detectable. Maple strips hold the coils secure in the slots of the armature core.

The heat losses in the armature are of very little consequence and the radiation due to scientific ventilation is so rapid that even with a heavy load, the armature runs cool and without danger.

Sparking is entirely absent from a machine of this construction and the brushes and commutators are not relied upon as in many other cases to subdue an existing evil. The armature is free from fault and the commutator therefore serves its proper purpose of allowing the current to escape into the brushes freely and without sparking.

From a mechanical standpoint the commutator, being made of dropped, forged copper bars and securely bolted with the finest mica insulation, cannot be excelled. The brush holders provide an even pressure upon the commutator; chattering or vibration is entirely absent and the completed machine represents the very acme of high-class electrical and mechanical engineering.

The Bullock generators have been frequently tested with heavy overloads and run under such conditions for a period of from one to five hours. Sparking and heat were practically absent as proven at a Navy test. No machine manufactured can surpass the Bullock multipolar generator in capacity for overload and smoothness of operation under such circumstances.

The telephone, it is said, is not making much progress in Russia. And no wonder! Fancy a man going to the 'phone and shouting:

"Halloa, is that you Dvisostkivchsmartzoiczski?"

"No, its Zolleemschousksmzyskaffrnocks tiffsgewoff. Who is speaking?

"Sezimochockiertrujauksmzyskischokemoff. I want to know if Xliferomanskeffskilmajuwschasttow aeksweibierski is still stopping with Dvisostkivchsmatvoiczski?"—The Telephone.

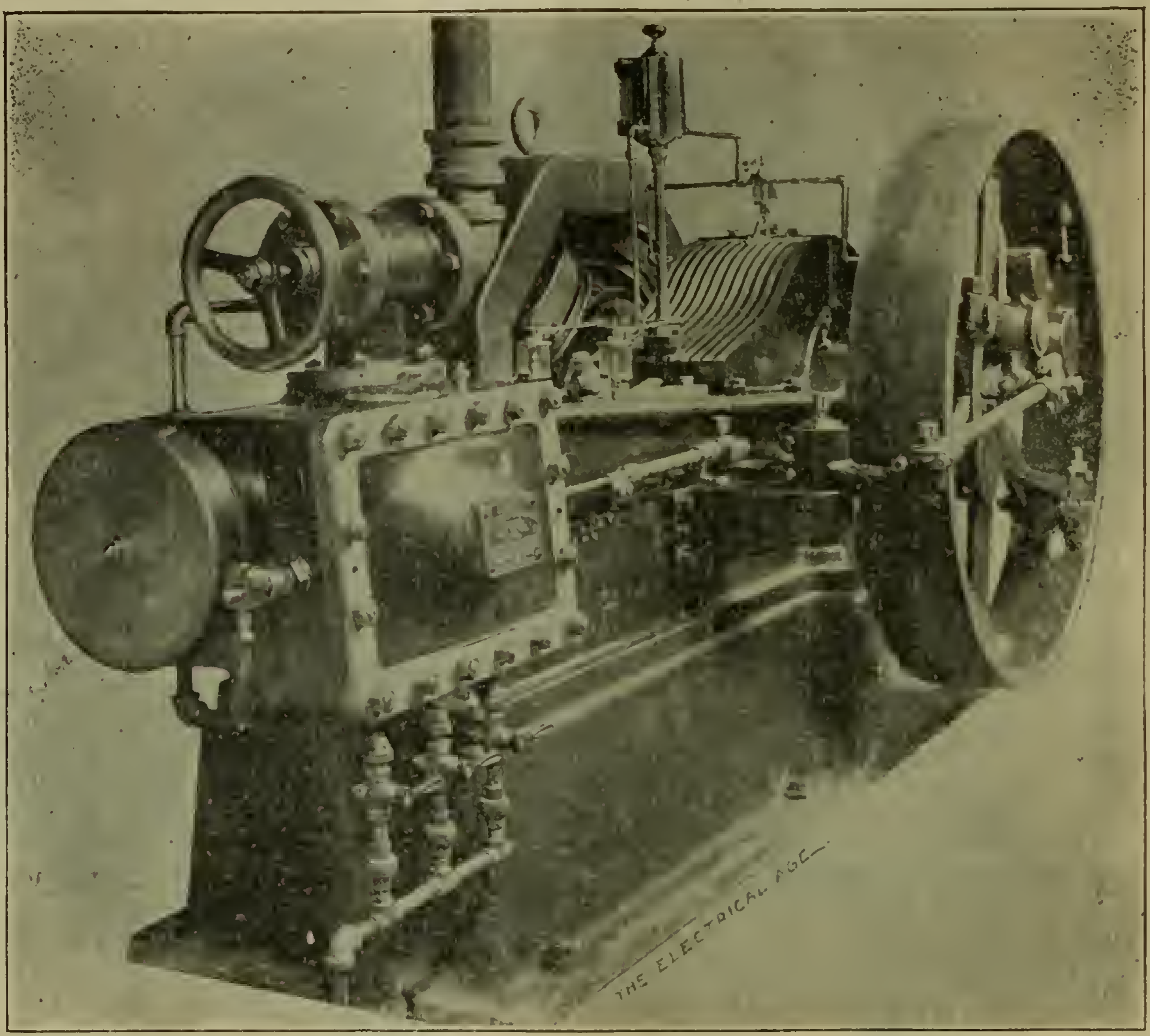
CHRISTMAS PRESENT FREE.

Will readers favor the Electrical Age — and more particularly please yourself if you are a lover of music—send ten cents in silver to E. O. McCormack, passenger traffic manager, Big Four Route, Cincinnati, O. He will send a handsome sheet of music, "The Big Four Two-Step;" regular price 50 cents; 10 cents only covers mailing and postage. Mention Electrical Age, as it will be a test of the value of our journal.

The Sun's Spots.—"The sun has great activity in its spots," says Bayne's "Pith of Astronomy," "these being sometimes 50,000 miles in diameter. These spots are enormous vents for the tempests of flame that sweep out of and down into the sun. An up-and-down rush has a velocity of about 20 miles a second, and a side rush a velocity of 120 miles a second. These tempests rage for days and months at a time, and as they cease the sides of the spots fly together at the rate of 20,000 miles an hour; they strike together and the rising spray of the fire leaps thousands of miles into space; it falls again and rolls over the Himalayas of fire as the sea over the pebbles on its beach. If strips as large as this earth were placed in such a tempest they would be mere corks as tossed by an ocean storm."

DIRECT-CONNECTED WOODBURY ENGINE AND EDDY GENERATOR.

The Woodbury engine, as recently improved, has been on the market for the last three years, and the many installations already in successful operation demonstrate its superiority over many of the old types of high-speed engines.



Direct-Connected Woodbury Engine and Eddy Generator, Installed by Burhorn & Granger

The governor used is the "Shepherd," which regulates the speed of the engine so that at no time, under the varying conditions of steam pressure and load, will the speed vary more than one-half of one per cent.; in fact, the regulation is so close that electric elevators and lights can be successfully run from the same machine without causing any variation in the light, noticeable to the eye. The engine is provided with an automatic lubricating system, so arranged that all the bearings are fed automatically from a central reservoir; the feed at each bearing can be controlled and the amount of oil fed can be readily seen. All the oil is drained to the inside of the frame and there is absolutely none on the outside, and the engine room and surroundings can be kept perfectly clean.

On larger sizes the main bearings are provided with an automatic ring oiling device with removable sleeve bearings. The illustration shows a direct-connected Woodbury engine and Eddy Generator installed in the large general stores of Messrs. F. Schneider & Sons, Union Hill, N. J. The engine drives an electric elevator, arc and incandescent lamps. The details of valve, etc., are fairly understood. The type of valve is a perfectly balanced flat valve, with relief plate to move from valve in case of water in the cylinder, preventing wreckage, due to this cause. The valve is of such design that wear is reduced to a minimum and provision is made for taking up the wear when it does occur, so that the valve remains practically steam-tight throughout its life, provided the engine is in the hands of competent engineers. On large engines, the horse-power is obtained with less than 30 pounds of steam per horse-power and the friction load does not exceed five per cent. Particular attention has been paid to the finish of the engine. All machined parts are carefully polished and the frame painted and varnished and striped to suit individual fancy. This engine was installed by Messrs. Burhorn & Granger, contracting mechanical engineers, who are sole selling agents for Stearns Manufacturing Company, Erie, Pa., in Eastern New York, Northern New Jersey, Connecticut and Rhode Island. Their specialties are: Horizontal tubular boilers, Manning vertical boilers, Gill water tube boilers, Woodbury high-speed engines, Woodbury medium speed engines, Stearns slide valve engines, pumps, tanks, smoke stacks, general wrought iron work. Complete steam and electric plants. 136 Liberty St., New York.

The Eddy generator and electrical plant were installed by H. B. Coho & Co., St. Paul Building, New York.

ELECTRIC HEATING AND ITS CALCULATION.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The subject of electric heating has become of commercial importance in the eyes of the world. Its study is of interest, as it lays bare the principles by which we can determine the extent and method of application of the current required for such purposes. One of the most extraordinary, yet most common, of phenomena is the heating of a wire by the passage of a current. The laws of heat were little understood at a time not much prior to the present date. Joule, of England, carefully investigated the rise and fall in temperature of bodies heated by an electric current, and thereby arrived at certain definite conclusions of the deepest interest. Before an examination is made of these facts it is best to review the physical basis of heat due to any cause whatsoever.

Heat is due to a variety of causes; amongst the most common being—

Chemical action,
Friction,
Electricity,
Shock.

It has been assumed by scientists that heat is merely a sort of motion of the particles of a body. The faster the particles move the hotter, we say, the body is. When chemical action occurs an exchange between different particles takes place, and this vibratory action in some mysterious manner asserts itself in the form of heat. Mechanical causes produce about the same condition, that is, a rude disturbance of the particles, and the results of friction or concussion are plainly visible—the action of a brake on a railroad train in producing sparks, and the blow of a steam hammer on a piece of iron heating and reddening it.

Electricity, in addition to its chemical and magnetic effects, produces heat. It always produces heat in its circuit, and that heat is due to something like an internal friction which the current meets with in the wire; it cannot excite heat unless the circuit has resistance, and as every electric circuit has some resistance, heat is ineradicable and is inseparably associated with the flow of a current.

Heat is work or power; that is, it can be measured in foot pounds.

One horse-power is equal to 33,000 foot pounds a minute, or is equivalent to one pound being raised 33,000 feet in a minute, or 33,000 pounds raised one foot in a minute. In either case, or any variation of it, the foot-pound of one horse-power must be the same.

Joule discovered that the heat required to raise one pound of water one degree, Fahrenheit, was equal to 772 foot pounds. This brings us at once to the previous statement that heat represents power, and a thorough comprehension of this fact will prepare the mind for the relation it bears to an electric current.

Indicated horse-power in engines is the power the engines are producing, not what they are giving out at the fly-wheel. The difference between these two is lost in radiation, etc., and in friction. Considerable power is lost every day in the shape of heat in all engines; enough, in fact, to supply five times as much power as is used.

When the water in a steam boiler is being heated each pound requires 772 foot pounds to increase its temperature one degree, Fahrenheit.

A boiler with 1,000 pounds of water raised through 50°, F., requires foot pounds equal to the following:

1 pound, 1° F., = 772 foot pounds,
1,000 pounds, 1° F., = 772,000 foot pounds,
1,000 pounds, 50° F., = 38,600,000 foot pounds,

or the equivalent of more than 1,000 H. P. This saving of heat in boilers is thus made manifest as a ready means of saving power.

The transformation of heat into power, or, as we are about to consider it, of power into heat—that is, of electricity into heat—is defined in the following manner:

The power dissipated as heat in an electric circuit is equal to the product of the current by the current and by the resistance.

For purposes of calculation the statement may be put into this form—

Heat = Current × Current × Resistance.

In the previous cases we have spoken of the power (772 foot pounds) required to raise one pound of water one degree, Fahrenheit; this is called Joule's equivalent. We have also given 33,000 foot pounds as the value of a mechanical horse-power. It remains to state that the electrical horse-power is equal to 746 watts.

Watts are found by multiplying volts by amperes.

When dealing with electrical energy, which is only measured by electromotive force and current, foot pounds cannot be used. The only two elements of power in a circuit are the units of pressure called volts and units of current called amperes.

Watts are calculated according to the rule, watts = volts × amperes.

In a circuit having 110 volts,
and 100 amperes,
the watts = 110 × 100 = 11,000
H. P. = 11,000 ÷ 746
= 14.

The kilowatt is equal to 1,000 watts, or about 1⅓ horse-power.

Heat in a circuit may be measured in watts, because

Watts = Current × Current × Resistance,
= Amperes × Amperes × Ohms,
= C × C × R.

If a circuit carries 1,000 amperes and has a resistance of one ohm, the heat dissipated equals

1,000 × 1,000 × 1 = 1,000,000 watts,
= 1,000 kilowatts,
= 1,340 horse-power.

Therefore, unless a circuit is made of the lowest possible resistance, power will be continually lost in the form of wasted heat.

Heat is measured by means of a calorimeter, a vessel containing a thermometer, a little water and a coil of wire. When the current flows the wire heats the water and raises the temperature.

The weight of the water and the number of degrees rise in temperature enables us to calculate the calories.

A calorie is the amount of heat required to raise one gramme of water one degree Centigrade.

It is similar to the Joule, because the Joule takes into consideration one pound of water and one degree Fahrenheit. The calorie is about four times as great as a Joule.

1 Joule = .24 Calorie.

Heat requires time; therefore, in using a heat measuring instrument, the seconds must be considered.

Calories are obtained by the rule—

Calories = .24 × Current × Current × Resistrnce,
with Amperes = 50,
Ohms = 10,
the Calories = .24 × 50 × 50 × 10,
= 6,000 per second.

Six thousand calories will heat one gramme of water 6,000 degrees, Centigrade; or, 6,000 grammes of water one degree, Centigrade; or, 3,000 grammes of water two degrees, Centigrade, etc.

If the fifty amperes flowed ten seconds, the total heat would be 10 × 6,000 = 60,000 calories.

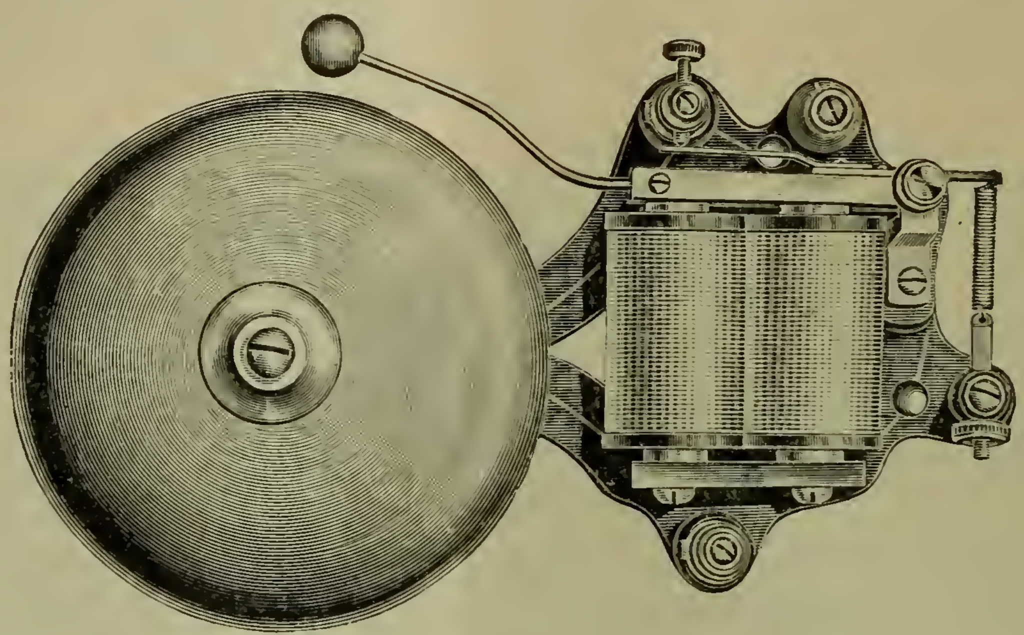
Metals increase in resistance with heat. Commercial heaters are, therefore, apt to take less current after operating a while than on starting.

In metals the ohms resistance increase one-fifth of one per cent. with each degree, Fahrenheit. Every five degrees, F., increases the resistance one per cent.

German silver, an alloy, increases in resistance .02 of one per cent. for each degree, Fahrenheit.

Manufacturers of commercial heaters employ the above principles. A warm, even flow of air is desired, not an intense heat. A great surface is required to radiate the heat rapidly and at a comfortable temperattre. A long spiral of iron wire wound spirally on an insulating and fireproof material is generally employed. The wire must not oxidize, and the coils must not touch. A regulating switch is required to throw the coils in series or multiple, or to at least control the current.

The heating costs in street cars from one-half to one and a half cents per ampere hour. The efficiency of electric heaters is very high, and they therefore promise to be in universal use when the cost of current, as delivered by illuminating companies, warrants it in the home.



Huebel & Manger Improved Bell.

QUESTIONS FOR REVIEW.

ELECTRIC HEATING.

(1) How is heat produced ?

(2) What is horse-power ?

(3) How many foot pounds in a heat unit ?

(4) Upon what does the amount of heat depend in an electric circuit ?

(5) How are watts calculated ?

(6) What is a kilowatt ?

What is a calorie ?

What is a Joule ?

(7) How many calories are produced in a circuit of 1,000 ohms resistance carrying two amperes of current ?

(8) What practical use is made of electric heating ?

IMPORTANT ELECTRICAL SPECIALTIES.

The oldest fields of work are often the scene of the greatest activity. Probably one of the most commonly seen pieces of electrical apparatus is the electric bell, yet it seems to be capable of higher improvement and is illustrated in this superior condition as it is manufactured by the firm of Huebel & Manger, makers of electrical and brass goods, 286–290 Graham street, Brooklyn, N. Y. Not alone are these bells of superior design, but the material of which they are made is superior to that generally used by unconscientious manufacturers. The reliability of a good bell generally depends upon the platinum contact, and the serviceableness resulting therefrom is directly dependent upon the purity of the platinum, its solid position and method of application. In the construction of the iron frame and iron box bells, representing style F, with pivoted armature, and style L, also pivoted armature with double adjustment, improved lock-nut, immovable binding and contact posts are used. The bell is also adjusted in a simple and convenient manner, which enables the novice in case it requires adjustment to immediately it for that purpose. The binding-posts of these bells do not turn when a wire is inserted under them. They are also provided with grooves in the base, so that wires will not show that lead to binding-posts.

On the whole, the line of electric specialties manufactured by Huebel & Manger represent the acme of design in each particular case, and have through long service and good satisfaction secured the esteem of the trade.

Shot Fired Fifteen Miles.—From twelve to thirteen miles is the computed range of the most powerful guns now made, but the longest distance that a shot has been fired is a few yards over fifteen miles, which was the range of Krupp's 130-ton steel gun, firing a shot weighing 2,600 pounds. The 111-ton Armstrong gun also has an extreme range of fourteen miles, firing a shot weighing 1,800 pounds and requiring 960 pounds of powder: but quick-firing guns are more depended upon at the present day than guns with such extreme range. Of quick-firing guns the most wonderful is, perhaps, the Maxim, which can fire as many as 600 shots a minute, and yet is so light that a soldier can carry it strapped on his back. Krupp's 130-ton gun and Armstrong's 111-ton proved too expensive, being unable to stand firing 100 times, and their manufacture has practically been abandoned. The gun most favored, perhaps, is the 22-ton Armstrong, which hurls a solid shot for a distance of twelve miles.—Ex.

The date of this edition of The Electrical Age, December 4, is the day W. T. Hunt, the president of The Electrical Age Publishing Company, celebrates once every year.

The Electrical Age.

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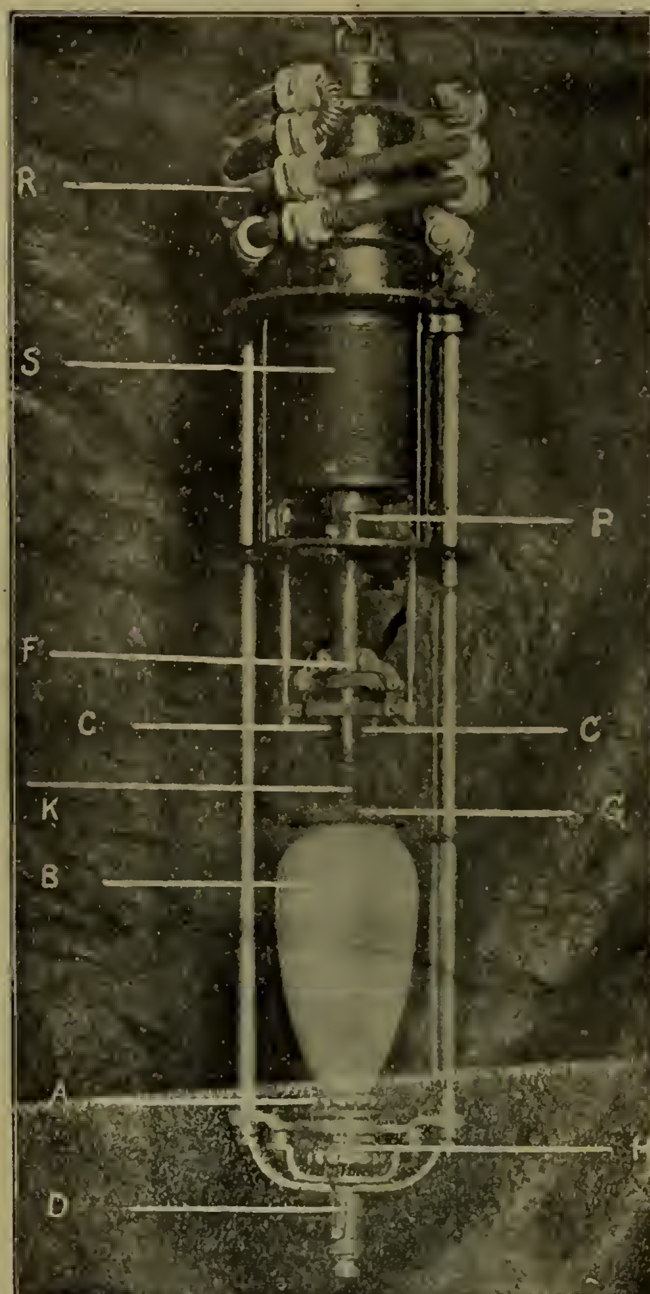


Fig. 1—Carbon Feed Lamp. Lamp is about 30 ins. long, whereas Lamp with Carbon Rods comes as high as 46 ins.

R. Extra Resistance.
S. Solemoid.
P. Plunger-with Dash-pot attachment.
F. Friction Coil.
CC. Contact Pieces of Clutch.
K†. Carbon.
GG. Gas Cap.
B. Inner Globe.
A. Inner Globe Holder.
H. Carbon Holder.
D. Holder for Outer Globe.

THE ENCLOSED ARC LAMP.

By W. H. Freedman, H. S. Burroughs and J. Rapaport.

Statistics show that the enclosed arc lamp is not only rapidly increasing in the point of numbers installed, but actually replacing, in many instances, the open arc lamp. The fact that one set of carbons will last from 75 to 150 hours, according to the make of the lamp, is in itself sufficient to explain the success and rapid introduction of this form of lamp. Feeling, however, that there were many facts and much data that could be presented in relation to the enclosed arc lamp, a large number of tests were carried on, the main results obtained being presented in the following paper.

Obtaining samples of the Manhattan, Helios, Bergmann, Imperial, Pioneer, Thomson 75-hour and Thomson 100-hour lamps, tests were made bearing upon the relation between length of arc and voltage across the arc, the regulaton, life of carbons, ratio of consumption of positive and negative carbons, and the distribution of light.

The method was adopted of assigning a number to each make of lamp, and using that instead of the name of the lamp in stating the results.

Mechanism of the Enclosed Arc Lamp.

All of the enelosed lamps now on the market work on the same general principles. They are placed singly across the ordinary incandescent lighting circuit, and are regulated to take, approximately, 80 volts across the arc, the rest of the potential being consumed in the regulating solenoid and extra resistance (shown in Fig. 1). There is a marked difference between all of these and the ordinary open arc. The standard current is five amperes, the arc being about five-sixteenths long, while the carbons burn nearly flat instend of taking the shape as in the open arc. This makes a change in the distribution of the light, compared with the open arc, which will be shown by curves later on. Fig. 2 shows the difference in appearance between the two styles of arc. The enclosed arc burns flat on the top or positive carbon, the lower or negative one becoming slightly convex. The arc itself does not remain in one spot, but wanders all around the flat ends. In the case of large carbons this is objectionable, as it causes rather heavy shadows to be cast, but, to a large extent, can be prevented by the use of proper globes. The experiment was tried of rounding the ends slightly. This arrangement did away with the shadows, but the carbons burned flat again in a very short time.

The current passes through the extra resistance, the solenoid and the carbons, in series. This series arrangement makes a very simple lamp, with very few parts, and working much steadier than the open-arc lamp. When no current is passing, the carbons touch; the moment the current is thrown on, the core is drawn up, carrying the carbon by a friction clutch. The negative carbon is fixed in a holder or socket, at the bottom of the lamp.

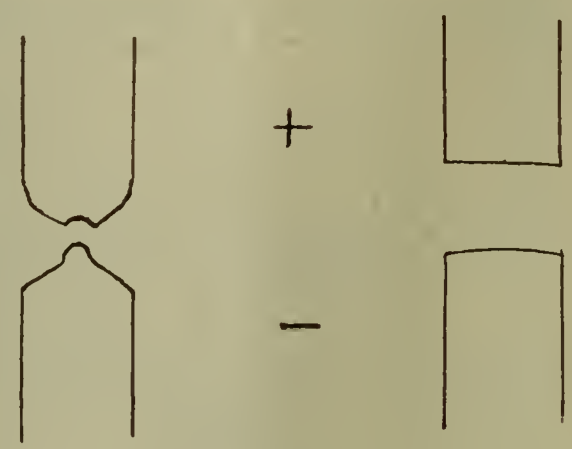


Fig. II.

rod are dropped when the device falls far enough to touch a stop that prevents the lower part of the clutch from coming down any further. A novel departure from this form of clutch consists of a cylindrical piece of brass, fitting around the rod, and having its upper end grooved to hold a row of steel balls. These are held in place by a conically-shaped cup. When the inner cylinder rests on the stop, the cup, which is attached to the plunger, falls enough to release the friction on the balls by reason of its sloping sides, and the carbon rod falls. When the core is drawn up, the cup follows, the balls being caught in the apex of the cup, and the rod is drawn up.

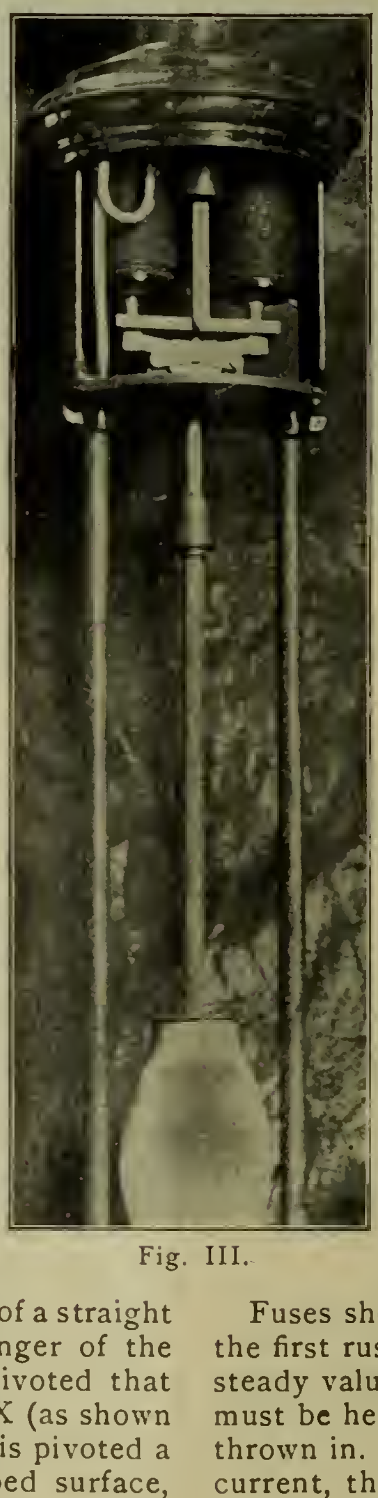


Fig. III.

The simplest form of friction clutch consists of a straight horizontal rod fastened to the end of the plunger of the solenoid, and having at each end an arm so pivoted that these two arms cross eaeh other like a letter X (as shown in Fig. 3). At each lower end of these arms is pivoted a friction piece, with either a rounded or V-shaped surface, that grasps the rod holding the upper carbon. Lifting the upper ends causes the lower ends to come nearer together, thus gripping the rod. The carbon and its

Fuses should be put in circuit with each lamp, and as the first rush of current is from 40 to 240 per cent. of the steady value, according to the make of the lamp, the fuse must be heavy enough not to blow when the lamp is first thrown in. In the case of lamps having a large flush of current, the lamp is not so well protected against an accidental heavy current, as the fuse must be of greater carrying capacity than in the case of lamps with a small flush of current, and may not blow until the lamp has been seriously overheated. One effect of high temperature around the working parts is to make the brass rod that carries the upper carbon stick, the surface losing its smoothness, so that in some cases it is necessary to take the rod out and polish it. This current is usually carried to the upper carbon by means of two brushes pressing on this rod. As the carbons wear away, the armature of the solenoid gradually descends, the current remaining practically constant whatever the position of the plunger, until it reaches the stop that releases the carbon from the friction clutch; the carbon then falls and strikes the lower one, but is immediately picked up again—the light sometimes. This process occurs, however, at comparatively long intervals as the core has a play of $\frac{3}{8}$ in. to $\frac{1}{2}$ in. before the stop is reached. The positive carbon wearing away at the rate of .05 of an inch, approximately, per hour, and the negative at half this rate; there will consequently be from 5 to 8 hours between the times of the resetting of the core to its top position. The open arc lamp feeds about 15 to 20 times as much, allowing a consumption of one inch per hour.

A good lamp should have the following points, the determination of which was one of the objects of our experimental work:

Long life for one set of carbons;

Simple and light, but strong mechanism;

Lamp must be short for use in low-ceiling rooms;

Must cast no shadows from the carbon points, and it must not be necessary to use very dense globes to obtain this result;

Smallest possible amount of deposit on the inner globe;

Smallest possible flush of current at start;

Lamp should pick up immediately when the carbons have fallen together;

Carbons should drop immediately at feed and if the arc should break;

Minimum hysteresis in the core and no friction of the moving parts sufficient to cause sticking;

Lamp should be so insulated that when the current is on, there is no uninsulated portion exposed;

The shell of the lamp should be readily removable so as to expose the working parts;

The outer globe should be easily removable and so fastened that, when hanging down it cannot be dropped or broken;

Old carbons and inner globe must be easily removable;

Both globes must admit of easy cleaning;

It should be easy to replace and centre the carbons;

The lower carbon holder and inner globe holder must be held firmly in place, and the arrangement for making the small bulb air-tight at the bottom should have no tendency to crack the glass or get it out of centre;

Regulating mechanism should give the smallest possible flickering of the light;

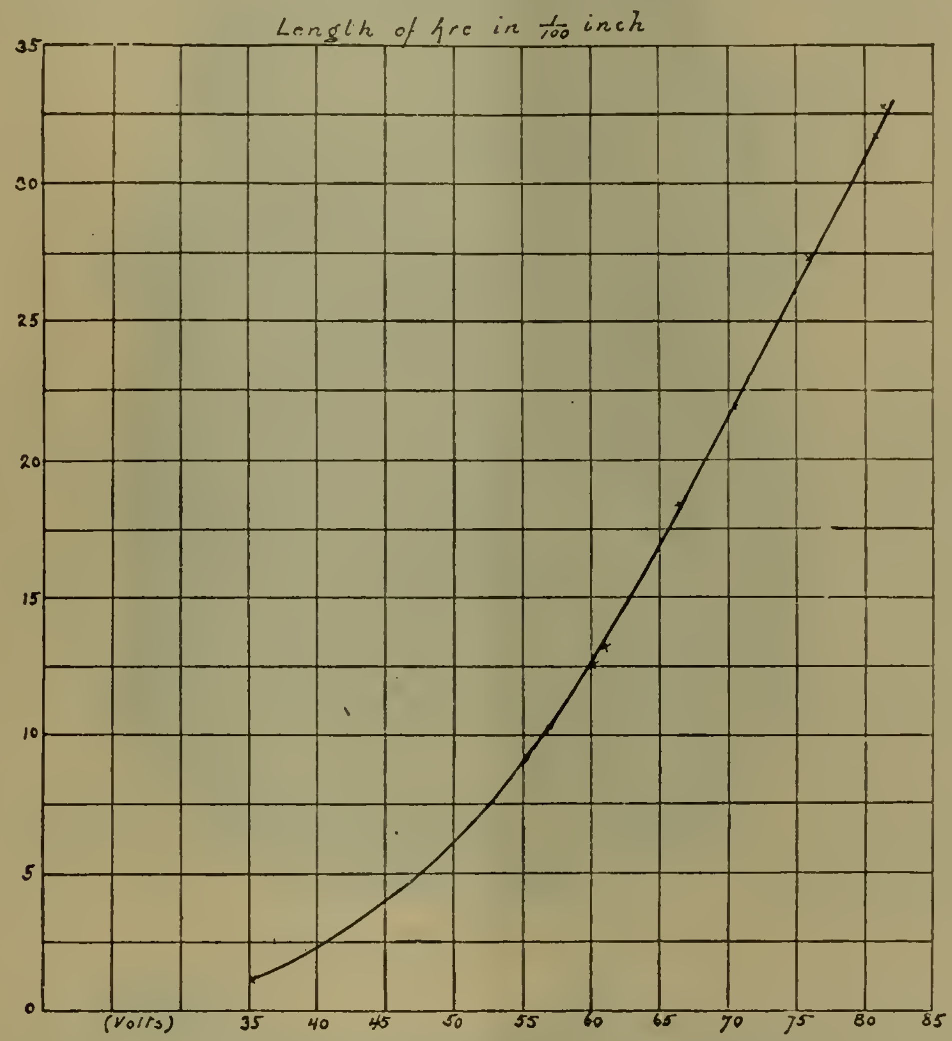


Fig. IV.

The dash-pot should be firm enough to resist sudden changes, but must not be so much so that it is slow in getting to its normal position.

Length of Arc.

In order to measure the length of the arc for different values of the voltage across it, the image was projected on a screen, on which the diameter of the carbon and the length of the arc were measured. The former being known, the true value of the length of the arc was determined by simple proportion. The results are given in Table I, and shown graphically in Fig. 4.

TABLE I.

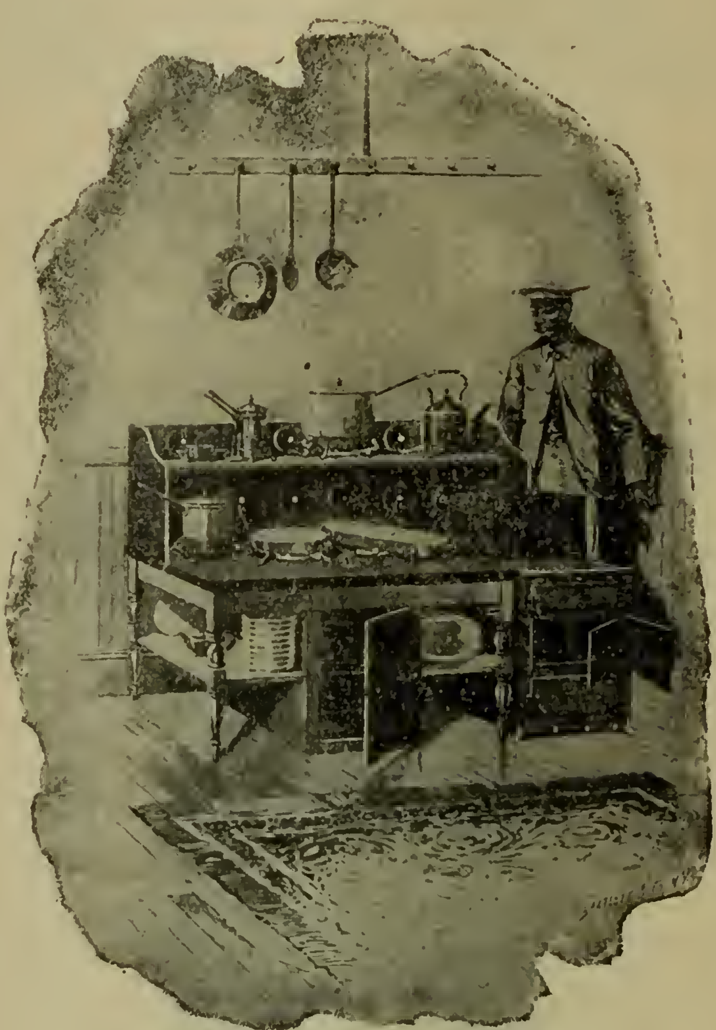
VOLTAGE ACROSS ARC.	LENGTH OF ARC.
83	.326″
82	.316
76.5	.271
71	.217
67.5	.184
62	.130
60	.125
35	.011

(To be continued.)

THE CHRISTMAS ISSUE of The Electrical Age will contain a stocking full of valuable articles.

THE COOKING STUDIO.

We cannot say that cooking has really become an art until it is disassociated from the conventional oven, the blazing fire and the sibilant gurgle of an eloquent saucepan. Cooking becomes an art then freed from much of the grossness that from time immemorial the kitchen has been famous for. It actually becomes an art when convenience and cleanliness so prevail that the artist and his canvas are viewed in a more reprehensible light than the modern chef with his electric kitchen. Many that recognize the convenience of an electrically equipped department of this kind most anxiously inquire into the cost of utensils and the price of current. We merely criticise such questions by stating that no one born and bred in a great city would ever be satisfied with the candle because it was cheaper than gas or because a gas range was so much more expensive than the coal stove. On many occasions the benefits derived from the use of a new thing are so apparent that the question of expense is never considered unless of so glaring a nature that the continued use of such an innovation would mean imminent bankruptcy. Special rates are going to be made by the Edison Electric Illuminating Company to users of electric heating and cooking apparatus in the same manner as a reduction for the benefit of consumers is made by the gas companies. The calories of heat produced by a current are the outcome of the most efficient method of producing caloric known to mankind. The high efficiency of electric appliances of this nature will continue to recommend them to consumers and certainly develop an enormous trade on account of the great cleanliness and unsurpassed convenience the use of electricity implies. In the illustrations a model electric kitchen and various cooking appliances are shown, including an electric sad-iron. The late morning riser merely turns the key and his coffee boils in a very few minutes. In fact, the present youth of epicurean tendencies could have a row of push-buttons arranged above his bed and prepare at will, by simple pressure, the smoking omelette, creamy chocolate and golden toast. The American Electric Corporation have completed for practical use every accessory to the kitchen a chef or housewife may desire. It is not necessary to state that in summer a system of this kind will satisfy the most critically inclined. We may truly say that the top notch of civilization has been reached when electric fans cool and ventilate our homes, electric light drive away the evening shadows and in a cabinet, for



ELECTRIC COOKING OUTFIT.

Electric Saucepan.

it is nothing less, our food is prepared in a manner that would surprise the very youngest of our ancestors. By corresponding with the American Electric Heating Corporation, Sears Building, Boston, Mass., further information of a more particular nature may be obtained.

HISTORICAL SKETCH OF THE FIRE ALARM TELEGRAPH.

(Continued.)

As in the original plan the apparatus furnished for the central office consisted of a cylinder transmitter or keyboard as it was called, very much improved; the keys were so arranged that simply depressing one of them would liberate the clockwork and start the cylinder, and upon releasing the pressure it would come to a stop in its normal position. In order to economize battery power, three metal springs were placed on the underside of the keys. Each spring was connected with one of the three alarm circuits and so arranged that, as the cylinder revolved, each metal strip on its surface would make connection with each spring successively, thus allowing the same battery to be thrown on each one of the three circuits in quick sucession.

For the Morse register to be used in connection with the alarm circuits to indicate the number of blows struck on the bells, an indicator was devised consisting of three revolving cylinders on which the numbers were exhibited in large plain figures.

On another instrument, not mentioned in the original plan but very useful and important, was an automatic circuit-testing clock which tested the circuits once every hour.

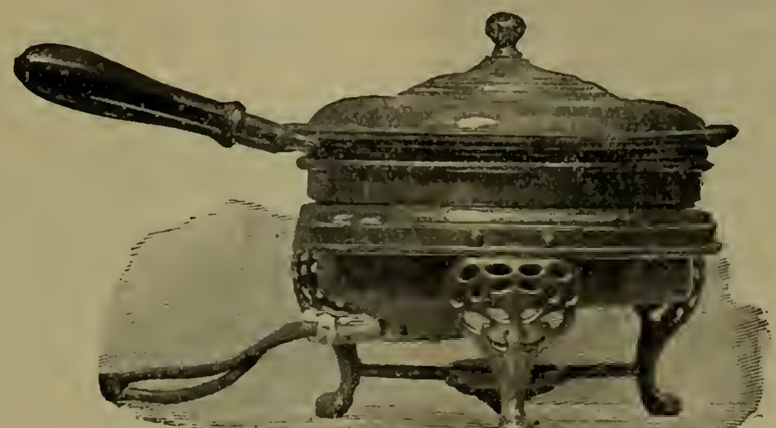
In the spring of 1852 the system was so far completed that it was deemed sufficiently reliable to submit it to public use. Nearly a year had passed since the work was begun. The time required, as well as the cost, far exceeded the original estimates. The $10,000 appropiated at the beginning was spent long before the work was completed, and a further appropriation amounting to nearly $6,000 was found to be necessary. This was caused partly by the extraordinary difficulties encountered, and partly by the extension and improvement of the system beyond the requirements of the original plan. Thus, instead of 26 signal stations, 39 were established.

April 28, 1852, was decided upon as the day on which the new method of giving alarms of fire should go into effect. That there was considerable misgiving concerning the reliability of the new system, and which, as the result showed, was not altogether groundless, the following extract from the printed directions issued before the telegraph went into use will abundantly show:

"Before giving an alarm be sure that a fire has occurred within your district; being reasonably certain of that, turn the crank within the box, say ten times, not too fast, and wait. If the signal is perfect, you now have registered at the central office the number of your district, as well as the number of your box. If the alarm is heard at the central office, the operator there will indicate the fact to you as soon as you have ceased, by striking the number of your district with the small magnet in your box, twice at least. Should you not hear this, turn the crank again, more slowly; should you not then hear the response, go to another box, and if equally unsuccessful there, carry the alarm yourself to the central office."

Electric Sad Iron.

That the latter injunction was not unnecessary is evinced by the entry in the Journal of the Central Office, on April 29, the day after the telegraph was given over to public use, this, "First Alarm, 8:25 P. M., from Station 7, District I, J. H. Goodale turns the crank like lightning, could not read; brought alarm to office." In this case the register failed on account of the great speed with which the signal was sent. During the striking of this alarm on the bells, four machines were disabled. For many months after the system went into operation, serious defects were continually developing, and a time of great anxiety for its projectors ensued. Farmer and his assistants, in ceaseless activity, spent day and night modifying, improving and adjusting apparatus. The alarm bells were a source of the greatest trouble and anxiety; their failure to strike correctly encouraged the opposition to the system to renewed effort in which, strange to say, the firemen were most prominent. But gradually, by unremitting exertion, difficulty after difficulty was overcome, and by the end of the year a reasonable amount of confidence was felt in the reliability of their performance. Another cause of anxiety, especially to the operators at the central office, was the irregular manner in which the crank was often turned, giving an alarm from the signal boxes; some persons laboring under intense excitement would whirl it around with a speed that fairly defied the register to print the signal; others mindful of the instructions to turn slowly, would turn the crank with such exaggerated deliberation that it required a long investigation on part of the operator, which was not always successful, to distinguish dots from the dashes. On January 1, 1852, in view of the early completion of the work, and in order to retain his services for the first few months



Electric Chafing Dish.

of its practical operation, the Board of Aldermen had elected Farmer, superintendent of the new system for a term of six months. It was generally conceded that no one else could make it a practical success. The friends of Farmer, who urged him to accept the position, deemed it of the utmost importance that the experiment should be made a success from the beginning, as a failure at that time in Boston would be fatal to its introduction into other cities. Farmer accepted the position, but instead of six months, three years passed before he considered the system in such a condition that he might safely place its management into other hands.

(To be Continued.)

GAS AND STREET-RAILWAY SECURITIES.

Traction securities this week continue dull, and but few changes in quotations are recorded. The various Brooklyn railroad securities continue firm and Brooklyn City Railroad is in good demand, in spite of the injunction restraining the company from completing the work on the Bridge loop. It is estimated that about 200,000 passengers would use the cars daily going to and from New York. Under present conditions the ride costs them 15 cents each for the round trip, which would be reduced to 10 cen cents when the work is completed, a saving of about $10,000 a day, or $300,000 a month. It was hoped that the injunction would be dissolved and the cars in operation by January 1. The purchase of the Sea Beach Railroad by the Brooklyn Rapid Transit Company would enable the latter to reach Coney Island. This company reported gross earnings for November amounting to $433,703, against $421,460 for the same month last year, a gain of $12,243, while for the five months ending with November the receipts amounted to $2,354,623, an increase of $50,220.

The heavy falling off in the New Orleans Traction earnings is attributed to the yellow fever epidemic, during which receipts were reduced from $600 to $800 a day. The October statement showed net earnings amounting to $22,101, against $45,519 last year. During November, however, the reports showed an improvement. The first twenty-three days of that month the company took in $67,330, or only $10,483 less than for the same period last year. The securities were dull and weak. The Buffalo Railway Directors declared the usual quarterly dividend of one per cent. payable on December 15. The bonds of the company are in good demand, but the stock is somewhat heavier.

$50,000,000 WIRE TRUST.

A local newspaper prints today what purports to be the details of the proposed wire trust. The facts are gathered, it is asserted, from an authoritative source, and are vouched for by parties interested in the deal. The combination will have a capital of $50,000,000, and is backed by J. Pierpont Morgan and other New York capitalists. It will take in every wire, wire rod, and wire-nail plant in the United States, two blast furnaces, one of which has its own ore supply, and three steel plants.

The proposition is to buy outright every plant which is in any way interested in the manufacture of wire in any shape, paying two-thirds of the purchase price in cash and the other third in stock of the new company. Appraisers are now at work fixing the value of the different plants which are to be bought up, and they are expected to get through with their work by February, when the consolidation of the interests will probably be finally effected.

On November 30, Judge Grosscup, in the United States Circuit at Chicago, issued an injunction in favor of the American Graphophone Company, restraining David E. Boswell from making, using or selling any sound record or recording tablets. A year ago Boswell was president of the National Ediphone Company, and it was alleged in a suit brought then that the ediphone was an infringement on the patents under which the graphophones were made. The court at that time issued a permanent injunction restraining Boswell from continuing the manufacture of the ediphone, but soon after, it is alleged, the company learned that Boswell was engaged in the manufacture of cones, or records, at the rate of 6,000 a day. Another bill for an injunction was filed on the ground that Boswell's records were also an infringement of patents.

The defendant assumed to attack the novelty of the sound record on the Edison tinfoil record and on the general ground that there had been no adjudication of the American Graphophone Company's claims. Whereupon Judge Grosscup took the matter up and gave a lecture on what constituted patentable invention, and said that if the sound record was not a patentable invention there never was one; that he had carefully considered this same matter on a previous occasion and reached the conclusion that the American Graphophone Company was the first to produce any sort of a record that was practical, or available for any use, and was the more impressed with the merit of the invention because "a hundred others" had tried to do the same thing and failed. He announced that he was of the same opinion still.

$250 FOR A METEORITE.

A. O. Elling of Ness County recently received a check from George L. English & Co., mineralogists, of New York, in payment for a meteorite which fell in Ness County, Kan., in 1894, and was picked up on the prairie the day after a terriffic hail storm. It weighs twenty pounds, is rectangular in shape and measures nine inches in length, six inches in width, and is about five inches thick.

THE GRAPHOPHONE IN POLITICS.

Graphophones are to be used by Kansas Republicans in their next campaign. The Sedgwick County Republican Central Committee has adopted by unanimous vote a suggestion offered by ex-County Attorney John Davis to raise $400 by assessment for the purchase of fifteen graphophones with records of the testimony of ex-Gov. Lewelling and Senator Titus of Harper County before the legislative investigating committee at Topeka last winter. The present plan is to rent halls at Cheney, Mount Hope, Colwich Maize, Valley Centre, Goddard and other places and keep the rooms open for several weeks before election day.

STATEN ISLAND TROLLEY ROADS.

A report is current on Staten Island that the Staten Island Electric road and the Staten Island Midland road, which have been fighting each other for three years, have buried the hatchet and are negotiating for a combination of the interests of both. It was said that the lines are to be reorganized under one head, of which Col. George B. M. Harvey is to be president and W. B. Rockwell the general manager. The officials of neither company would give any information about the rumored deal, but persons who are identified with one of the companies said that negotiations were pending.

It is understood that should the combination be made, the line to Tottenville will be rushed through, together with other branches into the interior which are now in abeyance. The two companies have spent thousands of dollars fighting each other.

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CONTENTS.

THE LOCOMOTIVE OF THE FUTURE.

The fact seems to be generally recognized that no one can obtain a franchise for an ærial track, and that when the day arrives for man to invade the higher regions of the air, great changes will result, not only in the circles of commerce but in the political, social and daily order of things. A few facts are recorded which will certainly be of interest to a man of modern ideas and progressive tendencies. In 1896 some experiments were made to find out what the problem of equilibrium consisted of and to determine the power required to support an ærostat in the air.

As regards the first, the conclusion was reached that a man moving by the aid of an ærostat would never be in a stable position unless he moved forward at a slightly descending angle or with the planes that support him pointing downward. The flight in such a case is of a gliding order, but is conducted with perfect safety to the passenger.

As regards the second problem, it was found that about 1.13 to 1.43 horse-power was required to sustain 178 pounds in the air, when a slight wind was blowing. With the air perfectly calm, two horse-power was required, showing that 100 pounds can be supported by a trifle more than one horse-power. The practical conclusions reached were that an electric motor, steam-engine or gas-engine of five horse-power would be required to move a man through the air in a horizontal flight. At present we may well understand that the greatest experiment ever performed was due to the efforts of Mr. Hiram Maxim, the great gun-maker. His general conclusion was briefly stated—ærial navigation is possible, but at the risk of one's neck, and, judging from the silence since his last experiment, we may infer that he has abandoned the idea of establishing a rapid transit overhead system in every sense of the word.

ELECTRIC LIGHTHOUSES IN JAPAN.

The coast of Japan is in many respects like the coast of Great Britain. In certain parts rocky and dangerous; in other parts full of shoals, a constant menace to passing ships. The Japanese Government being very much interested in the safety of vessels sailing in the proximity of their shores, recently corresponded with Messrs. Sautter, Harle & Company, of Paris, to find out whether they could successfully equip and erect a series of lighthouses along the coast, particularly one in the Island of Formosa.

The Japanese received a favorable reply and showed in their correspondence with the above concern that they were well acquainted with modern humanitarian methods of protecting vessels at sea from shipwreck on the coast. The so-called Feux-Eclairs system has been adopted by those commissioned with this particular field of work. The above system has been tried by the French lighthouse administration, the director-general of which is M. Bourdelles, and strange to say seems to be preferred to electricity or one involving its use. The Feux-Eclairs is one in which the lightning flash is employed and on account of the cheapness of construction and general reliability will for many years allow the idea to remain predominant in the minds of the Japanese authorities that the electric system is not the best for this purpose. The towers used as lighthouses are made of bamboo and though fragile in appearance are of considerable strength and elasticity, and perfectly able to stand the wild storms that rage with such fury on certain parts of the Japanese coast. Flashes are sent out to sea that last one-tenth of a second, and as the apparatus producing the light revolves during each revolution, three beams of light are sent forth on their errand of mercy.

Petroleum is used for fuel for the lamps and its flashing point is 35° Cent., about three pounds of which is used per hour in a lamp having a six-wick burner and producing a light equal to five hundred candle-power. The Formosa lighthouse has been tested, and with oil the light is found to be equal to that of one hundred and fifty-four thousand candles, the flash reaching seventy miles in clear, thirty-two miles in fair, and fourteen miles in hazy weather.

The cost of the Formosa lighthouse, including the revolving apparatus, reflectors and other accessories, was about $8,000 and from the standpoint of efficiency and cost it was impossible for the Japanese commission on lighthouses to have done better. The keen insight which led the gentlemen forming that commission to adopt the lightning flash system, indicates the up-to-date nature of their training. In all probability, the flash system will be universally adopted on the coast of every civilized country in the world.

Were it not for the difficulty and expense of erecting a plant the Japanese would probably have turned to electricity instead of petroleum, but in view of the fact that frequently lighthouses are erected at inaccessible points, remote from even the poorest class of villages, the Japanese have done well in adopting the above system. The French coast, however, is dotted at night by what appears to be winking lights to an observer on a distant vessel, but which upon closer approach turn out to be powerful streams of dazzling light, proceeding from lighthouse towers equipped by the firm of Sautter, Harle & Company; some of these beams having an intensity equal to that of 25 to 40,000,000 candle-power, produced of course from gigantic arc lamps. When the Japanese have advanced sufficiently to cover their island, wherever it is thickly settled, with a network of the Edison Electric Illuminating Company's mains, the petroleum flash light will undoubtedly be replaced by the more scientific, more modern and better operating electric search light.

GALVANOMETERS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

An instrument originally intended for the detection of currents was the basis from which sprang the subsequent types of galvanometers. The mere detection of a current did not give the galvanometer any important position in the world of science, but when its function as a means of measuring amperes, volts and ohms became evident the various styles of meters appeared and the laboratories considered their use indispensable.

A galvanometer consists essentially of a coil of wire and a magnet arranged in such a manner that the passage of a current in the coil moves either one or the other according to its adjustment.

The galvanometer may therefore be an instrument in which the coil is rigid and the magnetized needle free to move, or the needle fixed, in which case it would have to be very large and the coil movable.

An artificial magnetic field.—It is usual to supply galvanometers having one needle with an artificial magnetic field, that is, have an arched magnet capable of side and up and down adjustment placed over the galvanometer, for the purpose of neutralizing the magnetic field of the earth, which would tend to drag upon the needle at times and destroy its sensitiveness.

To understand the use of this curved magnet, imagine a magnetized bar suspended by a cord in the air. The earth would tend to set it pointing north and south. This is due to the magnetic field of the earth. If this field is neutralized the bar will remain indifferently suspended, taking no particular position. A weaker force will then move it than before, so that if a small needle be considered that is being similarly treated, as in a galvanometer, it will take but a weak current to deflect it from its position. The arched magnet acts as a directive force if the galvanometer is "astatic."

The deflection of the needle is due to the effect of the magnetic field (produced by the coil when current flows through it) upon the needle.

The more intense this field, the greater the twist or deflection of the needle. For the sake of convenience, heavy currents are measured in galvanometers of few turns but large sized wire, and weak currents in galvanometers of many turns and fine sized wire.

The classification resulting is therefore—

Low resistance galvanometers,
High resistance galvanometers;

or, as they are sometimes called,

Short coil and
Long coil galvanometers.

It makes but little difference whether a heavy current of low pressure or a weak current of high pressure affects the needle, certain facts are common in either case.

(1.) The delicacy of the galvanometer is dependent upon the method of suspension.

(2.) Upon the strength of the coil.

(3.) Upon its object.

As a rule the galvanometer in practice, either in laboratory or regular outdoor service, is made "astatic."

Astatic needles are merely two magnetized needles of equal strength placed upon a rigid bar, with opposite poles pointing in the same direction. One needle swings inside the coil, the other outside in unison with the first, because of its permanent connection with it. A galvanometer may have as many pairs of needles as it has coils, or it may have one in each coil.

The two needles, being of equal strength, practically neutralize each other. The earth does not exert any directive influence over them any more than if they were of neutral metal.

The arched magnet may supply an artificial field of greater or less strength as desired, by bringing it closer or further away from the coil.

A galvanometer constant is of consequence in determining the delicacy of the instrument.

As a rule mirror reflecting galvanometers are in use for testing. They were invented by Lord Kelvin, of England, for receiving signals over the Atlantic cable—a small coil, within which swings a bit of magnetized watch-spring stuck to the back of a concave mirror about three-eighths of an inch in diameter. A beam of light strikes the mirror from a slit in a scale placed about three feet away. When the needle is at rest, the mirror reflects the spot of light on the middle of the scale. The least change in the coil makes the needle swing either to one side or the other. By this arrangement a pointer is dispensed with, the beam of light being its substitute.

In a mirror galvanometer the current and the deflection increase or decrease together in uniform proportion.

The constant, or figure of merit, of a galvanometer, is the amount of current required to produce a deflection of one division on the scale.

It is found by connecting an adjustable resistance coil and a battery in series with the galvanometer. The resistance must be added to until the spot of light marks one division. By appying Ohm's law the current flowing is easily found.

If volts of battery = 1,
Total ohms in circuit = 10,000,

the current flowing, therefore, = $\frac{1}{10000}$ = .0001 of an ampere. When one is divided by 10,000, Ohm's law is applied

$$\text{Current} = \frac{\text{volts}}{\text{ohms}} = \frac{1}{10{,}000.}$$

One division deflection is due to .0001 of an ampere, which is the figure of merit or constant.

A heavy current in a sensitive galvanometer would throw the spot of light off the scale.

An arrangement is used which divides the current up, so that only part enters the galvanometer; the rest passes away in what is called a "shunt."

A shunt takes only a certain amount of the current, as its construction calls for

$\frac{9}{10}$ of the current,
$\frac{99}{100}$ of the current,
$\frac{999}{1000}$ of the current.

This is done by making the shunts of a resistance equal to $\frac{1}{9}$, $\frac{1}{99}$ and $\frac{1}{999}$ of the resistance of the galvanometer coil.

The galvanometer and shunt then take an amount of current that can be determined by Ohm's law. For instance, if a

Galvanometer has 1 ohm resistance,
Shunt $\frac{1}{9}$ of an ohm,

with a one-volt battery,

$$\text{the galvanometer would take } \frac{1 \text{ volt}}{1 \text{ ohm}} = 1 \text{ ampere;}$$

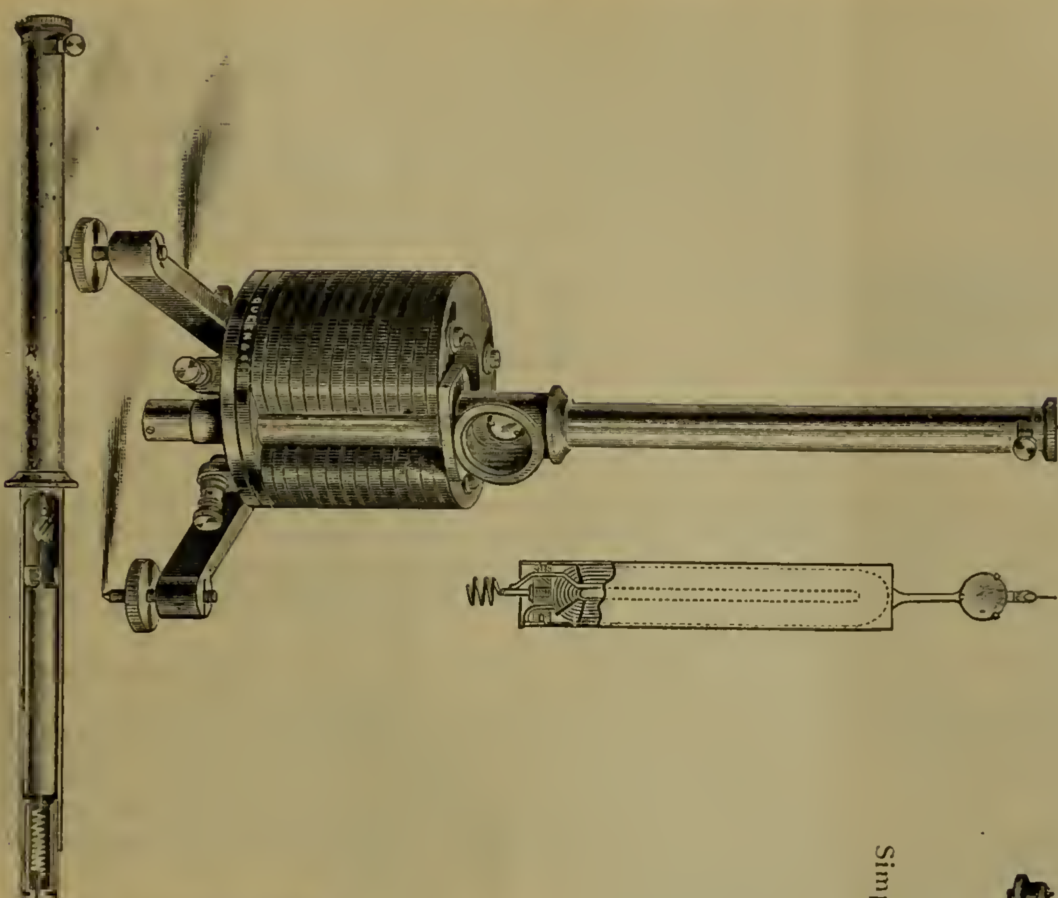
$$\text{the shunt would take } \frac{1 \text{ volt}}{\frac{1}{9} \text{ ohm}} = 9 \text{ amperes}$$

Total, 10 amperes.

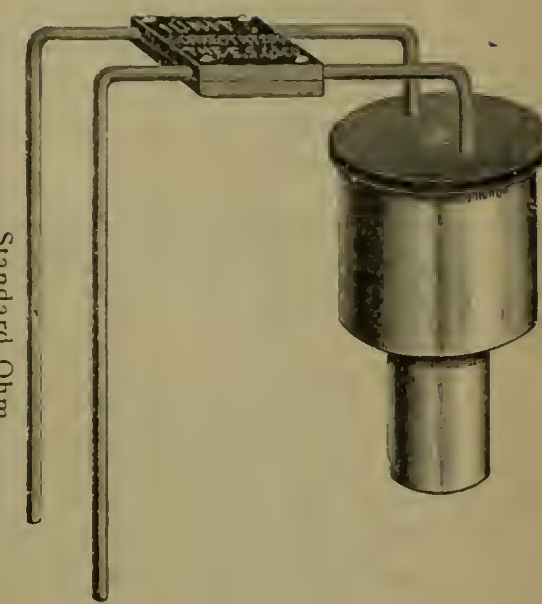
Out of a total of 10 amperes the galvanometer takes 1 and the shunt 9; therefore the shunt, having $\frac{1}{9}$ the resistance of the galvanometer to which it is connected, takes $\frac{9}{10}$ of the current.

Galvanometers serving various purposes are named as follows:

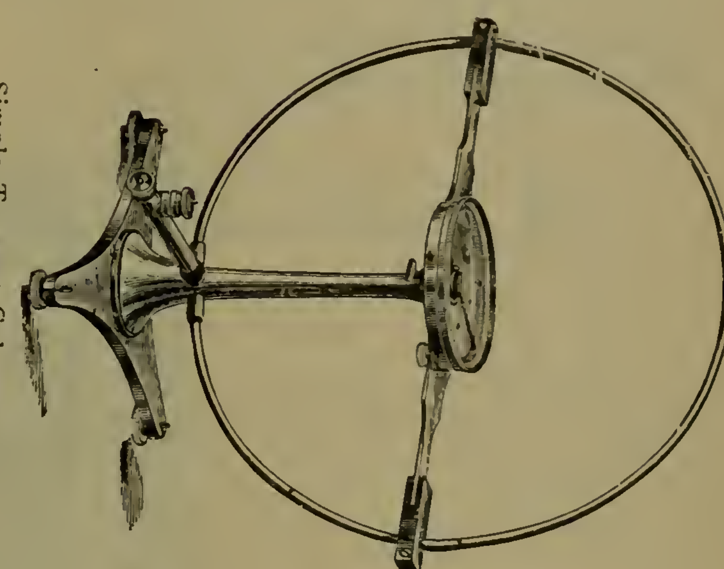
Tangent galvanometers,



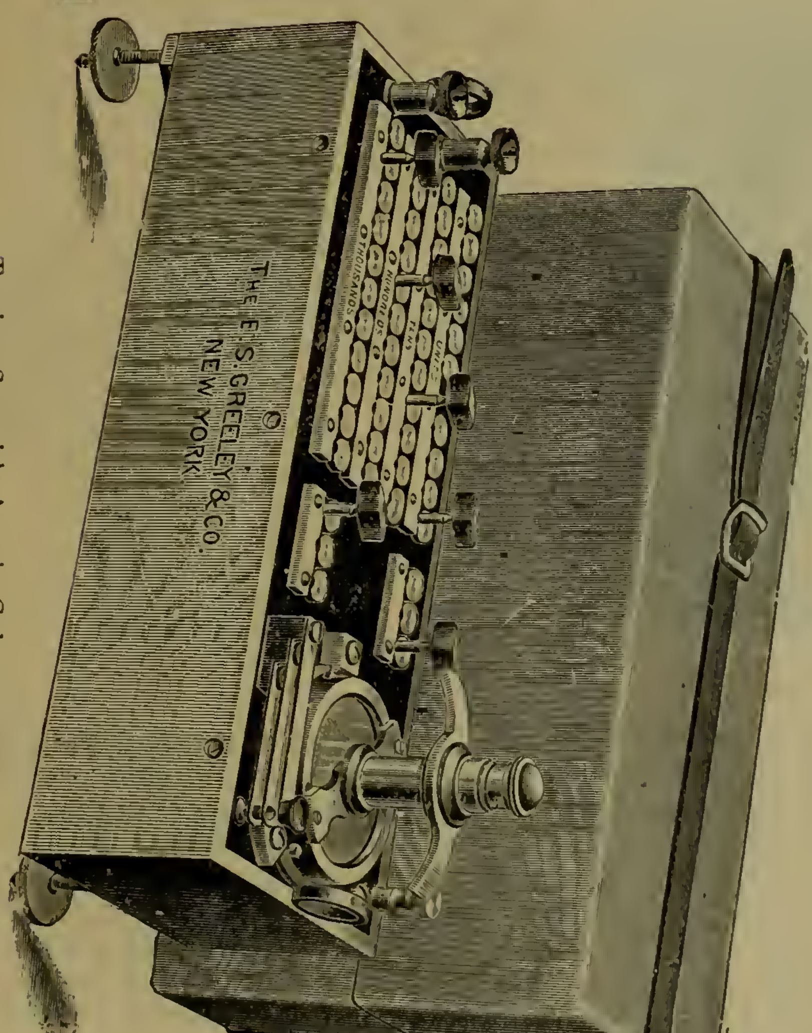
Ballistic Galvanometer.



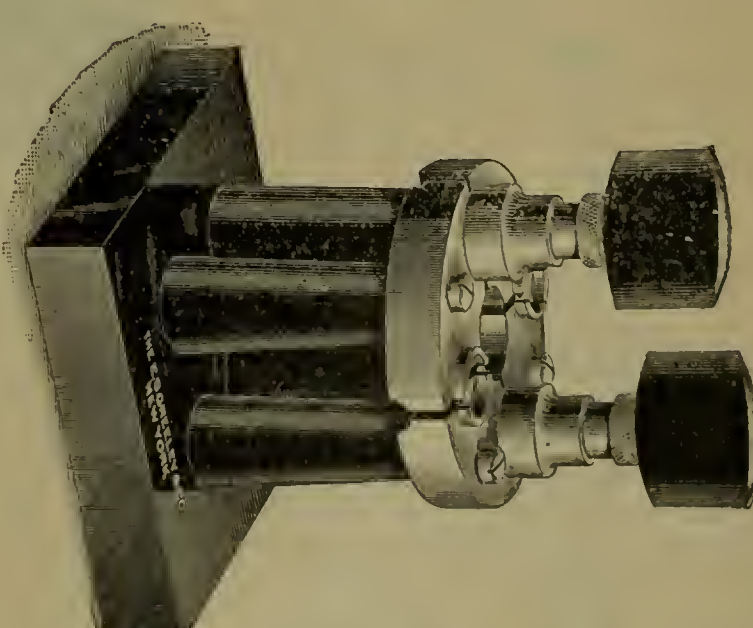
Standard Ohm.



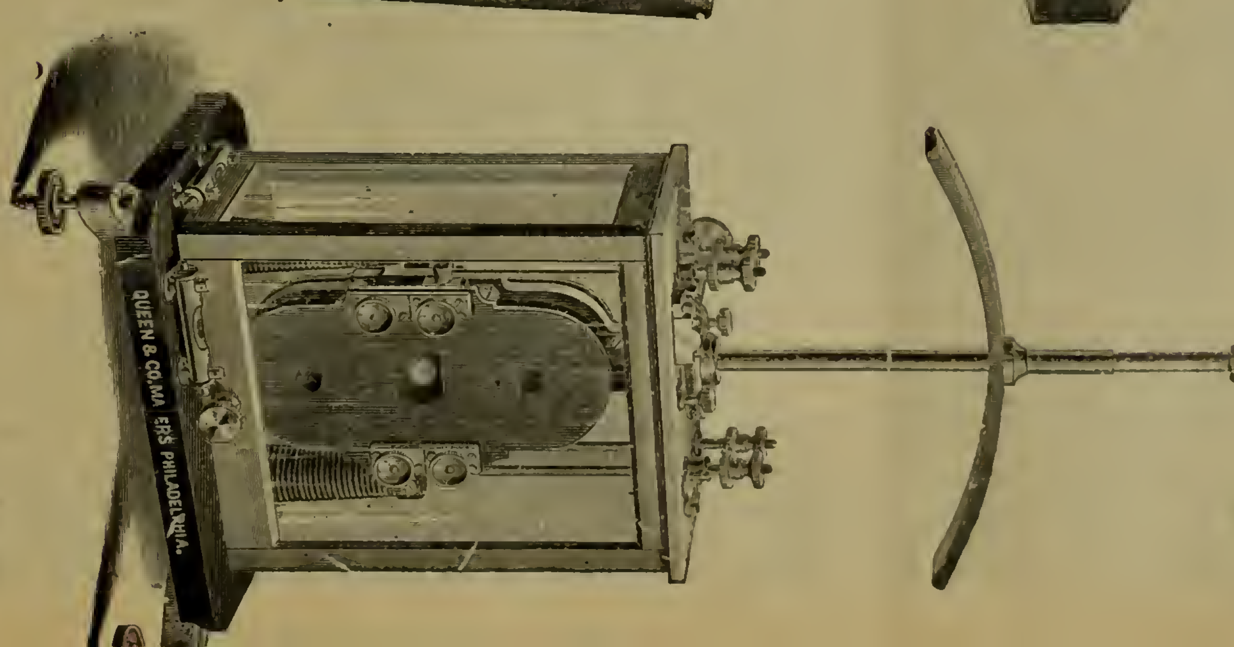
Simple Tangent Galvanometer.



Testing Set with Astatic Galvanometer.



Double Plug Galvanometer Key.



Double Coil Astatic Galvanometer.

D'Arsonval Galvanometer.

Sine galvanometers,
Astatic galvanometers,
D'Arsonval galvanometers,
Ballistic galvanometers.

The Weston instruments are patterned after the D'Arsonval galvanometer.

The detection and measurement of the current and pressure lie within the field of the galvanometer. For the measurement of resistance another department is required, vast in its extent and of the greatest importance.

QUESTIONS FOR REVIEW.

(1.) What was the original object of the galvanometer?
(2.) Describe a galvanometer in detail.
(3.) Of what use is an artificial magnetic field?
(4.) What kinds of galvanometers are there?
(5.) What is an astatic galvanometer?
(6.) (*a.*) Who invented the reflecting galvanometer? (*b.*) What is a mirror reflecting galvanometer?
(7.) Explain the use of a shunt.
(8.) Name the general makes of galvanometers.

DRINKS CHARGED TO "TELEPHONE."

A somewhat peculiar feature of itemising in the accounts of certain Custom House employees was testified to before Commissioner Shields yesterday afternoon by Edward T. McDonald, who up to last October had been in Government employ four years as a customs inspector. McDonald is accused by William H. Theobold, a special employee of the Treasury Department, of having presented to the Collector of the Port of New York a false claim for expenses. Among the items was "$3.80 for telephone charges." This money, it is alleged, was chiefly spent for drinks. Another item of $42 for remuneration of an outside detective is, it is charged, fraudulent.

McDonald admits that some of the expenditure charged to telephone account was for drinks and cigars, but asserts that the $42 was paid to a detective named Max Wolff for services rendered in shadowing men at the Bremen line docks in Hoboken.

Before the Commissioner McDonald testified that he had been authorized to employ such assistants when necessary by the late Collector Kilbreth, who further stated that it was often necessary, in the discharge of his duties, to spend money for drinks and cigars. The Custom House auditor, however, would not recognize claims for such expenditure, and, Mr. McDonald said, Collector Kilbreth had told him that when he was obliged to spend money for drinks or cigars to charge it to the account of "meals." "Such charges are common in the customs business," Mr. McDonald said.

At the conclusion of his testimony the hearing was adjourned, at the request of Charles A. Hess, his counsel, until next Saturday, to afford time for him to produce other witnesses for the defense. McDonald is under bail.

FRANK R. CHINNOCK.

We take pleasure in announcing that Mr. F. R. Chinnock, who for ten years represented the old "Edison" Manufacturing Co., and the General Electric Co., covering New York State and New Jersey, having headquarters in Buffalo, has been appointed manager and sole agent for the East of the Triumph Electric Company of Cincinnati, Ohio.

Mr. Chinnock, has been connected with some very large electrical installations, among some of which may be mentioned, The Flatbush Electric Light Plant, The Troy & Lansingburgh St. Electric Railway Co., The Watertown St. R. R., The Buffalo Electric R. R. Co., of Brooklyn, and many large illuminating companies throughout the State, and has been actively engaged in contract work on his own account for the past two or three years, such as erecting electric-light plants for the Bergen Turnpike Co., a road running from Union Hill to Hackensack, N. J.

Frank R. Chinnock.

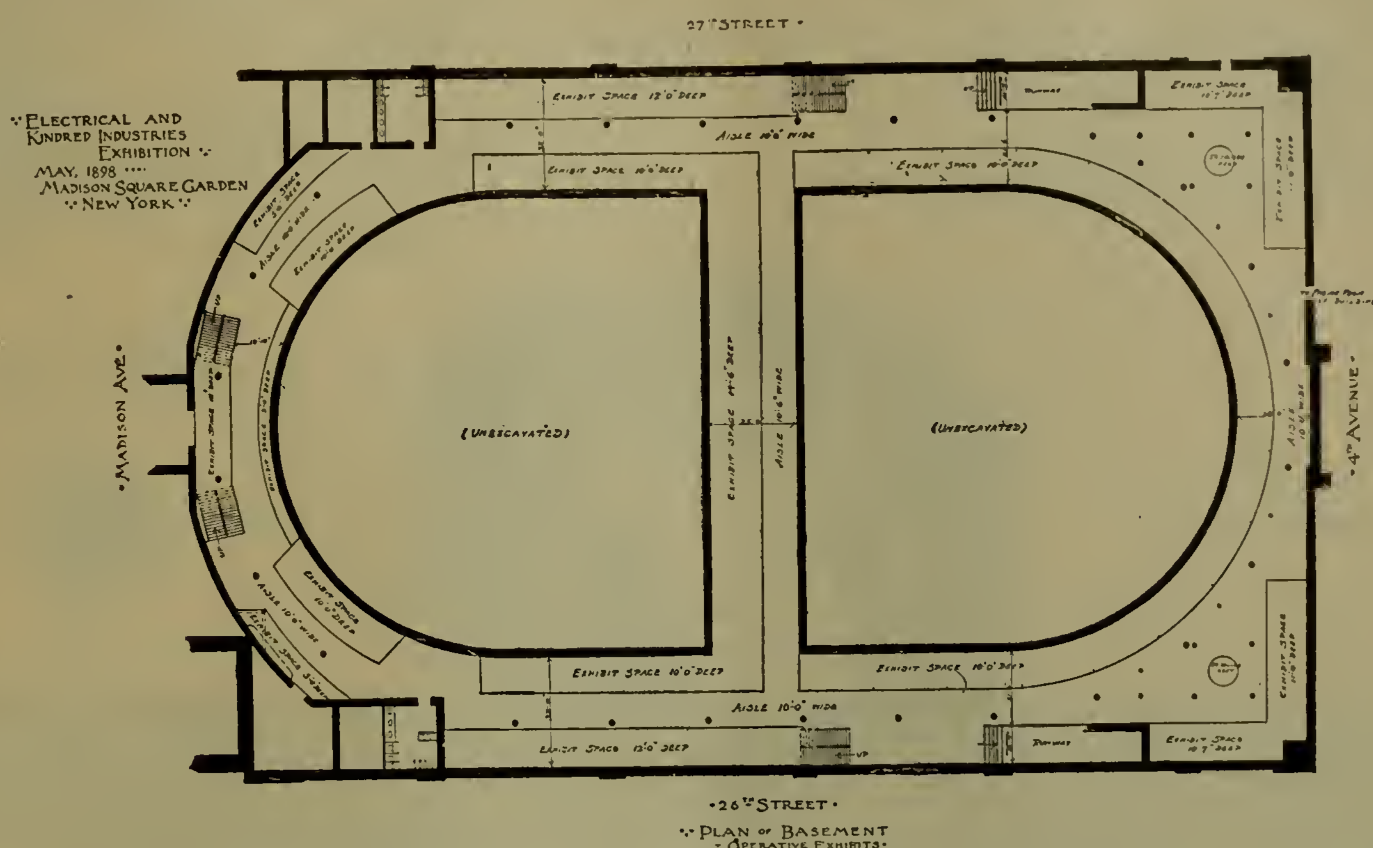
Mr. Chinnock has engaged the services of Mr. John Milne, who for the past three years represented The Hazelton Boiler. He has secured a number of important contracts within the past two weeks for The Triumph Electric Co., among which may be mentioned the "Renwick" Building and the Port Jervis Electric R. R. Co.

The business ability of Mr. Chinnock is of so pronounced a nature that we cannot but congratulate the Triumph Electric Co. on securing the services of so able and successful a man.

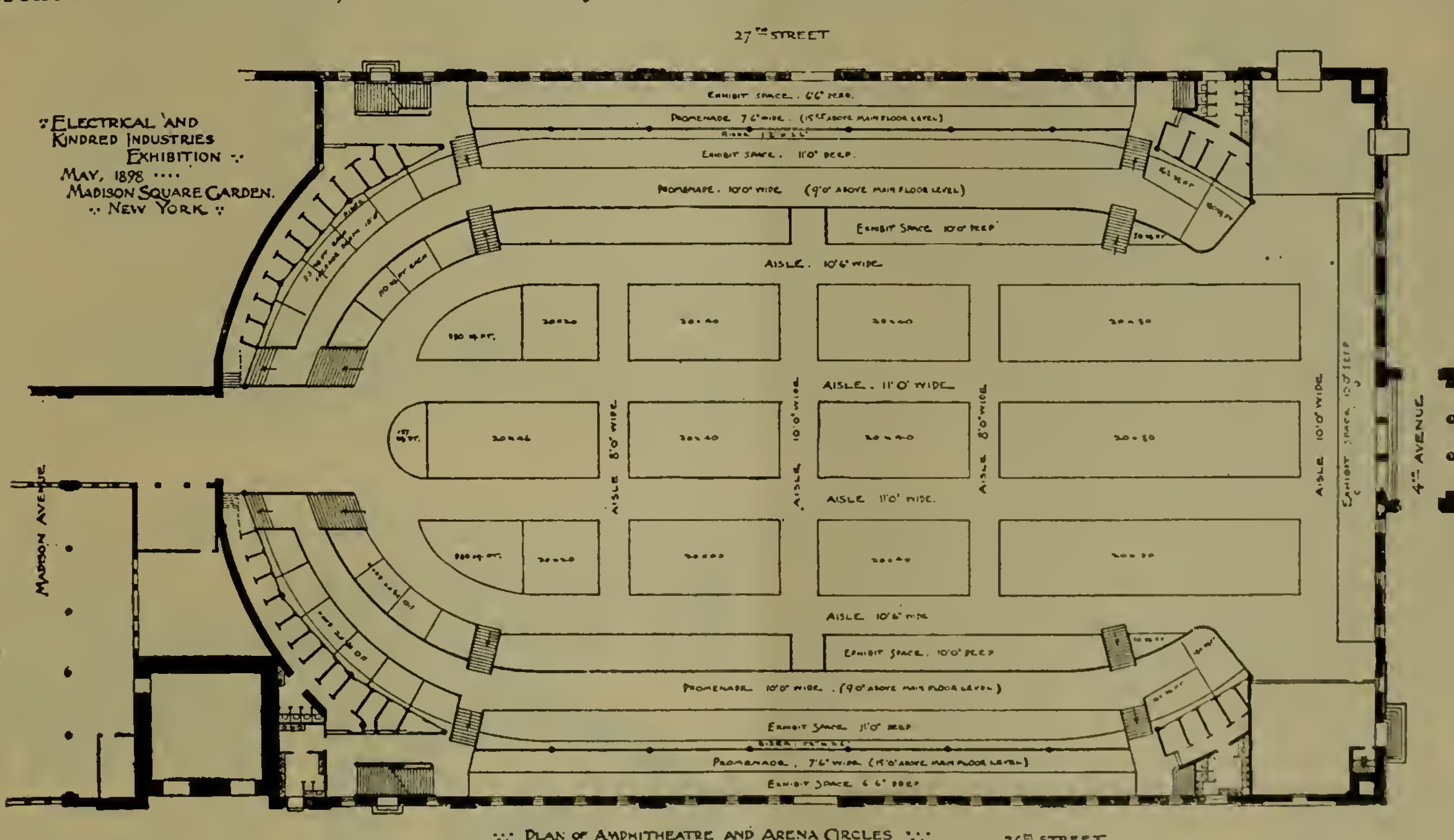
He has opened offices in the Taylor Building, No. 39 Cortlandt street, where he will be pleased to confer with his many friends in the electrical field.

MR. W. J. CLARKE AND WIRELESS TELEGRAPHY.

The great popularity and magnificent future of the Marconi system of wireless telegraphy among the scientific and general public has led Mr. W. J. Clarke, a popular lecturer on electricity, to construct and exhibit a system of this kind, at the residence of Mr. Jacob Schiff, on Thanksgiving Eve. Mr. Clarke, using a special appliance constructed for him by J. H. Bunnell & Company, in connection with the radiator, another part of the Marconi outfit, sent signals through a group of twenty-four guests without them being aware of any other feelings than those naturally suggested by the successful termination of a memorable banquet. The audience were astounded at the marvel and mystery of the performance and realized that they had witnessed an exhibition noteworthy in the annals of science. Mr. Clarke received many congratulations on the success of his experiment. There were present Prof. Morris Loeb, of the University of New York, Mr. T. C. Martin, of The Electrical Engineer, and several other gentlemen of prominence. For those desiring further information, correspondence may be addressed to Mr. W. J. Clarke, 120 Liberty street, New York.



Plan of Madison Square Garden, Electrical Exhibition Company.



Electrical Exhibition Company.

The early selling of space in the next Electrical Show to be held in Madison Square Garden, in May, is a good sign and a fair warning. Contracts are already in for more than one-third of the total space sold in 1896. There is always a rush just before the opening of such an exhibition, aud the laggards are the losers. This early increase in demand for space is much larger even than the increase of space, and of course the four walls of the Garden put an unyielding limit to the supply.

Nobody doubts that the second Electrical Exhibition to be held in Madison Square Garden, next May, will be a long step ahead of the one in 1896. In the operative section, it is reasonably sure that there will be not less than three batteries of boilers as against one in the last show. The dynamo and engine exhibit will also be multiplied at about the same ratio.

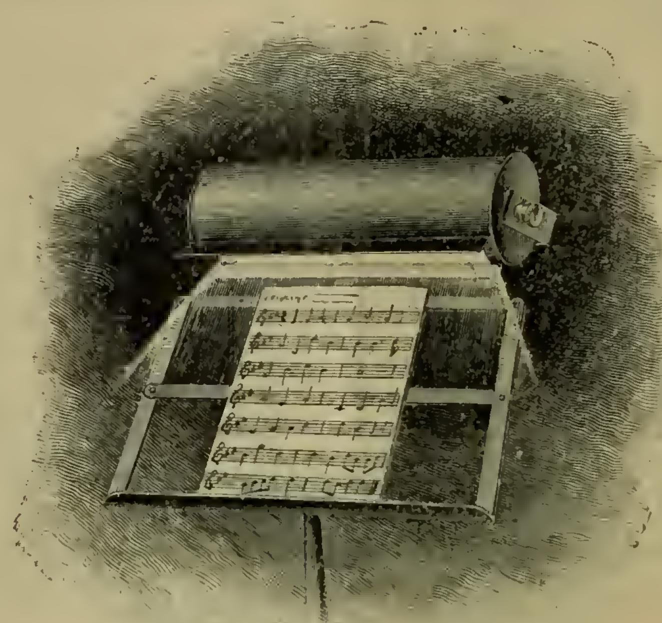
REMOVAL OF THE SPRAGUE AND THE INTERIOR CONDUIT COMPANY.

The removal of the above concerns, the consolidation of which has been noted in previous issues of our paper, has been to the Commercial Cable Building, No. 20–22

Broad St., New York City. They occupy a very fine suite of offices on the fifteenth floor, including in all about sixteen large rooms. The day on which the company opened business a contract was closed with the Union Terminal Depot, Boston, Mass., for nineteen Sprague electric elevators. The new concern, the Sprague Electric Company, will conduct their business on a broader and better basis than before. Those desiring to correspond for the purpose of obtaining information relative to interior conduit and "Lundell" improved motors, must write to the Interior Conduit & Insulation Company, of the above address, and those wanting Sprague elevators must write the Sprague Electric Company, at the same quarters. Circulars, catalogues, diagrams, etc., for public distribution will soon be ready and give a full description of the apparatus and special machinery sold by this newest and most enterprising corporation.

The well-known scientist and lecturer before the Lowell Institute, Boston, Mr. George H. Darwin, is the author of a theory of the origin of the moon, also its separation from the earth and the present state of the earth-moon system, which has attracted much attention. According to this theory, the heat generated by internal tidal friction may account in part for the increase in the earth's underground temperature. Concerning this matter of tidal friction, Mr. Darwin's opinion as set forth is alike learned and ingenious, namely, that after the speed of the moon's journey around the earth has finally become the very same as that of the earth's rotation—which now takes place in twenty-four hours—solar tidal friction will further reduce the earth's velocity about its own centre—the tidal reaction on the moon will be reversed, the swiftness of the moon's orbital journey will increase, and her distance from the earth will diminish. Before this reversal, however, the moon must have retired to an enormous distance, and the earth's rotation be so slackened that the day will be forty of our days—tidal friction will thus decrease planetary rotation, increase the distance of satellites and diminish the orbital, angular velocity.

McLEOD, WARD & CO., 27 Thames St., New York, have just placed on the market a new fixture which they have named the "Ward Orchestra Lamp." It is cylindrical in shape, the socket being inside the cylinder. The standard fixture is made to take a 16 c. p. lamp. The cyliuder is pivoted on the ends and may be revolved in any direction. The cylinder is composed of two pieces, one of which revolves inside the other so that any desired opening may be obtained depending on volume of light required. This device, although called an orchestra lamp, is just as valuable for lighting pulpits and pictures. The rector of St. Thomas' Church, New York, it is stated, experimented with several devices for lighting his pulpit, but did not find anything satisfactory until the Ward Orchestra Lamp was installed. It is fitted with an adjustable clamp for attaching to music racks. There is no doubt that this device will prove very popular.



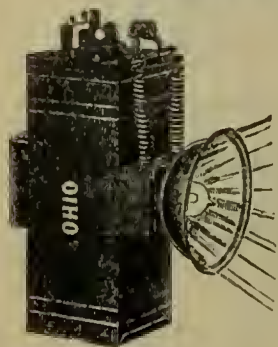
Ward Orchestra Lamp.

Some valuable experiments, made to determine the chemical composition of that fatal element, fire-damp, are reported by M. Chatelier, in the annales des Mines. In the samples examined the incombustible parts varied from 3.1 per cent. to 44.4 per cent. in volume, and contained 0 to 4 per cent. of carbonic acid, 0 to 0.9 per cent. of oxygen, and of nitrogen 2.2 to 39.8 per cent. Nitrogen was invariably present in quantities varying from 0.74 to as much as 30 per cent., and in all cases the nitrogen was found to contain argon varying in proportions from as low as 0.74 per cent. to as much as 3.28 per cent. of the total amount of nitrogen and argon together. As the result of these various experiments—probably the most careful and accurate yet made in this line of inquiry—the conclusion is regarded as legitimate that not only is the argon in fire-damp not derived from the coal, but is only probably present in fossil air of the carboniferous period; in this case being either absorbed directly or carried in by water, in which argon is more soluble than nitrogen, and which would account for its being generally present in higher proportion than in the atmosphere.

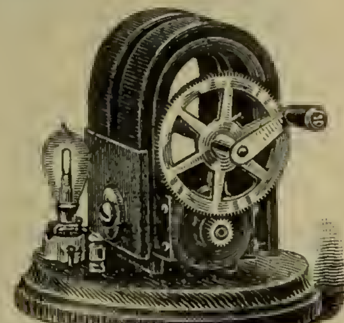
NOTE.—We call particular attention to the advertisement of Columbian Electrical Supply Co., page IV.

HOLIDAY PRESENTS. Bottom Prices.

Sent on receipt of price. **W. MULLER, World Building, New York.**



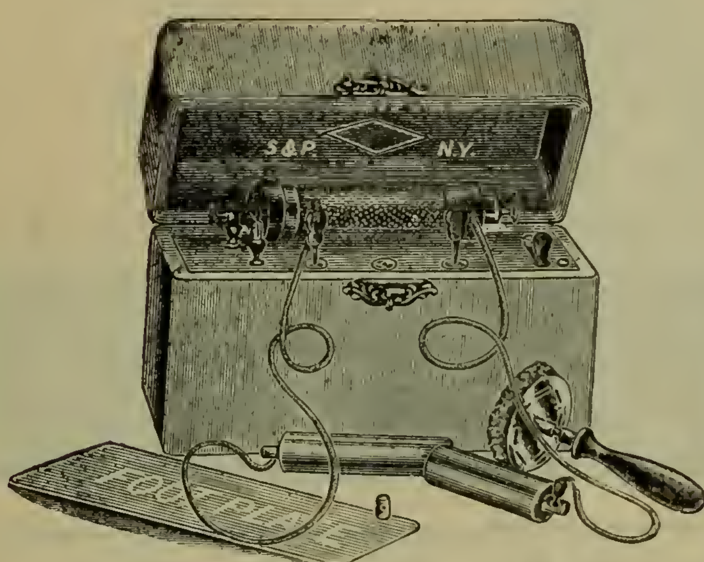
No. 1—Electric Lamp, $3.00



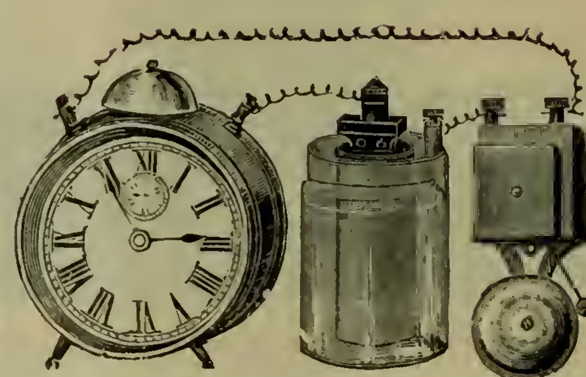
No. 2—Dynamo and Lamp, $3.75

No. 3—Scarf Pin, $1.50 and $3.00

No. 4—5-in. X-Ray Coil, $60.

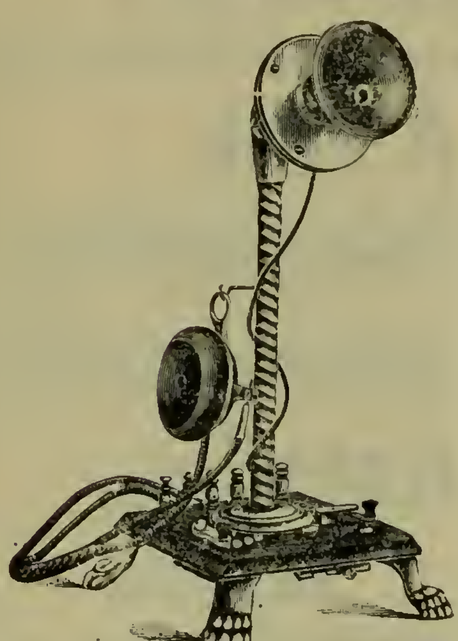


No. 5—Medical Battery, $6.00

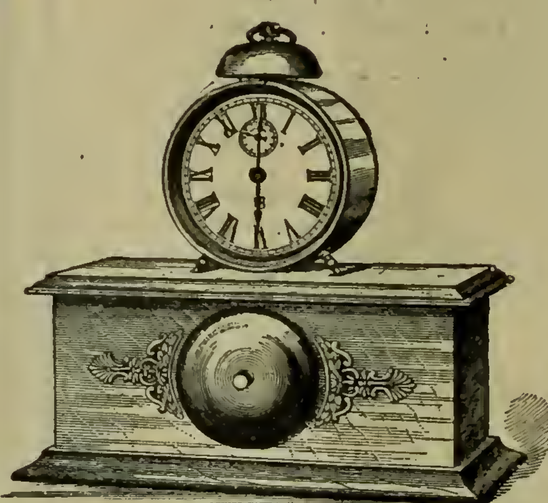


No. 6—Bell Outfit, $2.00

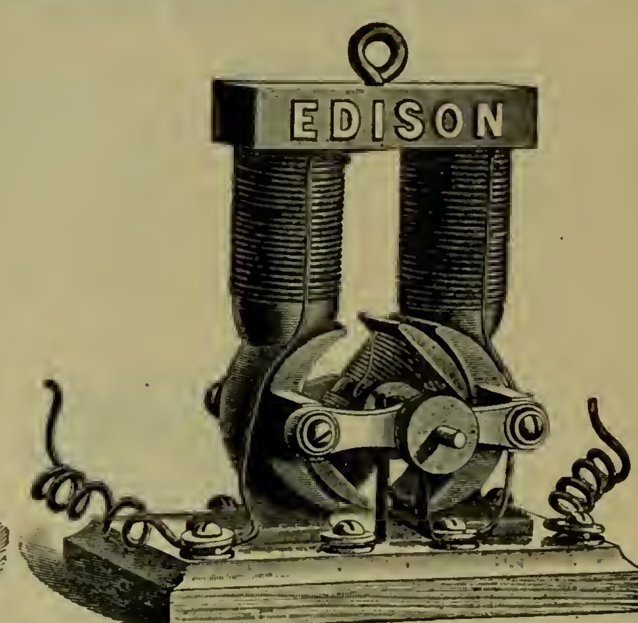
No. 7—Telephone, $1.00



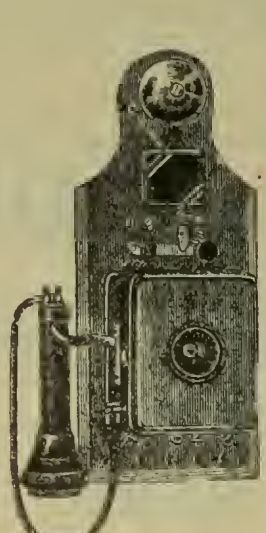
No. 10—Complete Telephone, $6.00



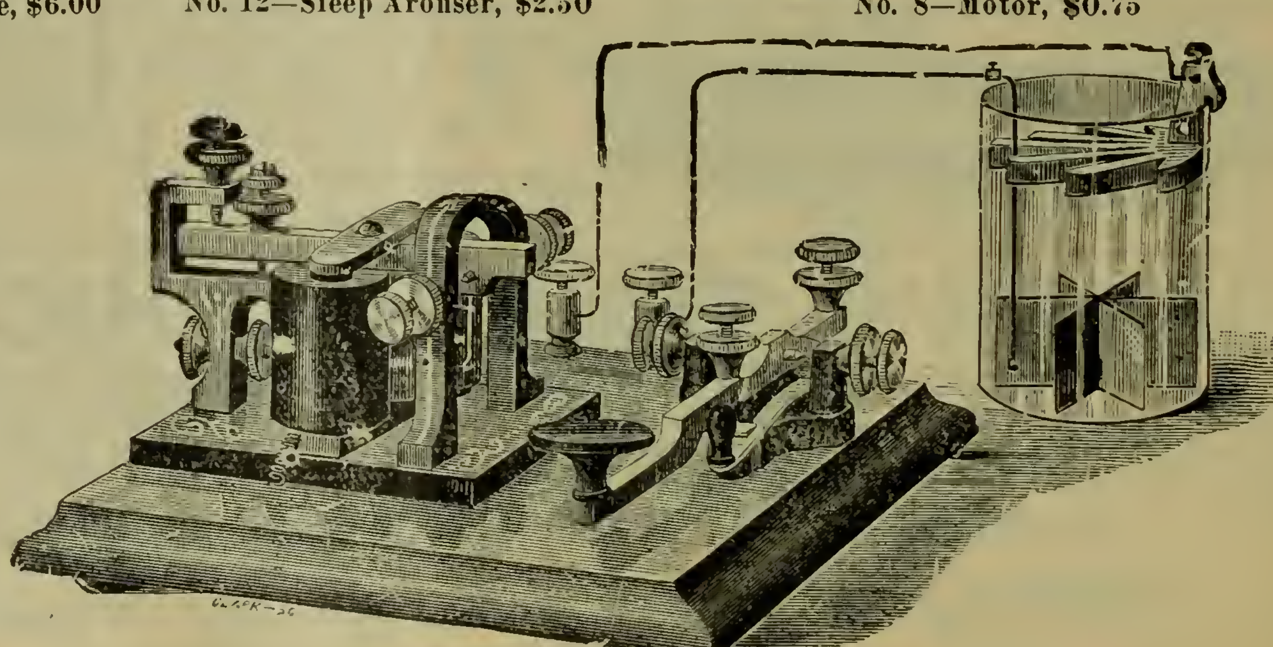
No. 12—Sleep Arouser, $2.50



No. 8—Motor, $0.75



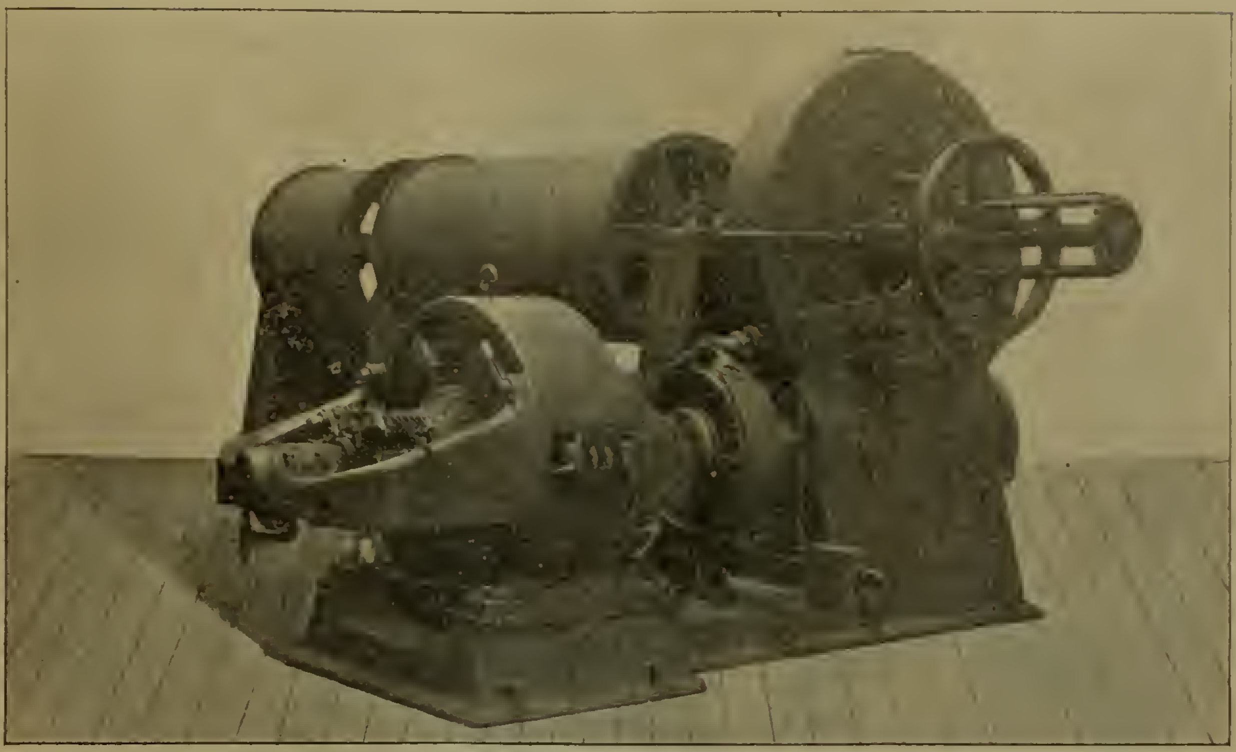
No. 11—Com. Telephone, $5.



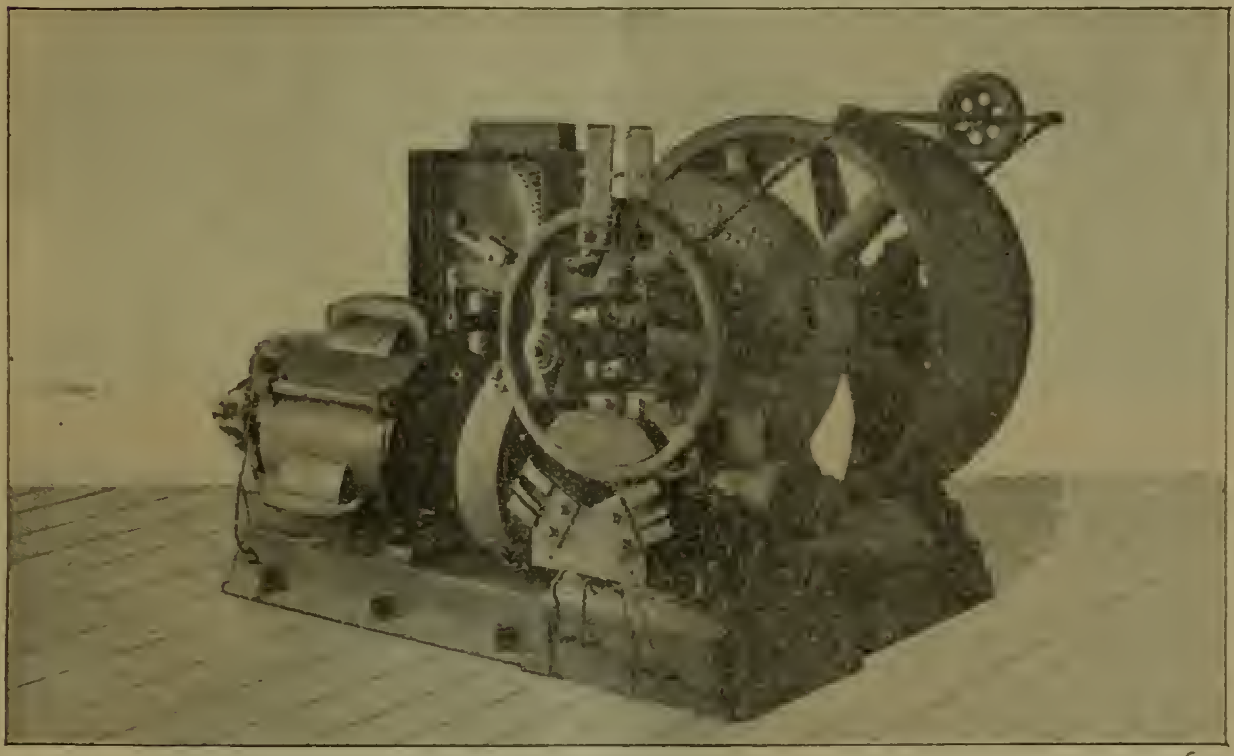
No. 9—Complete Telegraph Outfit, $3.75

The Electrical Age.

Vol. XX—No. 25 NEW YORK, DECEMBER 18, 1897 Whole No. 553



30-H. P. Motor, Connected Direct by Screw and Gear to Our Double Drum Engine.



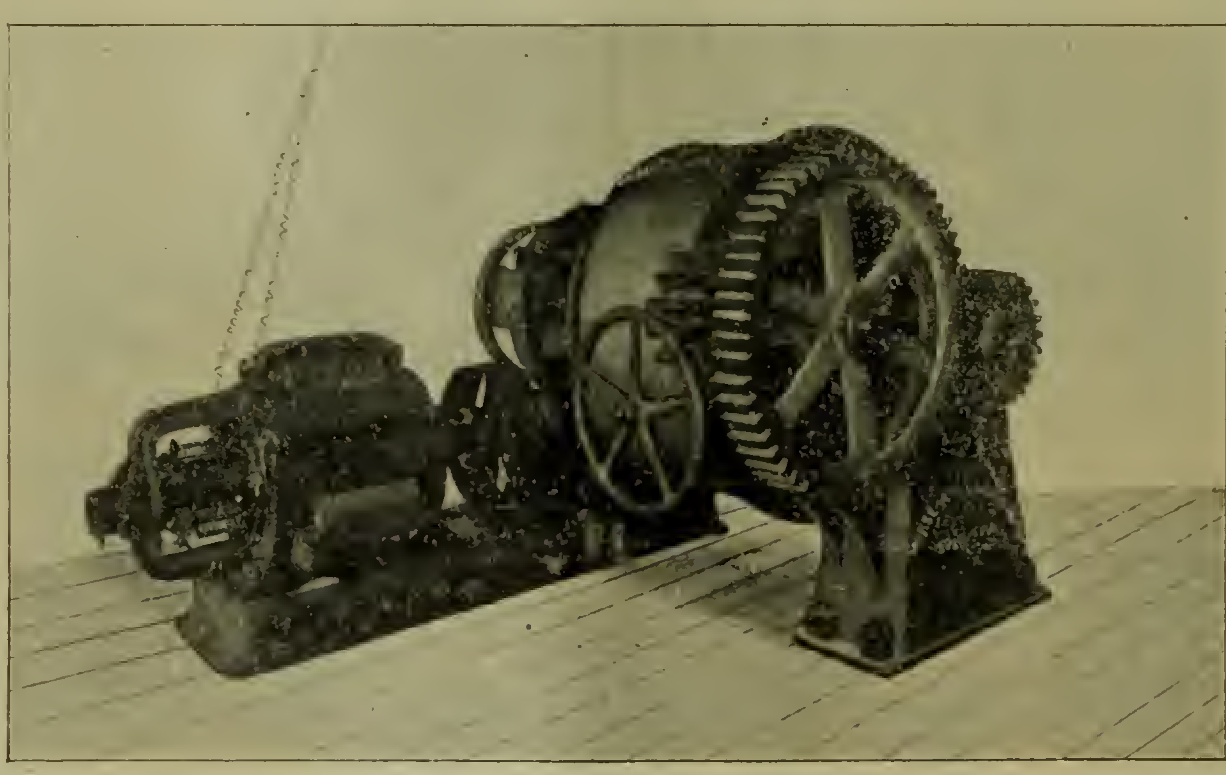
Improved Direct Electric Elevator Engine, Adapted to Both Passenger and Freight Service.

ELECTRIC ELEVATORS.

Many efforts have been made by competing concerns to place upon the market an elevator whose reliability, efficiency and features of general convenience are such as to recommend it to the attention of customers and the trade. Perhaps no field of work has been so carefully prospected as that which involves the construction of elevators, whether steam, hydraulic or electric. Yet the fact remains that but few concerns manufacturing elevators seem to properly gather up the grains of experience and use them when occasion demands. The firm of Morse, Williams & Company, established in 1871, have deviated from the conventional path and placed upon the market elevators designed and constructed on a broader and better basis than any hitherto presented to the public for inspection and use. The improved Morse, Williams & Company "Hindley" worm and gear is so carefully designed that the efficiency of its action is rated at 56.25, while those of mediocre construction in open tests show an efficiency of 43.25. There is a direct saving of twenty-eight per cent. in power by the use of the Morse, Williams & Company worm and gear. The deduction to be drawn from this is that the use of this special device will save twenty-five per cent. in electricity or power when applied to electric, steam or hydraulic elevators. The worm being cut from a solid piece of steel with the utmost care, applies in every respect to the design from which it is shaped, and the wheel itself is so constructed that the strain is not brought to bear upon any particular point; thereby reducing the friction and wear, and thus saving power otherwise wasted in the ordinary form of worm and gear.

The application of this perfect mechanical appliance to elevators is an established success, as proven by the fact that the U. S. Navy Department, though not cultivating the use of elevators, still utilize the Morse, Williams & Company gear on ships whenever occasion demands. If the opinion of such distinguished engineers as those paid by the U.S. Government has any weight, the general use of this improved worm and gear for elevator service is the only adjunct to safety, reliability and efficiency that need be sought. A series of illustrations have been added to this article which show the style of elevators manufactured by Morse, Williams & Co., with New York office at 108 Liberty st., John Keir, manager, and general offices and works at Frankfort avenue, Wildey and Shackamaxon streets, Philadelphia. The improved electric elevators for passengers and freight service put upon the market by the above concern have a lifting capacity varying from 500 to 5,000 pounds and possessing a car-speed of from 75 to 400 feet per minute. The application of the above-mentioned worm and gear in every case has shown a direct gain of twenty-eight per cent. over equipments of equal size and power. Various styles of lifting devices, some involving the use of duplex gearing to increase the lifting capacity, others constructed for the purpose of lifting from ten to fifteen thousand pounds direct, and a third style called the triple-geared elevator engine that can stand a load of 60,000, are manufactured by Morse, Williams & Company. In all these designs, the improved worm and gear performs its function with faithfulness, thus making the electric elevators of Morse, Williams & Company the most efficient and smoothest running of any the market affords. The reference list of this company is so great that a casual glance over it will quickly impress a prospective purchaser with the evident superiority and popularity of their elevators. Branch offices have been established in New Haven, Pittsburg, Boston, Baltimore and Scranton. The company was incorporated in 1893. Mr. Edwin F. Morse is president; William F. Sauter, vice-president; Chas. Beamish, secretary, and G. R. Rebmann, treasurer.

The Improved Morse-Williams & Co. (Hindley) Worm and Gear.



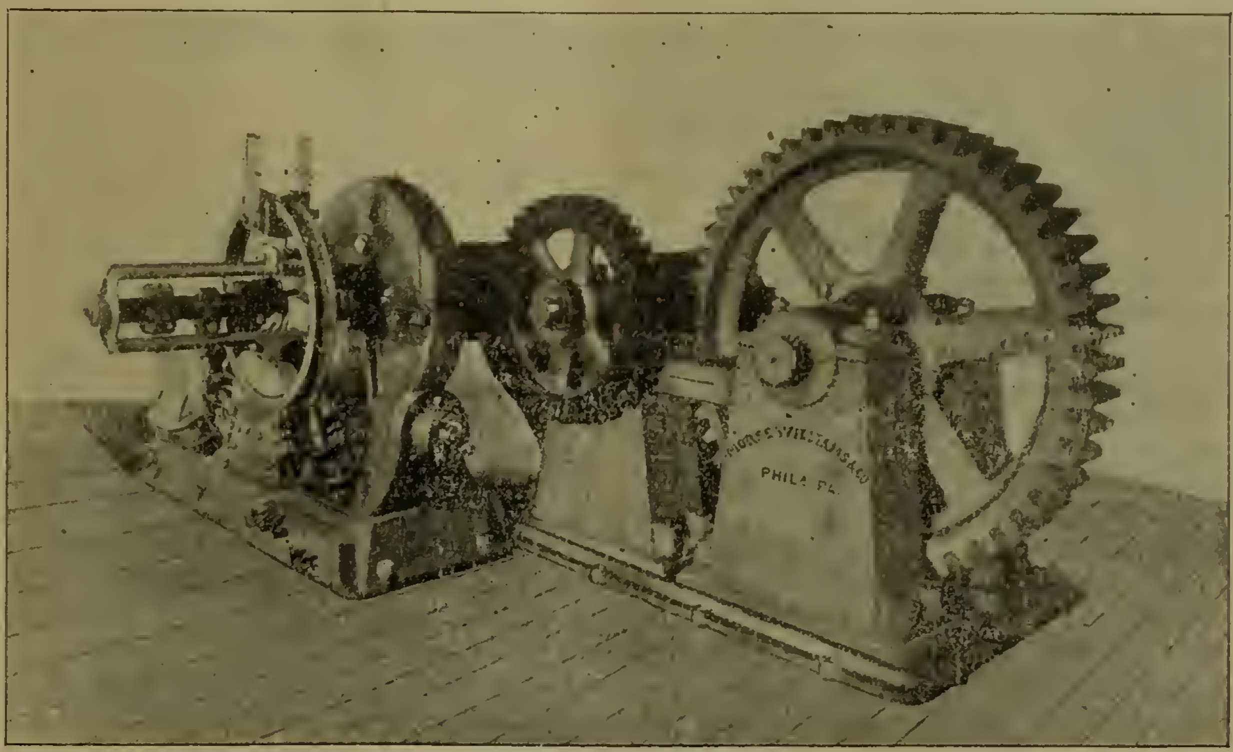
Electric Elevator Engine Arranged for Variable Loads.

FUTURE OF TURBINE ENGINES.

The general impression I have formed from the trials is entirely favorable to the prospects of this novel method of marine propulsion. The mechanical simplicity of the turbines and the absence of exposed parts and of working joints will go far to secure them against breakdown. They have a distinct advantage over ordinary engines in first cost, in probable cost of maintenance, and in cost of attendance, as well as in bulk, in weight, and in freedom from vibration. There appears no reason to doubt that in regular use at sea their running will be as consistently steady and good in every way as it has been throughout these trials.

The application of steam turbines to torpedo boats, destroyers, gunboats and cruisers is to be anticipated from their unique capacity for developing great power and high speed with light and compact machinery. Apart, however, from these uses, it appears to me highly probable that they will in time be adopted in the mercantile marine. The conditions in a fast passenger steamer are favorable to the economical application of steam turbines, and in such steamers the smoothness of their running will be a strong recommendation. I see no drawback likely to detract from the advantages which they plainly possess.

In conclusion, the application of the steam turbine principle to fast ships in general, including passenger vessels, Atlantic liners, and ships of war, would appear to present no special difficulties. It may be said, generally speaking, that the larger the scale on which the engines are made the simpler is the construction, the higher the steam efficiency, and the lower the speed of rotation. In the sizes hitherto constructed (the largest being the engines of the Turbinia) this has been found to be the case. In applying turbine engines to a large passenger vessel or warship of say 30,000 I. H. P., probably four screw shafts, with two screws on each shaft, would be adopted; each of the four shafts would be driven by one compound turbine at a rate of between 400 and 700 revolutions per minute, and the turbines would consist of the high pressure, the intermediate and two low pressure, each turbine developing approximately one-quarter of the total power. The screw propellers would be about one-half the diameter of ordinary twin-screw propellers, and the aggregate blade area would approximate closely to ordinary practice. With such engines the consumption of steam per propulsive horse-power would probably be less than that found in the mercantile marine, and considerably less than that found in engines of war vessels, where space and other conditions must necessarily be considered. There is also no limitation in steam pressure in the case of turbines other than those imposed by the boilers, and it is probable that in conjunction with water-tube boilers higher pressures than those at present usual would be generally adopted. With turbine engines in passenger vessels, there would arise no questions of vibration from machinery or propellers, and in the event of one screw shaft or one motor becoming disabled, the one affected can be more readily taken out of action than is the case with ordinary engines, and the parts, being lighter, can be more easily dealt with by the staff on board; thus the liability to serious breakdown is considerably reduced.



Triple-Geared Electric Elevator Engine.

HISTORICAL SKETCH OF THE FIRE-ALARM TELEGRAPH.

(Continued from page 348.)

The first city after Boston to adopt the fire-alarm telegraph was Philadelphia, where it was introduced in 1855.

In 1855 Dr. Channing, who had done much to bring the subject of the fire-alarm telegraph before the public and city authorities, delivered a very interesting lecture before the Smithsonian Institution. It was through this lecture that the attention of J. N. Gamewell was first directed to the fire-alarm telegraph. On the occasion of a visit Professor Henry called his attention to the lecture and presented him with a copy. Immediately after its perusal he started for Boston and acquired the rights for the Southern and Western States.

The fundamental patent covering the invention of the fire-alarm telegraph, as exemplified by the Boston system, was granted to Channing and Farmer, May 19th, 1857. Another patent was issued to them on March 8, 1859, for a repeater.

The following patents relating to fire-alarm telegraph apparatus were granted to Farmer alone:

May 4, 1852; Electro-Magnetic bell-striking apparatus.

Jan. 11, 1859, for an improved signal box, in which the magnets were shunted by the closing of the outside box door, a practice that has been followed up to the present day.

February 22, 1859, for an automatic system in which the central office is dispensed with, and the signal boxes and alarm bells are all placed on one circuit, and where consequently, when an alarm of fire is given, all the bells will strke instantly and simultaneously, without the aid of an operator. This was called the village system, from its adaptability to small places, where the expense of a central office would be prohibitory.

Two other patents were granted to Farmer in 1859. One was for an "electric-magnetic apparatus for setting water motors in motion." This was applied for a short time to operate some of the bell-striking machines of the Boston system in place of weights. The other patent was for "Mechanism for operating signal whistles by electro-magnetism."

A very important improvement was made in 1856 by Chas. T. Chester, to whom a patent was granted for an "automatic electrical circuit breaker." In this apparatus the break-wheel was moved automatically by means of clockwork actuated by a spring. Although this particular apparatus never came into public use, it is practically the first signal box of which we have any knowledge.

After three years of agitation and hard work, Gamewell & Company met with their first success in the city, of St. Louis, where they installed a plant in 1858. St. Louis was, therefore, the third city to adopt the fire-alarm telegraph.

In 1859 the same firm obtained, by purchase, complete control of all patents relating to the fire-alarm telegraph granted to Channing and Farmer, or to Farmer alone. Mr. Gamewell early recognized the fact that a fire-alarm telegraph having one of its most vital parts, the signal box, constantly exposed to the elements, to the heat of the summer and to the cold of winter, to rain and to dust, unused until an emergency arises, and where a failure of the apparatus to properly operate in that emergency might result in the destruction of property to the value of millions and even in the sacrifice of human life, should have the best apparatus that ingenuity could design and the highest skill execute. With this object in view he soon gathered around himself men of inventive genius and great mechanical skill, three of whom especially distinguished themselves by inventions of the greatest merit. These are Edwin Rogers, James M. Gardiner and Moses G. Crane, three names inseparably connected with the development of the fire-alarm telegraph. One other name should not be forgotten, that of John Polsey, to whose superior mechanical skill much of the early success of the fire-alarm telegraph is due.

The first fire-alarm system equipped with automatic signal boxes was introduced into the City of Mobile in 1866. This was an automatic system, but, unlike Farmer's village system, in which all the apparatus is placed on one circuit, four circuits were provided. This had never been attempted before, and to make it possible in this case a new apparatus had to be invented, by means of which a signal from any one circuit would be automatically transmitted to every other circuit, and which would mechanicallly close every other circuit, should any one circuit remain open. This was accomplished by Edwin Rogers, to whom a patent for the first automatic repeater for fire-alarm purposes was issued in 1870.

The original crank signal boxes remained in service in Boston until 1866, in which year automatic boxes were substituted in their place. The following year, Joseph B. Stearns, the immediate successor of Farmer in the superintendency of the Boston fire-alarm telegraph, received a patent for an apparatus operated by "reverse currents," which permitted the simultaneous use of the same wire for receiving a signal from a box and transmitting it to the alarm bells. Several years prior to the introduction of automatic signal boxes Stearns abandoned the method of striking the district numbers on the bells, and new boxes were designed to strike the box numbers only. While, with the adoption of the automatic signal box, the speed with which a fire-alarm box was operated no longer depended on the temperament or mental condition of the person giving the signal, a proof was soon furnished that, in a matter of this kind, as little as possible should be left to the intelligence of the public. Incorrect signals were often received from these boxes, for the occurrence of which no cause could be assigned. It was usually the first "round" that was found to be wrong. This remained a puzzle until the cause was discovered, which was this—that the person giving the alarm, disregarding the instructions to "pull the hook down once and let go," would, after the first pull, by way of emphasis, give the hook another pull or two. This would momentarily suspend the movement of the break-wheel, and if it occurred between two successive breaks a long pause would ensue, and the signal would be either unintelligible or a numher entirely different from the box number would be transmited. For inventions to remedy this difficulty two patents were issued, in 1869, "for non-interference pulls," one to Stephen and Chas. T. Chester, and the other to Edwin Rogers and Moses G. Crane. In the former invention the arrangement was such that, after the box was in operation, the hook could not again engage the mechanism until the full number of "rounds" were completed; in the latter, the mechanism could be engaged after each full round.

There was, however, another interference of a very serious nature which often resulted in trouble and delay; this was the interference caused by pulling a box while an alarm from another box was in process of transmission. It is not a very unusual occurrence to have two or three boxes pulled for the same fire, and if these boxes happened to be on the same circuit, and the second was pulled before a full round of the first box was completed, a mixed alarm was the result. In such cases it was usually, but not always possible to obtain the correct signal from the last round of the second box.

The first patent for a non-interference box was issued to J. N. Gamewell in 1871. This is a normally wound box (all other automatic boxes were either actuated by weight, or if by spring were pull wound) with trigger pull and a so-called skeleton break-wheel, that is, a wheel which in its revolution will keep the circuit open for the greatest length of time consistent with the proper transmission of the signal. It also contains an electro-magnet, and an armature which when it is in a position away from the magnet shunts the break-wheel. If the box is pulled while the armature is in its normal position against the magnet it is held there by a simple contrivance until the signal is completed. If a box is pulled while another is in operation, the same contrivance will hold the armature in a position to shunt the break-wheel of the second box during the time of its operation, and therefore no interference can take place. The only chance of an interference lies in the possibility that the hook of the second box should be pulled the instant the circuit is closed, and the armature held close to the magnet, but, as owing to the construction of the skeleton break-wheel these periods of contact are exceedingly brief the chances of an interference are very remote.

In 1880 J. M. Gardiner received a patent for a non-interference signal box which on account of its great simplicity and mechanical perfection has maintained its great popularity to the present day. In this box non-interference is not effected by shunting the break-wheel, but by a very simple method the box pulled while another box is transmitting its signal is rendered mechanically inoperative. This is accomplished in the following manner: A small electro-magnet in connection with the clockwork has an armature with a wide range of movement, so that when fully withdrawn by a retractile spring it is beyond the attractive force of its magnet. An extension on this armature carries a small movable disk. This disk when the armature is in its normal position drawn to the magnet, takes a position between the detent of the movement and the starting lever. If, while it is in this position, the box is pulled the starting lever raises the disk, which in turn raises the detent and allows the clockwork to start. A stationary pin on the outside door restores the armature and holds it close to the magnet, whether the circuit is open or closed. The skeleton break-wheel is also an essential feature of this box, and consequently during the entire transmission of a signal the circuit is never closed longer than a small fraction of a second at one time. If while a signal is being transmitted an attempt is made to pull another box the following will take place: Before the door of the box is opened an inch, the restoring pin will be withdrawn and the armature becomes free to recede, and before the door can be entirely opened and the hook pulled it will be withdrawn, together with the disk, but without the disk interposed between the starting lever and detent the movement cannot be started. (To be continued.)

MEASUREMENT OF RESISTANCE.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

In measuring resistance many methods have come into vogue, each applicable to a certain case and dependent

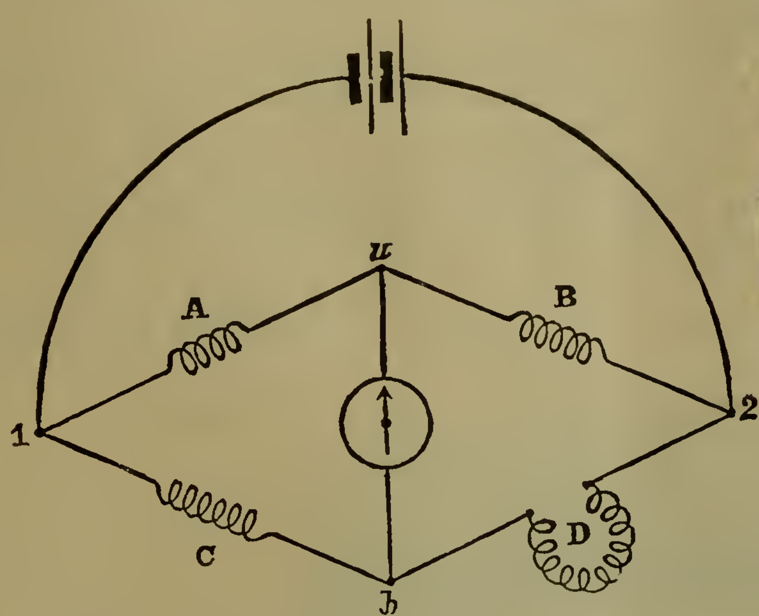
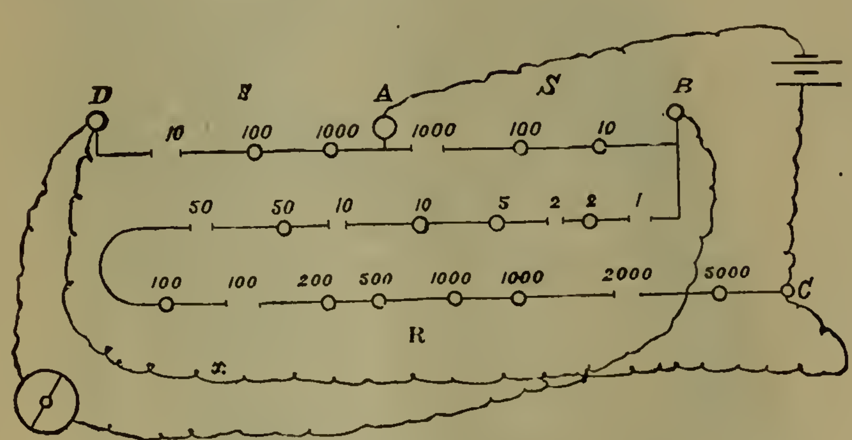


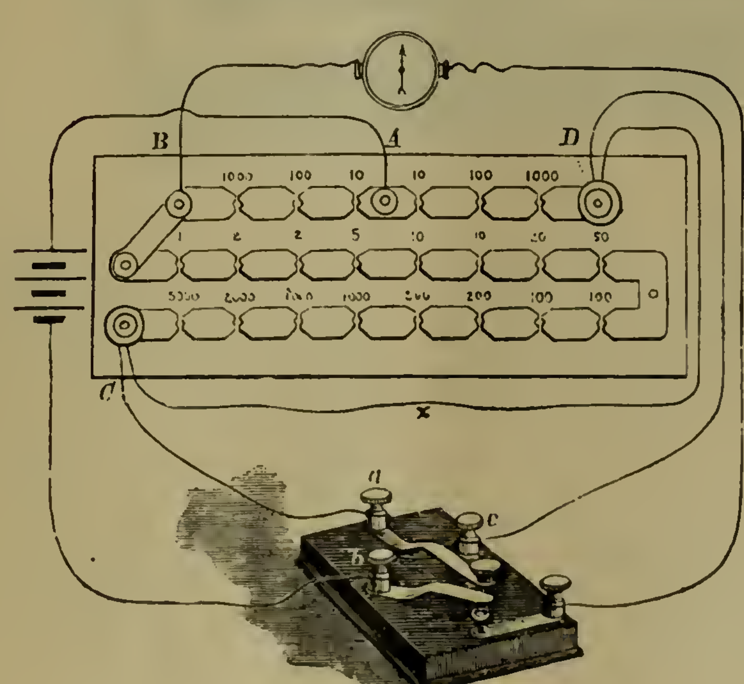
Diagram of Wheatstone Bridge.

upon circumstances for the results obtained and comparative accuracy.

Classes of Resistance.

Two classes of resistances may be measured, the





Post-office Bridge.

methods in each case being changed to suit the conditions. They are constituted under the head of

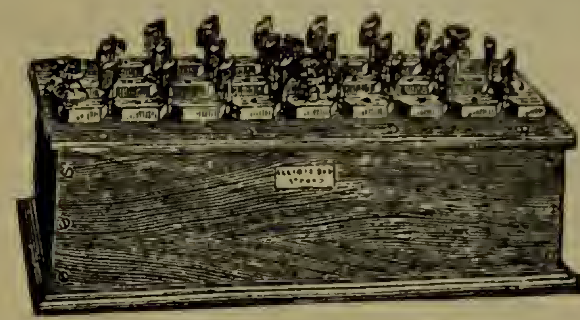
Low resistance tests,
High " "

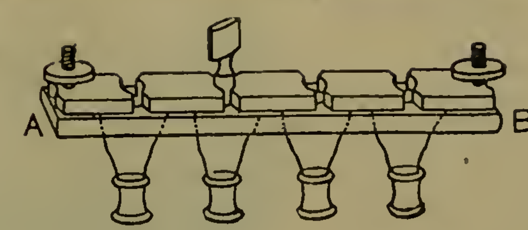
Use of Ohm's Law.

In any measurement of resistance Ohm's law comes into direct application. The three quantities which completely determine the conditions are the current, electromotive force and resistance.

When two of these are given the third can be determined by simple calculation.

If, for example, a current of ten amperes be passed through a wire so as to cause a drop of potential or loss





Connections of Interior of Post-office Set.

of pressure equal to five volts, the resistance of the wire is calculated as follows:

$$\left\{\begin{array}{l}\text{Current} = 10 \text{ amperes,}\\ \text{Pressure} = 5 \text{ volts,}\\ \quad\text{To find ohms.}\end{array}\right\}$$

By Ohm's law, current = volts ÷ ohms,
or resistance = volts ÷ current,
therefore resistance = 5 ÷ 10
= ½ ohm.

Resistance of Incandescent Lamp.

This method is of especial interest when it is desirable to know the resistance of a body while hot. The carbon of an incandescent lamp does not have the same resistance cold as when incandescent; the resistance of carbon continually diminishes with heat.

To find its resistance is not difficult if the above method is applied. Two factors must be known in such a case—the current and the pressure.

A sixteen-candle-power lamp having one-half an ampere and 110 volts applied to it would have the following resistance:

$$\text{volts} = 110$$
$$\text{amperes} = \tfrac{1}{2} = .5$$

By the rule—

$$\text{ohms} = \frac{110}{.5} = 220$$

and the resistance must be known in ohms. By thus connecting them a deflection occurs on the galvanometer which must be carefully observed. Supposing the conditions are as follows

The resistance = 100 ohms.
The deflection = 50 degrees.

This being noted, the resistance of 100 ohms is removed and the unknown resistance substituted therefor. If the unknown resistance be less, the deflection will be greater, because more current will flow through it. If the unknown resistance be greater than 100 ohms, the deflection of the galvanometer will be less, because less current passes.

Supposing, however, that the second deflection obtained with the unknown resistance equals 25 degrees, the results are tabulated thus:

(1st) Resistance = 100 ohms.
Deflection = 50 degrees.

Portable Wheatstone Bridge.

Use of Wheatstone Bridge.

For the determination of resistances in general a Wheatstone bridge is employed. A bridge may be constructed for portable use or for stationary purposes, and the galvanometer attached is made as sensitive as the usage it receives will allow.

For portable use the needle is pivoted instead of suspended, and the sensitiveness of the galvanometer correspondingly decreased. When fine tests are to be made, whether of high or low resistance, the needle has a silk suspension and is affected by the slightest changes.

The tests made under such circumstances are less rough and more thoroughly accurate than otherwise.

Method of Substitution.

A simple method of measuring a resistance will be briefly described; it is called the method of substitution.

A galvanometer, battery and resistance are connected n series. The E.M.F. of the battery must remain steady

(2d) Resistance = unknown ohms.
Deflection = 25 degrees.

The rule to be applied is then as follows:

Known resistance : unknown resistance = $25^\circ : 50^\circ$.

Care must be taken to remember which is the greater resistance—the one originally there or the unknown resistance. The galvanometer will indicate this by the deflection.

In this case the greater resistance is the unknown resistance, because it has only moved the needle through 25°; it has, therefore, allowed less current to pass and possesses a higher resistance.

In the proportion

$$100 \text{ ohms} : \text{unknown ohms} = 25^\circ : 50^\circ$$

$$\text{Unknown ohms} = \frac{50^\circ}{25^\circ} \times 100 \text{ ohms.}$$
$$= 200 \text{ ohms.}$$

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CONTENTS.

THE EVOLUTION OF THE ARC LAMP.

It is many years since the famous scientist, Sir Humphry Davy in his famous lecture before the Royal Society of England, gave an exhibition showing the intense heat produced from an electric arc. It may be worthy of mention to say that the miners' safety lamp differs in no respect from the present improved Welsbach burner. It is also true that the recent form of arc lamp with its luminescent tips enclosed within a globe represents no new departure, being more a mechanical advance than a decided electrical improvement. The incandescent lamp with its continuous globe differs from the closed globe arc lamp in this respect: it needs no valve to allow the escape of gases and is permanently sealed, thus making it impossible to renew the carbons without the application of heat to the glass plug or stem holding the platinum wires. The closed globe arc lamp need not be regarded as an advantage from an economic standpoint entirely, because it is only when very small carbons are used that a greater light is produced for equal power from this than from the ordinary type of are lamp. The long life of the lamp makes it unique and a great convenience to many consumers of current, such as the proprietors of large stores, the owners of great halls or, as far as the municipality is concerned, the lighting of public streets, stations, etc.

Were the incandescent lamp to be so developed as to enable customers to renew carbons as they might the wick in a lamp, the enclosed arc lamp and the incandescent lamp would be built on somewhat parallel lines. The slowest possible oxidation of the carbon rods in an arc lamp is to be desired, and the life of carbons may be prolonged ten times as great by the use of a globe with an appropriate valve attachment. The main object is to decrease the oxidation of the carbons to a minimum. Were an incandescent lamp constructed with an inoxidizable filament the renewal of the globe would be a matter of easy accomplishment and the hybrid nature of the present inclosed globe arc lamp (a cross between the arc and the incandescent lamp) would be clearly demonstrated.

In all probability the arc lamp has now attained a condition of maximum development, whereas the incandescent lamp, although cheapened in price and highly efficient, will certainly reach a point of greater perfection when the necessity for allowing the customer to renew its filament properly impresses the manufacturer. The present construction of closed globe arc lamps is such that an increase of power is required for the same light, while in the future form of incandescent lamp there will be a decided decrease of power for an equivalent light. We are now face to face with the fact that a more enduring filameet will raise the efficiency of light production from fifty to one hundred per cent, the direct benefits of which will be felt alike by the customer and the illuminating company.

THE PREVAILING USE OF STEEL FOR THE CONSTRUCTION OF GENERATORS.

The difficulty ten years ago of building a dynamo whose magnetic circuit was of high permeability was entirely due to the high price of wrought iron and the expense brought on by the use of dies for drop forgings. Magnetically speaking one thousandth of an inch of air is equivalent to one inch of iron, and the builders of ten years ago had a horror of poor magnetic joints, using heavy bolts and nuts and large surfaces of contact to avoid the evil consequences of a film ofair. The development of the steel industry is not due to the increased use of dynamos, although our modern generators are entirely made of mild steel as far as the frames are concerned, there being no joints of any description that might interfere with the continuity of the magnetic circuit. The great growth of the steel industry can be traced in some respects to the quantity of steel demanded for ship-building purposes, for bicycle manufacturers, for railroad work, by steamship companies and, incidentally, by electrical manufacturers. Since steel is cast into moulds the same as ordinary iron, drop forgings have greatly decreased in their use except when forming parts of small generators, motors, etc. The high permeability of steel brings it up to within eighty or ninety per cent of the value of wrought iron.

A dynamo built of cast iron would weigh at least twice as much, for equal power, as one made of steel, the magnetic permeability in each case being in the ratio of one to two. It is true that steel costs more than cast iron, but the amount of copper used in conjunction with it is so much less that manufacturers have found by actual experience that direct advantages, financial and economical, are gained by its use. Mention may also be made of the fact that space is so valuable and weight so much a matter of consideration that a small dynamo with a steel frame is always preferable to a massive, cumbersome and less efficient machine. Steel is the article of use today and will continue to retain its position as long as manufacturers possess reason and intelligence and as long as our own profession can pronounce the word "permeability."

Ventilators and Exhausters Free of Duty in the Netherlands.—Minister Newel reports from The Hague, under date of October 22, 1897, that, by ministerial order of October 11, 1897, it has been ordered that ventilators, exhausters and bellows which are worked by steam, gas, petroleum or electric motor only, and are used in factories and on ships, and only in exceptional cases elsewhere, may henceforth, and for that reason, be admitted free of import duty. Ventilators for ordinary ventilating purposes and not worked by the aforementioned motive power shall remain subject to the existing duty.

Resistance Boxes.—In order that standards may be conveniently handled, resistance boxes have been constructed composed of reels of German silver wire.

Standard Ohm.—The standard of resistance is the ohm; it has been made in two separate forms as a unit. One, the primitive form, is simply a mercury column of 106.3 centimeters in length and a given weight of mercury, the diameter being about 1 milimeter; and the other, called the B. A. unit, is composed of wire, either German silver or platinum silver alloy.

If the wire is fifty inches long, the point at which the slide rests gives the arms either 15 and 35, 20 or 30, or any other arrangement. The other two known resistances are inserted in the shape of resistance boxes and unplugged to the required extent. A galvanometer is connected across to the proper terminals and the absence of deflection denotes a balance.

The larger bridge of higher resistance sometimes comes in the form of a box called a post-office set, but its use does not vary in the least with that just described. The

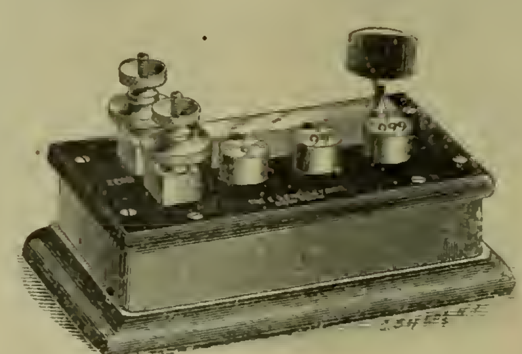
Box of Resistances.

divided wire or meter bridges are excellent for low resistances. When greater resistances are to be measured, although the principle employed does not alter in the least, the means for effecting the same does considerably. A very great resistance usually requires a greater pressure with the same galvanometer than that hitherto employed. Thus testing cells of chloride of silver are very convenient when from 50 to 100 volts is necessary in such work.

The insulation resistance of a wire is the number of ohms' resistance of its outer covering. This, as a rule, is so high that it is not measured in single units but in groups of 1,000,000 ohms apiece. These larger units are called megohms.

The general construction of resistance boxes is as follows: A series of reels of German silver wire are placed within a box, and their individual extremities connected to metal pieces on the outside. The extremities of each coil end in two brass blocks separated from each other, yet allowing a plug to be inserted between them when necessary.

By means of this plug the coil can be left in or cut out. When the plug is inserted the ends of the coil are in metallic communication, and the only resistance is that experienced by the current when passing between the metal blocks. The extremities of each coil are individually marked with their corresponding resistances.



Set of Shunts.

The boxes are made of a resistance either great or small as desired. One box may read in tenths and units, another in units and tenths, or hundreds and thousands, etc.

The resistance to be measured greatly determines the box to be used. With a 100,000-ohm coil very high resistances may be measured with the aid of a good galvanometer.

The Wheatstone bridge is used as in the above for either high or low resistances. The slide bridge, as seen in sketch, is utilized whenever it is desirable to measure very low resistances, the connections being the usual ones for a bridge test. When very low resistances are being tested, the differently heated currents of air passing at the time affect the bridge, giving rise in it at all its joints to thermo-electric currents. Protection against these is obtained by covering such parts with cotton-wool and keeping doors and windows closed.

The metallic piece on the bridge slides along a wire of alloyed metals and by its movement forth or back creates the proportional arms required for a balance of the bridge.

The two arms thus obtained by a division of the wire are not known in ohms, but are considered merely as proportional parts of each other.

The process of substitution for the measurement of insulation resistance is very convenient if, instead of a galvanometer, a Weston voltmeter be utilized.

The volts are noted and the resistance of the voltmeter as given on the cover. If the volts read off are 110 and the voltmeter have a resistance of 15,000 ohms, the test is continued by connecting the voltmeter and insulation of the wire in series with each other. This is done by immersing the coil of wire in a tub of water, its two ends protruding.

One end is connected to the voltmeter, the other pole of the voltmeter to the source of current, and the remaining extremity from the current supply to the water. When a current tries to pass it must pass from the source of current through the voltmeter, through the covering of the wire back to the point of starting. If the voltmeter reads half a volt, the resistance of the covering is as follows:

(1) voltmeter = 15,000 ohms,
reading = 110 volts.

(2) voltmeter = 15,000 + unknown ohms,
reading = ½ volt.

Therefore

$$15{,}000 + \text{unknown } R : 15{,}000 = 110 : \tfrac{1}{2}:$$
$$15{,}000 \times 110 = \tfrac{1}{2} \times (15{,}000 + \text{unknown } R)$$
$$= 7{,}500 + \tfrac{1}{2} \text{ unknown } R;$$
$$\text{or } \tfrac{1}{2} \text{ unknown } R = 15{,}000 \times 110 - 7{,}500;$$
$$\text{or } \tfrac{1}{2} \text{ unknown } R = 3{,}285{,}000.$$

This answer would be given as 3.28 megohms. The same practice is carried on with a testing set and a galvanometer.

Shunts.—When using galvanometers for such work, a set of shunts are used called

$\frac{1}{9}$, $\frac{1}{99}$ and $\frac{1}{999}$ shunts.

These are employed for the purpose of obtaining a readable deflection where a great pressure is applied to any high resistance. Were it not for these shunts a delicate galvanometer would be ruined by the heavy work thus put upon it and the experiment lack success. The above fractions denote the current passing through the galvanometers when they are used, the galvanometer taking $\frac{1}{9}$, $\frac{1}{99}$ or $\frac{1}{999}$ of the current from the circuit as the case may require.

QUESTIONS FOR REVIEW

IN THE MEASUREMENT OF RESISTANCE.

(1) Into what two general divisions are resistances divided?

(2) How is the resistance of an incandescent lamp measured?

(3) Describe the method of substitution.

(4) What is a standard ohm?

(5) What two forms of the Wheatstone Bridge are used, and for what purpose?

(6) Upon what principle does the operation of the Wheatstone Bridge depend?

(7) How is insulation resistance measured by a voltmeter?

—The total consumption of collar buttons in this country for all purposes probably exceeds a thousand millions annually, and the amount expended for them is probably not very far below $10,000,000.

MANHATTAN FOCUSSING LAMP.

The Manhattan automatic focussing photo-engraving lamp manufactured by the Manhattan General Construction Co., 11 Broadway, New York, and which is here illustrated, fills a long felt want for an article which operates to the entire satisfaction of the users of such apparatus.

The continued requests for a lamp of this description which have been made on the Manhattan Co. within the past three years (during which period the company had placed on the market 15,000 "Manhattan" arc lamps)

Manhattan Focussing Lamp.

made it apparent that a lamp constructed on substantial lines and to obtain proper results, including among other features "a lamp that will burn at any angle,"

Steady light,
No sputtering,
Elimination of spots and shadows,

so annoying in photo-engraving work, would fill the bill.

The Manhattan company accordingly went into the matter and have perfected the Manhattan Photo-Engraving Lamp, which they recommend as designed to meet all the requirements for photographic and blue print work.

The lamp is portable, weighing but forty pounds, and is constructed to operate singly or two in series on direct current 110 to 220 volt circuits.

THE ENCLOSED ARC LAMP.

(Continued from page 345.)

Regulation.

The simple regulating mechanism of the enclosed lamp has a very great advantage over that of the ordinary open lamp. The series mechanism is not applicable to short arc lamps, as a given variation makes a large proportional change, whereas this is obviated by using a long arc. The current and voltage variation in both styles of lamp at starting, each on constant potential of 115 volts the open arc being one of two in series, are shown in Table II and Fig. 5.

TABLE II.

TIME.	ENCLOSED ARC.		OPEN ARC.	
	Voltage.	Current.	Voltage.	Current.
0	74.	8.1	29	18
1 second	74.5	5.2	—	—
15 "	74.5	5.	33	19.4
30 "	75.	5.1	30	21
45 "	77.	4.8	—	—
1. minute	75.5	5.3	25	22
1.5 "	76.	5.1	35	18.6
2. "	78.	4.8	38	18
2.5 "	78.	5.	—	—
3. "	81.	4.6	40.5	17.1
3.5 "	80.	4.6	—	—
4. "	80	4.7	43	16.1
4.5 "	77.5	5.	38	20.6
5.5 "	77.	5.2	—	—
6.0 "	79.	4.8	42	19.0
6.5 "	79.	4.9	—	—
7. "	77.5	4.9	41	16.4
7.5 "	80.	4.7	42	16
8. "	79.	4.9	41	16.4
8.5 "	81.5	4.6	—	—
9. "	83.	4.3	43	14.9
9.5 "	79.5	4.8	42	15.5
10. "	76.5	5.1	44.5	14
10.5 "	76	5.2	—	—
11. "	78.	5.	41.5	14.6
11.5 "	81.	4.7	44	8
12. "	80.	4.5	42.5	8
12.5 "	79.	4.6	—	—
13. "	81.5	4.3	42.8	8.9
13.5 "	76.	4.9	45	7
14. "	79.	4.6	45.5	7.2
14.5 "	80.	4.3	38.5	11
15. "	79.5	5.1	36	9.8

The voltage is that across the arc. The normal currents were 475 for the enclosed and 8 for the open arc lamp.

The normal voltage across the arc, 5 amperes, in the enclosed lamp is 80. This gives 400 watts expanded at the arc, the rest depending upon the voltage of the circuit, being wasted in the extra resistance. On a 110-volt circuit this would give $72\frac{7}{10}$ per cent. of the energy supplied to the lamp spent at the carbon points. Eighty to 85 volts seems to be as high as is desirable to get the best regulation. Some extra resistance is necessary for this, as a given change in the resistance of the arc will make a less change relatively in the whole resistance when this is large.

It might appear advisable to run a special circuit of lower voltage to feed these lamps if they are of sufficient number. To determine how low the voltage may be carried on a regular commercial lamp such as is supplied for the standard voltage, the external resistance was gradually cut out until the regulation of the current began to get poor. The lamp tested had an extra resistance of 6 ohms. The solenoid was very nearly one ohm.

On the external resistance being cut down to 3.1 ohms the current became 4.8 amperes, while the voltage across the arc was 78 and across the lamp 100. No appreciable change was noticed in the steadiness of the lamp. This arrangement consumes 480 watts, total, and 374 across the arc, which latter remains practically the same. On a 115-volt circuit, where the lamp is normally run, the watts per lamp are 552, making a saving for this particular case of 72 watts. For every 100 lamps on the 115-volt circuit, 113 could be run on the 100-volt circuit.

The external resistance was next reduced to 2.3 ohms when the current became 4.85 amperes, the voltage across the lamp 95, while across the arc it remained at 78. As the extra resistance is cut out, the value of the current is slightly increased. At this voltage the current was too unsteady and caused considerable flickering. For out-door use this would not be noticeable, but for indoor use, such as reading and the like, it would be very objectionable. All the lamps tested showed flickering on a sheet of paper held a few feet away from the lamp. This experiment of lowering the voltage was performed with a small Edison machine, varying the field resistance to give the desired voltage.

Table III will be of interest in showing the steadiness it is possible to get in current and voltage across the arc. The readings were made every two seconds on lamp No. 7. The results are also plotted in Fig. 6. Considering that the arc is constantly moving and that the external voltage is not absolutely steady, the regulation is very good.

The largest swing noticed was from 5 to 5.3 amperes. Some of the lamps vary considerably in voltage at the start, taking about five minutes before their average vol-

TABLE III.

Voltage.	Current.	Voltage.	Current.
82	6.75	80.5	5.2
82.5	5.2	80.5	5.1
82	5.1	80.5	5.2
83	5.1	80	5.2
81.5	5.2	80.7	5.1
81	5.3	81	5.2
80.5	5.1	80.5	5.2
80.5	5.2	80.5	5.1
80.5	5.1	80.5	5.2
80.5	5.2	80.2	5.2
80.5	5.1	80	5.1
80.5	5.2	80	5.2
80.5	5.2	80.2	5.2
80.5	5.1	79.5	5.2
80	5.3	80	5.1
80.5	5.2		

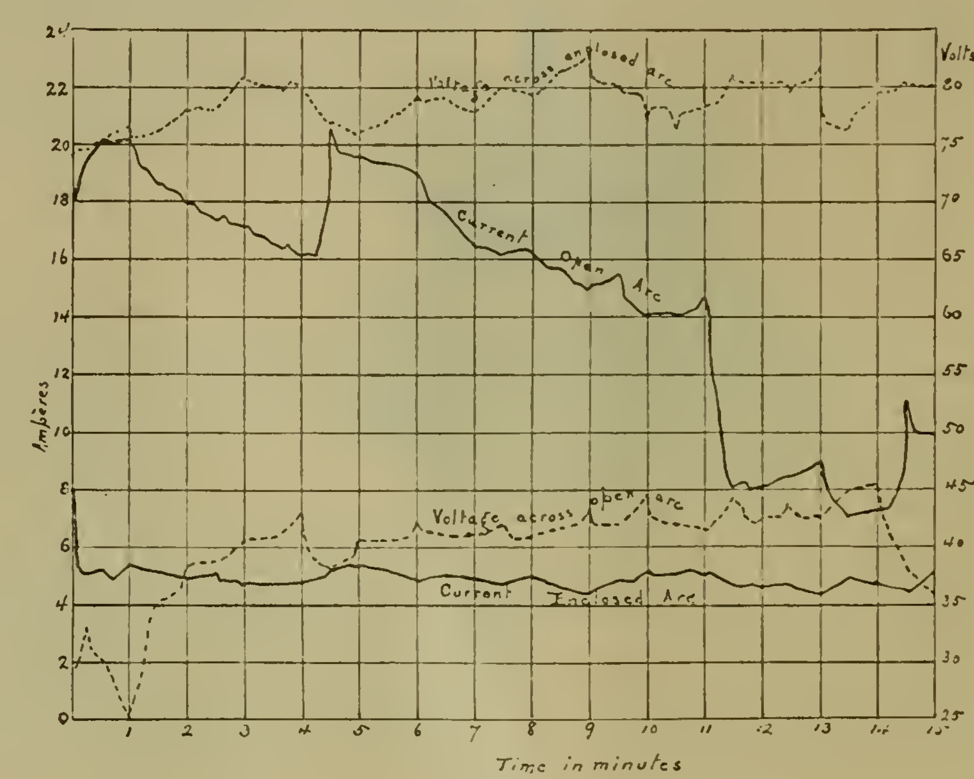


Fig. 5.

tage can be determined. The above lamp remained the same during its further run.

Table IV shows the initial rush of current compared to the average.

TABLE IV.

Lamp.	Initial Current.	Average Current.
1	8 to 9	4.75
2	9 to 9.7	5
3	8.5 to 9	4.9
4	12	5
5	7.5	4.9
6	11.3	5.15
7	6.75	5.15

This also shows the effect of loose and stiff dash-pots. The former have the advantage of taking small initial current, but are slower in falling and allowing the carbons to touch in case the arc breaks. With stiff dash-pots the carbons are forced together almost instantaneously. No better regulation, however, is secured during the ordinary running of the lamp.

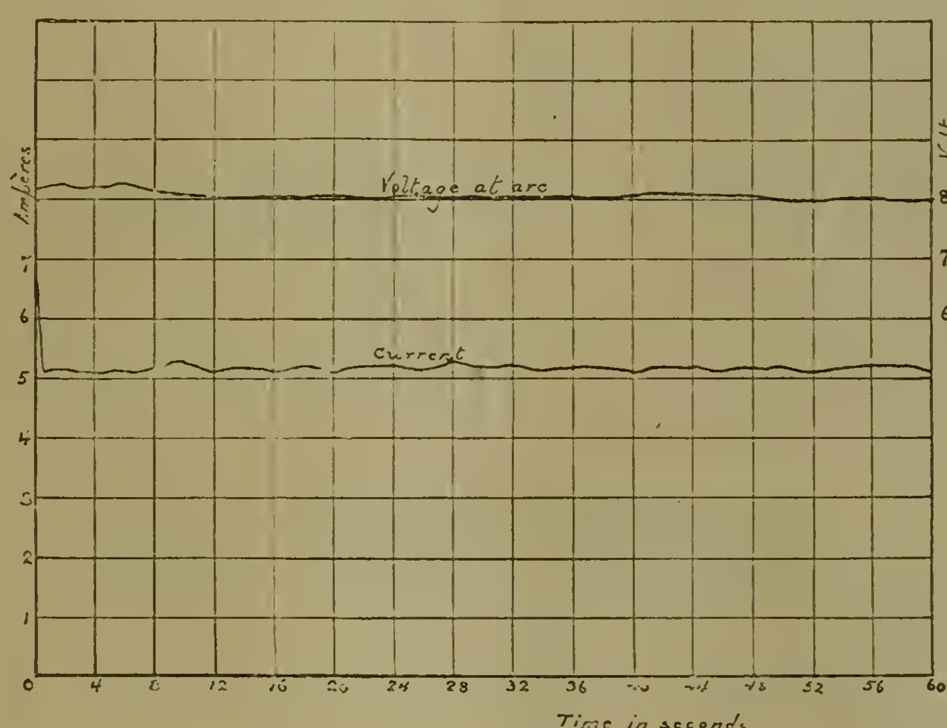


Fig. 6.

All the lamps having rods to hold the upper carbon are necessarily very long, but this can be obviated by using what is called a carbon feed. The carbon fits into a small sleeve at the top, but the friction clutch grasps the carbon itself. This gives poorer regulation, the light flickering more than when a carbon rod is used.

With brass rods, the method used for making contact is to employ a pair of brushes at the top. One of the lamps tested does not rely on this method, but uses a flexible asbestos-covered wire reaching to the end of the rod. This is an advantage over the brushes, as contact is sure to be made. When a lamp has been run for some length of time, getting the mechanism thoroughly heated, the rod gets sticky from what appears to be shellac. In one case noticed, the rod was so discolored and dirty after about 200 hours' use that the current would not pass from the brushes to the rod, the carbons being together. This shows the necessity of cleaning the rod at the end of every run. The rod must be easily and quickly detachable, or else so arranged that it can be cleaned for its whole length.

To get an idea of the variations in current of the different lamps, the ammeter in circuit was watched, and the data obtained is given in Table V. No lamp remains absolutely steady for more than a few seconds at a time.

TABLE V.

Lamp.	Regular Variations.	Occasional Variations.
1	4.5 to 5	4.5 to 5.3
2	4.5 to 5.5	
3	4.7 to 5.1	4.3 to 5.4
4	5.7 to 5.2	4.3 to 5.4
5	4.7 to 5.1	4.6 to 5.2
6	4.9 to 5.5	Flickers considerably
7	5 to 5.25	5 to 5.4

(To be continued.)

IN THE DECEMBER 16TH number of our contemporary, the Electrical Engineer, there appears under the portrait of Mr. Thomas A. Edison, Jr., a statement that reflects very much on Mr. Edison's veracity. The writer of the paragraph insinuates that young Mr. Edison cannot recall his father's endeavors to bring out the old tinfoil phonograph. The bold writer of this paragraph claims to have worked with Mr. Johnson and Mr. Bergmann on this experiment in 1877–8. Mr. Edison, Jr., was about and certainly saw the early experiments on the tinfoil phonograph as they were carried on until 1881. Exhibitions were given about the States on the tinfoil phonograph in the eighties. It is doubtful about Mr. Bergmann assisting in these experiments except at his own shop, after 1883, when Mr. Edison was experimenting with him. Does the author of the paragraph remember when he put on his first pants? There is a seven (7) year old son of Judge Gilbert, of Atchison, Kansas, who has just been granted a license to practice law. A child is gifted with memory, and Mr. Edison, Jr., has stronger recollections of his childhood than the would-be critic in the Electrical Engineer.

C. W. PHIPPS, eastern manager for The Adams-Bagnall Electric Co., with offices at 26 Cortlandt St., New York, is well satisfied with the business. Stronger prices and first-class goods is the tendency of the market. This company make only first-class incandescent and high tension arc lamps, enclosed and open.

EDWARD P. HAMPSON, formerly of 36 Cortlandt St., the popular steam-engine and power plant outfitters, has formed a company now known as The Edward P. Hampson Co., Engineers, of 26 Cortlandt St., and representing The Atlas Engine Works. Mr. S. J. J. Linher is associated with Mr. Hampson. Mr. Linher has been with Mr. Hampson for a number of years at the old stand.

C. I. HILLS, New York, manager of the New York office, 26 Cortlandt St., of The Perkins Electric Manufacturing Co., reports a good trade and advancing prices in some lines. The Perkins company are makers of incandescent specialties in cut-outs, sockets, switches, rosettes, etc.; also enclosed and open arc lamps, incandescent lamps, etc.

THE PENNSYLVANIA ELECTRIC COMPANY.

The writer desires to announce to his friends and the public generally that he has assumed the duties of Manager of the Pennsylvania Electric Company, an organization duly incorporated under the Pennsylvania statutes for the purpose of manufacturing a full line of latest improved high grade telephone apparatus. The plant and headquarters are located at Marietta, Pa. It is the intention of the company to manufacture a special line of telephones of superior merit, embodying new and distinctive features which have been suggested by reason of a long and intimate connection with the telephone business.

Our plant is equipped with the most modern machinery and every facility for producing a fine line of this class of goods. We expect to be ready to fill orders after January 1st. Circular matter, price lists, etc., are now being prepared, of which you will receive a supply in the near future.

We respectfully solicit at least a portion of your patronage. Promising in return guaranteed apparatus, reasonable prices and courteous treatment, I am,

Very respectfully,
THE PENNSYLVANIA ELECTRIC COMPANY,
by Paul W. Bossart, Mgr.

THE NEW CREDIT SYSTEM.

"There is a heap of difference," said a commercial agency man, "between the credit system now and the system of only a few years ago. When I started in business it was the fashion for the out-of-town merchant to come to the market to make his purchases. He visited the merchant he wanted to buy goods of, and whether he knew him or not, the merchant in five minutes had made up his mind whether he wanted to sell goods to him or not, and just the amount and just the length of credit he wanted to give. In very few cases was there any investigation of a man's record. The merchant simply sized his man up and then acted on his judgment. The system wasn't bad, either, for those days, for it was seldom that a merchant who had had experience in dealing with men made a mistake. You could tell then what a man was after a five-minute talk.

"But today, good heavens! you talk to a man five minutes and you probably know less about him than you did before you saw him. I mean, of course, in the matter of business standing. The merchant who tried to do business on that plan today would be bankrupt in a month if he was worth millions to start with. The man who comes in looking for credit today gets just as good a reception as he did in the old days; but after he has given his order and goes away his record is gone over with a fine tooth comb before he gets a cent's worth of credit. I don't know whether human nature has changed so that it is impossible to tell whether a man is honest now and will keep his word or not, but certain it is that you can't size a man up today by talking with him as you used to be able to size him up. More trouble is taken today to find out the trustworthiness of a man who wants $100 worth of credit than was taken twenty years ago to look up the trustworthiness of a man who wanted $20,000 worth of credit."

The carbon works of Julius Fuchs, in Nuremburg, who at one time manufactured the "Electra" carbons, are now controlled by Schiff, Jordan & Co., 232 Greenwich St., and the products of this factory, as well as the improved long-burning carbons now being made by Mr. Fuchs, will be imported exclusively by them.

Electric Street Railways in St. Etienne.—Consul H. S. Brunot, of St. Etienne, sends the following, dated October 21, 1897:

I beg leave to inform the Department that several new lines of electric street railways have just been voted by the municipal council of this city. These enterprises may afford good opportunities to our electric-plant builders to propose their machinery to the contractors of these lines. The names of the probable contractors are M. Cuffinhal, electric engineer, St. Etienne, and M. Buffaud, Rue Hotel de Ville, Lyons. Besides these urban lines, the surveys of two cross-country steam railways, each about 60 miles in length, have been completed and work is about to be commenced. Further, plans of a cog railway to the summit of Mount Pilal, a high mountain in this department are being discussed. The promoter of this latter is M. Doppler, Rue Grange de l'Œuvre, St. Etienne.

Incandescent Lamps in Colombia.—In his annual report, to be printed in full in Commercial Relations, 1896-97, Consul Bidlake, of Barranquilla, under date of October 1, 1897, says:

The manager of the electric-light plant in this city informs me that the lowest price that he has been offered incandescent lamps in the United States is 18 cents, but that he has had offers from Italy of ordinary lamps of 3.1 watts candlepower at 55 centimes (10.6 cents). He also informs me that wire can be bought in Germany at from 10 to 15 per cent. less than in the United States. In writing to me upon electrical apparatus in Colombia, the manager says:

In the country that you represent the major part of the manufacturers of this class of merchandise are sleeping upon their laurels waiting for orders to come in through commission firms. They do not study the South American market, so as to become acquainted with the requirements of these countries.

How to Further Our Trade in Mexico.—Consul-General Donnelly, of Nuevo Laredo, October 6, 1897, makes the following suggestion:

Wherever there is a United States consulate there are Americans who talk Spanish and are familiar with the business wants and methods of the community. These are known to the consul, and, through him can be put in communication with our merchants and manufacturers and made available for the work of seeking trade here with the vigor and directness it is sought for at home. This suggestion will doubtless apply to all Spanish America.

The Electrical Age.

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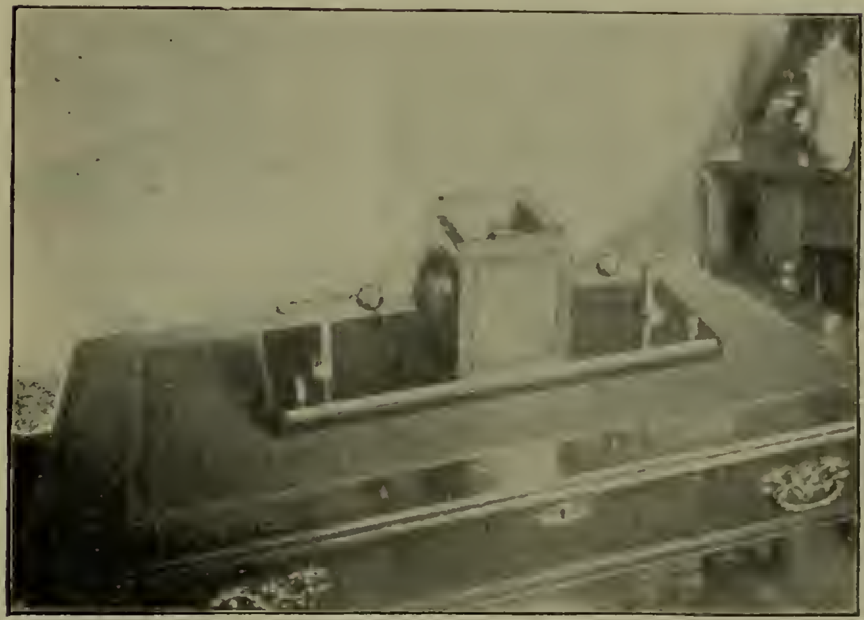
Mr. W. J. Clarke.



Device producing Hertzian Waves used in Wireless Telegraphy.

TELEGRAPHING THROUGH SPACE WITHOUT WIRES.

No field of investigation is more interesting than that which treats of a method of signalling or telegraphing without wires. To dispense with conductors after constantly having associated them with all known systems of transmitting intelligence, strikes the layman and even the scientist with feelings of surprise and doubt.

In reviewing the past history, for such it may now be called, of wireless telegraph, we are forced to consider certain interesting and important facts associated with this work. To begin with, the nature of electro-static charges require analysis, and in the light of criticism are found to be divided up into streaming brush discharges and the violent, noisy and highly oscillatory disruptive discharge. It seems as though a glow discharge is much less oscillatory if possessing any oscillations than the disruptive discharge. When Franklin experimented with the Leyden jar, he noted the loud and brilliant spark caused by the discharge. He advanced his opinions, and his celebrated one fluid theory, but it was not until the keen, analytic mind of Joseph Henry was brought to bear upon the subject of disruptive discharges that the first hint was given regarding the true nature of a high potential discharge. If the energy passed from the positive coating to the negative, a coil of wire connecting the two would certainly magnetize a steel needle in a known manner, but Joseph Henry discovered how difficult it was to depend upon any given direction of flow when the magnetizing of the needle was concerned. The polarity of the needle could not be predicted with any degree of certainty, being possibly north at one end or north at the other, as the flow of electricity from the positive inside tinfoil coating to the outer one, in some mysterious manner, could not be depended upon.

Joseph Henry's conclusion was this, that an oscillation took place, that the electricity surged back and forth in the wire in huge electric waves. The conclusion reached is unique, valuable and interesting. Sound is a product of wave motion in the air; heat, magnetism and light are now considered and known to be wave motions in the ether. An analysis of the discharge of the Leyden jar has clearly shown the presence of electric waves that radiate outward in ever-increasing spheres at the rate of

186,000 miles a second, with a length of wave depending entirely upon electrical conditions; the capacity of the condenser, the self-induction and resistance of the conductors connected to it. A light wave, such as affects the optic nerve, is one forty-thousandth of an inch in length.

By discharging a Leyden jar quickly enough, provided the jar or condenser is of molecular minuteness, the waves sent out by it would be so small and rapid as to leave an impression upon the retina, in fact, they would be light itself. Joseph Henry made this important discovery in 1840, and Lord Kelvin, in 1850, deduced the mathematical law governing such phenomena. Telegraphing without wires is successfully carried on by observing a very simple principle, that of resonance, well known in music but rather new to electricians.

The principle is this: that if a string of catgut be tuned to a certain note it will awaken vibrations in another string separated from it but tightened to the same degree of tension as itself. We can duplicate this condition electrically by building an electric circuit which sends out waves due to the discharge of a Leyden jar and having some distance away from it a similar circuit with a break in it, a spark gap which will respond to the discharges in the first circuit by a flow of energy of greater or less degree, according to the success with which the electric tuning has been carried ont. To establish this condition the self-induction, resistance and capacity of one circuit must be equal to that of another. This is the reigning condition required for any style of communication of this nature without wires. The apparatus illustrated above is built upon these principles and consists of a spark coil, a discharging device and a receiving device. The transmitter or discharging apparatus is placed at a distance of from ten feet to eight miles from the receiving device.

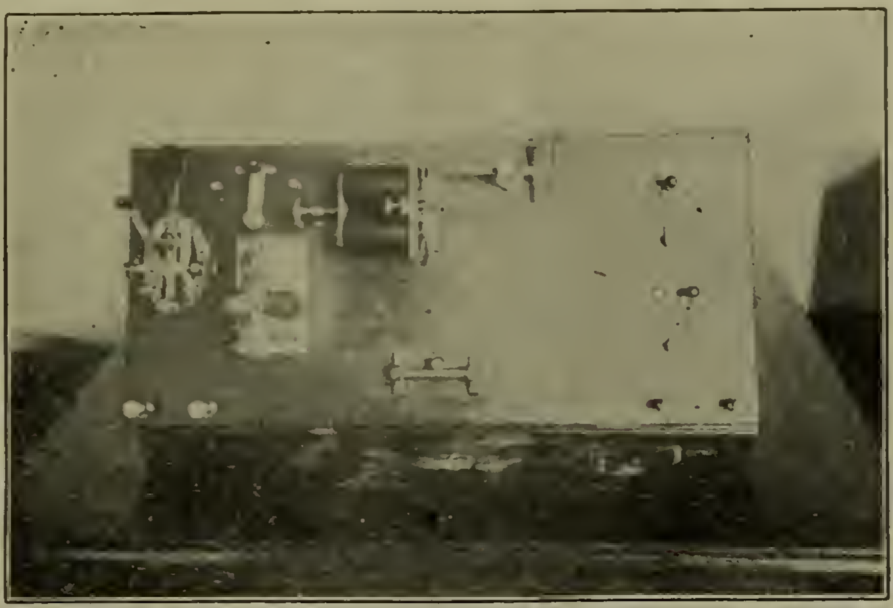
The writer has operated this outfit and had two men in line so that the signals passed through their bodies. They were entirely unaffected and the receiving device operated with undiminished vigor. Prof. Lodge suggested the use of a tube filled with iron filings in circuit with a galvanometer and a battery, the filings not being in actual contact with the terminals at each end of the tube. When a discharge occurs in the transmitting device the electric waves surge forward, strike the receiving end, excite a series of minute sparks in the tube and thereby allow the battery current to flow for a moment, moving the galvanometer and showing that a signal has been sent. The powder is affected by the waves as though its resistance was suddenly decreased whenever permeated by them. This tube is called the coherer, and when used in conjunction with Prof. Rhigi's apparatus makes telegraphing without wires a practical and successful achievement.

Prof. Rhigi, of Verona, made use of a smalll Holtz machine, which he discharged into a very simple piece of apparatus which might be called a transmitter. It consists of a cylinder plugged up at each end with a brass sphere and filled with oil. Separated from each of the brass spheres is another pair of spheres. By sending a discharge through this system from the Holtz static machine the electric waves (produced between the two spheres closing up the cylinder of oil) will be very rapid and only a few hundredths of an inch in length. Prof. Rhigi did not use a coherer, but a sheet of tinfoil on glass with a very fine cut run through it. When the discharging spheres (the two closing up the cylinder of oil) were tuned electrically to resonate with this tin-foil, sparks would appear between the two edges of it when a discharge occurred in the transmitting device. It is possible to reflect the Hertzian waves forward the same as light or heat. Prof. Hertz made use of parabolic mirrors, but recent investigations seem to show that a plane mirror is more serviceable because waves having the greatest reach are long waves, which waves are more easily projected by means of a flat and polished surface.

Complete outfit for Wireless Telegraphy, including spark coil, transmitter, coherer and Morse Telegraphic Apparatus.

To telegraph over long distances two general courses are open, to either produce very heavy discharges, using no mirror and trusting to their reaching the spot aimed for, or use weaker discharges and reflect them forward to a given distant point. The investigations of Bjerknes have shown that the height of electric waves changes as they recede from their origin, and that long waves are preferable to shorter ones for long distance signalling. The use of very powerful discharges is necessary for the production of long waves, and by using a mirror the rapid decay that ensues can be temporarily delayed. A light wave travels with uniform amplitude but it differs in this respect from a Hertzian wave, which constantly decreases as it recedes from the transmitting spark gap.

With Clarke's apparatus, illustrated above, it is possible to signal over distances of several miles. It consists of a spark coil, a transmitter, composed of an oil cylinder and discharge knob, as above described, which send the Hertzian waves forward with the speed of light. The receiving device, the most important part of which is the coherer, is a Morse telegraphic outfit, key, sounder and relay. In circuit with the relay are the coherer and a few dry cells. The waves strike the coherer, cause a spark to jump from side to side of the metallic powder, thereby allowing the battery current to act, operating the relay. The filings in the tube are separated in the middle by a slight air-gap and the co-herer is prevented from packing by the use of a vibrator which taps it whenever the current flows. Very distinct signals are produced by this apparatus. The transmitter may be started in front of a house and the receiver will answer with clearness, if placed in the yard, the signals passing through the entire structure. Bricks, mortar, hills and men are as transparent as crystal to these invisible waves. Mr. W. J. Clark has apparatus on exhibition at 120 Liberty Street, New York City. He will correspond with those desiring information on the subject and can supply outfits of the above nature to reach any reasonable distance.



Board mounted with sounder, key, and relay with coherer in circuit. (Coherer at lower part of board in middle.)

PROF. WILLIAM RAMSEY has given to the British Association his opinion that there is an element, as yet undiscovered, lying between helium and argon, when arranged according to the "periodic law." While experimenting with helium, in the attempt to purify it by rediffusion, it was found that this gas could be separated into a heavy and a light part, with densities of 2.0 and 2.4; continuing the experiment, after as many as 180 diffusions of helium, the density of the lightest portion remained constant at 1.98, and its refractivity to light as compared with air was 0.1245—the spectrum, too, not differing from helium, one element may therefore be considered as isolated as pure helium. The residue is easily altered in density by rediffusion, implying a small quantity of heavy gas mixed with a large quantity of light gas. The spark spectrum revealed argon in the mixture to the amount of 1.64 per cent. by density and 1.14 per cent. by refractivity, leading to the supposition that the new gas is contained as a very small proportion of argon. Neither helium nor argon form compounds, so that the new element as demanded by the "periodic law" must be determined by diffusion—this method, however, does not reveal the existence of such a gas, though it by no means follows, Prof. Ramsey holds, that there is no such gas.

Transmitting device undergoing adjustment by Mr. W. J. Clarke.

CANADIAN LETTER.

Gatineau Point, Que.—Wm. Smith has been given the contract for electric-light system. The plant will be installed at once. M. Dupont, C. E., of Montreal, made the plans.

Montreal, Que. — Noble & Barber, electrical contractors, have started in business in this city. The successors to the electrical supply business of C. W. Henderson, are Taylor Telfer & Co., and will commence business at the same stand.

ELECTRIC HAULAGE ALONG CANALS.

It is strange to realize that in the history of canal construction, which dates back to the days of Rameses in Egypt, little or nothing has been done to improve the ancient and honorable method of dragging canal boats through the water.

Canals form so important a part of any country's commercial equipment and add so much to the facilities by which freight is transported that no doubt whatever should exist as to the great advantage derived from the use of a practical and efficient system of towing boats along a canal. In this country the Erie canal, the D. & H., the Baltimore & Ohio and others of minor importance, utilize today what was in vogue in Holland, when the Spanish invaders landed on its shores. But fortunately a change has occurred which shows a spirit of enterprise on the part of American inventors and has brought particularly to our notice the work done by Adam E. Schatz, of New York City, who has decided to displace the ancient mule with a device whose kick need not be feared and whose pull is certain, effective and uniform. Judge Schatz has invented and built an electric mule which moves upon a single rail and is supplied with a gear engaging with a rack, as shown, beneath the rail. The rails and rack are raised about one or two feet above the ground, being supported upon short posts, and attached firmly in position are two copper conductors, which supply current to a motor actuating this device. The motor operates a set of gears and moves the apparatus by turning the gear engaging with the rack. The great advantages of this method of traction are in many respects obvious. The necessity of having a heavy weight to procure traction with disappears. The motive power, or machine from which it is derived, can never slip, and the energy transmitted through a train of gears to the rack gives us a positive and reliable means of propulsion. Five of these vessels can be moved at the rate of five miles an hour by an electric mule weighing seven hundred and fifty pounds and consuming about eight horse power. The arrangement is readily controlled by a lever operating a switch, the operator sitting upon the locomotive itself, or if necessary light ropes may be run from the lever to the boat and controlled by a man on board. Another advantage that appeals at once to the reflective mind may be introduced as follows: any system which lifts one end of the canal boat undoubtedly tilts the other end, making it dip deeper into the water and probably scrape along the bottom. When the mule is used it is given a long stretch of rope so as to have the motive power as nearly in line with the surface of the water as possible; that is, in a horizontal plane. In the system developed by Judge Schatz, this advantage still remains as a prominent feature; the electric locomotive with rack and pinion serves the same purpose and has the same steady pace as the customary mule.

The electric mule is very compact, being one foot wide, two feet long and about three feet high, and is in the opinion of competent engineers, the simplest and cheapest contrivance for this purpose ever constructed.

The cost of transportation by railway and canal may be understood by comparing the following columns of figures:

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

From the above table, compiled by Mr. Conder for the Select Committee on Canals, a copy of which is found in "Engineering," June 18th, 1897, it will be seen that transportation by railway costs three times as much as the moving of freight by canal. This is a comparison instituted between a steam road and a canal boat system. There is no doubt at all that the figures relating to canal boat propulsion would be cut in half by the installation of the Schatz electric system. The advantage being that the cost and keep of a mule as well as a man would represent in the electric system of propulsion the cost of power for towing not only one boat, but many boats. The ratio of costs between a well installed electric system and the old fashioned method with mule would be as one is to two; in such a case the ratio of cost between steam railway transportation and electric canal haulage would be about six to one.

It would not do to attempt to change the present canal boat in any manner whatsoever or to add to it a special propulsive device. It must be left alone, and the power controlling it operate along the regular track. An overhead electric system would lift the boat in the manner above described and the tractive force be of a very limited nature, as proven by experiment. Along the route of a canal we usually find villages from ten to twenty miles apart, in which, if necessary, small power plants could be installed; or, if they already contained an electric light plant, power could be fed at a slight expense direct to the conductors supplying the motor. In winter, when the canals freeze and snow falls to the ground, transportation might temporarily cease, but in wet weather or storms there would not be as great a difficulty in operating this system as an ordinary stretch of trolley road. The reinforcement of power along the route would not involve much expense, because with five hundred volts pressure but twenty or thirty amperes would be called for on any occasion. The drop in the line would consequently be very slight and the cheapest possible feeder system might be installed.

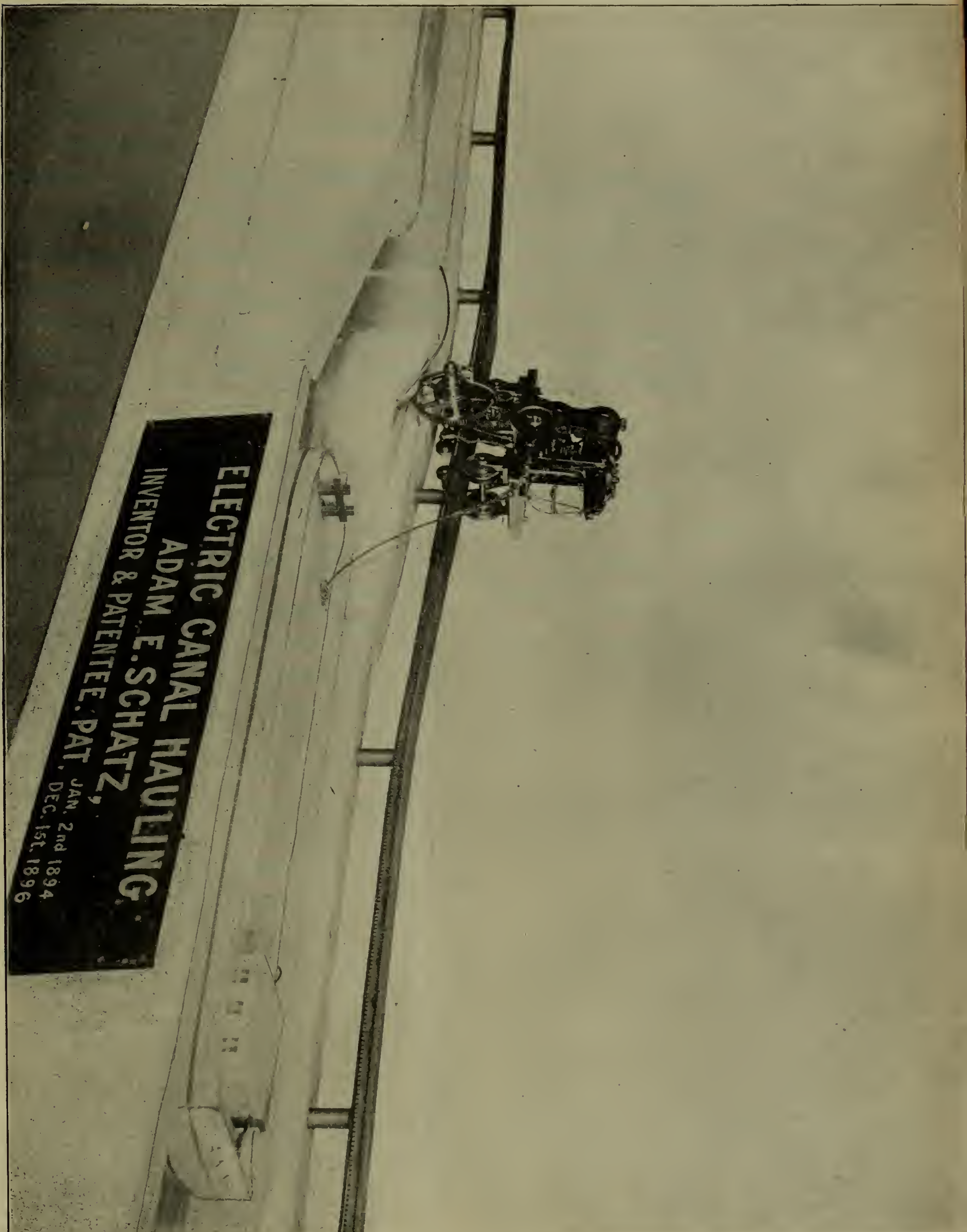
Judge Schatz has carefully studied this problem of canal haulage and would be pleased to show visitors his working models and explain whatever details may be required. His address is 63 Park Row, New York City. The universal adoption of an electric haulage system is inevitable, and when the engineering fraternity and commercial world fully realize the importance of giving it the proper attention, millions of dollars will be saved by concerns whose bills for transportation respectively annually represent a large fortune. The State of New York has spent $9,000,000.00 improving the Erie Canal and they demand $5,000,000.00 more. In spite of all this great sum that has been invested, mule power is still employed. If the State installed a simple and practical system as described it could charge low rates like any private concern, commensurate with the amount of freight

The time consumed in side-tracking a freight train is such that, with an electric-canal system, goods could be shipped in one-fifth the time at about one-fifth the expense

The adoption of this system would be a great incentive to manufacturers to build along the line of a canal where their facilities for transportation would be controlled by themselves and always be at their disposal at a minimum cost. The State of New York should devote $1,000,000 to the construction of the Schatz system of electric-canal haulage and thus develop cities along the entire canal where now we find deserted wastes.

Who can measure the vast value that such a system would be to the city of New York which, by its natural conditions, should be the port of the world?

The cereal products of all the great States bordering on the great lakes would be shipped to New York harbor, and thus the harbor of New York would become the funnel through which the wealth of the American nation must pass to be distributed to the world. This would develop the ship-building industry of which New York stands so much in need, and bottoms carrying the ters would have by being able to send their heavy freight direct to those States that border on the great lakes of



American flag would be seen on all the waters of the world. Again, imagine the advantage that the New York impor- this continent. The opinions of our friends regarding this nuuber will be found in the next issue of Elect. Age.

THE ENCLOSED ARC LAMP.

(Continued from page 368.)

Photometric Tests.

The figures given for the candle-power of the lamps when using different globes are only approximate on account of the difficulty caused by the difference in value of the standard source of illumination and a constant voltage, obtained by the use of several resistance boxes in parallel and all in series with the lamp. This lamp was recalibrated at frequent intervals.

The inner globes furnished by the different manufacturers vary in density, from a globe that will show the unlit carbons inside very plainly, to a form that is so dense as to be translucent, but not transparent. This latter form diffuses the light better than a thinner globe, although cutting off more light. All the opal globes, when held up to a window, show a reddish orange color,

Fig. 9.

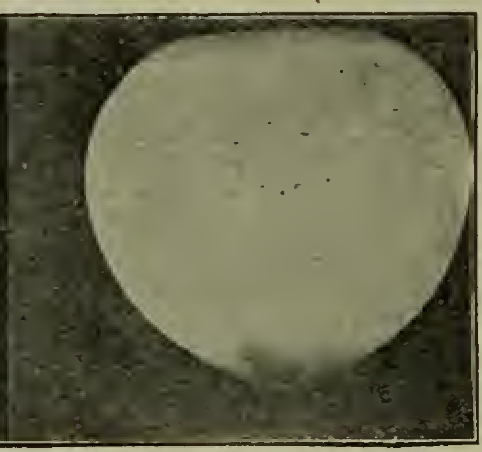


Fig. 10.

the arc, the very marked difference in the color of the light (the arc being violet around the horizontal plane and white below it. while the incandescent lamp gave an orange light even when run above its normal voltage), the wandering of the arc, and the personal error in comparing the lights. In making comparisons of the intensity of the lights we used a pencil photometer, determining the relative values of the arc and the standard lamps by means of the shadows cast by a pencil on a white card, the illumination at different angles being obtained by raising the lamp with a rope and pulley. If the carbons were not kept exactly centred, the angle of maximum which has the effect of softening the violet light cast by the naked arc. The use of a fairly dense opal inner globe and a light outer globe gives a soft light that is pleasing to the eye and free from shadows. Figs. 9 and 10, which are reproductions from photographs, show the shadow cast when a clear inner globe is used, and the softening effect of an opal inner globe, which makes a light entirely free from shadows, not even the side rods showing. When an opal globe is used, it appears like a solid source of light. It is this effect that does away with the shadows of the side rods. The shadow cast by the bottom of the lamp is also made very small, so that the effect

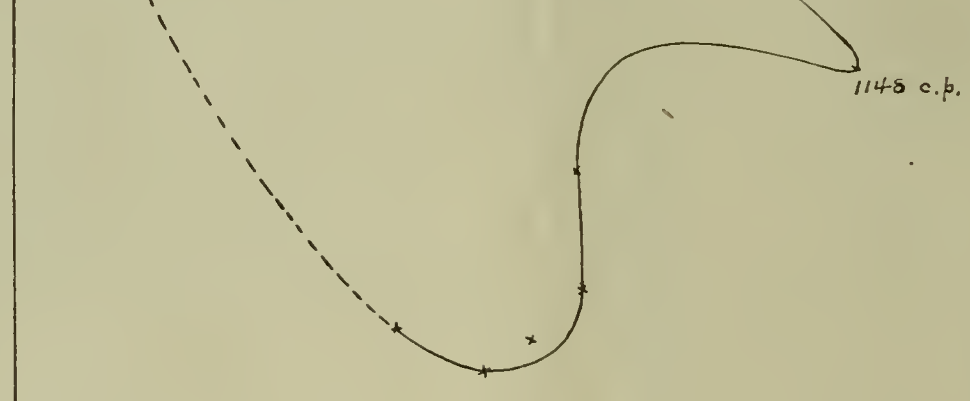


Fig. 11.

intensity could be shifted all around. Our figures for the different angles were obtained by taking the mean of about ten readings, taken around the surface of a cone whose slant is the same angle as that of the given angle. These mean values were then plotted, and from the area of the resulting curve the value of the radius of a circle of equal area is calculated. This radius gives the value of the mean hemispherical candle-power, as the case may be.

By means of a standard candle (British, having a 45 millimetre flame) an incandescent lamp was calibrated at to the eye is that of a bright, even illumination, apparently as much as the illumination from the naked arc, although the intensity has been cut down considerably by the globes. This is due to the fact that a light very intense in one spot seems to give no more illumination than a diffused light of smaller total value.

The distribution given by an open arc lamp is not the same as that from an enclosed arc lamp. The maximum in the latter is at an angle of 25 degrees below the horizontal, instead of 40 degrees. The intensity, after decreasing, reaches another high value at 40 degrees, but

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NEW YORK, DECEMBER 25, 1897.

CONTENTS.

THE TRANSMISSION OF ELECTRICAL ENERGY WITHOUT WIRES.

The student of electro-technics is well acquainted with the fact that the energy flowing in a wire is measured by the product of the current strength and electro-motive force. The means by which we measure this power is a relative and indirect one. Not only is this true in the case of an electric current, but doubly true when we measure gravitation, heat, magnetism or light. We are forced to institute a method of comparison and refer one force to another in examining it from a quantitative standpoint. To speak of the transmission of electrical energy without wires is to refer to a subject that has always aroused wonder in the layman's mind. Yet, when we realize that energy is naturally transmitted through space without the aid of a visible medium of communication, the fact that electrical energy can be and has been transmitted without wires should fall in line with many of the other manifestations so familiar to us. The phenomenon of gravitation is the basis from which we derive all our units of physical measurement; yet gravitation itself remains today an unexplained phenomenon. It is true that attempts have been made to give a reason for gravitative action between all bodies in space; the idea of a great ether ocean having a tide has been advanced, and although we know that the luminiferous ether is the medium by which all force is transmitted, the mystery is still as great as ever and will never be fully understood until we comprehend in a better sense the intimate relations existing between a molecule and its ether atmosphere. Not only is gravitation an ever-present illustration of energy transmitted without a so-called material medium being present; but light, heat and magnetism afford additional proof of the fact that action at a distance is one of the commonest sights presented to our field of vision.

The immensity of the stress causing gravitation is calculated by Williamson to be equal at the earth's surface to 4,000 tons to the square inch. The remarks of L-Sage and Clerk Maxwell, Challis and Lord Kelvin all coincide in the belief that action without other than an ether medium between bodies, is absolute proof that tremendous stress exists in the ether itself. When electrical energy is transmitted from point to point without wires, it is only through the close association existing between the ether and the centre of disturbance that ripples are set up of greater or less amplitude in this ever-present medium and transmitted to a device so adjusted that their reception is indicated by a spark. In other words, if we create in the ether ocean waves of light having a definite length and rate of motion, we can reabsorb this energy to a large extent and use it for the manifestation of power although a distance of miles may separate the first apparatus from the second. We do not as yet clearly understand the circumstances under which energy can be transmitted economically without the aid of wires. So far as we have gone effects have merely been produced which represent a great expenditure and waste of power. A better knowledge of the function of ether and a clearer insight into the nature of the multitudinous waves produced in it by various causes will bring down this higher study of kinetic optics to a comprehensible and practical basis. Untold millions of horse-power are being rained down upon us daily in the form of sunlight. Could some of this energy be gathered up and saved for use, daylight itself would provide an inexhaustible source of power from which we could draw for untold ages to come.

THE DEVELOPMENT OF WATER WAYS.

The present method of transporting freight is one which manufacturing concerns have become accustomed to, because they are not fully aware of the facilities offered by our great American canals. The Schatz system of electric haulage along the banks of a canal clears the way for a vast amount of enterprise. Were water-power used to supply energy to an electric system of this kind, it would in nature be so self-contained that it would certainly represent the acme of cheapness and convenience in transportation. If some of the inexhaustible fund of energy ceaselessly pouring from Niagara was turned from its source and used to move boats laden with freight and merchandise, along the Erie Canal, the practicability of this scheme and its success would so strongly appeal to those controlling the right of way to other canals that the utilization of an electric system of canal haulage would be regarded as the cheapest and best method in existence—the only true solution to a problem of so much national interest.

YE MERRIE CHRISTMAS.

The good ships Speedwell and Mayflower brought from England the hardy pioneers through whose energy, resolution and simplicity of life a solid foundation was laid upon which rests the pride, prosperity and independence of the Union. They brought Christmas with them across the dreary wastes of waters, and as year after year rolled by heralded its approach by preparations no less than our own. Fierce battles were fought with savage tribes and fierce struggles engaged in to procure food and a protecting roof. On Christmas-day the Puritan's home was decked with garlands of greens and holly and the odor of browned goose and steaming pudding made the day dear to the hearts of children and parents. Times may have changed, but our own appreciation of Christmas-day is as great as that of the Puritan fathers. In the midst of their struggles for life and independence they forgot it not. We say to our friends, rest and participate and enjoy the fleeting moments as they pass. We wish all our readers, from the bottom of our hearts, "A Merry Christmas."

not as great as at 25 degrees. We can give no explanation of the peculiar form of the curve obtained with clear glass, except that it is due to the globe, as a naked arc would seem to have no cause for the uneven curve as shown. The general variation is shown in a test on the Manhattan lamp by Houston and Kennelly (Fig. 11).

The comparative distribution of light in both forms of arc is shown by Table X. The figures given for the open arc are those of Wybauw[1], Palaz[2] "Industrial Photometry," p. 236.

These are comparative, not absolute values. It will be seen that the enclosed arc gives a wide zone of illumination that is not far from the maximum.

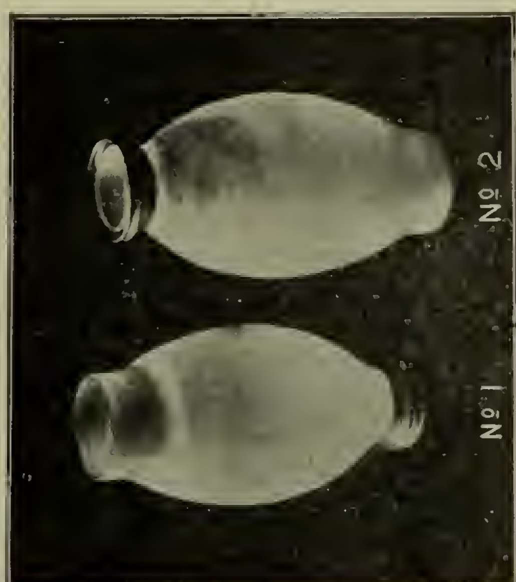


Fig. 16

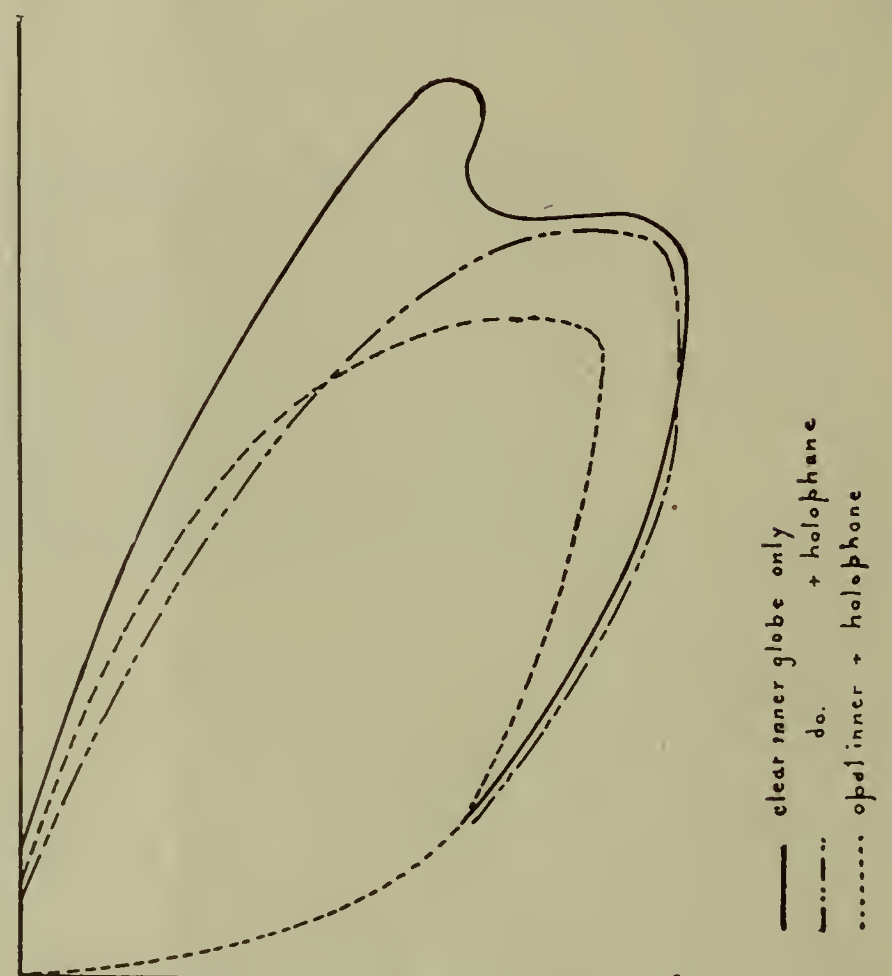


Fig. 13.

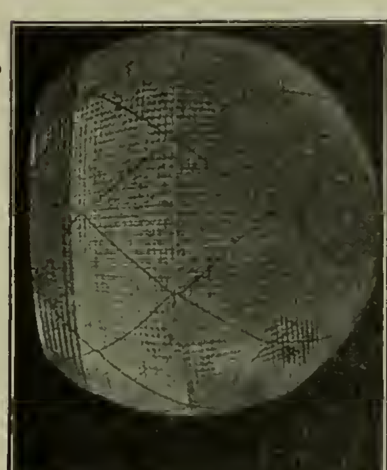


Fig. 15.

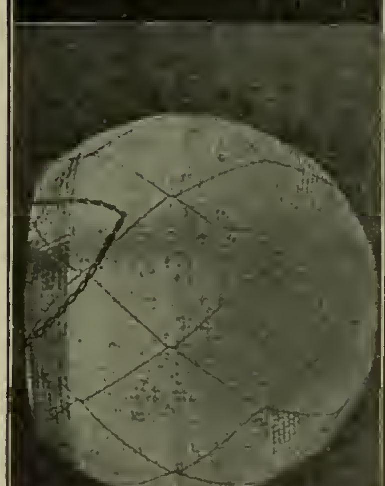


Fig. 14.

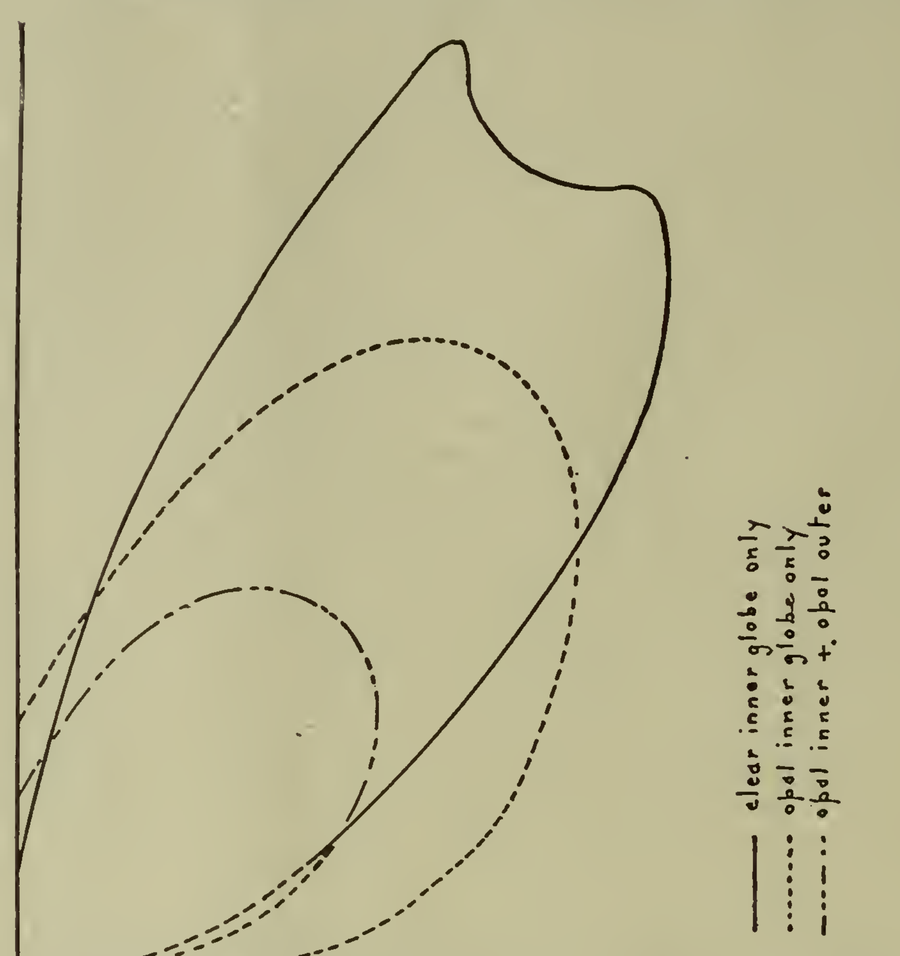


Fig. 12.

TABLE X.

ANGLE BELOW HORIZONTAL.	ENCLOSED ARC.	OPEN ARC.
0	132	208
10	455	401
20	755	612
25	1000	
30	900	871
40	990	1000
50	838	807
60	548	457
70	465	188

TABLE XI.
Clear Inner Globe.

ANGLE FROM HORIZONTAL.	CANDLE-POWER.
20 above	89
10 above	82
0	139
10 below	501
20 below	980
25 below	1397

30 below	1300
40 below	1355
50 below	1060
60 below	674
70 below	414
Mean hemispherical	850

The actual values with a clear inner globe, obtained by us, are shown in Table XI. Replacing the clear globe with an opal one, we obtained the values given in Table XII. All of these results are shown graphically in Fig. 12.

TABLE XII.

Opal Inner Globe.

ANGLE FROM HORIZONTAL.	CANDLE-POWER.
20 above	152
10 above	184
0	347
10 below	455
20 below	735
30 below	985
40 below	1050
50 below	969
60 below	855
70 below	734
Mean hemispherical	770

With opal globes, the angle of maximum illumination is at 40 degrees, the same as in the open arc, and the reading for 25 degrees was between the values for 20 and 30 degrees. This particular opal globe cuts off at least 10 per cent. more light than the clear globe.

Light Cut Off by Outer Globe.

The amount of light cut off by the outer globe varies according to the angle for a given globe, as well as for different globes, the actual figures found being from 34 per cent. to 40 per cent. for the same globe, the highest value observed for any globe being 50 per cent. This effect is shown by Table XIII.

TABLE XIII.

Angle below horizontal.	Candle-Power. Opal inner globe.	Candle-Power. Opal inner and outer globe.
0	184	123
20	844	442
40	1110	568
60	327	180
Mean hemispherical	652	380

Holophane Globe.

This is a globe of clear glass, made with vertical grooves inside and horizontal grooves outside. It is from the design of Blondel, and theoretically each groove has a different outline through its section.[1] The object is to get as near a perfect diffusion without loss from absorption as possible. Practically, the globe is made in several zones having the same form of groove throughout a given zone, but different in the next one. The most noticeacle change we observed from its use was in the horizontal diffusion. For a given angle, the readings in different directions around the lamp were very nearly alike, whereas in the ordinary globe these readings were sometimes in as high a ratio as 1 to 3.

TABLE XIV.

Angle below horizontal.	Candle-Power. Clear inner globe.	Candle-Power. Clear globe and holophane.	Candle-Power. Opal globe and holophane.
0	171	96	137
10	380	335	252
20	974	496	639
25	1289	783	820
30	1173	1043	950
40	1278	1255	1116
50	1081	1051	915
60	707	852	707
70	600	629	604
Mean hemispherical	854	776	700

1. For a full description of the "Holophane Globe" see Electrical World Jan. 23, 1897, by E. L. Elliott.

The effect of the holophane globe on the distribution is shown by Table XIV, and Fig. 13.

The holophane globe, therefore, reduces the light through a clear globe only 9.2 per cent. This seems very small, but a test given in the Electrical World, Nov. 10, 1894 (Digest), gives two values, 13 per cent. and 9 per cent.

The appearance of the globe to the eye is different from the opal globe; it has a whiter looking light, and appears darker in portions, whereas the opal globe appears of even brightness. A comparison of Figs. 14 and 15 with Figs. 9 and 10 shows this. Really, none of the globes are exactly of the same brightness all over, as, in the development of the negative, only a portion appeared at first, and not the whole area.

The combination of opal and holophane given above reduces the mean hemispherical candle-power 18.1 per cent from that given through a clear globe.

To sum up, we find:

For two clear glass globes, allowing 5 per cent. to 8 per cent. absorption for the outer one, the watts per candle are about 0.5, and the candles per watt 1.9;

With opal inner and clear outer, watts per candle 0.56 to 0.60, and candles per watt 1.7 to 1.5;

With both inner and outer opal, watts per candle 0.9 to 1, and candles per watt 1.1 to 1.

Also, the efficiency from the use of the holophane globe was but little less than with the ordinary clear outer globe, some of the latter not appearing to be of good quality.

Light Cut Off by Deposit on Inner Globe.

The advantage of long life, obtained by the use of larger diameter or greater length of carbon, is reduced by the fact that the deposit formed on the inner globe cuts off considerable light. In the early part of the run this is not objectionable; but it would seem advisable not to have a run of over 130 to 140 hours. The deposits all varied in density in the same general ratio, the thickest being at the top, and the bottom slightly heavier than the middle. The coating was analyzed, and found to contain ferric oxide at the top, silica all over, and carbon dust at the bottom. In some cases it was impossible to clean the globe properly without the use of water. (We are informed that the New York Edison Illuminating Company requires its trimmers to carry extra globes with them, so that if any are still hot, the use of a wet cloth is not required until they can be cooled, the extra globe being substituted.)

The two globes shown in Fig. 16 show a deposit in one case that came from the brass cap, fusing into the glass so that water would not remove it; in the other it is a deposit of carbon, also fused into the glass. The carbon rod had burned to an angle of nearly 45 degrees, and the particles were projected right along this line.

The amount of light cut off by deposits on inner globe is shown by Table XV. As the arc is low down in the globe at the end of the run, the deposit at top has little effect. The middle and bottom are the important parts.

TABLE XV.

TEST.	TOP OF GLOBE.	MIDDLE.	BOTTOM.
a	30 p. ct.	20 p. ct.	20.5 p. ct.
b	48 "	18 "	———
c	60 "	14 "	16 p. ct.

Insulation of Lamp.

The tests made were with the tail-piece as one terminal, and the rest of the lamp in turn as the other, the terminals of the lamp itself being included; also, between the shell and the lamp, terminals. Only lamps Nos. 4, 5 and 7 were completely insulated.

Conclusion.

To sum up, we find these advantages of the enclosed arc over the open arc lamp:

Long life, and consequent saving of carbon, trimming expenses and annoyance from frequent renewals;

Pleasant light, free from hissing and spluttering, and with very little flickering;

Absence from flying dust and sparks, and fireproof qualities resulting from the use of two globes;

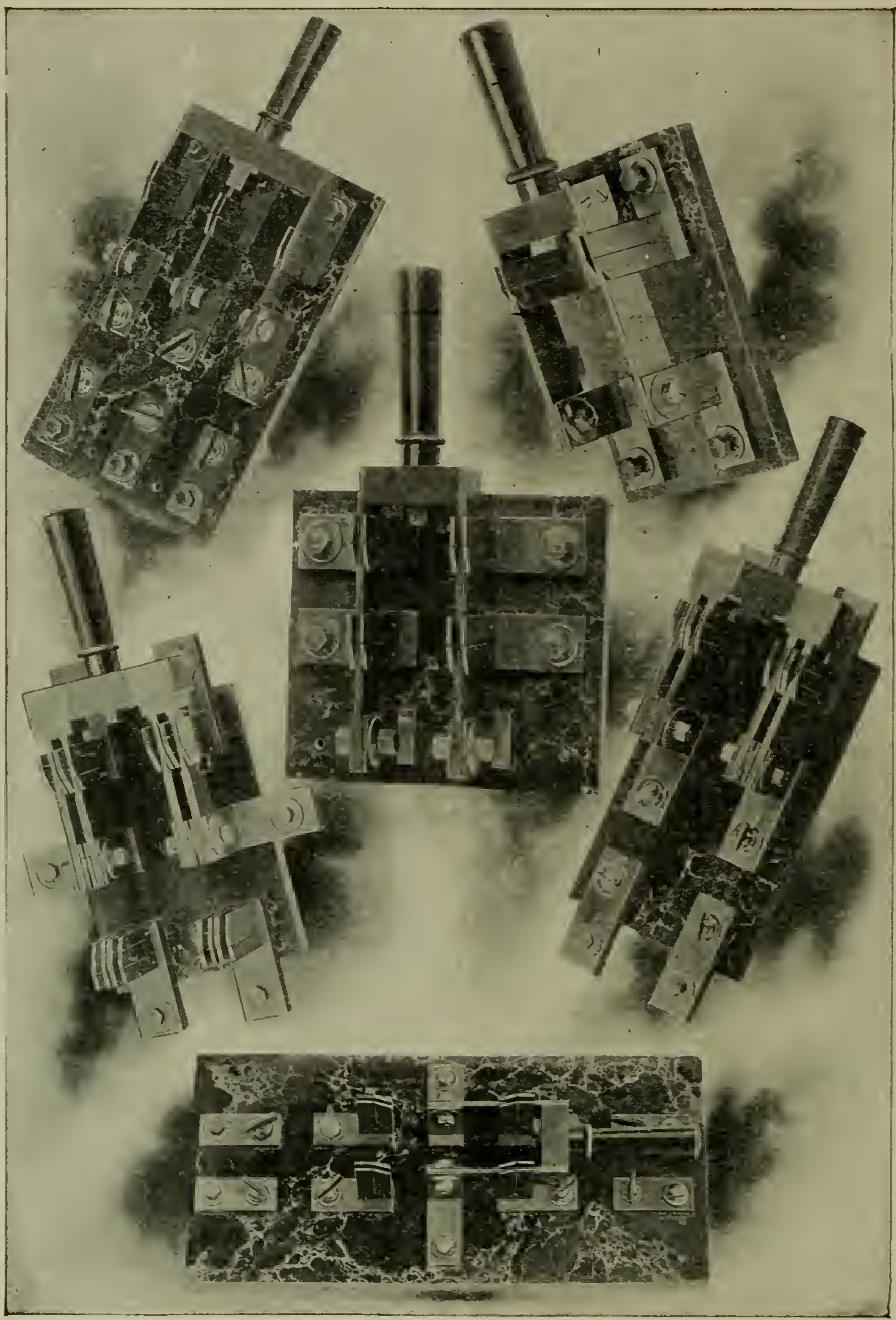
Being run on the incandescent circuit, there is no danger from high potentials, and no need of an automatic cut-out;

Simplicity of mechanism, and consequently, less need of repairs.

Brookville, Ont.—A rumor is current that an electric ... will be built in the spring.

SOME REMARKS ON HIGH GRADE ELECTRIC LIGHT AND POWER SPECIALTIES.

A great deal of trouble has of late been experienced by electrical contractors and supply houses in obtaining certain classes of electrical apparatus of a really first grade quality. When a buyer stops to examine his purchase he in many cases finds that the article has been constructed of an inferior quality of material and loosely thrown together, most likely by inexperienced boys who



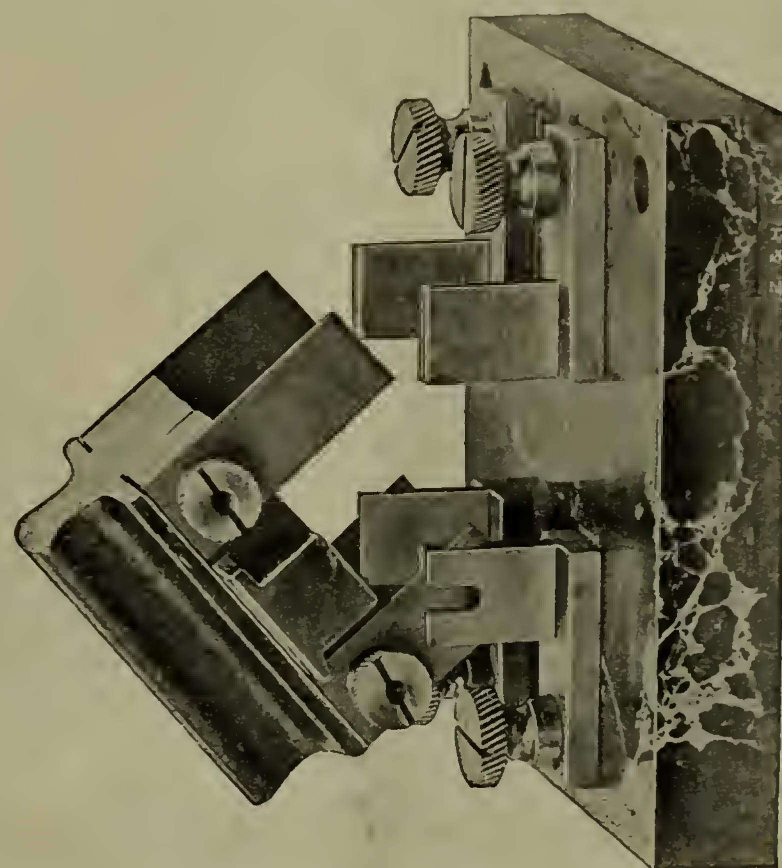
Zimdars & Hunt, two and three wire, single and double throw switches.

know nothing of the function of the article they are making and care less.

This very undesirable state of affairs has primarily been due to the recent depression in business with the consequent scramble to cut prices and get orders; but as the manufacturer has operating expenses to pay, and in some cases aims to get a little profit out of his business the logical result is that the quality of the product is cheapened and the purchaser is the actual sufferer.

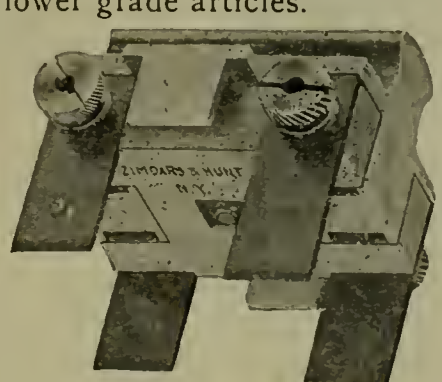
But the reputable contractor or supply man has a reputation to sustain and hopelessly looks about for some remedy.

To them it will be gratifying to learn that there are still a few manufacturers who have steadfastly refused to cut their prices down to that point where a reduction in quality becomes a necessity, and who are now offering apparatus of a quality far in advance of anything heretofore offered, and at tempting figures; notably among these being the firm of Zimdars & Hunt, of 127 Fifth avenue, this city.



Zimdars & Hunt Removable Fuse Holder Switch

This concern, one of the oldest and most reliable in the business, have approached the problem of getting prices down from another direction, namely, by the introduction and use of new and improved machinery and the employment of none but skilled and experienced mechanics. This, supplemented by the perfect system in force at their factory, accounts for the fact that they are now supplying their Electric Light aud Power Specialties of a quality unknown heretofore at prices one has been used to paying only for the lower grade articles.

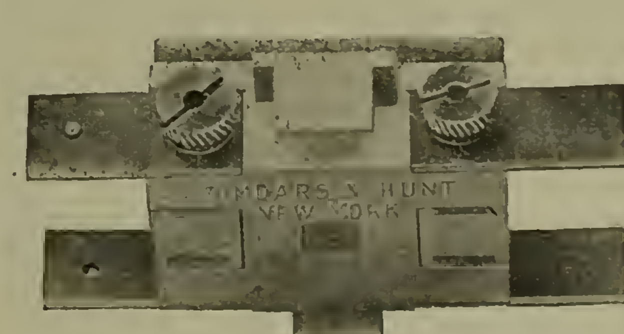


Removable Fuse Holders.

In their catalogues just issued, a fund of useful information to the buyer will be found. Catalogue "A," dealing with knife switches, switchboard fittings, etc., covers this line thoroughly. Starting at the beginning with the standard type and knife switches, the other articles follow along in their logical order. Many things in this catalogue will make their impression on the reader; a variety of switches are shown suitable for all purposes—single break, double break, quick break, high voltage, low voltage, and so on. The great variety of connecting lugs illustrated and listed here will appeal with special force to the supply man who has had to content himself heretofore with a mixed assortment, very few of which were alike and totally unsuitable for his customer's needs. Here he will find them of all sizes and types and suited for all classes of work, listed in such a manner that he can have no difficulty in selecting the exact lug his requirements call for.

The back connections shown represent a radical departure from existing methods, making a distinct step in advance that no manufacturer before has dared to take. Anyone familiar with the difficulties encountered in working soft copper can testify to the progressive spirit of this concern and their determination to keep their productions in the lead, when it is stated that this is the metal that they are now using for their back-connection studs—the best grade of Lake copper, specially drawn for the purpose. The special machinery installed for threading this copper alone has cost a very considerable figure. Before closing this catalogue the reader should not fail to note the instrument switches shown and compare them with those that he has been accustomed to using.

Catalogue "C" deals exclusively with Automatic Switches and Motor Starters, a variety of types being shown, each specially designed for its particular purpose. Many unpleasant experiences with devices of this kind



Removable Fuse Holders.

which have been placed on the market from time to time can be recalled by many of our readers, and they will doubtless be glad to become acquainted with this line of apparatus, the serviceability of which has been demonstrated.

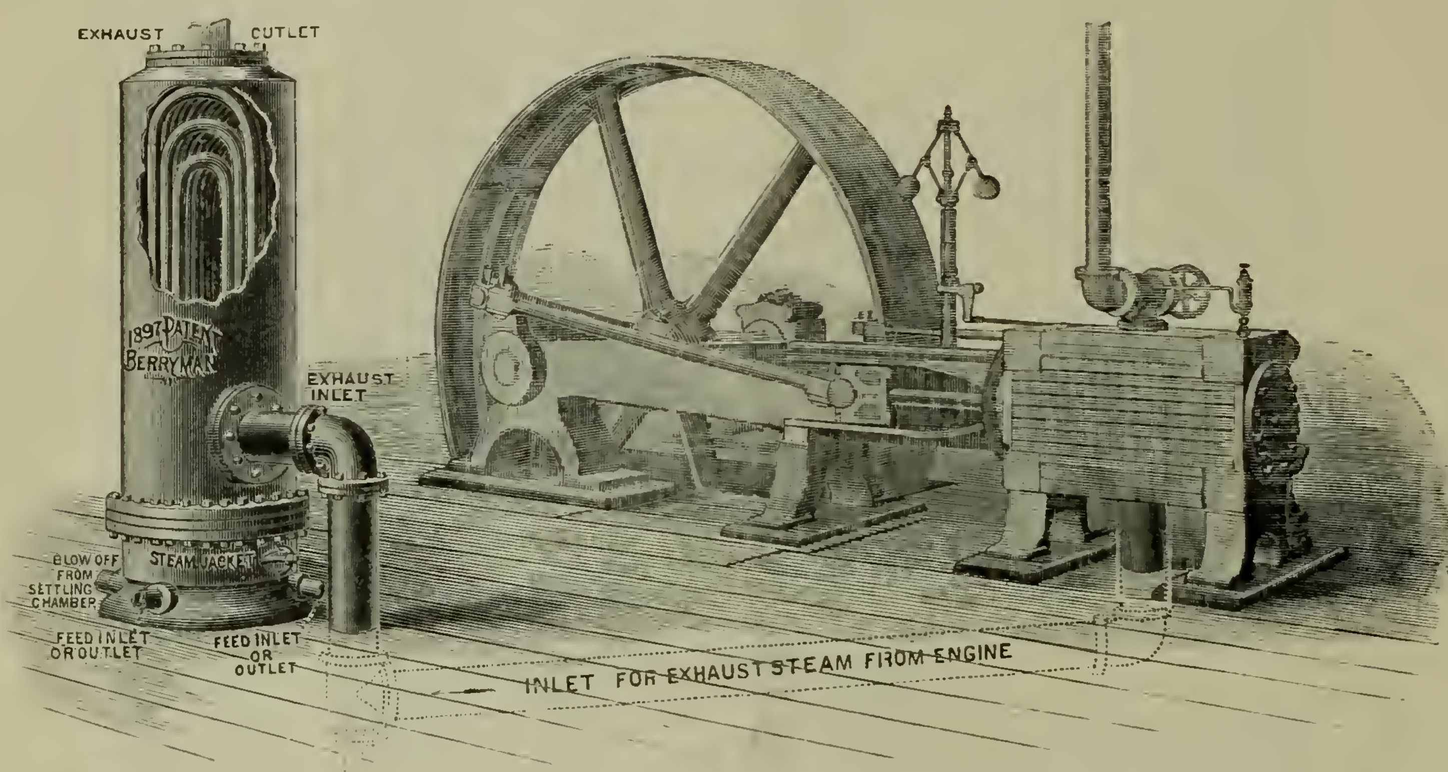
These articles have now been on the market and under the vital test of actual use a sufficient length of time to demonstrate beyond a doubt their many points of excellence and their absolute reliability in every respect. The half-tones in this catalogue show very clearly their main features and a good idea of their mode of operation can be formed from them. Complete price lists of all sizes can be found under this cover. These devices are adapted to all forms of service where automatic starting is desired, elevator, pump, crane, etc., and further made for use on either direct or alternating current circuits.

This concerns Catalogue "B," dealing with panel boards, slate cutouts, etc., is still in the hands of the printer, but if it covers its field as completely as the two catalogues above discussed, nothing further can be desired.

In conclusion we can but advise those of our readers who are desirous of being supplied wih electric light and power specialties of the very highest grade, at prices no higher than those usually paid for inferior articles, to communicate with this house, Zimdars & Hunt, 127 Fifth Avenue, New York.

Copies of catalogues will be sent postpaid to those of the trade interested, upon receipt of business card.

eighty horse-power up. In their construction, which is of the highest grade, every care is taken that a machine shop offers to turn out a well-fitted, strong and reliable heater. The efficiency and durability of this device has stamped it among consumers as the "ne plus ultra" of heaters, that will save users its cost many times over during the long period of its usefulness. Every heater is guaranteed and its manufacturers have taken the greatest pride, not merely in selling it, but in constructing it upon the best scientific principles of the day. The patents were granted in United States last July and recently in Great Britain. A large number of the heaters are in successful operation.



One of the Many Methods of Connecting the Improved Berryman Feed-Water Heater.

THE KELLEY PATENT IMPROVED BERRYMAN WATER-TUBE FEED-WATER HEATER AND PURIFIER.

The dollars and cents saved by the use of a well-constructed and efficient feed-water heater is evident to the novice in steam engineering. It has been a difficult matter to overcome the expansion and contraction which is inevitably associated with a feed-water heater. The Kelley Patent Improved Berriman, manufactured by Benjamin F. Kelley & Son, 91 Liberty Street, New York, and of Philadelphia and Boston, is known by all engineers of prominence to have overcome, by its special construction and use of the U-shaped brass tube, the above fault. In this device, not only is expansion and contraction successfully annihilated, but the heater is supplied in addition with a steam jacket and a settling chamber. The economy derived from this system is obvious. The exhaust steam jacket embraces a settling chamber and heats the water to nearly the same temperature as the exhaust. By this means all foreign matter falls to the bottom, but the clarified and heated water passes onward to the boiler. For use in connection with condensing engines, the Kelley Patent Improved Berriman will successfully withstand any form of competition. "The exhaust steam being in the shell, which is many times the diameter of the exhaust pipe, there is no danger of any back pressure. The vacuum will, in fact, be increased, if anything, the heater acting in a manner as surface condenser. When used in connection with a condensing engine, the heat of the feed water will depend upon the vacuum. The higher the vacuum the less heat there will be in the feed water." In use with non-condensing engines the water is delivered at the boiling point to the boilers. The sizes of heaters made vary from

The electric show next May will eclipse the show of 1896 in every particular. The interest manifested by the trade in general is evidence that the last show was a great success, and they evince their appreciation by their interest in the coming show.

Chas. S. Pease, for a number of years with the Interior Conduit Co., and an M. E. of note, is now eastern representative of the Sterling Co., 126 Liberty Street. He will become the manager of the eastern branch of this company on and after January 1.

THE MEASUREMENT OF CURRENT.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

In order that currents may be measured with accuracy, either for purposes of comparison or direct use, certain methods must be adopted which may be generally classed under the following headings:

(a) Electro-Chemical, { Volume Voltameter / Metal " }
(b) Electro-Thermal,
(c) Electro-Magnetic.

The electro-chemical, as defined by its title, is one closely allied to certain chemical reactions produced by the passage of a current through a solution. It is therefore possible to review the means by which a current passing through an electrolyte, either of metallic salts or water, produces effects of a reliable and visible nature capable of immediate measurement.

The electro-chemical method calls into use a simple form of instrument called a voltameter.

Voltameters, while serving the same purpose in this case, are divided into two kinds—the volume voltameter and the metal voltameter.

A volume voltameter consists of a glass vessel containing a conducting liquid in which is immersed two narrow plates of platinum called electrodes. Upon passing a current through this instrument, the liquid (a weak solution of sulphuric acid), becomes decomposed and a mixed gas is evolved, composed of oxygen and hydrogen. The greater the current applied to the voltameter the more rapidly is the gaseous mixture set free. Each unit of current is capable of producing equal quantities of oyxgen and hydrogen, or equal volumes of gas are produced by equal currents flowing for an equal time. Thus it may be proven that the strength of the current is proportional to the number of cubic inches of gas developed in one minute. If by previous experiments the volume of gas set free from water undergoing electrolysis be ascertained, the strength of current corresponding to a given volume of gas may be used for all future experiments. A volume voltameter may be constructed by means of two copper plates, a glass jar and a deep basin.

The number of cubic inches or cubic centimeters of the jar must be determined. A scale is affixed to the side of the jar denoting this capacity in graduated steps with the zero mark at the bottom of the jar. A wide cork or cover is placed over the jar containing a tube and the two electrodes. If the jar be filled with acidulated water and inverted into the half-filled basin, the jar will remain full; but when the two electrodes are attached to a source of current decomposition ensues and the gas forces the water out.

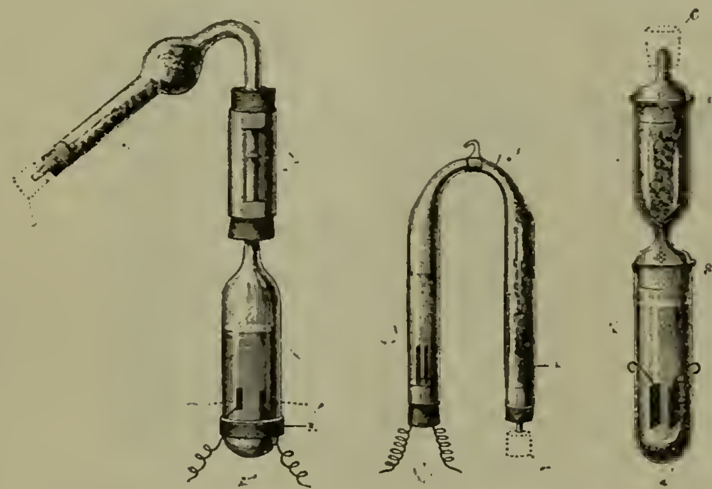
The number of cubic inches or centimeters of gas remaining between the level of the water and the bottom of the jar can be at once determined.

A metal voltameter consists of two electrodes dipping into a solution of metallic salts. If the electrodes or plates are of copper, a solution of copper sulphate will be most satisfactory. Upon passing a current between the two electrodes, pure copper is deposited upon the negative electrode. If the negative plate is weighed before and after the experiment, and the time in minutes and seconds carefully noted, the amount of copper deposited each second or minute is quickly determined in grams.

A repetition of this experiment will prove that equal currents always deposit equal weights of the same metal. The current flowing between the plates can be computed by calculating the weight of the metal, in grams, deposited per second.

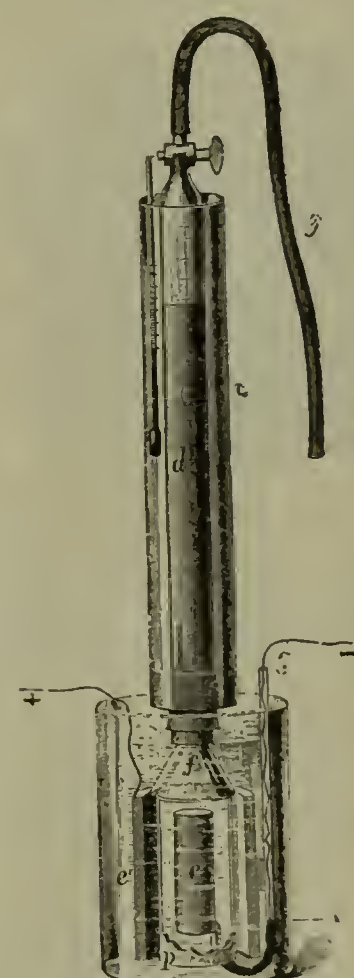
One ampere deposits 0.32709 milligramme per second; therefore, knowing the weight actually deposited, the true current in amperes is obtained by division.

A coulomb being equal to an ampere flowing for one second, the above method calls for the number of coulombs per second.

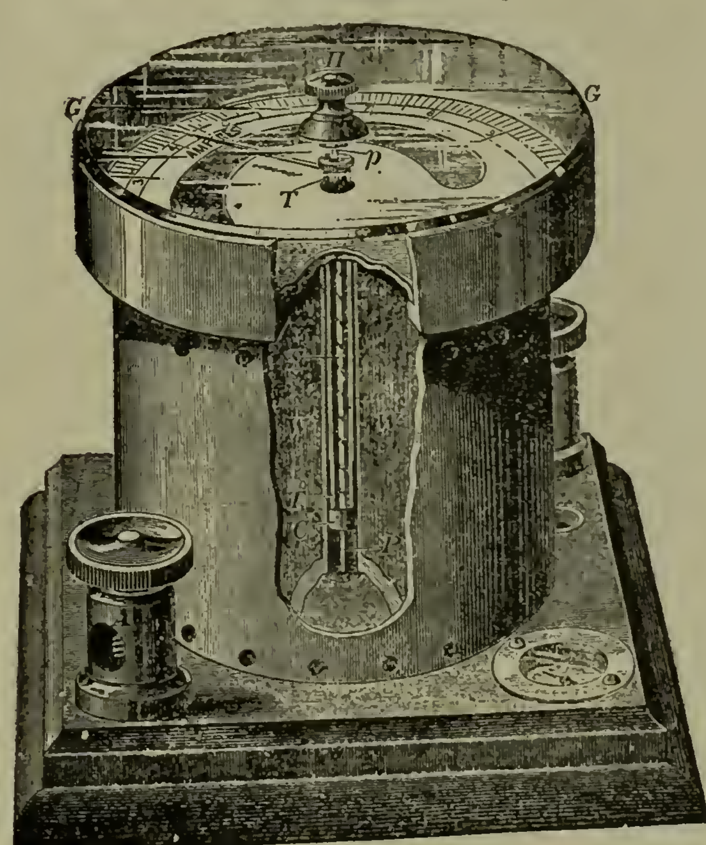


Metal Voltmeters for Measuring Currrent.

Volume Voltmeter, for Measuring Current.



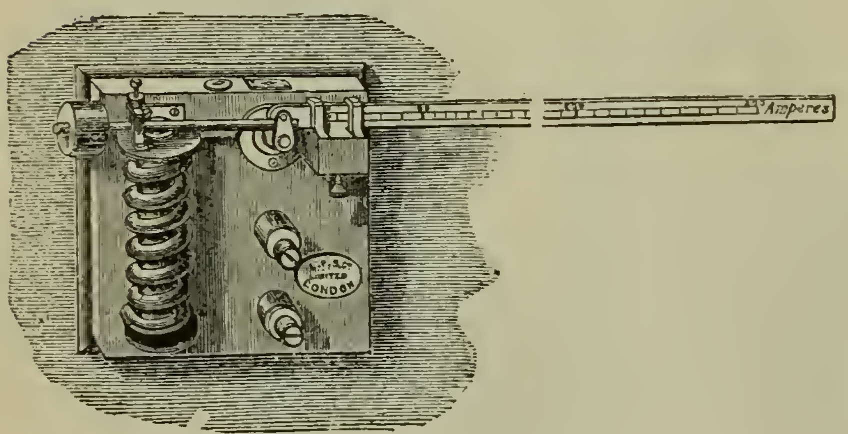
Volume Voltmeter, for Measuring Current.



Hot Wire Amperemeter.

The ampere balance, invented by Sir Wm. Thomson (Lord Kelvin), depends upon a very simple principle for its action.

A pair of coils are placed side by side and another pair placed above, but balanced like a pair of scale pans on two fulcrums, both being connected rigidly by a bar or pair of bars. The repulsion and attraction are compensated for by weights, which increase the range of the instrument or diminish it. The weights are slid along an arm and thus bring about a balance. The coils are calibrated so as to give a variety of readings, dependent upon the weights, and the extent of correct readings runs into hundreds of amperes. Its great advantage lies in the fact that it can be used equally as well for alternating currents.



Steel Yard Amperemeter.

Ampere meters are of a variety of shapes as well as kinds, but the majority work on an exceedingly simple principle, as previoasly described.

(To be continued.)

QUESTIONS FOR REVIEW.

The Measurement of Current.

(1) By what methods can a current be measured?
(2) What is a voltameter, and how many kinds are there?
(3) (a.) Describe a volume voltameter.
(b.) Describe a metal voltameter.
(4) How is a hot-wire ammeter constructed?
(5) Is heat developed in proportion to the strength of current?
(6) Upon what principle do electro-magnetic ammeters operate?
(7) What is the principle upon which a D'Arsonval galvanometer works?
(8) How can a recordlng ammeter be constructed?
(9) Define the electro-chemical equivalent.

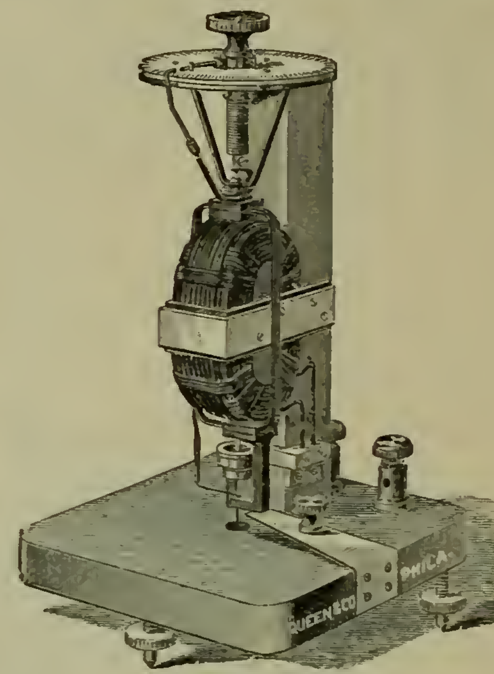
WIRELESS TELEGRAPHY.

After months of experimenting, the U. S. Electrica Supply Co., of 120 Liberty street, New York, are now placing upon the market a complete line of apparatus for wireless telegraphy. Mr. W. J. Clarke, the general manager of the company, was the first in this country to give a public exhibition of the Marconi system, and states that the apparatus which his company is manufacturing is not only low in price but it is in many ways a great improvement on the Marconi system.

NEW STANDARD OPEN CIRCUIT DRY BATTERY.

The Standard Dry Battery is the production of Mr. William Roche, of 259 Greenwich Street, N. Y. Mr. Roche has made dry batteries for the past nine years and his ability to place upon the market a dry battery of exceptional quality is universally recognized. He claims the "Standard" is the strongest, quickest to recuperate and the most durable dry battery on the market. Mr. Roche made the M. E. S. Co. batteries until this fall.

The Standard Dry Battery.



Dynamometer.

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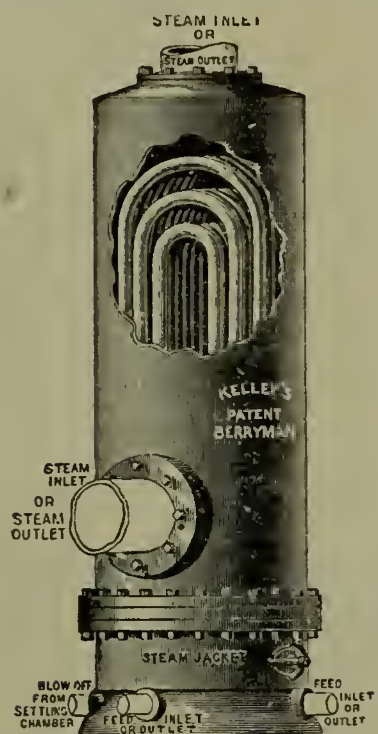

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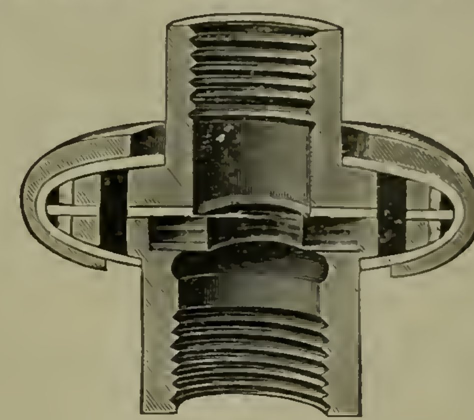

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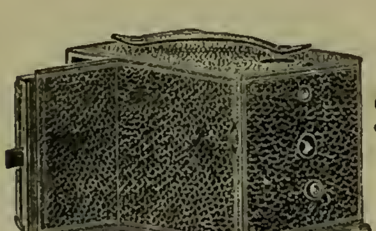

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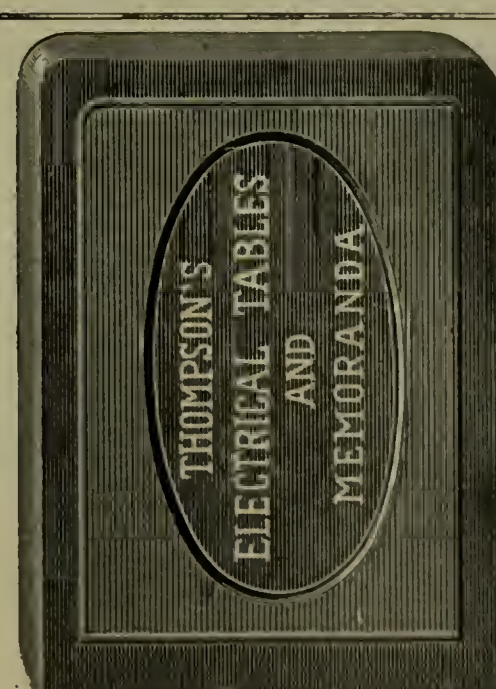

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