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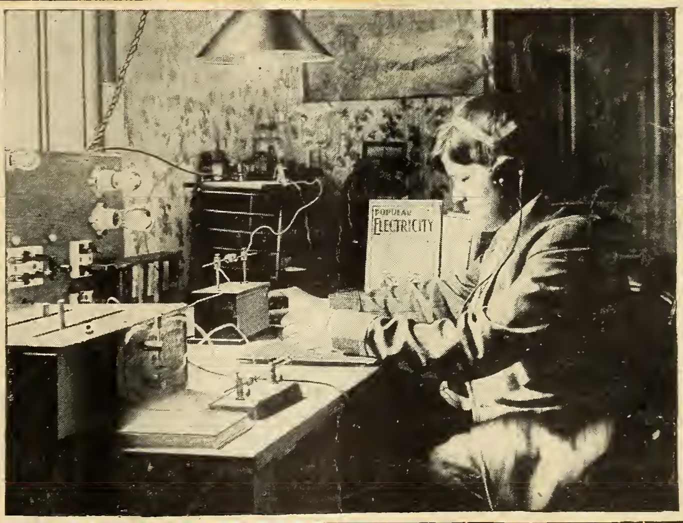

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Vol. II. SEPTEMBER 1909 No. 5.

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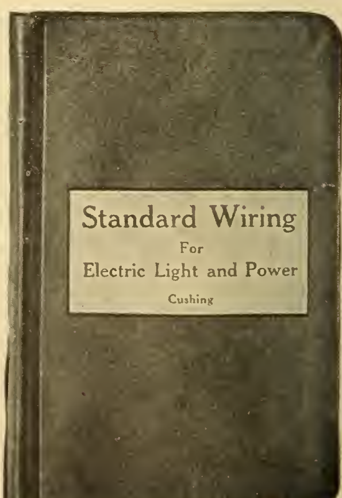

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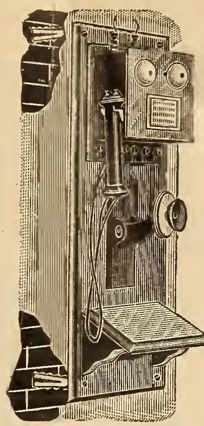

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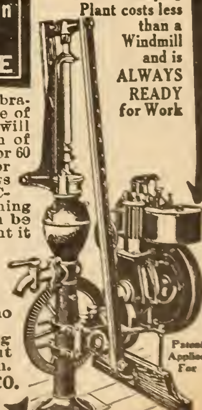

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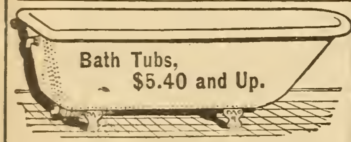

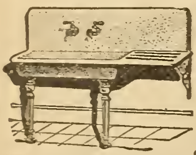

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Low Tank Closet like shown in bath-room cut for

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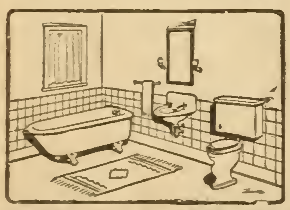

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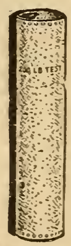

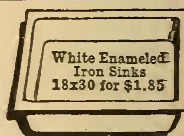

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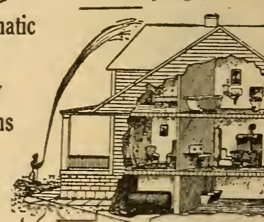
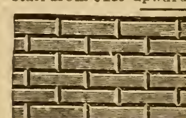


We will furnish you with a complete pneumatic or air pressure water supply outfit that will furnish you running water the same as city waterworks. Prices range from $40 upward. We will furnish you complete house plumbing outfit like shown in this picture, including the pneumatic water supply system, the bath room outfit, the kitchen sink and range boiler and all the pipe and pipe fittings to install from $125 upward.



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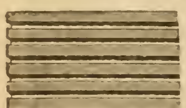

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POPULAR ELECTRICITY

IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. II SEPTEMBER, 1909 No. 5

CONTENTS

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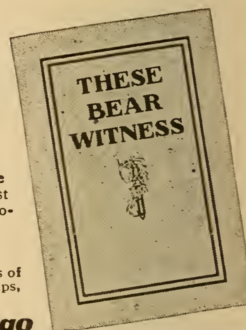
Send us a rough sketch of any building you wish to heat and we will have our experts prepare a simple, clear plan showing the best arrangement of furnace, pipes and registers, for your building together with the exact cost to you of the complete outfit.



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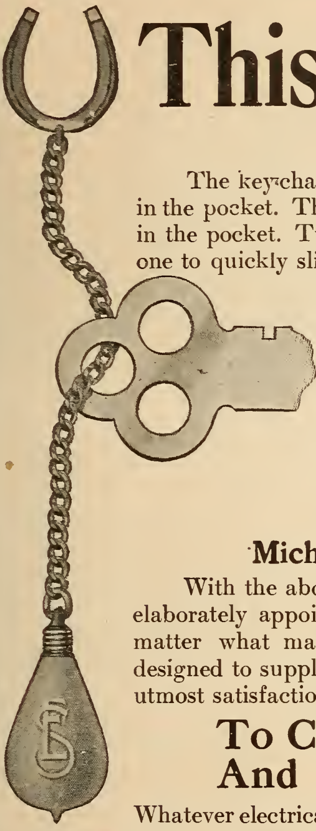

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The key-chain replaces the old fashioned key ring which is so uncomfortable in the pocket. The keys lie flat—no bulging, sharp pointed bunch to wear holes in the pocket. Turning the horse shoe so one point parallels the chain, enables one to quickly slip keys on or off the chain. Chain is heavily nickeled, while the electric lamp ornament is of handsome silver ox. finish.

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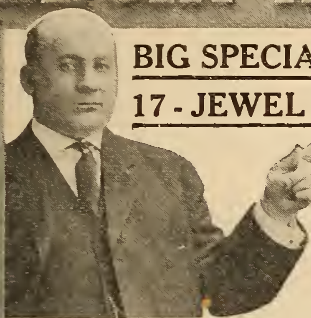

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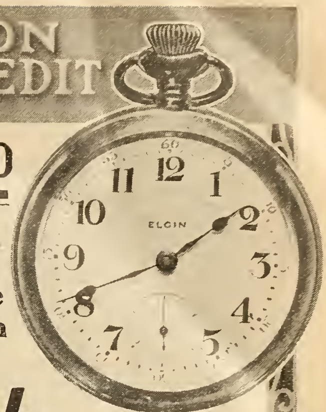

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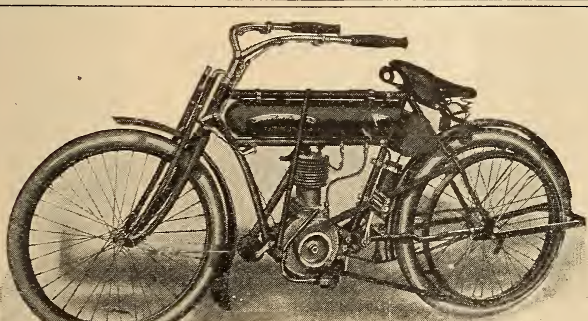

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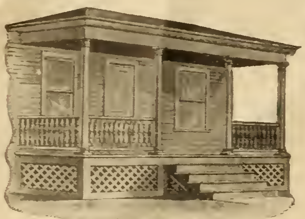

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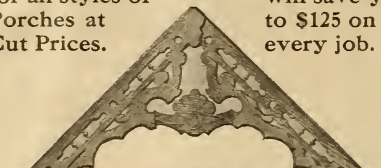

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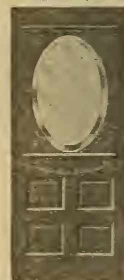

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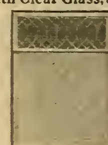

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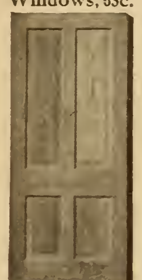

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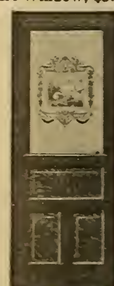

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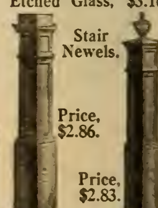

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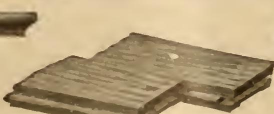

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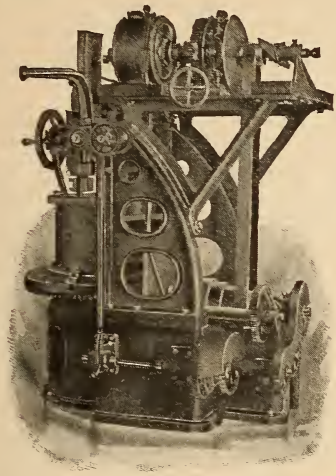

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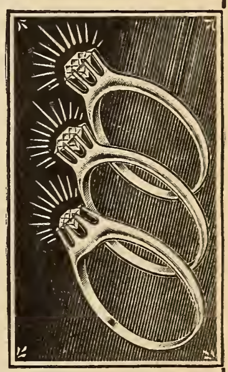

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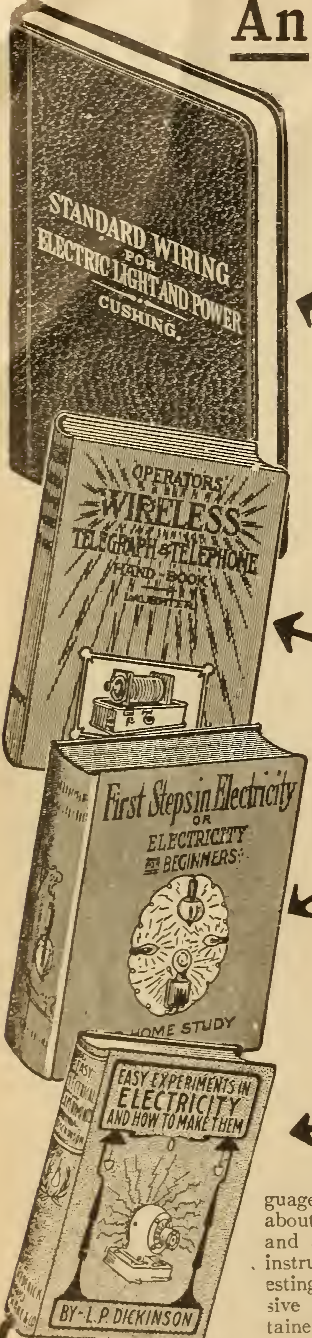

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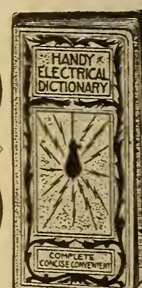

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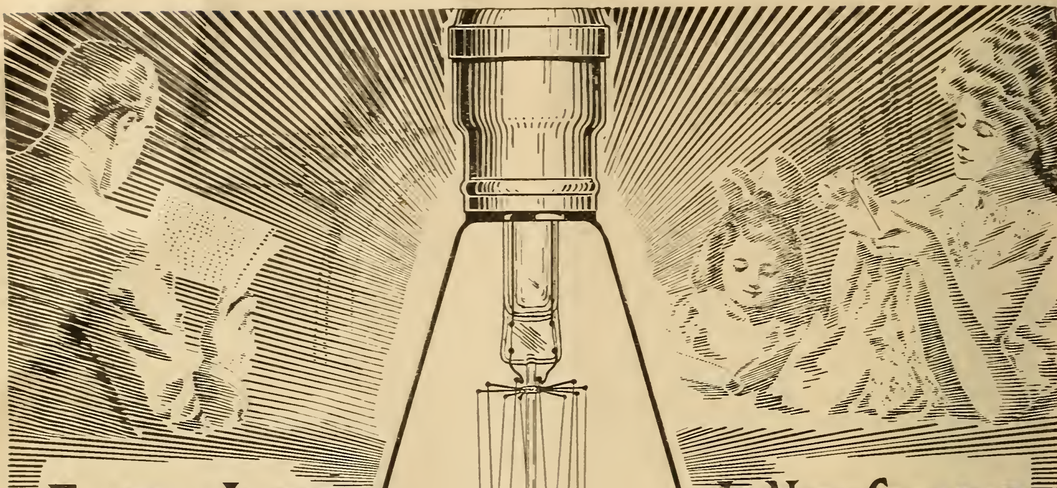

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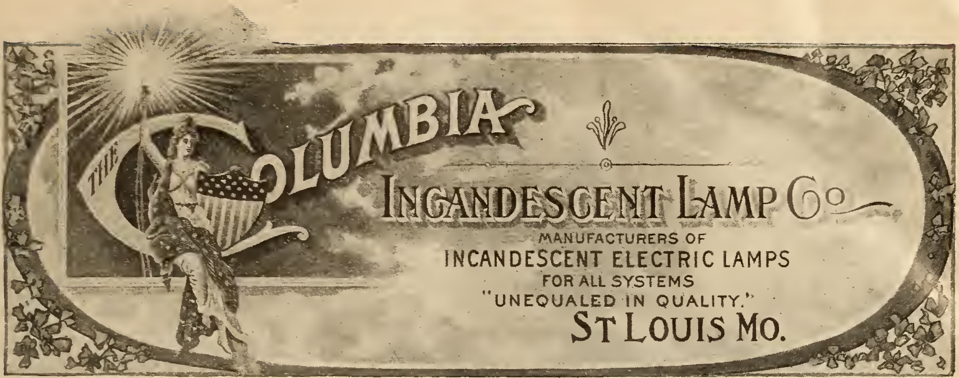

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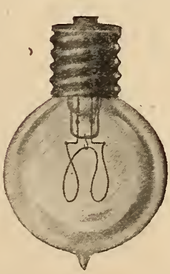

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60-watt "	1.40	1.47	50
100-watt "	1.75	1.85	24
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Upon the request of my sister, who urged me to use her great Electric Vibrator on my son when I was thoroughly hopeless of his cure from physicians' treatment, I write you this recommendation. My son is 16 years old, and eight months ago became paralyzed from the after-effects of diphtheria. He was so badly afflicted that his arms and limbs were twisted out of shape and was confined, all doubled up, in his bed. Medicine and attention did no good, and I had become discouraged in all ways. After treating first his spine at the base and then his limbs with your vibrator he felt such relief that I kept up the treatment regularly, with the result that we soon had him around in a wheel chair. Next he was going around on crutches, and now, after three months' treatment, he is going around with a cane and will soon be entirely cured.
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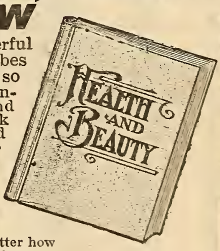

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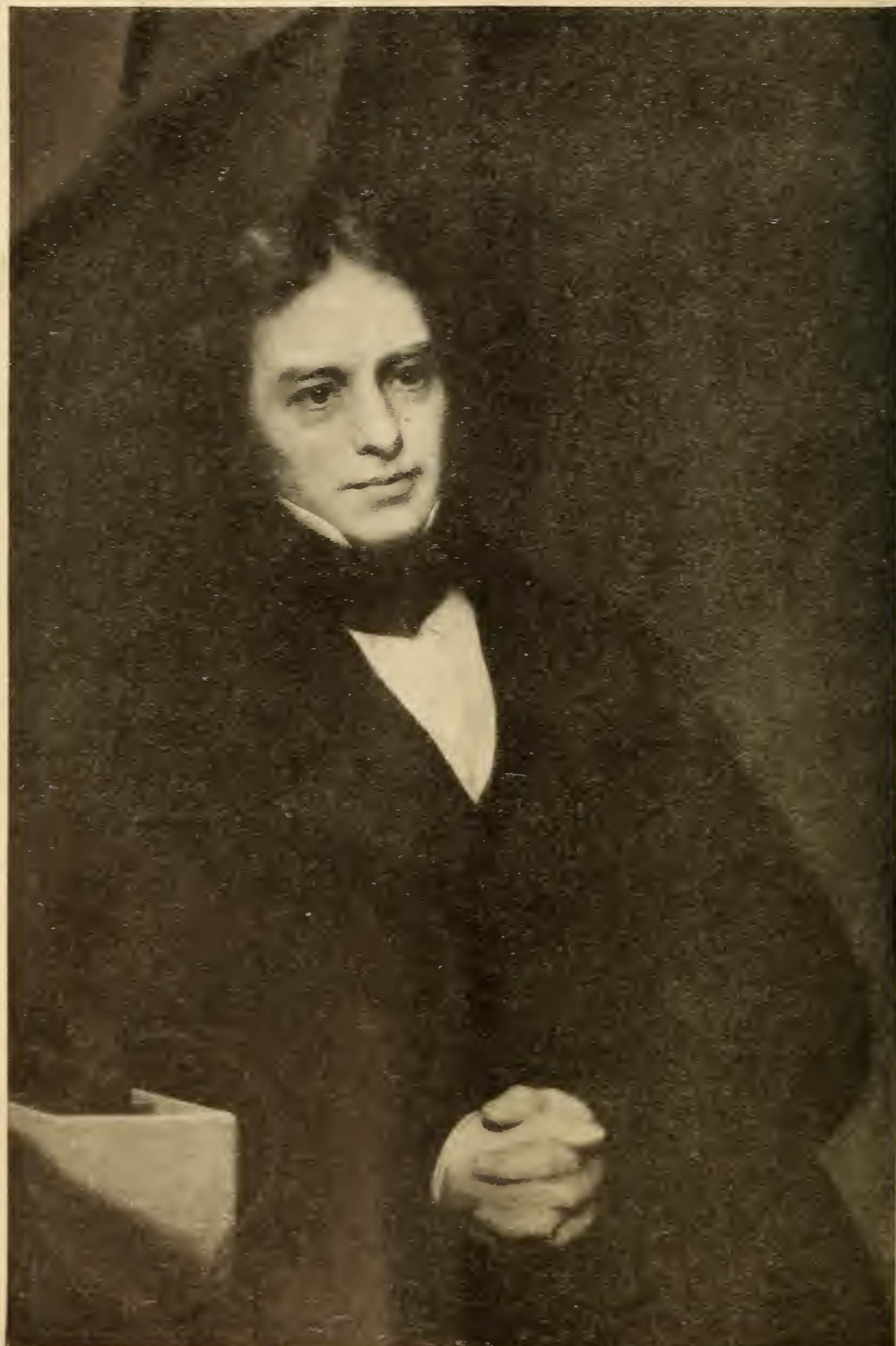

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POPULAR ELECTRICITY
IN PLAIN ENGLISH

VOL. II SEPTEMBER 1909 No. 5

MICHAEL FARADAY

The man who discovered the principle of the dynamo, upon which rests almost all electrical science and art as they exist today

Michael Faraday's work and discoveries were the immediate forerunner of the modern electric dynamo. In August, 1831, he performed a series of five immortal experiments, extending over a period of ten days, from which began a new era of applied electricity.

Upon the first day he obtained his first evidence that an electric current through one of two insulated wires, wound upon one-half of a soft iron ring, induced a momentary current in a second insulated coil on the other half of the ring, upon making and breaking the current, as shown by the deflection of the needle of a galvanometer connected to the second coil.

He next observed that with an iron cylinder having a helix of wire wound about it, and the iron cylinder being placed between the poles of bar magnets, that every time the magnetic contact of the bar magnets with the cylinder was made or broken, there was an electric current induced in the helix. This showed that electricity could be produced by magnetism in motion.

Upon his fifth day of experimenting he discovered the production of electricity by the approximation of a magnet to a wire. A cylindrical bar magnet was thrust in or withdrawn from a cylindrical wire helix, whereupon the galvanometer needle was deflected. This showed that the mere presence of a magnet near the coil was sufficient to induce a current.

Upon the ninth day he made a copper disk turn between the poles of a great horse-shoe magnet, the outer edge and the center of the disk being connected with a galvanometer by wires. The needle was deflected steadily as the disk turned in one direction, and as the rotation of the disk was reversed the needle was deflected in the opposite direction. This was the first dynamo.

The following day he found that a one-eighth inch copper wire drawn back and forth between the poles produced the same effect. This is the principle of the operation of the modern dynamo.

Michael Faraday was born at Newington, near London, September 22, 1791. At the age of twenty-two he was appointed an assistant in chemistry at the Royal Institute, London, the same year becoming private secretary to and attending Sir Humphrey Davy in a tour of the Continent. Upon his return in 1815 he was re-appointed at the Royal Institute, and there commenced his great career of investigation and discovery in the field of electricity and magnetism. He died in 1867, one of the most honored men of all the group of early investigators to whom modern electrical art owes its being.

Elementary Electricity

By PROF. EDWIN J. HOUSTON, Ph. D. (Princeton)

CHAPTER XVII.—ELECTRIC SOURCES (CONTINUED). CHEMICAL ACTION.

The pressure or electromotive force produced by a frictional electric machine is greater than practically any other source, yet the quantity of electricity is extremely small. Frictional electric machines remained practically the only electric sources until about the beginning of the year 1800, when Alexander Volta, Professor of Physics in the University of Padua, discovered an entirely new source, that, although not capable of producing very high E. M. F.'s, yet could continue to furnish a greater quantity of electricity than any form of frictional or induction machine.

There is an interesting history connected with the discovery of this electric source. It appears that for many years prior to Volta's discovery, Luigi Galvani, a noted physician and professor of anatomy in the University of Bologna, had been in the habit of employing the hind legs of recently killed frogs as exceedingly sensitive electroscopes. These legs, prepared as shown in Fig. 75, were, according to some accounts, hung outside the window of his laboratory against the iron of a balcony. It so happened to Galvani's surprise that the nerves and muscles of the frog happening to be connected by the iron of the balcony the legs were at once set into strong convulsions.

It is strange in view of his knowledge of the fact that the passage of an electric current would produce such convulsions, that Galvani should not have recognized the fact that he had made the magnificent discovery of a new electric source. But Galvani had for many years been endeavoring to discover the cause of life, and being prone, as was perhaps natural, to believe that what he had observed was what he so greatly wished to discover, came to the incorrect conclusion that the convulsions were due to a vital fluid that, flowing out of the nerves of the frog and passing through the conducting path of the iron, was conveyed to its muscles. This was in the year 1786.

When Galvani published his discovery of a vital fluid, an immense enthusiasm was created throughout the scientific world, and his experiments were repeated by hosts of investigators.

Among the most prominent of these was Volta, who at first accepted Galvani's belief that the convulsive movement of the frog's legs was due to a vital fluid. Extended observations, however, soon led Volta to the conclusion that the phenomena were due not to a vital fluid but to electricity. Further investigations led him to believe that this electricity was produced by the contact of dissimilar metals, for he obtained the most pronounced twitchings when two dissimilar metals, such as zinc and copper, were employed; the zinc, placed in contact with the nerves and the copper with the muscles, while the other ends were held together in the hand.

A lengthy controversy followed Volta's announcement that what Galvani had discovered was not a vital fluid, but an entirely new electric source. Indeed, when it was afterwards recognized that a pair of dissimilar metals placed in contact at one of their ends and connected at the other end by a liquid capable of conducting electricity, and of acting chemically on one of the metals, would produce a current of electricity, a still greater difference of opinion arose as to the cause.

Volta believed, at any rate in his early experiments, that the electricity was produced by the mere contact of dissimilar metals, while others contended that the cause of electricity was chemical action. Without going any further into this question it is sufficient to say that while mere contact is capable of producing an electromotive force, yet chemical action is necessary to permit the electricity to continue to be produced, when dissimilar metals are connected at one set of ends and have their remaining ends connected by the kind of liquid referred to above.

Volta continued his experimental investigations and finally produced an apparatus that was named after him, the voltaic pile or column, and is now generally known as the voltaic battery.

Volta's original pile was constructed as follows: Two metallic disks, one of zinc and the other of copper, were placed on each other and separated from another set of zinc and copper disks by a disk of cloth or paper

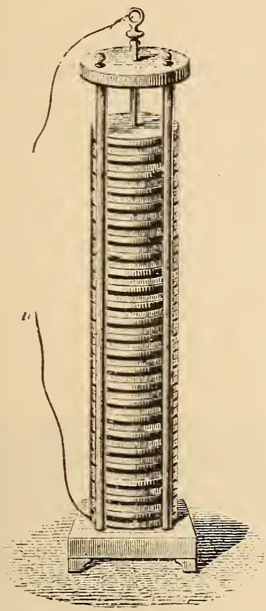


FIG. 113. VOLTA'S PILE

moistened by water containing a small quantity of sulphuric acid or common table salt. These separate sets were placed in regular order between the three vertical glass rods represented in Fig. 113, so as to form a cylindrical column or pile. The order was as follows: Zinc, copper, cloth; zinc, copper, cloth; zinc, copper, cloth, etc., from the bottom to the top of the pile. The different portions were then brought into contact with one another by pressure.

The pile or battery thus formed was capable of producing a constant flow of electricity that passed from a conducting wire connected with the copper plate on top of the pile, to a conducting wire connected to the zinc plate on the bottom of the pile. In other words, the wire connected with the end copper plate at the top of the pile was positive, and that connected with the end zinc plate at the bottom of the pile was negative.

Each combination of copper, cloth and zinc formed what is now called a voltaic cell. Since these cells were connected in series, it is evident that the battery will produce an electromotive force equal to the sum of the separate electromotive forces produced by each cell. Consequently, such a battery is capable of providing a fairly constant electric current that will continue to flow as long as sufficient zinc and acid remain.

In order the better to understand what takes place in the voltaic pile or battery we will first endeavor to see what takes place in a single cell. Such a cell is represented in Fig. 114, where a zinc plate (Z) and a copper plate (C) are dipped in water containing sulphuric acid. When the portions of the zinc and copper plates that extend above the surface of the liquid are connected as shown by the copper wire (M), an electric current passes through the liquid of the cell from the zinc to the copper plates, and outside the cell from the copper to the zinc. Since that portion of an electric source or

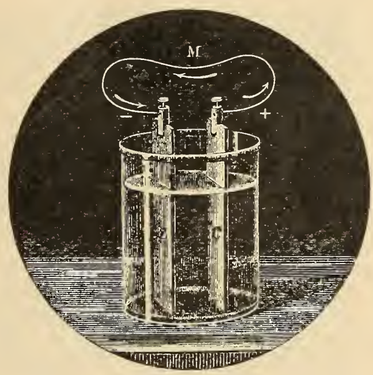


FIG. 114. VOLTAIC ELEMENT

circuit from out of which the current flows is positive, and that portion into which it flows is negative, the portions of the zinc and copper plates that are dipped into the liquid become respectively positive and negative, while the terminals that project above the liquid are respectively negative and positive.

A few definitions will aid in the explanations that are to follow. The zinc and copper plates are known as voltaic elements. The liquid in which they are dipped is called the electrolyte. To be capable of acting, an electrolyte must possess the power of acting, chemically on one of the elements and of conducting electricity. The portions of the plate that are immersed in the electrolyte are known generally as the positive plate and the negative plate, while the portions that project outside the liquid are known as the electrodes or poles.

The following facts have been discovered respecting a simple voltaic cell consisting of zinc and copper immersed in dilute sulphuric acid. When the cell is open, that is, when the zinc and copper are not connected at their electrodes by the conductor (M), then, if ordinary commercial zinc is employed, a chemical action still goes on, the zinc plate is slowly dissolved and bubbles of hydrogen gas are given off from its surface. At the same time the heat generated by this chemical action of the acid on the zinc, which is practically the same as the burning of the zinc in acid, heats the entire mass of the electrolyte.

When, however, the cell is closed, or the terminals are connected by (M), bubbles of hydrogen are no longer given off by the zinc plate but all appear at the copper plate, while the energy produced by the burning zinc now appears in the circuit no longer as heat but as an electric current. It is evident, therefore, that the energy producing the current is the chemical potential energy of the zinc.

As will be seen, the elements of the voltaic cell, in this case the zinc and the copper, have opposite polarities below and above the surface of the liquid, those portions immersed in the electrolyte being in the case of the zinc positive, and negative in the case of the copper, while outside the electrolyte the copper is positive and the zinc negative.

In Fig. 115 fifteen separate voltaic cells are connected with the copper pole of each cell connected with the zinc of the adjoining cell. This leaves the zinc of the first cell and the copper of the last cell as the poles or terminals of the battery. The cells are, therefore, connected in series.

In the early days of the voltaic battery much difficulty was experienced by the unequal action of the acid on the zinc. In a properly arranged cell no chemical action should take place when the circuit of the battery is open, for then no regular current is possible. Unless, however, care is taken as to the employment of chemically pure zinc only, a chemical action of the acid on the zinc will occur whether the circuit of the cell is opened or closed. This action is known as local action and is due to impurities in the zinc, generally of small particles of iron, that form with the zinc minute voltaic couples that produce electricity in local circuits. The electricity, however, is not useful since it never reaches the external circuit. It merely attacks the zinc, uselessly burning it at the expense of a portion of the acid of the electrolyte.

Probably one of the most important improvements in the voltaic cell was the discovery that this local action could be avoided by what was known as the amalgamation of the zinc plate, effected by dipping the zinc plate into a weak solution of sulphuric acid and then rubbing its surface by a few drops of mercury, by means of a bit of rag tied to a stick. There is thus produced on the surface of the zinc plate a film of amalgam consisting of pure zinc combined with mercury. The particles of iron present in the zinc are

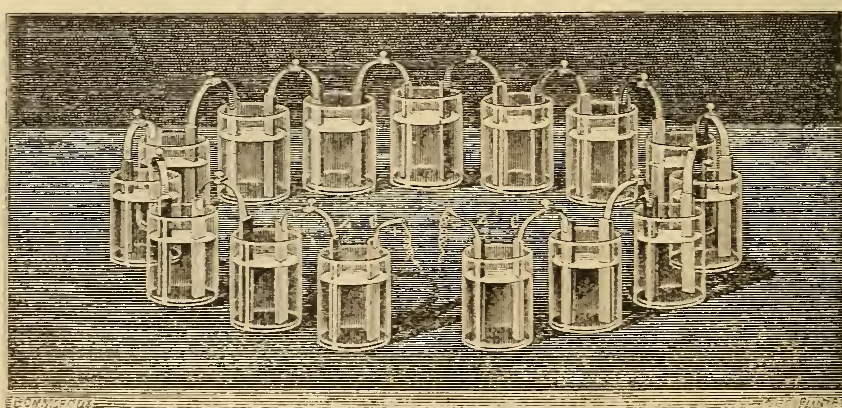


FIG. 115. FIFTEEN VOLTAIC CELLS CONNECTED IN SERIES

not dissolved in the mercury, but are carried off by the bubbles of gas and float in the liquid. There is thus produced a surface of practically pure zinc that is not acted on by the electrolyte until the circuit of the battery is closed.

In actual practice the electromotive force produced by a voltaic battery rapidly decreases after the battery has been for some little while on closed circuit. This is due to what is known as polarization.

Polarization is caused by bubbles of hydrogen that collect on the surface of the negative plate. Since hydrogen forms with zinc a voltaic couple, capable of producing a greater electromotive force than that produced by the zinc and copper, there is a tendency in a polarized cell to set up an electromotive force in the opposite direction to the electromotive force produced by the zinc-copper couple. This, of course, lowers the efficiency of the battery for the following reasons:

(1) The bubbles of hydrogen being non-conductors of electricity, increase the resistance of the cell, and, therefore, decrease the amount of current that flows through it.

(2) The oppositely directed electromotive force, produced by the hydrogen-zinc couple, being opposed to the E. M. F. produced by the copper, tends to decrease the effectiveness of the E. M. F. of the cell.

There are various methods by means of which the polarization of voltaic cells may be either decreased or entirely avoided. The most important of these are as follows:

(1) Mechanical methods, by which the hydrogen bubbles are brushed from the surface of the negative plate by a properly directed stream of air, so thrown against the plate, as mechanically to carry off the gas. Since gas bubbles will cling with greater strength to a smooth surface than to a rough surface, the plan is sometimes adopted of roughening the surface of the negative plate.

(2) Chemical methods, which consist in employing substances possessing great oxidizing powers, such as chromate of potash, permanganate of potash, oxide of copper, nitric acid, etc., that remove the bubbles of hydrogen by entering into chemical combination with them.

(3) Electro-chemical methods, which consist in employing what are known as double fluid cells, containing two electrolytes, and dipping the negative element, say copper, into a solution of copper sulphate so that instead of the hydrogen collecting on its surface, a film of metallic copper is deposited, thus absolutely avoiding objectionable polarization.

According to Ayrton and Perry, the electromotive forces in volts for the following different pairs of voltaic couples are:

Zinc / Lead	.210
Lead / Tin	.069
Tin / Iron	.313
Iron / Copper	.146
Copper / Platinum	.238
Platinum / Carbon	.113

The E. M. F. produced by the contact of any of the elements in this table is obtained by adding the successive E. M. F.'s. Thus, a couple of zinc and carbon would produce an E. M. F. of 1.09 volts.

(To be continued.)

Electricity an Insignificant Fire Hazard

From Jan. 1, 1908, to and including Dec. 15 of the same year, Chicago had 4621 fires, of which only 1.9 per cent. were reported due to electric wires or apparatus.

The following record covering a period of 135 days gives a means of comparison as to various causes of fires, electricity included:

Unknown	628
Careless use of matches	164
Overheated stove	109
Sparks from chimneys	100
Defective flues	88
Overheated furnace	60
Supposed incendiary	52
Spontaneous combustion	51
Explosion of gasoline	46
Thawing of water pipes	43
Explosion of gas	38
Electric wires	37
Gas jet	36
Oil lamps	35
Carelessness with candles	26
Hot ashes	26
Boiling oil	17
Cigar stub	12
Hot box	9
Christmas tree	5
Spark from locomotive	5
Explosion of chemicals	4
Plumber's torch	3
Incendiary	2
Lightning	1
	1633

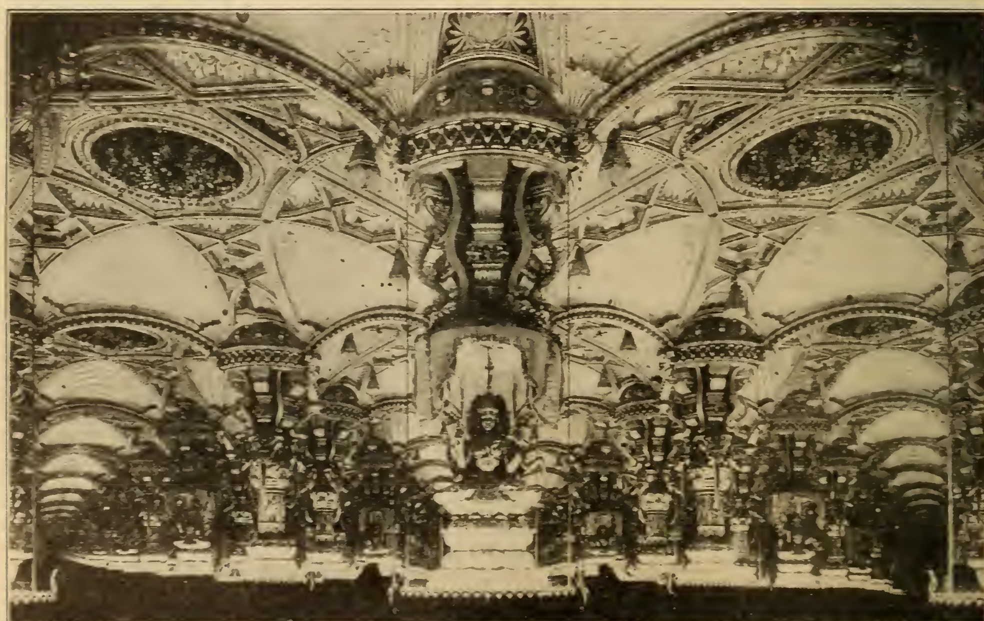
Electricity is, according to these figures, a very infrequent offender and it is hard to understand why it is that the public press and unthinking people will almost always attribute the cause of fires of unknown origin to "crossed electric wires."

The Palace of Mirages

Novel utilization of electricity has been largely instrumental in giving to the pleasure loving city of Paris, France, its latest and in many respects its most ingenious amusement enterprise. This innovation that has aroused the enthusiasm of the French people—famous for their love of new sensations—is an institution known as "The Palace of Mirages." Fundamentally it is an elaboration of the theory of the apparent multiplication of objects placed between two parallel mirrors. In homely phrase it might be referred to as a development from the "crystal maze" familiar to all visitors to modern amusement parks. But this Parisian creation represents so high a development and embodies so much that is unique and interesting from an electrical and scientific standpoint that it is scarcely to be mentioned in the same breath as its more commonplace predecessors.

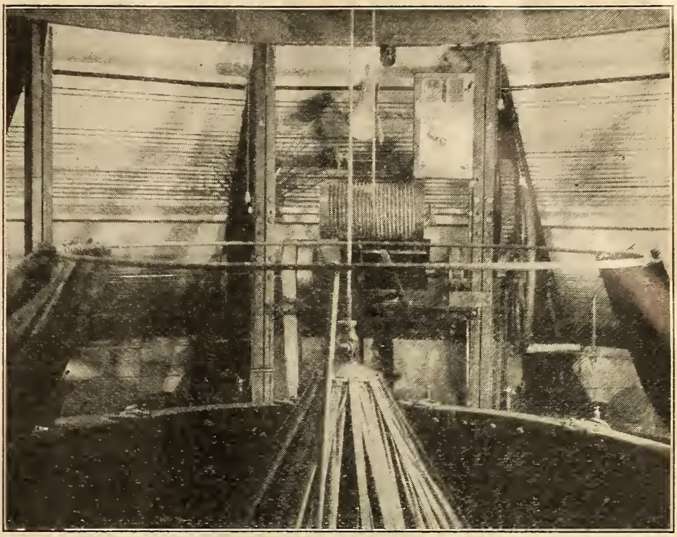
The primary feature of the equipment of this manufactory of illusions is found in six large fixed mirrors, attached to the walls of the building, and twelve smaller mirrors which are revolvable and which form the angles of a hexagon. The six main mirrors are the largest of their kind ever manufactured and measure, in each instance, 11 by 16 feet. The dozen smaller mirrors are mounted pivotally, enabling them to be turned simultaneously and it is this facility of manipulation which makes possible the presentation of three different and distinct schemes of decoration, each of this trio of decorative schemes being, of course, infinitely multiplied by reflection.

Stationed at the various angles of the hall, erected especially for this institution, are six rotary drums, each of these drums carrying six mirrors arranged in pairs and forming three angles of 120 degrees each. Each angle of the hexagon likewise measures 120 degrees. With this mechanical arrangement it is possible by giving the drums one-third of a turn to change the entire aspect of the hall. It is just here that one of the crucial functions of the electrical installation is manifest. The delicate, electrically controlled mechanism is such that the six drums can be turned either independently or simultaneously. When they are stationary, the mirrors of the drums complete the angle of the hexagon and are thus, to all appearances, part of the walls.



BEAUTIFUL PALACE OF MIRAGES

The decorative effects which are reproduced and multiplied by reflection are in great part affixed to the mirrors and this circumstance brought about one of the problems of operation. The mirrors must be started, move and stop so gradually and carefully that none of the delicate decorations are dislodged or jarred from their proper position. The solution was found in the invention of a new type of brake. The drums above mentioned are actuated by a friction wheel and are stopped without shock by means of this special brake.



CANOPY MANIPULATING APPARATUS

The Palace of Mirages presents (by means of quick transformations effected in total darkness) three different schemes of decoration, representing, respectively, a Hindu temple, a forest and an Arabian palace—each seemingly limitless in extent, thanks to the aid of the mirrors. Although there are but three main "scenes" or settings, forty-five different luminous effects are rendered possible by the electric lights of which more than 2,500, involving lamps of all colors, are employed. As many as 1,800 of these incandescents lamps can be simultaneously illuminated and in the final effect in the last scene the mirrors create the illusion of 64,800 lamps. Not only are stationary incandescents used but portable or moving lamps are employed in the simulation of birds, butterflies and other aerial travelers.

ELECTRICAL CONTROL OF PALACE OF MIRAGES

The system of electrical illumination is supplied with a direct current of 500 amperes and 110 volts. The 45 different luminous effects above mentioned are controlled by means of a special switchboard with 45 keys. A particularly novel feature of the electrical equipment is that provided for the manipulation of a great decorative canopy which is utilized in the forest scene in order to convey to the spectator the illusion of a continuous leafy bower. Under electrical impulse this huge, painted, flexible fabric slides through a central ring and expands until it forms a canopy over the entire central hall. For the speedy manipulation of this tent-like covering there are employed numerous counterweights and a network of wires.

According to the estimates of Mr. Lewis B. Stillwell, presented before the American Institute of Electrical Engineers, the Niagara Falls hydro-electric plants, during the year 1908, saved the equivalent of more than a million tons of coal.

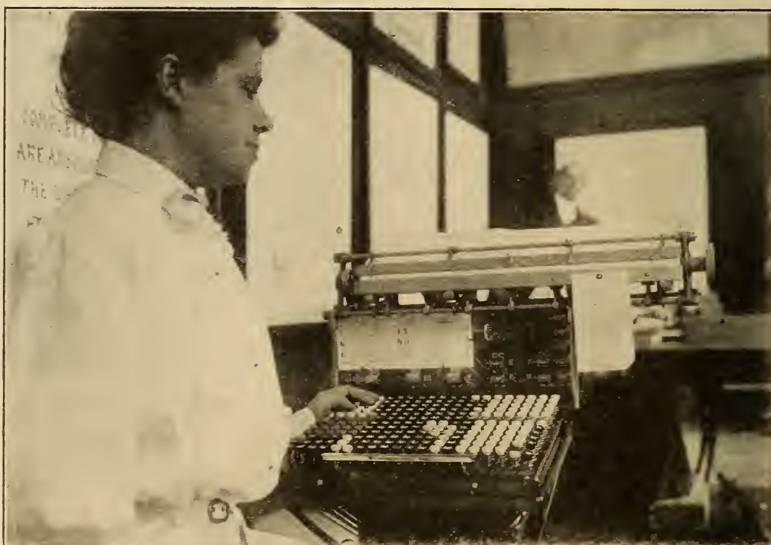
Card Indexing the Country

By WALDON FAWCETT

The thirteenth national enumeration of the population of the United States which will be made next year may be termed, very appropriately, the "electrical census." This nick-name is deserved because of the extensive dependence which will be placed upon electrical energy for carrying out this gigantic job of figuring and by reason of the invention of some marvelous electrically operated machines for conducting the statistical work by mechanical means. Indeed, there is no precedent, either in governmental activities or in the modern business world, for such widespread utilization of the magic current for clerical and kindred work, and the fact that Uncle Sam relies so largely on this form of power in the biggest undertaking in which he is called upon to engage, is, to say the least, highly significant.

The decennial counting of every man, woman and child in the republic, for which the U. S. Congress recently appropriated the sum of $10,000,000 will not take place until the year 1910 but very active preparations have been in progress for some time past for this unique enterprise which will engage the services for long or short periods of upward of sixty thousand regular and temporary employees of the government. Most important of those preliminaries has been the invention by the electrical and mechanical experts of the United States Census Bureau of a remarkable series of recording and tabulating machines which, under electrical impulse, perform statistical work that would require thousands of human hands. To be sure, most of the new machines require a man or woman operative (although some are entirely automatic in action) but this does not mean that they are not economical, for each electrical toiler accomplishes as much, in a given time, as would scores of clerks, figuring with pen or pencil in the old-fashioned way.

The next Federal Census, as becomes the foremost job of accounting that befalls a progressive government, is to be taken on the card index plan—"card indexing the country," the project has been termed—with an individual pasteboard for each and every inhabitant of the United States. It is in preparing and handling these personal records, probably ninety odd million in number, that the newly perfected electrical machines find their chief functions. Just here it should be explained that the facts concerning the age, color, sex, nationality, etc., of an individual are not penned or typewritten on the card reserved for him as would be the case in any ordinary card index system. Instead this biographical data that is essential to the compilation of an informative census is recorded by means of holes punched in the card. The number



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OPERATING ELECTRICAL CARD INDEXING PUNCH and locations of these round punctures carry significance. In other words, the positions of the holes on the surface of a minutely ruled and blocked card indicates to any person conversant with Census Office practice all the needed information relative to the individual who is represented by the card. No writing whatever is necessary.

Perhaps the most wonderful of the new electrically muscled census machines is the card punching apparatus, the purpose of which is to transform blank cards into biographical records in accordance with the system above described. The machine has a keyboard very similar in appearance to that of a typewriter but with 240 different keys instead of less than one-sixth that number. Each key when depressed records one fact. The keys are not only inscribed to indicate their functions but the main groups of facts are differentiated by keys of different colors, thus guarding against confusion. The machine, in its operation, differs from the typewriter in one important respect. In the familiar type of writing machine a record is made—that is a letter or figure is printed—every time a key is depressed and if a mistake is made it must be crossed out or corrected with some inconvenience. In this novel new form of recording mechanism, however, the operator instead of punching one hole at a time, can depress as many keys as are necessary to record the biography in hand and after all the lines of inquiry have been thus disposed of, a button is pressed bringing an electric motor into play and all the holes are punched simultaneously without further effort on the part of the operator.

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ELECTRICAL TABULATOR

This latitude of operation has the advantage that each key being independent of all the others can be released at will without a hole being punched or any fact recorded. Thus the operator before turning on the electric current for the punching operation, can look over the depressed keys to make sure that the chronicle is correct and if an error be discovered the wrong key can be released and the error rectified before any punching is done, thus effecting a great saving both in cards and labor. An average operative can by means of one of these new machines punch more than 4,000 cards per day, as compared with perhaps 900 cards per day with the old-style hand punch which this new invention has superseded. Moreover, not one per cent of the cards are spoiled in the course of the operation.

While the operator of one of these new punching machines is recording the distinctive facts concerning the individual whose card is in course of preparation, the machine is automatically performing a supplementary operation of almost equal importance—namely applying by means of a "gang punch" a mark common to a considerable number of cards, for instance, all the cards for a given city, county or state—cards that would obviously be duplicates of one another in so far as their geographical data is concerned. As further evidence of the versatility of this new card punch, it may be mentioned that automatic counters are attached to the keys and thus every time a hole is punched the fact is duly recorded on a dial. This adjunct is exceedingly valuable in census practice since it will make possible the announcement of important totals as soon as all the cards have been punched. There are a dozen of these dials on each punching machine and once the ninety million cards, representing the country's population, have been put through the punching process the officials can, by consulting the dials, learn not only the exact total of the country's population but the numerical strength of the grand divisions of the population as to males, females, native, foreign, white, colored, married, single, etc.

Finally, the cause of economy is furthered by the circumstance that there is no hand feeding of cards in the new machine. The operator places about 600 cards—sufficient for the average "run"—in a magazine at the back of the machine; sets up in front of her in an automatic "schedule turner" the sheet of returns received from a census enumerator in the field, and leaves the rest of the work to the machine. All she has to do is to touch the keys as above described. When the keys have been depressed as desired the operator touches a bar similar to the space bar of a typewriter and the motor with one complete revolution punches all the holes in the card; gang punches the card; records all the required facts on the automatic counters, and turns the schedule to the next set of facts. At the same time the punched card is fed out automatically to a magazine in front of the machine and a blank card is fed in from the rear to undergo a similar operation, after which the motor stops automatically.

Invented to supplement the work of the machine above described, particularly in compiling combinations of facts that involve more or less intricate records, is the lately perfected electric tabulator. This tabulating machine is in the form of a heavy cabinet from the front of which extends a movable arm or lever attached to the outer extremity of which is a "pin box" containing a needle for each possible hole in a card. When the pin box is brought down over each card in turn, that is fed into the machine, the needles which meet the unpunched surface are repressed while those that pass through holes make an electric contact below and by means of relays cause one or more counters or dials to register. The complement of dials are connected with an automatic recording and printing system, suggestive in its operation of the familiar stock ticker, and thus the totals compiled by the tabulator are printed on tapes.

The form of tabulator above described is semi-automatic but requires the constant attention of an operative when in service. However, the census experts are now at work on a tabulator designed to be wholly automatic in its action, which will feed cards from a magazine and receive them into another magazine after the fashion of the new card punch. Electric motors of one-half horse power are employed for the operation of the new census machines and great numbers of these will be in simultaneous operation when the work of compilation is in full swing.

Memorizing Ohm's Law

"E" stands for the pressure
Which we are taught to use,
Divided by "R", for resistance,
Will give us "C," the juice

$$\frac{E}{R} = C$$

"C" is "E divided by R,"
With this we don't get very far,

$$C = \frac{E}{R}$$

But "E" is "R times C," you see,

$$E = R \times C$$

And "R" is "E divided by C."

$$R = \frac{E}{C}$$

"W," watt, is "Current times
Electromotive force,"

$$W = C \times E$$

And "seven forty-six" of them
The "Power of a horse."

$$746 = H.P.$$

—Telegraph Age.

Rapid Transit and the Round City

All large cities tend to grow round in form unless there are natural restrictions to such growth. The cause of this tendency is the necessity of concentration in a comparatively small area of the great interests in the world of trade, where a large portion of the city's inhabitants find their daily occupation. The agent which makes possible this state of affairs is rapid transit or more strictly speaking electric rapid transit, for without electricity subways and elevated roads would be practicably impossible. Without swift and ample transportation facilities great cities of today would be composite in character, consisting of a number of business centers instead of being a single unit built up around one great center.

Problems of transportation in a city of two or three millions of inhabitants are the most serious with which the city has to contend, and they result from one cause—that little congested district. The lateral limits of this congested district are restricted to a half a mile or even a quarter of a mile from the center. Then, when necessity demands, the city at this point grows straight up in the air, ten, twenty, even forty stories. In this beehive a million people may work every day. Every morning they must be brought into it, every evening taken home, and a large part of this coming and going occurs within a period of an hour and a half night and morning.

Outside of a zone extending two or three miles from the center, and which is served principally by the surface cars live the people who are affected by rapid transit. They live in the outskirts of the city or in suburban homes, where there is light and air. Their station in life permits them to do this. But they object strenuously to consuming more than 30 or 40 minutes in going or coming. As the city grows it is continually reaching out and out to provide dwelling places for the new thousands. It it should grow straight out in one direction and try to become a long city there would come a time when the distance in this direction would become so great that the time limit in going from and coming to the city would be reached, also the point would be reached when the transportation company could no longer maintain the five cent fare, for people carried above a certain distance are carried at a loss which must be made up for by the short haul passengers. Therefore transportation facilities must be extended out in all directions toward these limits and the city becomes a circle.

A peculiar state of affairs exists in New York city. It has tried its hardest to become a long city. Manhattan and the Bronx, occupying as they do a long point with the Hudson River on one side and East River on the other, tend naturally toward this condition. So the city started out to grow with the evident intention of overthrowing this law of great cities. First the surface cars took the people to the point where lies the greatest activity. They were soon overwhelmed. Then the elevated roads were built—four long parallel lines of them—and they likewise could not handle the traffic. Then came the famous subway, and it is now crowded to its utmost and more people clamoring to live farther out. The limit of this long city is reached, and slowly and surely, with its constantly growing and magnificent system of great bridges and tunnels, new rapid transit outlets are being made in all directions to be filled up with a rush by the home-seeking public, and the New York of the future will be round.

Did you ever attend a great base-ball game, and go early to watch the crowd arrive? If you did you may, in a manner, watch the growth of a great city. First come the "general admissions" and fill up the most desirable seats in the bleachers nearest the field. As the time draws near for the opening of the game the bleachers are filled up to the very top and to the farthest end. Meanwhile the grandstand is filling up. Now our little city is triangular in form with the congested district near the apex.

Still thousands are clamoring for admission. So the late comers are allowed to fill up the field along the side lines, and they crowd in along a narrow strip on each side extending farther and farther down. They want to fill in the whole end of the field but at first they are not allowed to do so, unless the game is an extraordinary one. Then they are not to be denied. A policeman or two gives away here and there along the line. A little tongue of people shoots out here and another there toward the center of the field. These flying wedges become surging crowds. In a few minutes they fill up the entire back part of the field in a neat semicircle and our little round city is complete.

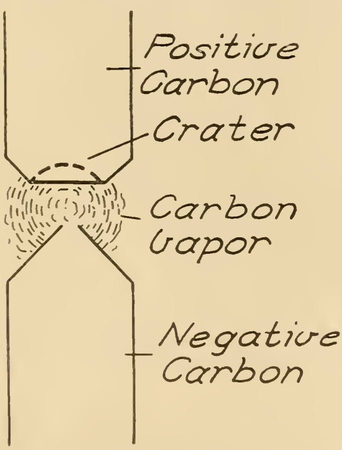
So it is with the building of a great city. Conditions demand a common meeting point or center. Rapid transit makes possible this single center instead of a number of isolated ones. The quickest and easiest way to reach this center is along radial lines and the city becomes round.

How Light is Made

We are all more or less familiar with the effects of different sources of electric light. But how many are able to explain the principles of the four most common kinds of electric lights? There are the arc lamp, incandescent lamp, the mercury vapor or Cooper-Hewitt lamp and the Nernst lamp. What are they and how do they make light?

THE ARC LAMP

Fundamentally the arc lamp consists of two carbon rods inserted in a break in the electric circuit and separated a slight distance so that the current jumps across the break and continues on its way. The carbons are first touched together to complete the circuit and start the current flowing, then they are drawn apart, the current continuing to flow across the gap through a conducting vapor of carbon which is formed. This is the principle. There are a great many accessories to the arc lamp, however, which are provided for automatically maintaining the proper distance between the carbons. These are operated by electro-magnets affected by the current flowing through the arc lamp circuit.



ACTION OF THE ELECTRIC ARC

There are many interesting features in the carbon arc of which the casual observer never dreams. For instance the two carbons do not burn away alike. The positive carbon, which is generally made the upper one in the lamp does not burn away evenly but is hollowed out at the end like the crater of a volcano. The lower or negative carbon on the other hand soon forms a point and is consumed very slowly.

It is from the crater that most of the light is emitted, not from the incandescent vapor of the arc. The temperature of this crater is 3500° C., or 7420°F. which is the temperature of melting carbon, the most refractory substance known. This crater of a carbon arc is literally "the hottest place on earth" and will melt any known substance.

The light emitted by the arc crater approaches very nearly that of sunlight, containing all the colors of the spectrum in nearly sunlight proportions.

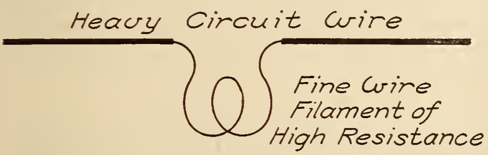
The ordinary direct current open arc consumes about 10 amperes at 45 volts, or 450 watts. This means that in the little crater, a fraction of an inch across, there is constantly being used up over one-half of a horse power of energy.

There are various types of arc lamps now on the market. They are made for alternating and for direct current, open and enclosed, for series and for multiple operation, with solid and with special cored carbons (the flaming arc is an example of the latter), but they all embody the principle of the current jumping across a gap between the carbons.

It may be interesting to know that Sir Humphrey Davy, in 1808, made the first arc lamp. This was before there was a commercial dynamo even. He used a galvanic battery of 2000 cells. The arc lamp did not become a commercial proposition, however, until the dynamo was developed.

THE INCANDESCENT LAMP

The incandescent electric lamp is perhaps simplest of all and the public is the most familiar with it. It was found in the beginning that electricity flowed more easily through large wires than through small ones, the latter presenting a greater resistance. To force current through a small wire takes energy which is expended in the form of heat. Edison first applied this principle to the incandescent lamp. To do this it was necessary to make the resistance element of carbon in the form of a fine filament. A wire of copper or iron that fine would melt like wax from the heat developed by the current trying to crowd through it. The carbon filament must even be enclosed in a bulb from which the air is exhausted, for if it were operated in the open air the oxygen combining with the carbon at the high temperature would very soon destroy the filament; in other words it would be oxidized or burned up.



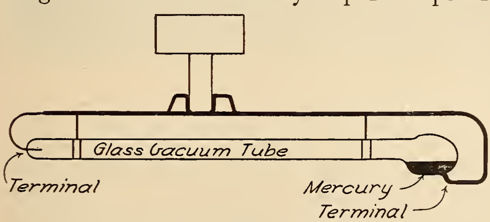
PRINCIPLE OF THE INCANDESCENT LAMP

The incandescent lamp is, therefore, nothing more than a very fine filament of high resistance inserted in an electric circuit and enclosed in a vacuum bulb for protection. The current passing through the filament heats it up to incandescence and it emits light.

There are many different types of incandescent lamps, such as the carbon filament, metallic filament, tungsten, tantalum, etc., the newer types, such as the tungsten, having a higher efficiency, owing to the fact that they can be operated at a higher temperature.

MERCURY VAPOR LAMP

Most of us have seen the long glass tubes which emit a greenish or bluish light and which gives one's face a peculiar ghastly tinge. These are mercury vapor lamps or



PRINCIPLE OF THE MERCURY VAPOR LAMP

Cooper-Hewitt lamps, as they are often called, after their inventor Peter Cooper-Hewitt.

The mercury vapor lamp consists of a long glass vacuum tube in one end of which is a little cup containing mercury. One terminal of the electric circuit enters this mercury; the other terminal enters the other end of the tube. By tilting the tube and agitating the mercury the latter is partially vaporized and the tube is filled with the mercury vapor. This vapor then conducts the current across from one terminal to the other through the tube, but in passing it heats the particles of mercury vapor to a high state of incandescence, emitting the peculiar light mentioned. This is the principle of the mercury vapor arc although there are modifications such as devices for starting the arc without tilting the lamp, etc.

NERNST LAMP

An interesting type of incandescent lamp is known as the Nernst. It has a glower which is neither carbon nor metal and this glower has first to be heated by external means before the lamp will light up. The glowers are made of a mixture of "rare earths", something like those used in the mantels of Welsbach burners. They are inserted in the circuit as in the case of the incandescent lamp, though no protecting bulb is necessary. But they do not heat up at once as the current cannot flow through them while cold. So a wire from the main circuit, very fine and of high resistance, is wound around them. When the current is turned on, this fine wire heats up as in the case of the incandescent filament and in doing so, soon heats up the glowers to a temperature at which they will conduct electricity. The current then flows through the glowers and maintains them at the temperature of incandescence. Meanwhile the fine wire heating coil, being no longer needed, is automatically cut out of the circuit.

Electricity in Kodak Films

Some of the hitherto unexplainable tricks played upon photograph films have been found to be caused by static electricity. The band of celluloid that serves as foundation for the layer of gelatinobromide becomes electrified by contact with the black paper that protects the roll against light, or simply by contact with the next sensitive layer in the roll, so that in certain conditions there are actual electrical discharges that leave their traces on the image, after development, in the form of branched or zigzag lines.

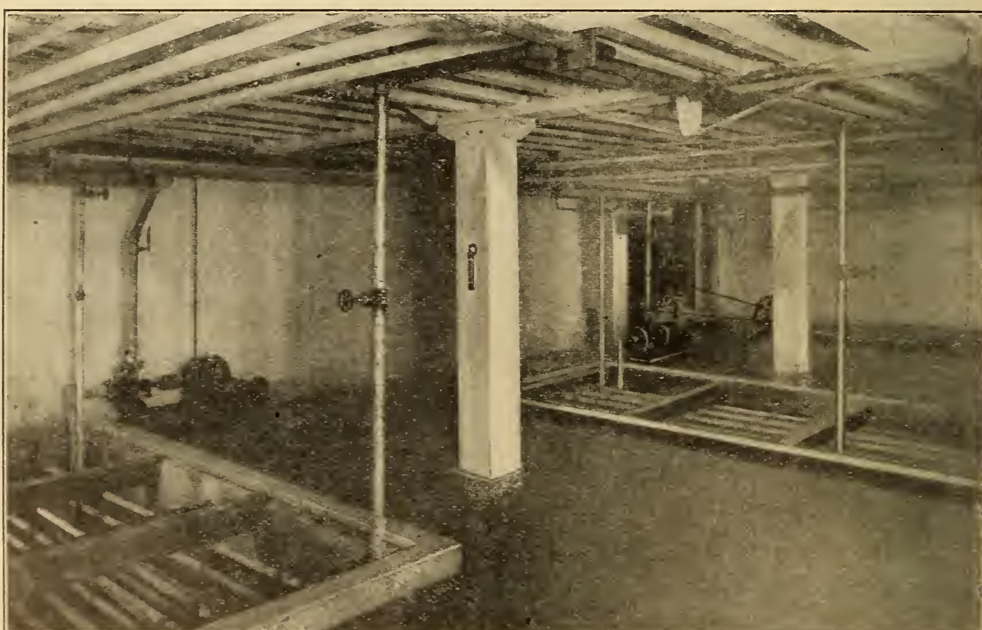
A warm and dry atmosphere seems to favor the accident, which occurs notably when the operator removes the roll from the apparatus; if the spool is partly unrolled he squeezes it lightly and thus gives a slight motion of rotation to the interior coils; friction then determines the phenomenon, and the harm is done.

Electrical Curing of Meats

In Cleveland, Ohio, is to be found a model plant for the curing of meat by electrical process; the first of its kind. The purpose of the plant is to demonstrate the practicability of the method, and in that respect it is creating somewhat of a sensation.

The company's object in erecting a plant of 50 tons capacity of cured meat per month, was not for the purpose of engaging to a large extent in the packing business, but that the packers might be able to see the practical side of a complete plant—and have demonstrated to them by actual trial on a commercial scale that electricity fits into the curing of meats just as perfectly as it has into every other enterprise to which it has been applied with revolutionizing effect. The introduction of electricity to the curing of meats adds no complications, but simplifies the old method. The result is a saving in time, labor, pickle, cooperage and floor space.

Vats about 14 feet long, four feet high, and four feet wide, are substituted for the hogshead and barrels as seen in the packing house of today. The meat to be cured is placed in layers in these tanks, each layer being separated by wooden racks. Layer upon layer of meat is laid in until the vat is full, each vat holding approximately 5,000 pounds of meat. The vat is then filled with pickle (no particular formula being required, as no change in a packer's formula is necessary). The electric current is turned on. The circulating pump is started, and, if the meat be bacon, four days are required to produce a perfectly mild cured meat, ready for the smoke, No handling of the meat is necessary during the process of curing and the same is true whether the meat be bacon in cure four days, hams in cure 30 days or beef 20 days. No changing of meat from tank to tank is necessary and no pickle is wasted.



MEAT CURING VATS WITH ELECTRIC CIRCULATING PUMPS

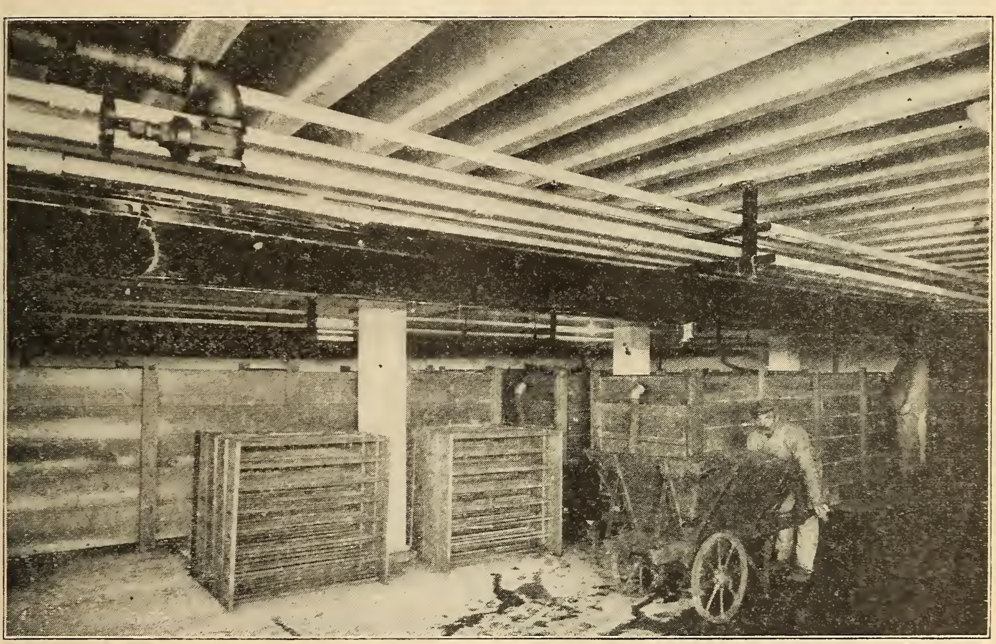
The same pickle is now used with which operations were started on March 17th, 1909, there having been cured to date 10 batches aggregating 5,000 pounds to the batch, and the pickle is as good as ever. The saturation is kept up by adding ingredients to the pickle in the cooling tank outside the vat from time to time as needed. The purity and lasting qualities of the brine is attributable to the purifying influence of the electric current.

The vats in the company's plant are arranged in sections of from one to as many as may be required for hams, beef and bacon, each section having its own formula of brine. An overflow tank with cooling coils in it takes care of the circulation of each section. One electrical centrifugal pump and one overflow tank will cool the brine and handle the circulation for a section of 10 tanks or more.

The necessity for circulating the brine arises from the fact that a system of electrodes is placed at the ends of each vat, forming the poles from which the current travels through the brine and meat, alternating from pole to pole 7,200 times per second. This raises the temperature of the brine, and it is therefore necessary to circulate it through a cooling vat. The brine is thus constantly being returned to the vat at the proper temperature by the aid of a contrifugal pump.

Electrical control consists of one transformer for each 20 vats, one switch and a regulating rheostat for each vat, mounted upon a switchboard. These devices are located in the engine room and are under the control of the engineer.

It took years of experimenting to bring the electric process of curing to a practical point. All preliminary experiments were carried on at a large packing house in Cincinnati, Ohio. It was with meat cured at this plant that many features valuable to the packer were discovered, principal among them that of the keeping qualities. It has been clearly demonstrated that the meat will not skipper, due to there being no impurities in the meat, after it comes from the electric bath, in which the skipper fly may nest. Tests have proven that bacteria, which cooking does not appear to destroy, are annihilated by the electric current. The company has in its offices, on exhibition, a piece of bacon cured in five days by electric process, shipped to Hon. Wm. Canada, U. S. Consul, Vera Cruz, Mexico, by express, in a slatted box so that flies could enter, but barring rats and mice. This shipment was intended to make a quick express trip but got lost in transit and remained in that hot country four months. It finally reached Consul Canada, he examined it, found it O. K. and reshipped it to the sender. It arrived in Cincinnati, was opened by a United States Inspector who passed it as being in good condition.



MEAT CURING TANKS—CAPACITY, 5,000 POUNDS

When Lightning Strikes

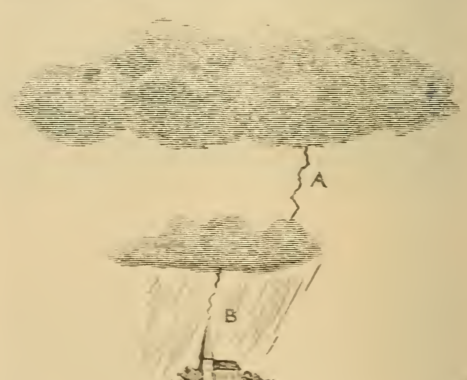
In studying the actions and vagaries of lightning it must be remembered that a mass of vapor, which we call a cloud, as it is carried along through the atmosphere, develops upon its surface a charge of static electricity through friction with the air. This static electricity should not be confused with current electricity such as is developed by a dynamo or battery. As the name implies it is "electricity at rest." Although at rest normally it has enormous potential possibilities and the charge on the cloud is at all times seeking to reach the earth which is of the opposite polarity, or else to jump to a neighboring cloud of lower potential or opposite polarity. The air between the cloud and the earth is a non-conducting medium or dielectric which prevents this discharge until such time as the pent-up pressure becomes so enormous (millions upon millions of volts) that the layer of air is punctured, and then we see the lightning flash, that which is visible to the eye being particles in the atmosphere heated to incandescence by the passage of the discharge.

ORDINARY "A" DISCHARGE

Sir Oliver Lodge, the noted English scientist, has pointed out that lightning discharges are of two distinct characters which he has named the A and B flashes respectively.

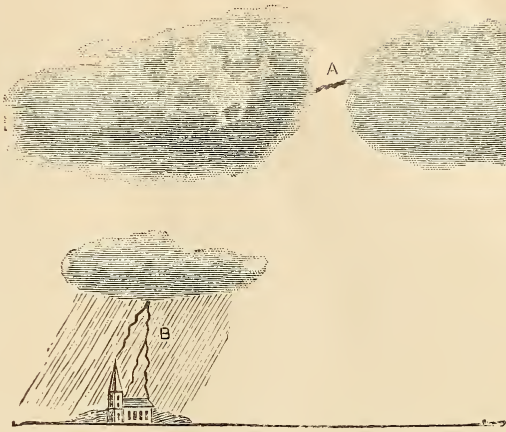
The A flash is of the simpler type which occurs when a charged cloud approaches the earth without another cloud intervening. In this case the discharge is not as powerful as in the case of the B type where another cloud intervenes between the cloud carrying the primary charge and the earth. In the first case an ordinary lightning rod may be effective either by absorbing the energy of the stroke or by conducting it to ground in the form of a "silent discharge." In the B type, however, the two clouds practically form a condenser, and when a discharge from the upper cloud takes place to the lower cloud the potential between the lower cloud and the earth reaches appalling proportions and the resulting lightning stroke to the earth is a veritable electrical avalanche. In its erratic course it overwhelms everything and no lightning rod or conductor was ever made which can for a moment carry away safely this electrical deluge.

In an English work entitled "Modern Lightning Conductors" this difference between the A and the B discharges is graphically illustrated. In the first figure we have the ordinary A discharge which seeks the highest point on the earth's surface in order to relieve the pressure. As mentioned before in such an instance a lightning rod properly installed may be effective. In the second instance there is an ordinary A discharge from the upper cloud to the



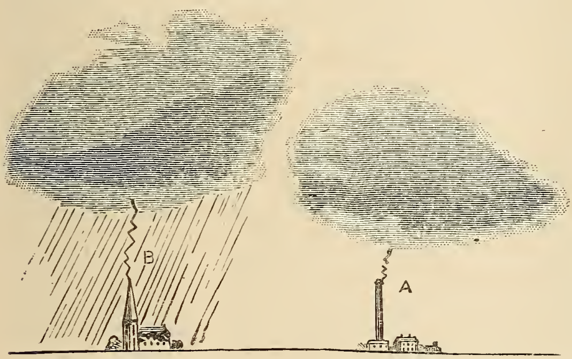
ORDINARY "B" DISCHARGE

lower one, resulting in a B discharge to earth. The third and fourth illustrations show modifications of this class, the discharge at A precipitating a discharge at B, the place where B occurs having been subjected to no preliminary strain.



"B" DISCHARGE INDUCED BY "A" DISCHARGE BETWEEN UPPER CLOUDS

With the A flash the difference of pressure is gradually established between the cloud and earth, and in this case pointed conductors are efficient lightning protectors. The glow discharge in such cases which is noticeable on the upper parts of the building and from the air terminals of the lightning rods seems to prepare the path for the real discharge and neutralize its force to a great extent when it does come. The heated air from the chimney acts in a somewhat similar manner and will conduct the discharge to the stove or source of heat in a dangerous manner, if it is not in connection with the earth. The lightning rod, if properly installed will prevent this deviation.



"B" DISCHARGE INDUCED BY NEIGHBORING "A" DISCHARGE

Motors to Drive Ship Propellers

The Institute of Marine Engineers in London recently discussed the subject of electric propulsion of ships, and H. A. Mavor of Glasgow said that the prospect is very hopeful. Leading ship-builders have been considering it for some time. W. P. Durtnall said that in the all-electric Paragon method of driving vessels, the electric motors are coupled direct to the propellers, and run at equally high efficiency in either direction. Since the ordinary steam turbine can run in only one direction, the new method saves the expense of a reversible turbine.

Kaiser Studies Electrical Farming

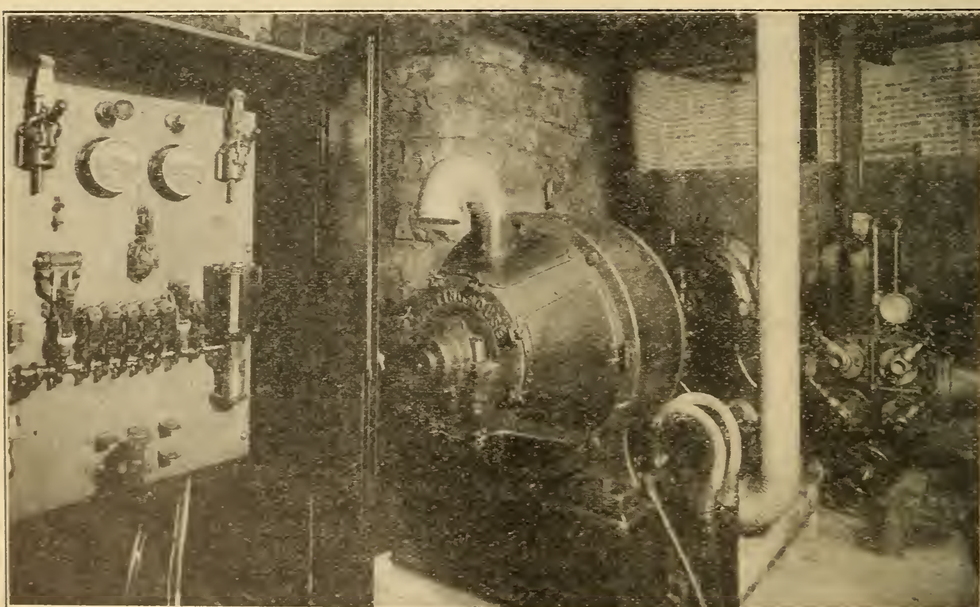
Emperor William of Germany is said to be backing a series of experiments being made to stimulate plant growth by means of electrical currents. An electric plant producing electricity at 250,000 volts has been installed and a large tract of ground is strung with an intricate network of wires over which the electricity is distributed.

Dr. Hoechstermann, who is conducting the experiments, declares that cereals, flowers and all kinds of vegetation have grown more rapidly under this sort of electric stimulation.

It is the statement of Dr. Hoechstermann that not only will vegetation grow more rapidly under electric stimulation, but also that more abundant crops can be grown. He also says that all fertilizers can be done away with. It is his prediction that, within a few years, "electrical farming" will be the rule among the agricultural classes. The experiments at Dahlem station are being done in a private manner. Emperor William is greatly interested in the scheme and permitted the experiments to be conducted on one of the estates belonging to the imperial family.

Approved Electrical Fire Fighting Equipment

A complete fire-fighting outfit, consisting of an electrically driven centrifugal fire pump, motor, starting apparatus and compression tank is shown in the accompanying picture. This outfit has been accepted by the Underwriters, when properly installed in connection with sprinkler systems in Chicago. These sprinkler systems consist of a great number of water pipes arranged under the ceilings of the rooms, each having numerous "heads" which open when the temperature reaches a given degree, literally drenching the room with water, putting out the fire which caused the rise in temperature.



APPROVED ELECTRICAL FIRE EQUIPMENT

The most interesting part of the equipment is the starter shown in a metal cabinet at the left. It starts the motor (shown in the foreground), the pump being on the same shaft, whenever the pressure in the sprinkler system falls below a certain point, and stops the same whenever a predetermined high pressure is reached. This maintains a practically steady pressure on the system whenever a leak occurs or a sprinkler head or heads are fused.

At the extreme rear in the illustration is a 2,000 gallon steel compression tank partly filled with water, above which is air. This tank is connected with the fire pump and the sprinkler system as a sort of cushion to prevent a too frequent starting and stopping of the motor. From the top of this tank, a half inch pipe runs to a diaphragm or pneumatic governor. When the pressure in this tank and consequently in the system falls below a given point, as would be the case if a head were opened, the pressure on the diaphragm decreases, and the movement of the diaphragm automatically closes a switch which allows current from the regular power circuit to pass around through a coil of iron on the solenoid, which is the largest device on the board, shown on the right. A plunger in this solenoid then rises slowly, due to the action of the electric current flowing in the coil, and in doing so turns the horizontal shaft to which it is geared by a rack and pinion. On this shaft are crank operated carbon contacts. You can see a half a dozen of them in a row, which are thrown in one at a time. These cut out in regular sequence what are known as "starting resistances" in the motor circuit, causing the latter to start up and operate the pump. As soon as the water pressure is restored to the desired point, the diaphragm governor opens the circuit through the solenoid and the motor stops. The motor can also be started by hand if desired.

No fuses are used in either of the motor leads, circuit breakers being employed instead, the idea being that circuit breakers can be almost instantly thrown in should they open the circuit, while to replace a fuse requires too much time in case of fire. Each circuit breaker is set to open only upon 150 percent in excess of the current which the motor would ordinarily require, to avoid opening except in case of extreme trouble or a short circuit.

The motor is so well enclosed as to be termed "splash proof." Between the motor and pump is an enclosed cooling fan to keep the motor cool. This draws the air into the short pipe, down upon the commutator of the motor, through the machine, and discharges it through the longer pipe, running up to the ceiling, and delivers it to a point outside the motor room. The motor is of 100 horse-power capacity, and the two stage centrifugal pump is capable of delivering 1,000 gallons per minute against a net pressure of 100 pounds at the pump, or equivalent to four good $1\frac{1}{8}$ inch fire streams.

Finally to make sure that current to the motor can not be cut off by opening the switch or a circuit breaker, or by failure of the city lighting company on account of accident, without this fact being instantly known, the leads from the board to the motor are connected with an ingenious electrical device which automatically closes a transmitter circuit, sending in a fire alarm signal.

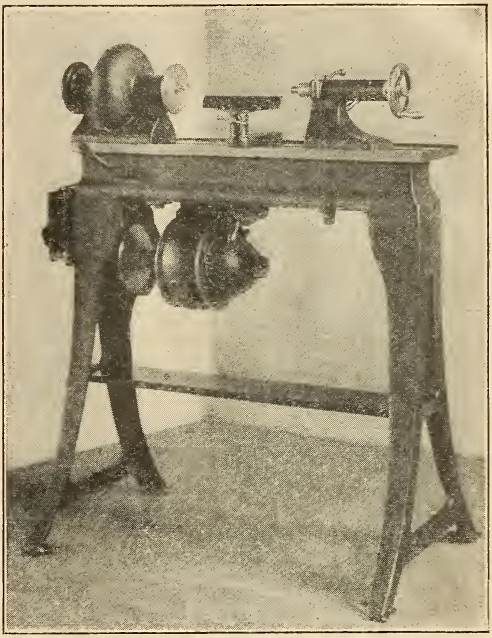
Musical Advertising

A Paris correspondent of Popular Electricity draws attention to the fact that musical advertising, by means of the singing or whistling arc lamp, is being tried in that city. To the right and to the left of one of the store entrances there were hung rather low, two singing, whistling and talking arc lamps, and during their operation a considerable crowd would constantly be gathered in front of the entrance listening to the sounds. [The mechanism of such a singing arc lamp was described in the June issue.]

Instead of offering the crowd something to see it was enchanted by the sweet tones of a familiar tune intermingled with some advertising talks in order to render the advertising most interesting.

Electric Lathe Designed by Students

Students at the shops of the Worcester Polytechnic Institute have designed and built a type of electric driven, high speed lathe which operates somewhat on the principle of the friction-driven drill. The object



NEW TYPE OF ELECTRIC LATHE

of this design is to obtain absolute control of the speed variation.

Operation of the machine is as follows: Underneath the bed is mounted an electric motor which carries on the end of its shaft a vertical steel disk which revolves at great speed. At the left of this disk, and barely visible in the picture is a vertical shaft carrying a little wheel with a face of some frictional material which will give it a good grip on the face of the steel disk. This friction wheel can be moved up and down against the face of the disk. When it presses near the center of the disk the speed is slow. When it presses near the outer circumference where the speed of the disk is greater this little friction wheel revolves at a much higher rate. The shaft of the friction wheel in turn drives the lathe. The handle shown on the left end of the machine is for raising and lowering the vertical driving shaft and gives any speed adjustment desired.

Readiness to Serve

"My light bill was $6.87 this month" says Jones to Smith. "Outrageous! Can't understand it," says Smith. "The lighting company is getting thousands of new customers every year. The plant is more economical than ever before. Why don't they think of us poor fellows and cut the rates a little more." We often hear remarks like these. But do we stop to think of the problem with which the central station must contend? If you who are reading this have figured it out suppose you propound a universal plan of charging for current that will do away with all "kicks," make every customer satisfied and give the central station a fair return on its investment. It would be an easy way to become famous; that is, if you could dream out the solution of the problem. But were you to begin to study the question and try to calculate what the rates should be you would find yourself in more than a peck of trouble.

Mr. S. E. Doane, chief engineer of the National Electric Lamp Association recently read a paper before the Canadian Electrical Association on the "Conservation of Our Natural Resources Through the Use of High Efficiency Lamps." In this paper he endeavored to show how the introduction of the new tungsten lamps, which give a much greater candle power for the same current than the old carbon filament lamps, will have the effect of saving a great deal of our rapidly decreasing fuel supply, but how it incidentally turns topsy turvy all the established methods of charging for current. For instance, the central stations want to save fuel. They want to give their customers more and better light. But they don't want to necessarily "saturate" them with light by giving them three times the light for the same money, and if they give them the same light for one-third the money fair profit will vanish—and you couldn't expect that of a corporation any more than of an individual.

What is to be done in a case like this? What remedy can be suggested to eradicate the shortcomings of the system of charging for current by the number of kilowatt-hours used? This system has its disadvantages and inconsistencies realized by the central stations as well as their customers, but to date it seems to have been the only way out.

Mr. Doane dwells upon this point in his paper and brings out that factor in establishing rates which few of us realize; that is, the ability of "readiness-to-serve" on the part of the central station. The following is quoted from his remarks and will open the eyes of users of current to the fact that the path is not all roses to the central station manager who is endeavoring to establish a rate at once fair to the company and to its patrons.

"A rather striking analogy may be drawn to show the present situation [referring to the introduction of tungsten lamps]. Suppose that a small city of 10,000 inhabitants has organized a fire department, investing considerable money in a building and equipment. A force of men is maintained constantly at the station, in order to answer any alarm sent in. We will suppose that, for several years, this department had on an average one call a week, and that for some reason (as illogical as that upon which the present system of rates was based) it was decided to pay the department on a call basis, that is, so much for each call attended. The records are carefully gone over, and it is found that the yearly expense, including fixed and operating charges is $26,000.00, and that 52 calls (or an average of one call a week) were responded to during the period considered. This makes a total cost of $500.00 per call, and so, upon the basis of these figures and conditions, it is provided that the department shall receive $500.00 for each fire attended, which amount just covers all expenses.

"Here we have adjusted the rate for service on a basis which very apparently is illogical but which under the conditions permits an income sufficient to meet the cost of service. After having this all nicely adjusted assume that, due to the installation of a lot of fire-extinguishers and sprinkler system, the number of fires is suddenly reduced to one-third of the previous number so that the station responds to an average of only one call in three weeks. With the income reduced to one-third of its former value the station rapidly becomes heavily involved in debt.

"The original figures, taken from the period of operation before the number of fires was reduced shows, upon closer analysis, that the total yearly expense of $26,000 was made up of fixed expense of $23,400 and a variable expense of $2,600. Dividing $2,600, the variable expense, by the number of calls responded to shows that the actual cost per call is only $50 in excess of the fixed charges. The logical basis of appropriation would have been to have allowed $23,400 per year to cover the expense which is fixed regardless of the number of calls attended, and, in addition, to have allowed $50 for each fire attended, which would have covered the actual expense created by the call.

"The department would then have been on a readiness-to-serve basis, and a fixed income to cover the fixed expense would have been assured. With a reduced number of fires the saving to the community would have been the saving due to a fewer number of runs at $50 each.

"The $23,400 per year is the readiness-to-serve charge, and represents a value received in assurance of prompt service on demand. The $50.00 per fire simply covers the expense which an actual run entails. It would be folly for the community to expect a reduction in the readiness-to-serve rate under such conditions, since fire protection represents a certain definite value and requires a definite fixed charge to cover the interest on investment, and the fixed operating expense of the department. A reduction in the number of fires only makes the possibility of loss more remote but does not decrease the value of the protection.

"Such, to a great extent, is the state of affairs in the central station field today. The system of charging for service by the number of kilowatt-hours consumed does not represent and cannot represent the true cost of service. It is manifestly a poor arrangement by which the consumer is charged for service on a basis which does not represent the cost of such service, and it needed but the advent of a high efficiency lamp to make the incongruities most apparent. When we remember that from fifty to ninety percent of the central station's yearly expense is fixed regardless of the output, and that the income which is to cover such fixed expense and presumably leave a margin of profit in the majority of cases varies directly with the output, we see at once that with high efficiency lamps there is a great possibility that the revenue may be reduced to such a point that the margin of profit is entirely wiped out, and the plant operated at an actual deficit.

"Central station expense can be classified broadly under two heads, Investment and Operating.

"The Investment expense covers the principal items of—

"Interest on notes and outstanding bonds.

"Dividends on Capital Stock.

"Reserve and Depreciation Fund.

"The Operating expense includes all—

"Fuel.

"Wages.

"Repairs.

"Supplies.

"General Expense.

"A careful analysis of the investment expense shows that part of it is proportional to capacity and part of it to the number of consumers connected. Each item of investment should be considered individually and placed as a definite charge to capacity or to number of consumers connected. The same analysis can be applied to the operating expense with the addition of a charge to output. A considerable part of the operating expense is proportional either to the size or capacity of the system or to the number of consumers connected. Only part is strictly proportional to the actual output of the station.

"To be more specific, practically all fuel, oil, water and boiler room labor is proportional to output, although a part of each can properly be charged to capacity. The expense of keeping fires banked in readiness to serve a quick rise in demand is a capacity charge. As to boiler room labor, as a rule the smaller the station the larger is the proportion of this expense which is chargeable to capacity. General office and executive expense is largely dependent upon the capacity of the plant. Meter reading, billing and other work in connection with customers' accounts, and much of the labor and repair of the distributing system is proportional principally to the number of consumers connected.

"Having analyzed the cost of service and distributed every item under the head of Capacity, Consumer, or Output charge, it is very desirable to evolve a system of rates which will cover the expense as above determined. This is the remedy for the present situation—a remedy which would put the entire matter of rates on a proper foundation, and would enable the central station to keep up its income, and conserve fuel at the same time.

"The Doherty Readiness-to-Serve rate is based upon this sound reasoning, and covers the three items of expense by three corresponding charges to the consumer. This system can be illustrated by the following schedule:

15c per month for every 16 c. p. lamp or equivalent c. p. connected, as capacity charge.
75c per month regardless of current consumption or connected load, as consumer charge.
5c per kilowatt-hour used additional to above fixed charges, as output charge.

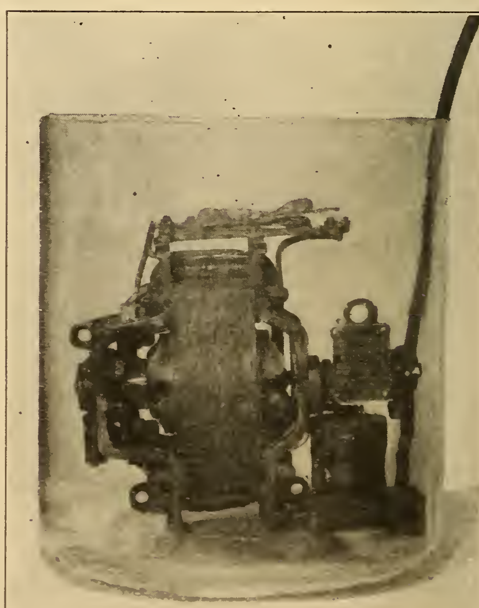
"A discount of 10 percent is usually allowed on the bill if payment is made before a specified time. The capacity charge of 15c per 16 c. p. lamp connected is, as will be noted, based upon the candlepower and not the wattage connected; this arrangement can be justified on the following basis: Suppose a central station has a certain number of customers all using low efficiency carbon lamps; if all these customers should at one time replace their carbon lamps with the equivalent c. p. in tungsten the current consumption and connected load would both drop to one-third of their former value. Now the customers have to bear the fixed expense of the station; and as neither the fixed expense nor the number of customers is changed by the substitution of the high efficiency lamps the fixed charge must be the same, that is, the only saving to the consumers will be the saving in current consumption made possible by using the high efficiency lamps.

"The central station will, however, have at its disposal two-thirds of its capacity, released by the use of the more efficient means of producing light. This represents a potential saving which will benefit both the central station and the consumer. The central station is in a position to increase the number of customers served very greatly without any increase in generating equipment so that, while the increase in customers may represent a small increase in distributing investment, the total fixed charges are not increased nearly as rapidly as the number of consumers. This makes the burden of fixed expense per consumer less and less, as the apparatus released by the use of high efficiency lamps can be utilized in supplying additional consumers. It is only as this apparatus is put into economic use that the fullest benefit of the lamp will make itself felt to both the central station and the consumer, in the gradual reduction of fixed charges and the possibility of producing the light at the best economy. The saving immediately felt is one in the output or current consumption and it is gratifying to know that with every installation of high efficiency lamps on central station circuits, progress is being made towards the more economic use of the natural resources which it is our duty to conserve."

Motor Runs Two Weeks Under Water

The accompanying illustration shows an electric motor undergoing one of the most severe tests to which it could be subjected and through which it passed successfully without a breakdown.

A company which manufactures a well known cash register wished to demonstrate



MOTOR RUNNING UNDER WATER

the high efficiency of the insulation used on the motors built to operate some types of the cash registers in place of the ordinary crank handle. So one of the motors was placed in a glass jar of water and the current turned on.

The motor was in continuous operation under water for over two weeks. At the end of that time the commutator bars (the copper segments which collect the current from the brushes and pass it on to the armature wires) were badly eaten away by the electrolytic or battery action of the current flowing through the water from one commutator bar to the next. But the machine was still able to be operated and the insulation was found to be perfectly sound.

A second motor was then submerged. This was run for one week and the current then turned off and the motor left under water for about two months. After this the current was again turned on and to everyone's surprise the motor started right off as if nothing out of the ordinary had transpired, despite its long bath.

The entire armature and field coils of these motors are impregnated with insulating compound by a vacuum process. After being so impregnated the field coils will withstand an insulation test of 50,000 volts before they will break down.

Water Heaters for Dentists

Did you ever sit in a dentist's chair and after the tearing and rasping of the drill had ceased experience the appalling sensation of having water, either too hot or too cold,

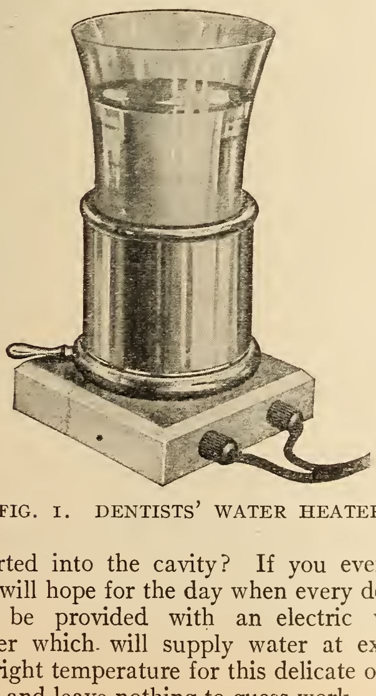


FIG. 1. DENTISTS' WATER HEATER

squirted into the cavity? If you ever did you will hope for the day when every dentist will be provided with an electric water heater which will supply water at exactly the right temperature for this delicate operation, and leave nothing to guess work. Such water heaters are now made and are becoming widely used.

The heater shown in Fig. 1 consists of a nickel plated cup mounted on a polished marble base $3\frac{1}{2}$ inches square. This metal

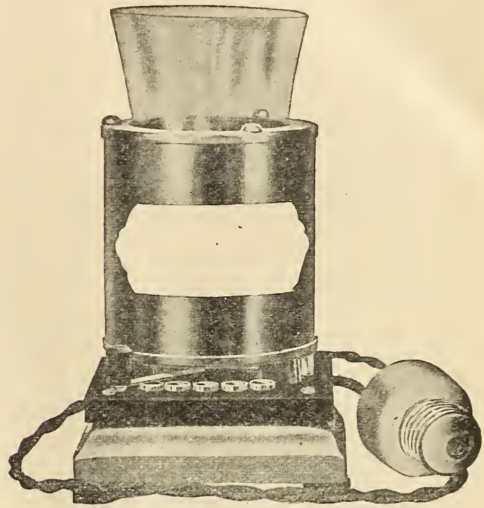


FIG. 2. DENTISTS' WATER HEATER

cup embodies an electric heating device supplied with current from the lamp socket; either alternating or direct current may be used. A tumbler conforming to the shape of the metal cup is supplied.

At the bottom of the heater is seen a small handle by turning which five different heats may be obtained giving approximately 90, 100, 110, 138 and 165 degrees Fahrenheit. To keep the water at the right temperature for syringing cavities use the first or second heat and leave the current on continuously. So little current is used that it would not cost over one cent for 10 hours. The fourth heat is very convenient for softening inlay wax.

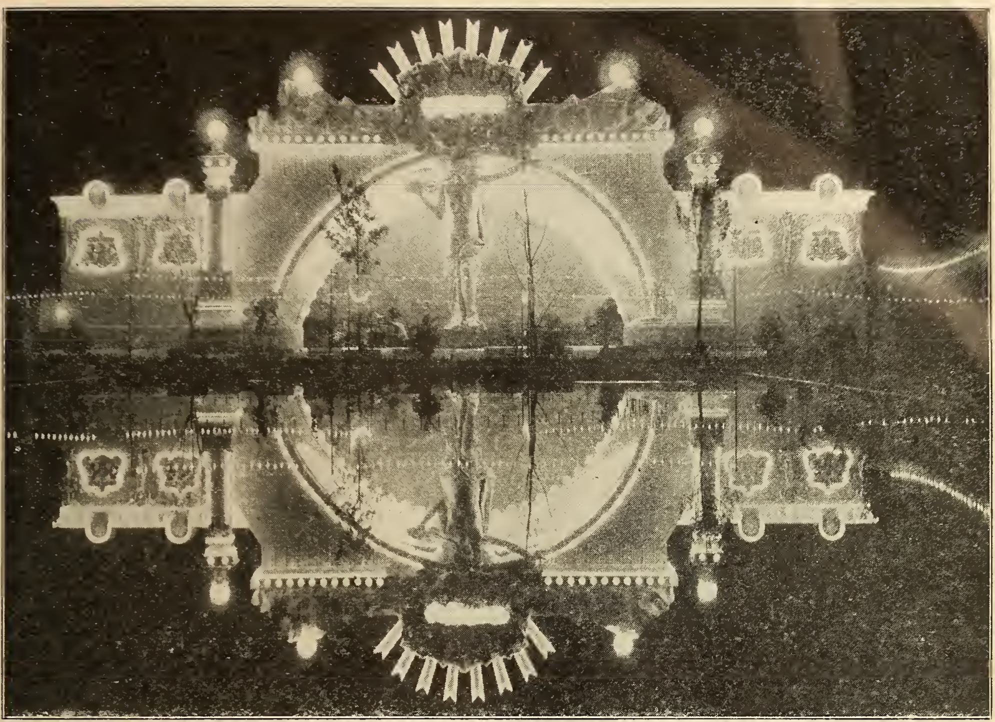
An important feature of the device lies in the fact that it is always ready right at the dentist's hand, saving many steps in the case of a long operation.

Fig. 2 shows a slightly different type. This has four distinct heats obtainable by moving the lever at the bottom over the contact buttons of which there are five, current being off on the first button. The glass holds 140 cubic centimeters of liquid which heats very rapidly on the fourth button. The lever may then be dropped back to the second button, which will hold the temperature at approximately 104 degrees Fahrenheit.

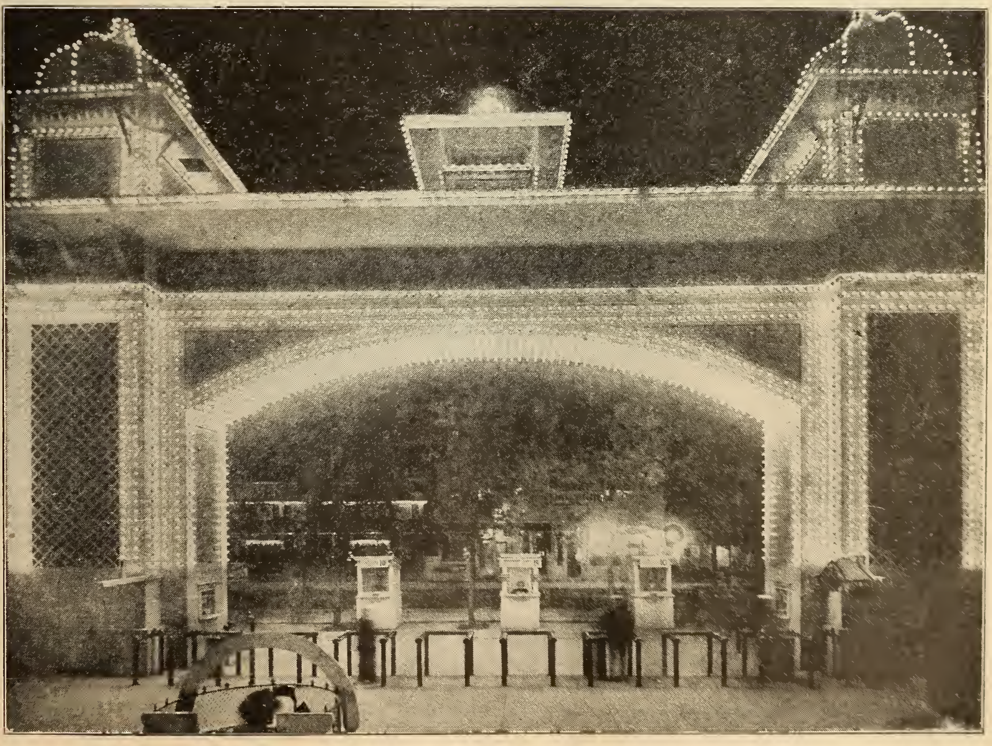
The Playgrounds of a Big City

What shall we do tonight? Too hot to go to the theater. Let's go to White City, Riverview, Forest Park, San Souci. This is the question that is asked and answered by thousands upon thousands in the city of Chicago. The same question is asked and answered in the same way in almost every city of any considerable size in the country, for today the amusement park is the recognized playground of a city. People must play as well as work in this world, and these little cities of light, life and activity, to which the name "amusement park" has been given, present a natural outlet for the pent up spirits of those who play as strenuously as they work.

WHITE CITY AND ITS ELECTRIC TOWER



CREATION--A MARVEL OF LIGHTS AND REFLECTIONS



ENTRANCE TO RIVERVIEW EXPOSITION

THE GATES OF FOREST PARK

And did you ever stop to think that these pleasure resorts owe their existence solely to electricity and its myriad applications? In the first place there must be light—light almost like the day itself—for both illumination and decoration. Electricity alone gives the desired effect. Then, too, the various amusement "features" depend upon electricity for power to operate them and for the illusion effects which can only be obtained by use of the magic current. Scenic railways, giant swings, human roulette wheels, chutes, steeplechases, creations and doomsdays—all respond to the turn of a switch.

LEADING THE FIELD

In Chicago the four great amusement parks represent four distinct types. White City represents the concentration of light and activity. Situated within the confines of two or three city blocks and lighted with tens of thousands of electric lamps and with the lofty electric tower, second only, in beauty, to the famous Pan American tower, it is truly the gem of the great South Side.

Riverview Exposition with its 106 acres of grounds is laid out after an entirely different plan. Here are cool groves with lighted walks, little streets of intense illumination, and in the midst of all "Creation," a central figure of entrancing beauty with its every detail faithfully reflected in the pool of the Grand Basin.

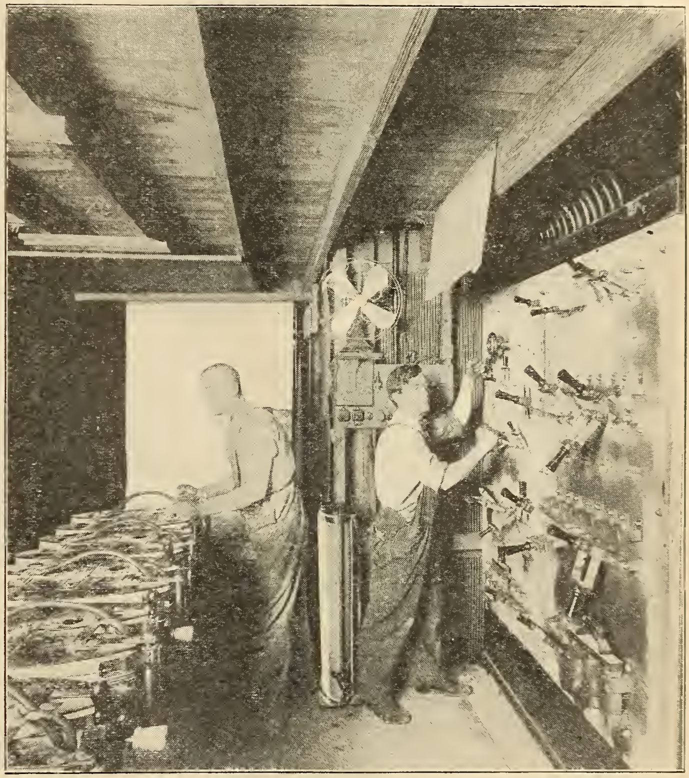
Forest Park in the West Side suburbs is built up around the steeplechase as the central attraction, where thousands flock to enjoy a ride on "the ponies."

San Souci is the "family park" of the city. Though not possessing the grandeur and display of the other parks it has a picturesque beauty as distinctive in its own way.

As an example of how electric current is utilized in some of the features of entertainment, "Creation" at Riverview may be cited. The entrance to this remarkable product of human ingenuity is shown in one of the illustrations, the figure in the foreground being over fifty feet high. In the decoration of this entrance 4,680 incandescent lamps are used. Within is a great amphitheater with a stage nearly twice the length of that of an ordinary theater. In the rear of the stage and facing the audience is a vaulted background against which the wonderful effects are produced.

The successive scenes in the drama, silent save for the occasional uproar of the elements, represent the creation of the world—the first six days and finally the day of rest. First is utter darkness: unbounded space. From out the turmoil of the elements and the formless nebula gradually appear the waters—a heaving sea covering all. Then out of the waters rises the first mountain peak followed by others until the scene represents a land of mountains, valleys and plains. Presently plant life appears on the hills and in the valleys, followed by animal life and then by the first man and woman. On the seventh day the turmoil of the elements has ceased and peace and quiet are over all.

The performance lasts for over half an hour and during all this time in the switch-board and spot-light galleries above the stage, and in the room beneath, men have been performing in predetermined sequence the various manipulations necessary to the production of the spectacle.



CONTROLLING THE LIGHTING EFFECTS IN CREATION

The appearance and disappearance of the various elements which go to make up each scene, such as clouds, mountains, hills, etc., are brought about by raising and lowering from beneath the stage successive rows of painted scenes which extend higher and higher in successive tiers toward the back of the stage. Upon these scenes are thrown all the electric light effects known to the modern stage art.

One of the illustrations shows the electric switchboard gallery from which the electrical effects are controlled. There are eight sets of border lights each containing 125 lamps which are thrown on and off in any combination from the switchboard. In the front is a row of eight "dimmers" by which the intensity of the light from these border lamps can be controlled so as to bring the light up from a faint glow to full brilliancy, producing any effect from faintest dawn to broad daylight. The wave motion of the sea is produced by a device worked by electric motors, also controlled from this switchboard, as are the lamps which make the stars twinkle in the background.

Extending across in front of the stage but above it and out of sight of the audience is a long gallery where are located the thunder machines, the "volcano" cannon, rain machines and also eight electric arc spot lights, among them special lamps for making the sun and moon and for producing snow and rainstorm effects, and the zig-zag lightning flashes across the vaulted background of the stage.

To make the sun rise, for instance, one of these lamps is provided with a special shutter with a round hole for throwing the "sun" spot on the background. This shutter is operated by clock-work. The light is thrown on at the horizon and the clock started going, which moves the slide slowly so that the sun travels at a uniform rate up across the sky. The moon is operated in the same manner, also the rain and snow lamps, which project rapidly falling points of light.

Lightning flashes are projected from other lamps having special shutters or screens in which zig-zag openings are cut. These are momentarily exposed in front of the projector.

"Creation" is of course but a single example of the numberless concessions which depend entirely upon electric current for their operation. Without it there would be no amusement parks and it would be more difficult to find an answer to that little question: "What shall we do tonight?"

Traveling Electric Sign in Paris

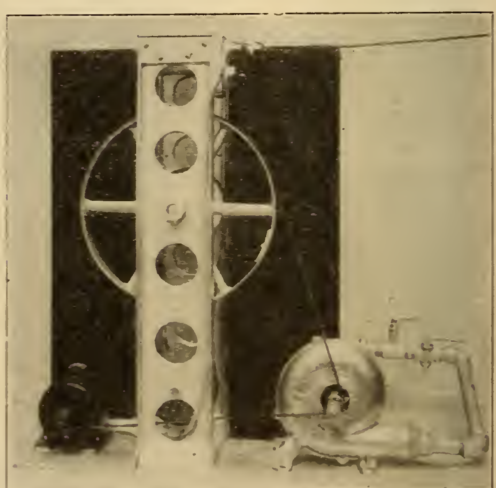
Perhaps the most original electric sign in Paris, France, is that of a representative of an English firm. It is located on the facade of the building and the letters travel around on a track like miniature railway cars. Just below the fourth floor are fastened the electric rails following the curves of the entire facade. On these rails are hung the wooden letters forming the sign. Each letter has two or more wheels, according to the size of the letter, so that all the letters can roll along on the rails. In order to insure a regular movement of the whole the different letters are tied together by means of steel wire.

TRAVELING ELECTRIC SIGN

Every third letter is provided with a small electric motor, and when the current is switched on in the office the whole mass of letters forming the sign is made to move clear around the whole front like a miniature electric train. In the evening the letters are illuminated by incandescent lamps. The effect of such an electric moving sign is quite extraordinary and presents a novel spectacle.

Electric Driven Corn Popper

Popcorn, as every one knows, is consumed literally by the wagon loads at large amusement resorts. It is a problem for those who have concessions in the most favorable locations to turn out the product fast enough to supply the corn hungry public, by old hand operated poppers—hence the electric power popper. A power driven equipment of this nature is shown in the cut. The small electric motor down in the left hand corner of the picture, which is a view of the back of the machine, drives the chain gear which rotates the corn popper and also drives a small blower attachment. This blower is used to increase the gas pressure to the burner and consequently the heat, and enables three or four times the amount of corn to be turned out for the same fuel cost.

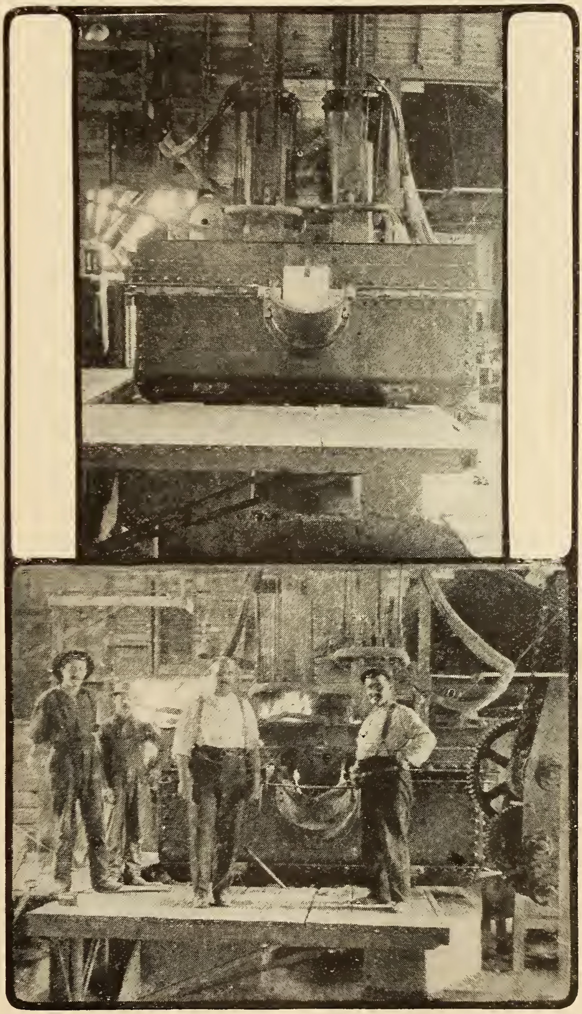


ELECTRIC DRIVEN CORN POPPER

Making Steel by Niagara Power

Ingots of solid steel, weighing 500 pounds each, are produced by a giant electric furnace in a plant located near Niagara Falls. Electric current for this process is obtained from one of the hydroelectric plants at the Falls where the price of electric power, due to the exceptional natural facilities for its production, is so low as to make it available for the making of steel.

The electric furnace is of the Heroult design and consumes 1,000 horsepower while in operation. It is capable of making five tons of steel in a single heat. The Lash process, which is used, consists of making a mixture of concentrated magnetic ores or iron ore sands, granulated pig iron and carbon for charging the electric furnace. It is held that it is not strictly a direct process but is an ore and pig process, the ore being greatly in excess of the pig iron employed. It is maintained that the amount of pig iron required to make a ton of steel in this manner is only about half of that required in the open hearth furnace, as the electric furnace operates with a non-oxidizing atmosphere. The ore, cast iron borings or granulated pig iron and charcoal or coke are thoroughly mixed with a small proportion of lime, the latter being used to keep the material embalmed, and consisting of only about four per cent. The mixture mostly used includes about 10 per cent of coke dust and 23 per cent of granulated pig iron or cast iron borings, and about 63 per cent being magnetic iron ore.



ELECTRIC FURNACE AT NIAGARA PLANT

The batches of this mixture are 500 pounds in weight, and the mixing requires about 15 minutes. The electric furnace is charged with enough of these mixed batches to make approximately four tons of steel, and then steel scrap is scattered over the top, 100 pounds being used with a small bar of iron to form an arc between the electrodes when they are lowered into position and the current turned on. The current then continues to flow from one electrode to the other through the mass and develops intense heat. The entire batch of material being melted thoroughly the slag is poured off and a final refining material added for producing the quality of steel desired.

It is held that the physical properties of the steel are superior to steel made with the usual scrap and pig processes.

Current Economy for Moving Picture Arcs

By F. G. WALDENFELS

Motion pictures are a form of public entertainment that has developed with great rapidity into an industry of enormous proportions, employing thousands of men and women and with millions of dollars invested in property. As in any other undertaking, the success or failure of a moving picture theater depends as much upon the economy of its operation as upon the volume of its business, and the ability of the manager to stop the little "leaks" may spell the difference between success and failure.

Moving picture theaters are great users of electric current, and indeed without electricity they could scarcely exist. The intensely illuminated snow-white fronts first attract the passer-by and invite him to enjoy the sights within, and the amusing and instructive entertainments which it is his privilege to enjoy for the small sum of a nickel or a dime are made possible only by the modern electric projectoscope.

In the operation of the moving picture arc lamp lies one of the opportunities to economize. These arcs may be operated with a great waste of current, or devices may be employed which will cut down this expense to a minimum, and not only does the theater management appreciate the significance of such innovations but the central station company furnishing the current, as well, for it is the satisfied and prosperous customer which in the long run is the paying customer for the central station.

It is the object of this article to discuss the different successful devices used for operating moving picture arcs on alternating current so that any operator or electrician can understand them.

There is always a certain important item to consider in electrical construction and that item is safety from fire, and everything will be presented in this article from an underwriter's point of view, and this is to eliminate the fire hazard and install all wiring according to the rules of the Underwriter's National Electrical Code. In the beginning a great many oil cooled rheostats were sold in the field, but were condemned by the Underwriters, and now most of the manufacturers of these devices are making the air cooled type which is approved.

In the use of alternating current it is a problem to supply low voltage to moving picture arc lamps, and the following methods are a few solutions which best fill the requirements at present:

1. Jacobi & Harris Reducer: a reactance coil in series with the arc lamp.
2. Don J. Bell Auto-transformer or Inductor Compensator: having three sets of connections in the primaries to give about 55 amperes at about 33 volts in the secondary leading to the arc carbons.
3. Ft. Wayne Compensarc: a simple transformer winding and core with lamp directly across the secondary winding. To adjust the current, two reactance coils are provided in series with the arc lamp.
4. Winchester Magnetic Rheostat: a transformer with the secondary current adjusted by means of a magnetic shunt.
5. General Electric Economy-Arc: a step-down core type transformer with a one primary and one secondary coil. The secondary coil is in series with an auxiliary winding so connected as to introduce a current in the secondary opposite in direction to that in the main winding.
6. General Electric Mercury Arc Rectifier: for converting alternating to direct current, with the assistance of a compensating resistance.
7. Motor-Generator: for converting alternating to direct current of suitable voltage for operating the arc.

These devices have all been tested by the Underwriters Laboratories, for economy, efficiency, variable voltages, high power factor, insulation and break down test, temperature rise, etc. The laboratory has endeavored to induce the manufacturers to dispense with the waste heat, noise and humming at the lamp, reduce the carbon consumption and increase the light 30 to 50 percent above the results from the same amperage obtained from a rheostat. Also to make the efficiency of the lamps great enough to overcome the greatest film densities, long distances, irregular strength and eventually breakdowns.

All these devices can be subjected to a severe breakdown insulation test with 1000 to 5000 volts alternating current and are absolutely safe and indestructible. Lighting companies are favorable toward them because they are not troublesome and are square with the meter.

Moving picture arc lamps operate at approximately 35 to 55 volts and 20 to 80 amperes. They are generally connected to 110 volt circuits, but in many cases where 220-volt, Edison, three-wire distribution is used, central stations have insisted on connecting the arc lamps on the two outside lines (220 volts) on account of the unbalancing of the system that the lamps would cause when placed across the neutral and one side of the line (110 volts).

Past practice used to reduce the line voltage to that required by the lamp has been to employ rheostats or reactance coils. Both of these methods are very wasteful of energy and therefore enlarge the current bill. Furthermore, the rheostats, nicknamed "stoves" by inspectors, are objectionable on account of the large amount of heat generated which not only makes the lamp house very uncomfortable for the operator, but is also a great fire hazard, as the rheostats often become hot enough to set fire to anything combustible that comes in contact with them.

Reactance or choke coils, while not quite so wasteful of energy as the rheostat, are not desirable on account of introducing into the circuit what is known to electricians as "reactance" which results in a large current at a low power factor being taken from the system, thereby affecting the voltage of the lighting circuit.

Of the approved devices it remains for the theater manager to choose the one best suited to his needs, and following is a brief explanation of the different devices:

J. & H. REDUCER

The Jacobi & Harris Reducer, Fig. 1, is an air cooled device composed of choke coils and replaces the ohmic resistance type of rheostat generally used. The coil consists of two windings of about No. 4 B. & S. gauge, cotton-covered, copper wire connected in series on a core of laminated sheet iron punchings. This device is designed for 110 or 220 volts, 60 cycles, 30 amperes, and can stand the test on a machine rated as high as 67 amperes, 220 volts. The device is manufactured to order and wound according to the circuit to which it is to be connected. The size of wire used for the coil is much larger than the rating of the device would require.

BELL AUTO-TRANSFORMER

The Don J. Bell Auto-transformer, or Inductor-compensator is a device which is used on alternating current circuits ranging

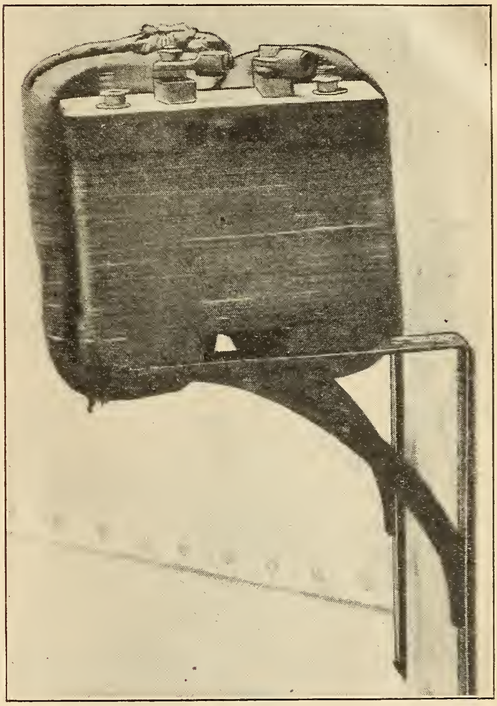


FIG. I. J. & H. REDUCER

from 90 to 115 volts. It is provided with three sets of connections for the primary circuit and is designed to supply a current of 55 amperes in the secondary with a voltage of 33 at the lamp terminals. It has a power factor of .8864. The core is built up with sheet iron punchings in accordance with standard transformer practice and held together with brass bolts and nuts. The coils are form wound and dipped in an insulating compound and baked with two layers of tape over the outer surfaces of the coils.

The primary coil consists of a good many turns of about No. 6 B. & S. gauge, copper wire, cotton covered. Taps are brought out from a certain number of turns on the coil to separate terminal posts on the front. The secondary has a less number of turns of No. 6 B. & S. gauge, cotton-covered, copper wire, with taps brought out from different parts of the winding to separate binding posts on the front. From a common point of these coils a wire is brought out to a terminal in the front for a conductor leading to one lamp terminal.

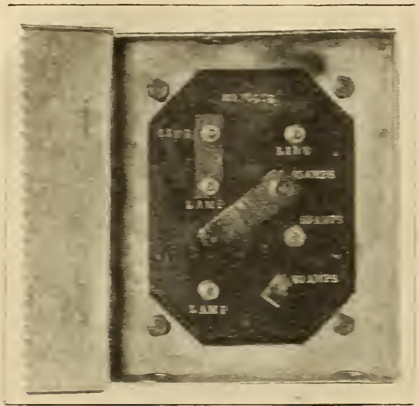


FIG. 2. TERMINAL BOARD OF BELL AUTO-TRANSFORMER

The front of the terminal board is provided with three sets of connections as shown in the diagram, Fig. 4, for line voltages ranging from 90 to 95, 100 to 104, and 110 to 115 respectively, which shows the device is adjustable to the extreme variation of the voltages.

FIG. 3. BELL AUTO-TRANSFORMER

Terminals (A1-a1), (A2-a2) and (A3-a3) are for 110-115, 100-104 and 90-95 volts respectively.

(L) is the common lamp terminal for all three variations. (C1), (C2) and (C3) are connected to the other terminal of the lamp according to the current that is desired.

A modified form of the auto-transformer recently put out is arranged so that current to the lamp can be easily varied. The design of wiring has been changed in the secondary, otherwise the compensator is about the same as the one previously explained.

On the slate base contained in the metal box at the top of the device, Fig. 2, are mounted three contacts marked respectively 45, 53 and 60 amperes, and a substantial spring brass switch arm is pivoted so as to be capable of being set on any one of these buttons. The purpose of this change is to permit ready variation in the amount of current to be delivered to the lamp from the secondary circuit. The lowest amperage on the board, 45 amperes, is sufficient for stereopticon projection, while the moving

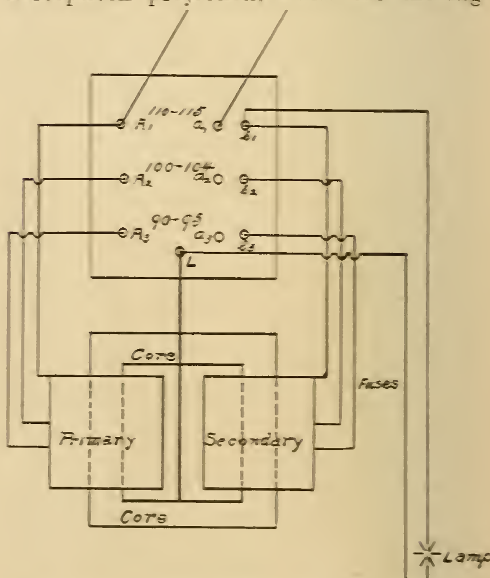


FIG. 4. CONNECTIONS OF BELL AUTO-TRANSFORMER

picture film very often requires the highest amperage obtainable. The complete device is shown in Fig. 3.

COMPENSARC

The Ft. Wayne Electric Works manufactures a Compensarc, or auto-transformer, Fig. 5, designed to furnish 14, 40 or 60 amperes to the lamps of moving picture machine outfits for 110 or 220 volts a. c. It is used intead of the common iron or other ohmic resistance type of rheostat.

It consists of a simple transformer winding and core with the moving picture arc lamp directly on the secondary of the transformer winding. Two reactance coils are provided in addition which may be put in series with the carbons of the lamp.

The transformer is of the air-cooled type, and as shown in the diagram, Fig. 6, and has two additional windings, one in each side of the line. The core is built up of sheet iron punchings mounted on a flange.

A single pole, 500 volt, main-line switch with three contact jaws, controls the current in an odd way. When the switch is open the lamp circuit is open. When the switch blade makes contact with the first pair of jaws as shown in Fig. 5, the lamp circuit is closed with the two reactance coils in series with the carbons. When the knife blade is in contact with second pair of jaws the light reactance coil is short circuited. In the third position the knife blade is in contact with the first and third pair of jaws only, the second pair of jaws being so designed that they are not in contact with the switch blade when it is completely closed. In this position both reactance coils are short circuited and the lamp is directly across the line with the two transformer windings in each side.

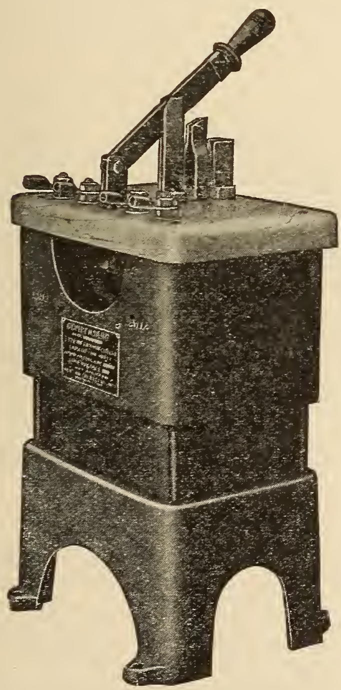


FIG. 5. COMPENSARC

These devices are furnished for any frequency desired, 110 or 220 volts a. c., and are designed to furnish currents in the lamp circuit with a voltage of 55 at the lamp carbons as follows:

Position 1. Both reactance coils in series with lamp, 14 amperes. This current will warm up the lamp carbons and permit the operator to throw a bright light immediately.

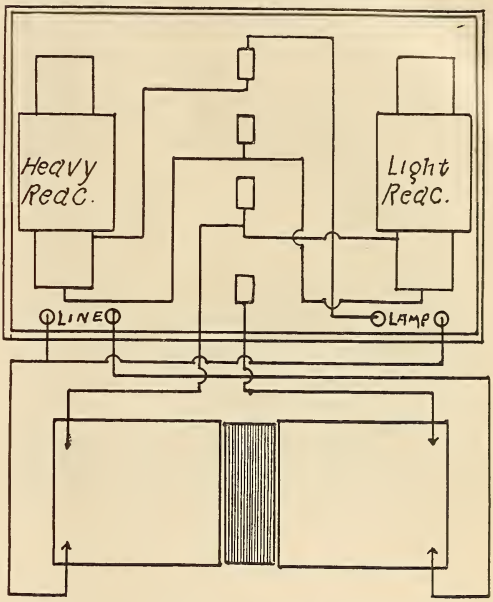


FIG. 6. CONNECTIONS OF COMPENSARC

Position 2. Light reactance coil short circuited, 40 amperes. Normal running current.

Position 3. Both reactance coils cut out; maximum running current 60 amperes. This current is often used when film is thick or smoked. The maximum loss on position 3 is about 200 watts.

WINCHESTER TRANSFORMER

A transformer with adjustable reactance coils in the secondary circuit is made by the Winchester Electrical Works, and is a simple transformer as shown in Fig. 7. A reactance coil having the winding adjustable in relation to the core is placed in the secondary circuit in the series with the lamp. It is air cooled and designed for a primary voltage of 110 or 220 volts a. c. as desired, and for a secondary voltage of 55.

About No. 4 copper wire is used for the reactance coils and these are wound in the same manner as the secondary coil. These coils are mounted on a heavy wooden strip which is secured at the ends by slide bolts. These bolts engage holes in the sides of the case and the coils are thus supported. A series of these holes is provided, permitting

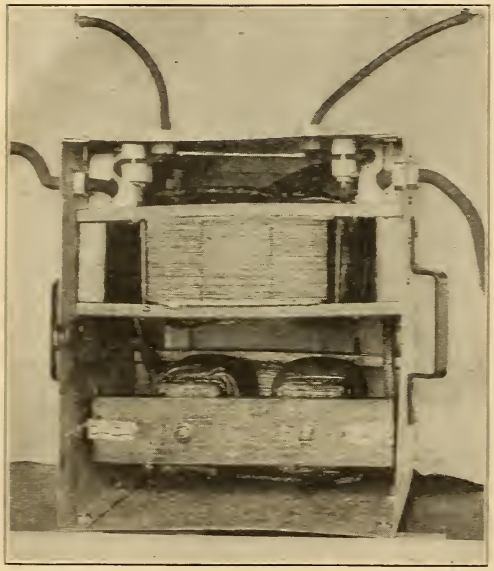


FIG. 7. WINCHESTER TRANSFORMER

adjustment of the coils so as to vary the number of turns about the wire. This adjustment provides a means of regulating the reactance in the secondary and provides for a corresponding range in the current flow.

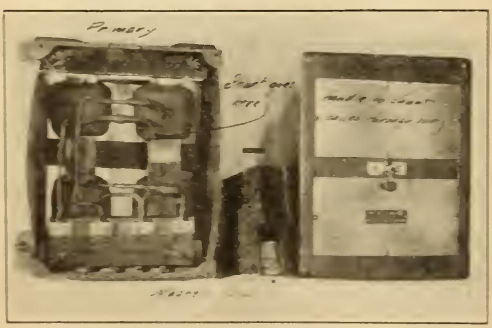


FIG. 8. IMPROVED WINCHESTER TRANSFORMER

An improvement on the preceding device, by regulating the secondary current with a magnetic shunt as shown in Fig. 8, is supplied by the Winchester Company. It is air-cooled and designed for 115 volts a. c. on the primary with the secondary current ranging from 40 to 55 amperes at 57 volts.

Two coils each are provided for the primary and secondary of the transformer. The primary and secondary connections are made on a board.

Fastened to a rod which runs through the center of the cover is the magnetic shunt, and by raising and lowering the shunt between the cores, a means of adjustment of the secondary current is provided. The shunt rod passes through the cover of the device and is readily accessible to the operator.

ECONOMY-ARC

Fig. 9 shows the General Electric low-potential transformer or Economy-arc. This is an air cooled transformer, designed for 110 or 220 volts a. c. with a secondary voltage of 35 volts. It is a step-down transformer, with the secondary coil in series with an

FIG. 9. ECONOMY-ARC

auxiliary winding so connected as to introduce a current in the secondary opposite in direction to that in the main winding and tending to reduce the low voltage current output of the transformer. This auxiliary is equally sub-divided into two parts, taps being brought from each end and from the center to three respective sets of contact clips, between which operates a short circuiting bar, and the coil is so arranged and connected with respect to the main secondary winding as to deliver maximum currents of 30, 40 and 50 amperes in the three positions of the regulating switch for the operation of the arc lamp.

The primary coil is arranged with four leads or taps so as to adopt the transformer for use on 200, 210 or 220 volts. The auxiliary winding is of similar construction and is wound between the main primary

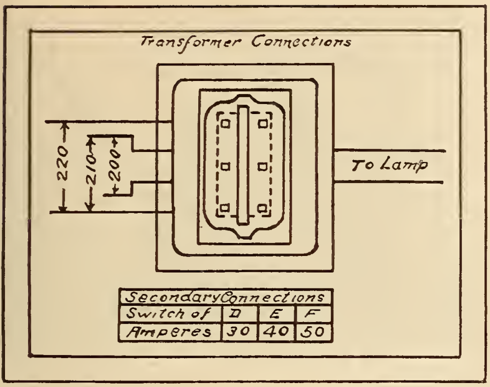
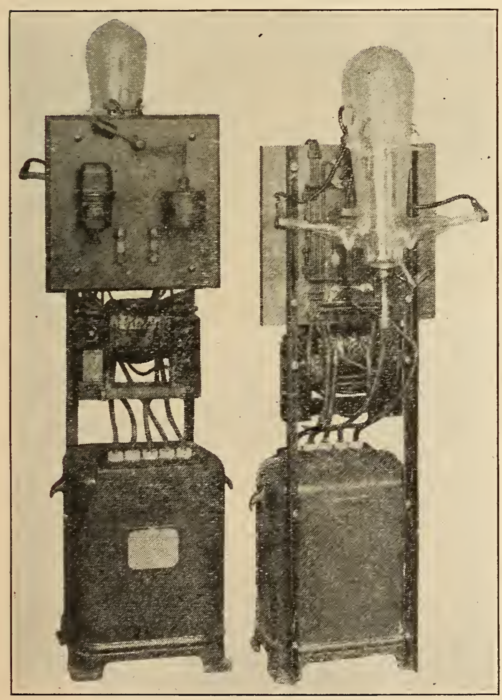


FIG. 10. CONNECTIONS OF ECONOMY-ARC

and secondary coils. Leads from the auxiliary secondary winding are brought out to copper contact plates mounted on each side of the slot through which the switch is moved. The short circuiting bar is con-



FIGS. 11 AND 12. FRONT AND REAR OF MERCURY ARC RECTIFIER

structed of black fibre, upon which are bolted two copper contacts each of which is sufficient width to bridge across the gap between the copper clips, and is so arranged as to maintain the short circuit during movement of the switch and until its corresponding contact piece engages with adjacent clips of the switch, thus preventing fluctuations in the lamp during the period of change. Fig. 10 shows connections.

MERCURY ARC RECTIFIER

Mercury arc rectifiers for moving picture machines are made in a simplified form, being minus all instruments, all main line and regulating switches, circuit breakers, etc. The rectifier tube is equipped with an automatic shaking magnet in the a. c. circuit to start the arc. The shaker attachment consists of a solenoid coil and plunger in circuit with the alternating current. The electric

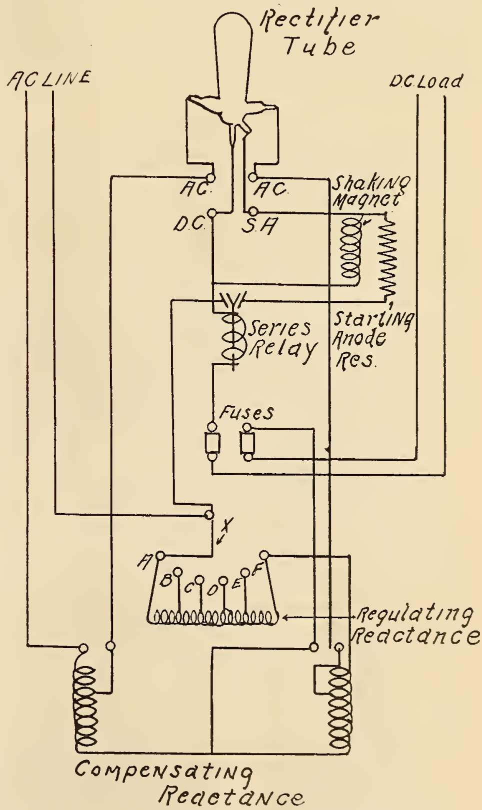


FIG. 13. CONNECTIONS OF MERCURY ARC RECTIFIER

current passing through the coil causes the plunger to jump up and down, a series of levers communicating this movement to the tube carriage and starting the arc. When direct current begins to flow out of the tube it passes through a relay which automatically cuts the shaker coil out of the circuit.

The rectifier tube is of 40 ampere capacity whereas the compensator coils, etc., are designed for 30 ampere outfits. This allows for the initial starting current when carbons of the arc lamp are closed, and where normal current is approximately 30 amperes. A regulating reactance is used to limit the current for the moving picture arc, which reactance is connected in series with the a. c. supply.

The rectifier is designed to start automatically when the carbons of the arc lamp are touched together. The shaking coil tilts the tube and starts the arc as in the mercury vapor or Cooper Hewitt lamp. As soon as the arc is started only direct current is obtained from the terminals. Figs. 11 and 12 show the front and back, respectively, of a mercury arc rectifier. Fig. 13 shows connections.

MOTOR-GENERATOR

The remaining device which may be used for the operation of the moving picture arc is the motor-generator. This is a well known electrical machine, used for many purposes. It consists of a motor and a dynamo or generator mounted on one shaft. The motor takes current from the main line, and as it revolves it drives the generator which latter is so designed and wound as to give the current necessary for the economical operation of the lamp.

Floor Surfacing and Polishing

An entirely new industry has sprung up since application of electricity has been made to floor sanding and polishing machines, one that has been enthusiastically received by architects, contractors, builders, owners and tenants of large buildings of any kind. To the owner of such a machine the field is fresh, and active competition is not yet a problem. These machines will go over a floor and grind down and polish the surface in a manner that cannot be approached by hand methods. They are operated by electric motors which take current from the lighting circuit through a long flexible cord.

Fig. 1 is a surfacing machine only, that is it does not perform the sanding and polishing operations. In front is seen a disk like cutter which bears heavily on the floor and is at the same time revolved by the motor, the latter being carried by a little truck with rubber tired wheels to prevent marring or

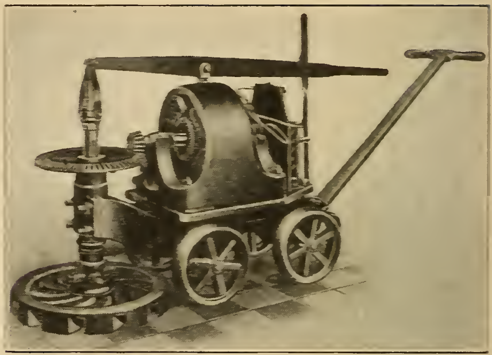


FIG. 1. SURFACING MACHINE

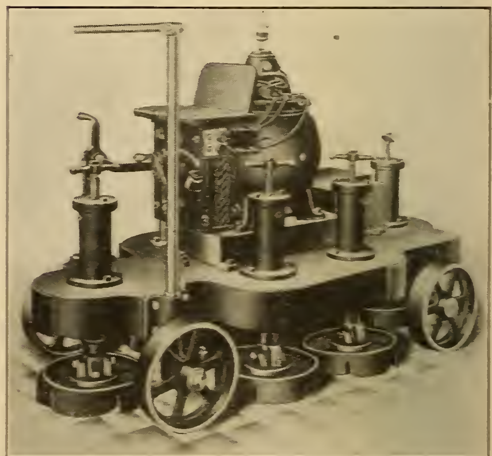


FIG. 2. SURFACING MACHINE FOR HEAVY WORK

FIG. 3. SANDING AND POLISHING MACHINE

scratching. The machine is pushed along over the floor by hand and the lever permits variation of the pressure on the cutting head. The motor is of two horse power. In addition to the surfacing disk a sanding head or special head with carborundum blocks is supplied if desired.

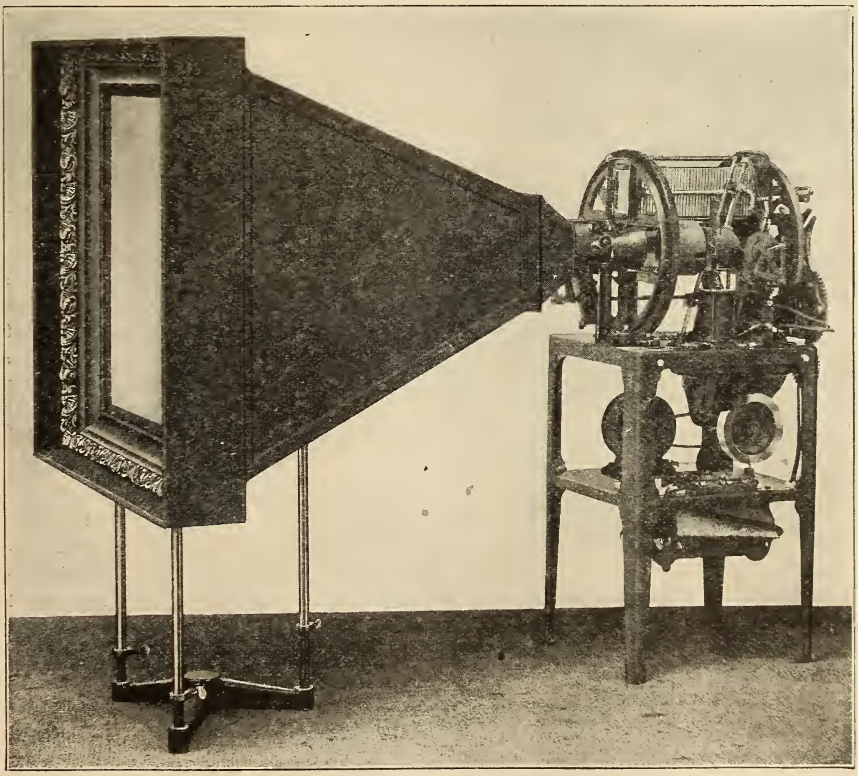
A heavy machine for use on large surfaces of tile, mosaic or terrazzo floors is shown in Fig. 2. The motor which drives the machine and operates the surfacing disks at the same time is of $7\frac{1}{2}$ horsepower. Each grinding head is provided with an independent pressure device. This machine leaves behind it a perfectly smooth even track 33 inches in width.

The sanding and polishing machine shown in Fig. 3 is of quite different design. The sanding and polishing wheels are underneath while in front is a sort of friction roller which is driven by the motor. As this roller revolves it draws the machine along, so that the whole device is virtually self propelling.

The Automaticon

A new form of electrically operated advertising device is represented by the Automaticon which is especially adapted for window display purposes. In front of the machine is a ground glass screen 26 by 28 inches, fitted in a handsome frame. Extending back from this screen is a funnel which excludes all light from the back of the screen with the exception of that which comes from an automatic, self-centering arc lamp situated back of the rear opening in the funnel.

The machine is equipped with 86 slides, showing any subjects desired, and when in operation will automatically display these in succession upon the ground glass screen at intervals of eight to nine seconds. Apparatus which automatically moves the slides in front of the projector is driven by a $\frac{1}{8}$ horse-power electric motor and either alternating or direct current may be used.



THE AUTOMATICON

Electricity in the Laundry

By NORMAN G. MEADE

A large shirt factory in Bridgeport, Connecticut, has one of the most complete electric laundry equipments of any similar concern in the country, including electric irons, electrically heated rolls, electric motor drive, etc. The principal feature of the installation is two hundred Simplex irons in use on 150 tables, some of the tables having a double equipment. There are two sizes of irons in use, the largest a $6\frac{1}{2}$ pound iron for general ironing of shirts, and the small or glossing iron weighing three pounds, used for neck and wrist bands. The large irons have a round nose and a round edge, while the small irons have a sharp edge and round nose and rocker-shaped bottom.

WHERE 150 ELECTRIC IRONS ARE USED

APPARATUS TO PRODUCE CHLORINE BLEACH

The manner of wiring and supporting the cords is quite unique. The mains are run on the ceiling of the floor below, and double branch cutouts placed under each table. The cord support consists of a piece of conduit extended through the floor and supported by a flanged plate. A receptacle with two plugs, one for each iron, is mounted on the support within convenient reach of the operator. Every iron is provided with a special regulator stand, so arranged that when the iron is not in use the current is reduced $33\frac{1}{3}$ percent, preventing the iron from overheating, but maintaining a working temperature. In this installation a saving of nearly 30 horsepower per day is made, as one iron is always on the stand, and the other about one-third of the time, while the shirts are folded and pinned.

In the same room, but not shown in the accompanying illustration, are five electric rolls for ironing bosoms of shirts. The rolls revolve in one direction until the bosom is covered, then reverse, returning to their original position. The reversal is accomplished by a specially constructed commutator.

A large New York laundry is using, with good results, an apparatus which produces chlorine bleach electrolytically, by the dissociation of salt water. This bleach consists of a mixture principally of sodium hypochlorite and caustic soda. The hypochlorite is the active agent when in combination with the soap and oxalic acid used in the washing of linen, and acts as a powerful bleach and disinfectant.

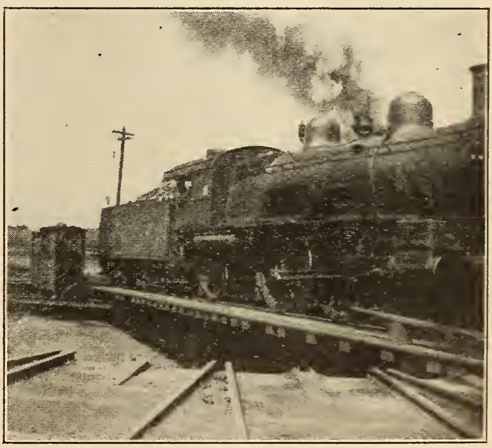
The apparatus consists of a supply tank which contains the salt solution (about 21 pounds of salt in 86.4 gallons of water), an electrolytic vat containing the electrodes, and a tank in which flows the resultant liquid. Edison 120- volt service is applied directly to the electrodes through a reversing switch and ammeter. The reversing switch is used to clean off the electrodes by the reversing of the current after every four hours' running. The flow of the salt water is regulated by a valve from the supply tank and is maintained at a rate which keeps the thermometer in the electrolytic vat at about 95°F., which is the best temperature for the proper formation of the hypochlorites. The current is maintained at as near 25 amperes as possible, and is readily adjusted by the quantity of salt added and by the rate of the flow of the solution.

The method as described above, though more expensive than the common way, which consists of mixing bleaching powder with water, allowing the solution to remain quiet for some time and using the clear liquid from the top for the suds—gives better results and has many advantages over the old method. The solution as obtained with the electrolytic process is so nearly perfect that very little oxalic acid is required in the washing water. One gallon of solution is used with 25 gallons of water for white goods; less solution is used for colored articles. Linen is given a softer finish and no spots appear, as is sometimes the case when the bleaching powder solution is improperly mixed, or when too strong for the soap water; under such conditions holes are often burned in linen and bad stains made. Labor involved in the two methods is practically the same. The cost of bleaching powder is about $8.50 per month as compared with the cost of current and salt at $12.50 per month.

The laundry is doing nearly $10,000 worth of business in a month. The apparatus serves as an advertisement as it is a neat arrangement set up in the front part of the place, easily seen by entering customers, and its sanitary properties being readily apparent.

Electric Turntable

Once upon a time locomotive turntables were laboriously operated by hand. Nowadays in the large shops and yards electric motors are made to do the work. The accompanying picture shows an electrically operated turntable with a locomotive on it ready to be turned. To the left is the cab in which the controlling mechanism is placed to feed a 10 horsepower, 115 volt, direct



ELECTRIC TURNTABLE

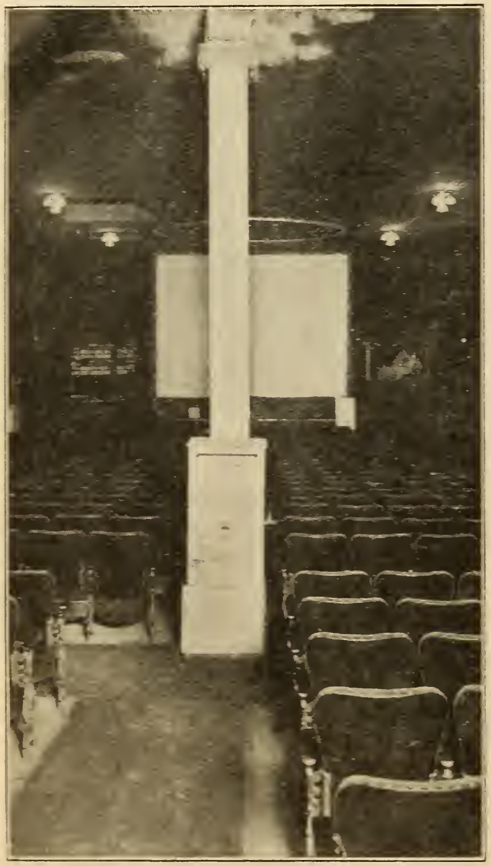
current motor located under the cab.

Current is supplied to the table by wires run underground in a conduit to the center of the table and collector rings are employed to receive the current.

The turntable thus equipped is very economical in time and operation. The old method required from six to eight men, the work being now done by one.

Ventilator and Air Cooler

Artificial cooling of the air in theaters and public halls to make them bearable on hot summer nights is rapidly gaining ground. A new electrically operated apparatus known as the Enpeesee fan is one of the devices by which this may be done.



VENTILATOR AND AIR COOLER

This combined ventilator and cooler consists of a sheet iron casing in the lower part of which is an electric fan which draws the air into a purifying chamber. This chamber contains a pan filled with a chemical solution and mineral wool and drippings from pipes surrounding the ice chest, purifying the air and collecting all dust and particles that may come in through the fan. The air goes out at a temperature 10 to 15 degrees cooler than that at which it is taken in at the bottom.

Concealed Porch Lighting

The main object of a light outside the hall door of a residence is usually to light up the steps so as to prevent any one stumbling, and also, perhaps, to enable those within the house to see the faces of people outside before they are admitted.

This last consideration is often of some moment in country districts, where tramps are a nuisance, says the London Illuminating Engineer, and it is worth while to point out that the position of the lamp in this case requires a little care; otherwise it will actually prevent the accomplishment of the very object for which it is installed. If, as often happens, the lamp is hung immediately outside the door, so as to be in the line of view of a person looking out from the brightly illuminated interior, it merely makes it impossible for him to see anything outside at all. If, however, the lamp is concealed so that he only sees the objects illuminated by it, it serves its right purpose.

CONCEALED PORCH LIGHTING

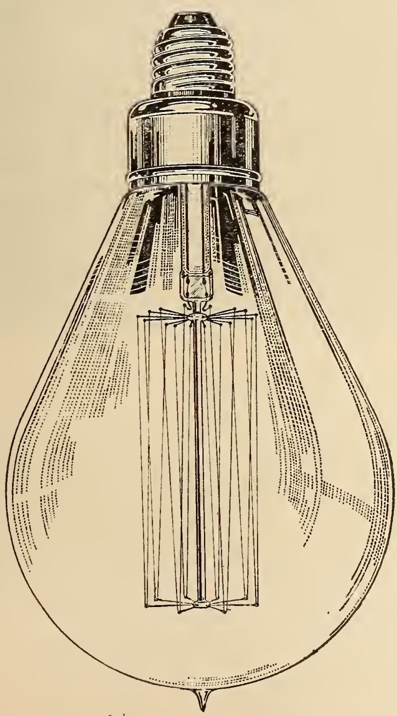
The illustration accompanying this article shows one form of porch lighting which doubtless has some drawbacks, but, is, at any rate, an illustration of the principle on which such lights should be installed.

It will be seen that the sources are quite out of the field of view, being placed in the cornice well above the top of the door. They consist of incandescent lamps with reflectors, so as to concentrate the light downwards, and also throw a certain amount of light on the white surface above the door, which, therefore, assists in promoting the general diffused illumination.

The method shown, besides apparently complying with the utilitarian aspects of the problem, seems to be preferable from the artistic standpoint. Certainly, the general effect produced by the illuminated white moulding, lighted by the concealed sources above the door, is more interesting to the eye than the mere exhibition of an unscreened lamp filament, which is too often considered all that is necessary.

New Tungsten for 220 Volts

The advantages and economy of the tungsten incandescent over the carbon filament lamp have been practically denied to most circuits operating at 200 to 250 volts, because the regular multiple tungsten lamps were designed for the standard voltage of 100 to 125 volts. On these higher voltage circuits—for example, 220 volts—in order to use tungsten lamps at all it was necessary to operate two 110-volt lamps in series, since a 110-volt lamp would be immediately burned out if connected across a 220 volt circuit. Most users of the higher voltages therefore preferred to wait for the advent of the tungsten adapted to their voltage.



TUNGSTEN LAMP FOR 220 TO 250 VOLTS

In answer to this considerable demand, a new style of tungsten has been designed which will operate on 200 to 250 volts. This gives to the users of higher voltages the opportunity for the adoption of the economical high-efficiency lamps for multiple service. This new lamp has the usual tungsten efficiency of $1\frac{1}{4}$ watts per candle power.

The First Wire Tapper

The first telegraph operator in the world to tap a telegraph wire for war purposes was Emmett Howard, who since the early seventies has been a prominent and respected citizen of Memphis, Tenn. This feat was performed by Mr. Howard in September, 1861, while the Confederate army under General Pillow was concentrated at Columbus, Ky., and the Federal army was concentrated at Cairo, Ill., under General Grant.

On September 6, 1861, Grant's cavalry destroyed the telegraph wires between Cairo and Blandville, Ky. After their hasty return to Cairo, Mr. Howard cut the wire a half a mile south of Blandville, and, by using a small relay wire, concealed under the bark of a tree and leaves on the ground to prevent discovery, connected it with an instrument, which he located under a fallen tree in a deep ravine forty feet from the road.

Watching the instrument day and night, Mr. Howard was able to report to General Pillow the movements of the federal cavalry and other important matters for two weeks. At the end of this time he was ordered to report for duty at Columbus. When Columbus was evacuated, General Polk ordered him to remain at Hickman.

He was driven out of Hickman, along with many other citizens, by federal gunboats, but returned the next day and connected a wire with an instrument concealed in the woods about a mile from the town. For three weeks he watched the river and instrument day and night, reporting the passage of gunboats and transports to General Polk at Jackson, Tenn.

After the fall of Island No. 10 Mr. Howard reported to General Cheathan, just before the battle of Shiloh. A week before the fall of Memphis he was ordered to gather up at all stations, including Memphis, telegraph apparatus and material. He reached Grenada with a carload, which was of inestimable value, as nothing in this line could possibly be manufactured in the South.

Mr. Howard ended an honorable career as military telegrapher by transmitting the last official despatch of President Davis, containing 2,000 words, filed at Charlotte, N. C., and addressed to General E. Kirby Smith. This despatch contained instructions as to the disposition of fragments of the armies west of the Mississippi River. The courier detailed to carry the despatch was killed by shots from a gunboat and the message was lost in the river.

So far as is known and believed, Mr. Howard is the only living person who has knowledge of this interesting and memorable document.

At the close of the war Mr. Howard went to Columbia, S. C., where he accepted a position as manager of the local office of the Western Union Telegraph Company.

In the early seventies he went to Memphis and for twenty-five years held a similar position there. Of late years he has been engaged in the insurance business.—Telegraph Age.

The Modern and The Ancient

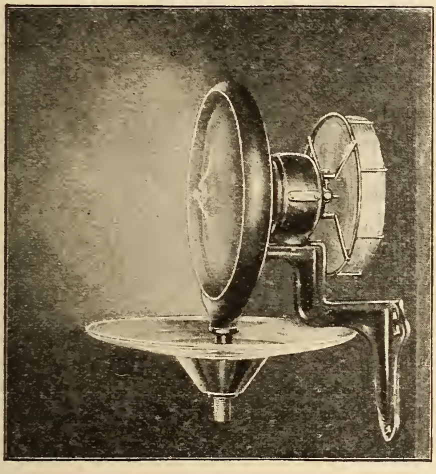
On July 5th, Pittsfield, Mass., held a Fourth of July celebration, including among other things a civic parade with decorated floats. Now Pittsfield is the home of a branch of one of the largest electrical manufacturing companies in the country, so it was fitting that this company, to which Pittsfield owes much of its prosperity, should be well represented in the parade. Two unique floats were consequently fitted out, one representing the "Modern and Ancient," typifying the revolutionary effect of the modern use of electricity for household purposes, and the other showing the different appliances for light and power.

ILLUSTRATING THE ANCIENT AND THE MODERN

The modern and the ancient kitchen were effectively represented, the one being demonstrated by almost every kind of modern electric cooking and heating device, the other by the antiquated wood cook stove.

An Electric Humidifier

All textile fibres absorb moisture, and when reasonably damp are more elastic and work better than when dry. Thus, in former times, weavers set up their looms in damp cellars and today we see how great textile industries have grown up in humid localities such as Lancashire and New Bedford.



AN ELECTRIC HUMIDIFIER

With moist, and consequently elastic yarns, all departments of a textile mill can be run at top speed and a full and perfect production assured, and in favorable weather this is what can ordinarily be done. When cool, dry, brisk days come with the moisture in the air at a minimum we find ends breaking and snapping, machinery stopping, and trouble everywhere, accentuated by the fact that in dry weather fibres in process become highly electrified.

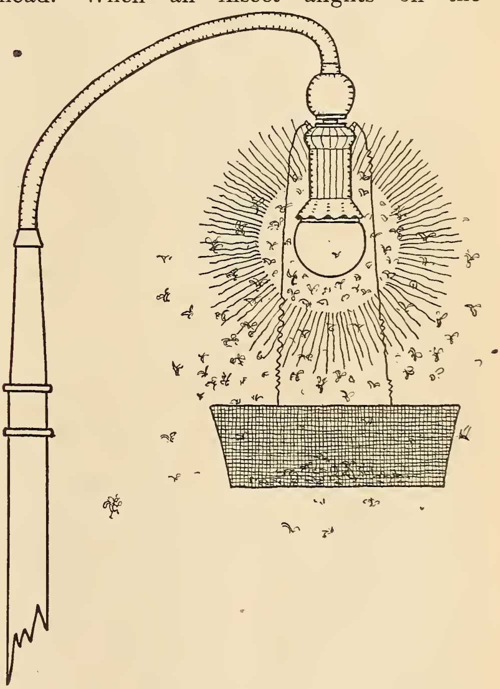
Artificial humidification has been resorted to in order that such trouble may be cured, and by placing humidifiers in the stock room, quilling department and other suitable places much loss may be avoided. One type of humidifier for this purpose is called the Hygrosso and the illustration gives an idea of the appearance of the apparatus. The water, hot or cold and with or without pressure, is fed into the hollow of the vertical revolving disk and reduced to the finest possible vapor by the centrifugal force. At the same time the fan blowing directly over the case distributes the moisture uniformly throughout the room. Both the fan and the disk are mounted on the shaft of an electric motor which is situated between the two.

The units being small and self-contained they may be located in such positions as are best suited for each particular case.

Moth Destroyer

An inventor of Dover, N. H., Charles P. Chesley, has perfected an electrical device for the destruction of brown-tailed moths and other insect pests. These myriads of flying creatures fly mostly by night and are strongly attracted by light.

The device of Mr. Chesley consists of a copper wire basket or frame which is intended to be suspended from the city and town arc lights and to hang about two feet below the light. The mesh of the wire basket is made of positive and negative wires, insulated from each other and deriving their current from the light overhead. When an insect alights on the



MOTH DESTROYER

framework and touches any two wires it immediately closes the circuit and is killed, falling to the ground, or into the basket.

A practical demonstration of the device, with honey bees as the victims, is said to have been a great success. The expense of the device is confined to its first cost, which amounts to about $5 per lamp.

POPULAR ELECTRICITY WIRELESS CLUB

Membership in Popular Electricity Wireless Club is made up of readers of this magazine who have constructed or are operating wireless apparatus or systems. Membership blanks will be sent upon request. This department of the magazine is devoted to the interests of the Club, and members are invited to assist in making it as valuable and interesting as possible, by sending in descriptions and photographs of their equipments

Construction of a Wireless Transformer

ALFRED P. MORGAN

In commercial wireless telegraph stations where alternating current is available the induction coil has been superseded by the more modern transformer. The transformer is also favored by many amateur experimenters since it is more efficient and less expensive to construct.

A one quarter kilowatt transformer is probably the size best suited to the average private installation. It will transmit messages from 50 to 100 miles when used with a proper aerial about 80 feet high.

The electromotive forces developed in a wireless transformer are seldom greater than 15,000–20,000 volts, while those of induction coils range from 20,000 to 300,000 volts. However the currents generated in the secondary of the transformer are much greater and they develop more powerful and penetrating waves than the induction coil. The efficiency also being greater, larger amounts of the initial energy are transformed into oscillations. For these reasons a transformer is always rated by its output in watts or kilowatts rather than its spark length. The spark length of a 250 watt transformer is only 0.25–0.50 inch. The spark of a 500 watt or ½ kilowatt transformer might be the same length but still represent more energy.

There are two distinct types of transformers in use, known as the "open core" and the "closed core," but in this article we shall concern ourselves only with the latter type.

A closed core transformer in its simplest form consists of two independent coils of wire wound upon an iron ring. When an alternating current is passed through one of the coils, known as the primary it generates a magnetic flux, which in flowing through the other coil induces in it an electromotive force. The magnitude of the secondary electromotive force is in nearly the same ratio to the primary inducing electromotive force or voltage as the number of turns in the secondary is to the number of turns in the primary winding. For example, if it is desired to raise the voltage of the 110 volt circuit to 22,000 volts, the number of turns in the secondary must be 200 times as many as in the primary.

It seems almost unnecessary to state here, but it possibly may save work for some not familiar with the underlying principles, that a closed core transformer cannot be used with an interrupter on a direct current circuit. The reason is because the interrupted primary currents cannot die away quickly enough on a closed core to generate sufficient electromotive force in the secondary.

A circular ring of iron wire wound with two coils presents several theoretical advantages as a transformer but would be difficult to construct. The core is usually in the form of a hollow rectangle. The core is built up of thin sheets of very soft iron carefully insulated from one another by a coat of varnish. If the core were solid or not insulated, heavy currents known as eddy currents would be set up in the core and cause great heating. There would also result a considerable loss in the electromotive force and efficiency of the transformer.

One half of both the secondary and primary of a properly designed transformer are placed on opposite sides of the rectangle in order to reduce the leakage of magnetic flux to a minimum. Do not put thep rimary

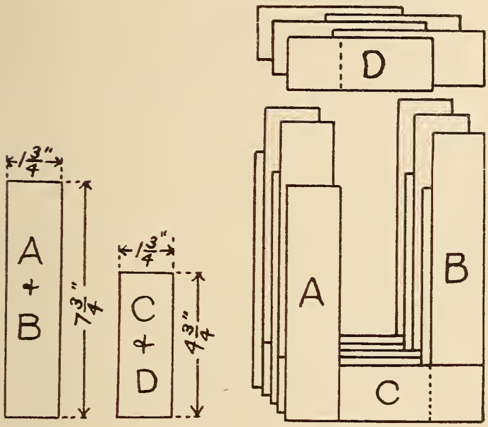


FIG. 1. THE DIMENSIONS OF CORE

all on one side and the secondary all on the other. The only difficulty involved in the first method is the proper insulation of the primary and secondary. This point must be given very careful attention in constructing a transformer.

CORE

The dimensions and assembly of the core are shown in Fig. 1. Strips $1\frac{3}{4}$ inches wide are cut from soft

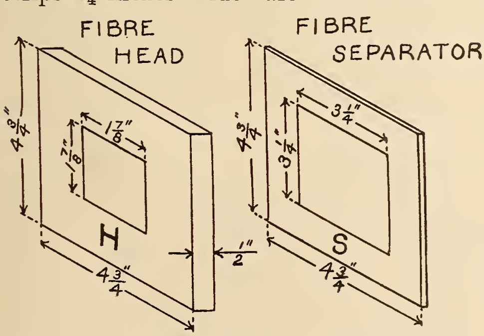


FIG. 2. CONSTRUCTION OF FIBRE HEADS

Russian or Swedish stovepipe iron. Half of them should be $7\frac{3}{4}$ inches long and the other half 5 inches. Enough of the strips should be cut to make two piles of each size $1\frac{3}{4}$ inches high when compressed. The completed core will form a hollow rectangle $9\frac{1}{2}$ by $6\frac{1}{2}$ by $1\frac{3}{4}$ inches.

The strips must be dipped in some good insulating varnish such as P. & B. compound and dried before they are assembled. Both "legs" (the longest sides) are built up with alternate ends overlapping as shown by (A) and (B) in Fig. 1. The short pieces (C) and (D) are slipped between the over-lapping ends and squared up. One end of the core is left open until all the windings are in place. Three or four layers of well varnished linen cloth are wound over the legs preparatory to winding the primary.

PRIMARY

Four fibre heads or cheeks (H) $4\frac{3}{4}$ inches square and $\frac{1}{2}$ inch thick are made as shown in Fig. 1. A square hole $1\frac{7}{8}$ by $1\frac{7}{8}$ inches is cut in the centre. One of these is placed on each of the assembled legs as shown in Fig. 3.

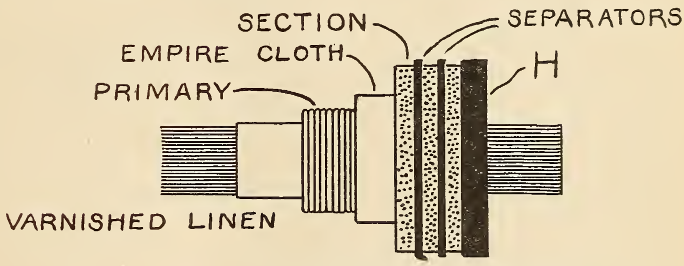


FIG. 3. ASSEMBLY OF PRIMARY AND SECONDARY

The primary winding is $4\frac{1}{2}$ inches long and is wound in six layers, three layers on each leg. The wire used is No. 16 B. & S. gauge double cotton covered magnet wire. About three pounds will be required.

The terminals of the two windings should all lead out through the fibre heads at the same end of the transformer and as near to the core as possible. The windings should not be carried close up to the fibre heads but begin and end about one quarter inch from them. The remaining space is filled by winding in a strip of empire cloth one quarter of an inch wide. A strip of micanite or empire cloth 5 inches wide is wound over both of the primary windings close up to the head until it forms a layer one-half of an inch thick.

SECONDARY

A form must be constructed on which to wind the secondary sections. The sections are sixteen in number. They are in the form of hollow squares and measure 4½ by 4½ by 7-16 inches outside dimensions. The dimensions and form of the winder are most easily understood from Fig. 4. The secondary sections when mounted on the transformer are insulated from one another by fibre separators (S). (Fig. 2 and Fig. 6). They are 4¾ by 4¾ inches on the outside, ⅛ inch thick and have a square hole 3¼ inches square cut in the centre.

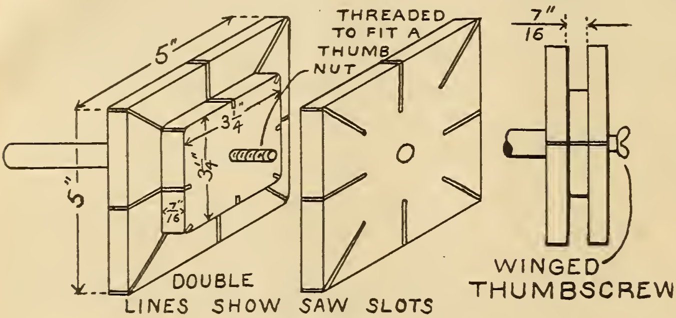


FIG. 4. SECONDARY FORMER

The wire used to wind the secondary of the transformer is No. 34 B. & S. gauge enameled copper wire. About ten pounds is required. Cotton covered wire should not be used in this transformer because a sufficient number of turns cannot be secured to bring the secondary current up to the proper voltage. By observing all the instructions and precautions given below no trouble will be experienced in winding enameled wire. The form should be placed in a lathe chuck or in some other similar machine which is convenient and whereby it may be revolved. Saw slots are cut in the flanges and centre of the winder or form so that silk threads may be passed under and around the completed section and tied up so that a possible cave in of the wire is prevented.

The section may then be removed from the form and wound with insulating tape.

The wire must be evenly and carefully wound on the form. No loops or kinks must be wound on. They must first be straightened out or untangled. In case the wire becomes broken the connection must be smoothly made and soldered. Do not attempt to use acid as a flux or to heat the wire by means of a flame. Use a piece of No. 8 B. & S. gauge tinned copper wire as a soldering iron and rosin as a flux. Paraffin some silk taffeta binding such as dressmakers use and wrap the joint or connection with a small piece of it.

The sections as they are taken from the winder must be carefully and distinctly marked with an arrow which points up or in the direction of the winding. The terminals are led out on opposite faces of the sections.

The two methods of connecting up the sections are illustrated in Fig. 5. The second method (B) is the best. It will be noticed that the arrow on every alternate section points down. This does not mean that the wire was wound in the opposite direction on the form. The coils are simply turned around so that the arrows come on a reverse side of the core from the others and point in an opposite direction. This precaution must be taken in order that the current will flow through all the sections in the same direction. The first method (A) does not require this reversal but is not to be recommended.

Careful scrutiny of (B) will show that the inside terminal of one section is connected to the inside terminal of the adjacent section, and the outside terminal of that section is connected to the outside terminal of its adjacent section.

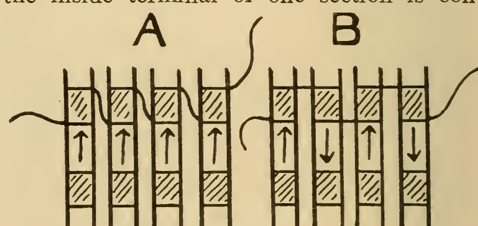


FIG. 5. METHODS OF CONNECTING SECTIONS

Place eight of the completed and taped sections on each leg of the transformer and interpose one of the fibre separators between each pair. Connect the terminals up as in (B) Fig. 5 and solder them.

Put the remaining fibre heads (H) on the core up flush with the windings and finish assembling the core by slipping the other end strips (D) in the alternating overlapping ends of the legs.

Square the core up perfectly true. The whole transformer is then fastened together by four fibre strips (M), Fig. 6, 9¾ inches long, 1¾ inches wide and ½ inch thick. A ¼ inch hole (P) is bored in each end of the strips. The strips are placed in the position shown in Fig. 6 at the ends of the transformer. Four ¼-inch bolts, two of them three inches long and two 3½ inches long are passed through the holes in the fibre strips. The nuts are screwed on the bolts and tightened until the fibre clamps the core firmly. The two longer bolts should both be placed at the same end of the transformer.

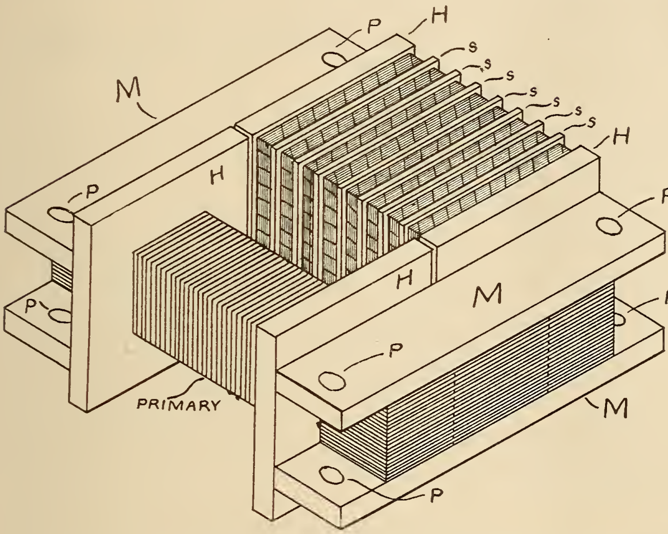


FIG. 6. PERSPECTIVE VIEW OF TRANSFORMER PARTS

The terminals of the primary are led out to four binding posts mounted on the fibre strips. The secondary binding posts are mounted on pillars. The pillars are one-inch fibre rods, two inches long. A hole is bored in the lower end of each and tapped so that they may be screwed onto the ends of the longer bolts which clamp the strips together. A piece of fibre five inches square and ⅛ inch thick must be placed between the two secondary windings to form an insulating shield and prevent sparks from jumping from one winding over to the other.

The primary windings should be connected in series. It will then consume from 250 to 300 watts. If the transformer is placed in a box and the box filled with some boiled amber petroleum, the windings may be connected in parallel. The transformer may then be rated at over ½ kilowatt and will transmit over 100 miles, providing the aerial is at least 100 feet high.

Fig. 7 shows a diagram of the complete wiring connections. The ordinary, transmitting helix, condenser spark gap, etc., of a tuned transmitter are connected as usual with the exception that the spark gap must not be placed directly across the transformer terminals as in some circuits but must be in series with the helix as shown. This prevents much of the arcing across the spark gap which otherwise takes place.

The reactance coil is placed in series with the primary of the transformer to steady the current and prevent further arcing of the spark. A suitable reactance coil may be constructed by making a hollow coil of wire and sliding an iron coil in or out. The core should be built up of sheet iron and form a rectangle 1¾ by 1¾ by

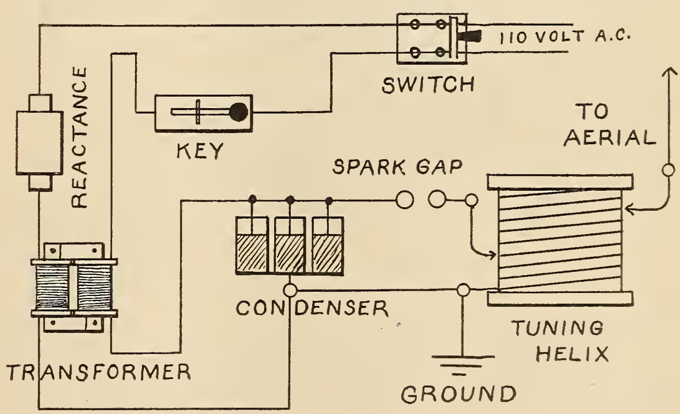


FIG. 7. COMPLETE WIRING CONNECTIONS

eight inches. The winding is composed of two layers of No. 12 B. & S. gauge double cotton covered magnet wire. The layers are six inches long. Make a hollow wooden tube from cigar box wood. The iron core should just slide in and out of the tube. Wind the wire over the wooden tube and leave it on permanently so that it will retain its form.

Five ½-gallon Leyden jars form the right condenser capacity for the transformer when the primary windings are in series. Twice that number must be used when the windings are in parallel.

A glass plate condenser is perhaps more convenient and desirable than Leyden jars. In this case all blistering of the tinfoil is avoided and brushing or corona discharges eliminated. This, besides giving a better spark, makes much sharper tuning possible.

A condenser may be built up from old photographic plates. About twenty-four 8 by 10 inch plates are necessary. The emulsion may be softened and washed off with boiling water. The tinfoil is cut 6 by 8 inches so as to leave an inch margin on all sides. The condenser is assembled as in Fig. 8. The alternate sheets of tin-

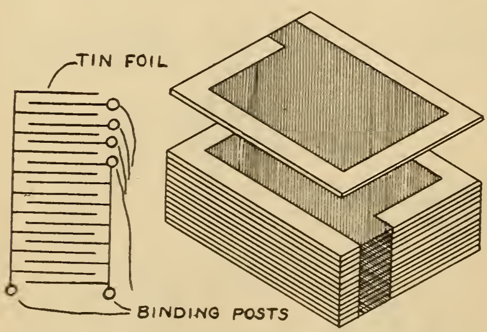


FIG. 8. METHOD OF ASSEMBLING CONDENSER

foil are connected together by a strip of thin copper foil or thick tinfoil about an inch wide. It is a good plan to lead out the last two or three strips on one side separately and connect them to binding posts. The capacity of the condenser may then be adjusted by connecting one or more of the strips in with the rest.

The condenser must be placed in a wooden box about 9 by 10 by 5 inches and poured full of boiled oil. Otherwise the spark would jump around the glass plates. Two such condensers connected in parallel are necessary when the transformer is used to its full capacity at ½ K. W.

When making changes or connections about the transformer be very certain to disconnect entirely all alternating current leads from the primary for an accidental passage of the full secondary current through the body would prove very serious and probably fatal.

Young America at the Wireless Key

The front cover picture of this issue is indicative of what "Young America" is doing in the way of wireless experimental work. The Young Marconi, whom you see in the picture, is C. H. Brubaker of Columbia, Pa., one of the enthusiastic members of Popular Electricity Wireless Club.

All the receiving apparatus is home-made with the exception of head telephone receivers. The sending apparatus consists of a spark coil operated through a water rheostat by 110 volt lighting current, although a transformer will be installed soon which will increase the efficiency of the sending outfit. The sending equipment also includes an ordinary telegraph key, home-made spark gap, home-made brass wire helix and adjustable leyden jar condensers. The sending range is about three miles.

For receiving there is an enameled wire, single-slide tuning coil, potentiometer, electrolytic, carborundum and molybdenite detectors, 1500 ohm receivers and a variable condenser.

The young experimenter has also rigged up an ingenious switchboard, part of which shows in the picture, to control the different apparatus. It is provided with the necessary switches, test lamps, fuses, etc. Meters will be put in later.

With this apparatus messages have been received from the large stations within its range, up to 400 miles.

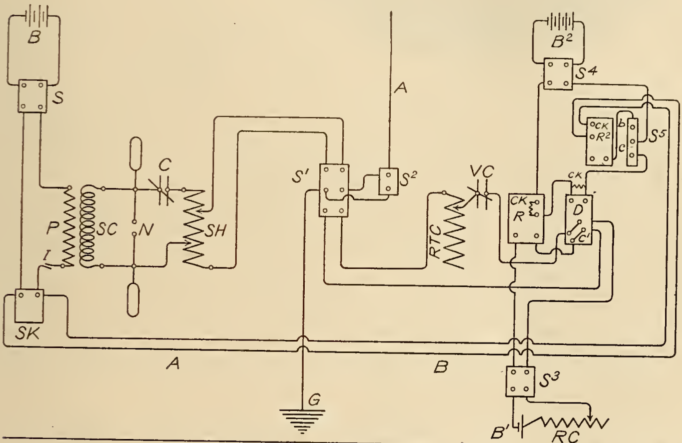
It is stated that the wireless telegraph station on the Eiffel tower in Paris has been receiving messages from the station at Glace bay, Canada, a distance of 3,250 miles. A new installation is being fitted at the Eiffel tower, by means of which it is hoped to establish wireless telegraphic communication with Saigon (Cochin-China), a distance of 6,800 miles.

Auto-Spontaneous Repeating System

By DAVID MARCUS

The object of this system is to repeat spontaneously and automatically to the operator of the transmitting station sending the message an exact duplicate of the signals being received at the other station.

Receiving stations experience more or less difficulty in receiving a perfectly intelligible message, due to the unfavorable condition of the "magnetic waves," especially if the message be of a long distance transmission. With the present systems of wireless telegraphic communication the operator at the transmitting station is absolutely ignorant as to the condition of the receiving capacity of the station with which he is communicating. It therefore often happens that the transmitting operator is several times requested to repeat his message, and if his receiving instruments are improperly balanced sensitively, he fails to receive, or intelligently understand the sender's complaints.



G – Ground
B – Battery
A – Aerial
R – Relay
S – Double Pole Single Throw Switch
SK – Signal Key
I – Interrupter
P – Primary of Induction Coils
SC – Secondary of " "
N – Zinc Spark Gap
C – Adjustable Condenser
SH – Sending Helix
S' Double Pole, Double-Throw Switch
S^2 Single Pole, Single-Throw "
RTC – Receiving Tuning Coil
VC – Variable Condenser
D – Decoherer
C' – Coherer
R^2 – Repeating Relay
S^5 – Single-Pole, Double-Throw Switch
S^4 – Double Pole, Single-Throw Switch
B^2 – Batteries
S^3 – Double-Pole, Single Throw Switch
B' – Battery of Single Cell
RC – Resistance Coil or Rheostat
CK – Choking Coils

CONNECTIONS OF AUTO-SPONTANEOUS REPEATING SYSTEM

To entirely remove the above obstacles, and to bring both operator at the transmitting station and operator at the receiving station in closer relation as to the condition of each other's transmitting and receiving, the writer has invented the following system:

Connect up instruments as shown in Fig. 1, (A) representing the transmitting station, and (B) the receiving station. By carefully tracing and studying the various connections the reader will easily find that the only important change from the various systems now employed is in the use of a second relay with additional switches to throw in or cut out the repeating relay.

When the station is not transmitting, the single pole, double throw switch (S^5) should always be kept closed on the contact (b), which from the wiring in the diagram puts the second relay (R^2) in series with relay (R) and the decoherer circuit (D). Now if you desire to transmit signals, all that will be necessary is to throw the switch (S^5) on the contacts (c) which cuts out the repeating relay (R^2).

The action of the system will then take place as follows:

You desire to call a friend or some other wireless station with a call letter P. E. and a wave length of 400 meters.

Regulate your transmitting tuning coil to the proper wave length, and throw the switch (S^5) on the contact (c), thus cutting out the repeater. Now call your station, also giving them your call letter and wave length. If you are in proper tune with your distant station and both transmitting capacities of the required radius, you should receive a duplicate of the exact call you have made. For you will understand that the switch (S^5) at the receiving station that you are communicating with has the repeating relay (R^2) in series with the relay (R) and the decoherer (D).

RECEIVING APPARATUS

As it is customary to call a station at least three times, a short space of time will be required by the operator to properly adjust the tuning coil of the transmitting station, to the station that you desire to communicate with, in order that the regulation of the signal may be in tune with your receiving capacity. For your receiving capacity may be of 600 meters wave length, while that of the station you are communicating with is only 400 meters. It is therefore advisable to make each call at an interval of at least one minute. The operator of the transmitting station will therefore only receive one or two repetitions of his call, depending on the promptness of the operator at the other end in adjusting his apparatus. If the coherers at both stations are properly adjusted no difficulty whatsoever will be experienced in receiving correct repetitions. Should the repet'tion at the transmitting station be received orrectly, the operator may continue sending the message, at the same time directing his attention to the receiving apparatus and noting whether the repetitions are just as those transmitted. If they are not the "error" signal should be inserted and the word again repeated until the correct repetition is received.

TRANSMITTING APPARATUS

When the message is completed and the "finished" signal given, the switch (a) of your receiving station should be adjusted on the contact (b), then await the final O. K. from your distant station, which will be repeated back to him as an acknowledgment from you.

It will be necessary to enclose the coherer in a metal case with a wire leading from the case and connected to the ground. This will ground the oscillations which otherwise would infringe upon the receiver and cause confusion of the incoming signals.

Switches (S^1) and (S^2) form a novel arrangement to ground the aerial when the station is not in use, or in case of electrical storms. To ground the aerial it is only necessary to close the switch (S^2). When operating, (S^2) must always be open, and (S^1) adjusted, depending on the will of the operator.

Wireless Works Best By Night

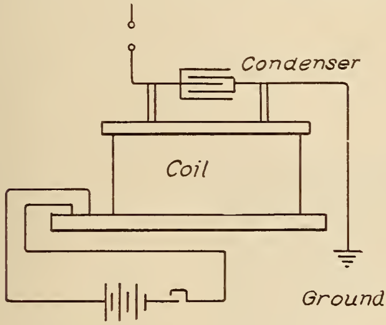
It is one of the many marvels of wireless telegraphy that the ether waves which carry its messages, unlike light waves, suffer no absorption in mist or fog. Quite the opposite, in fact, is the case, for the effect on them of clear sunshine is so marked that they can be sent with equal initial power less than half the distance by day as by night. For this reason press dispatches and long-distance messages sent by wireless telegraphy are, whenever possible, committed to the ether waves after sunset, when they may be transmitted to a much greater distance.

WIRELESS QUERIES

Spark Coil and Condenser

Questions.—(A) Please give data for a six-inch spark coil which will use no finer wire than No. 30 B. & S., S. C. C. for the secondary and give a big fat spark. (B) What voltage is required for above coil? (C) If a coil is connected as shown in the diagram will it be damaged? (D) What condenser is best to use, a jar or plate condenser?—C. S., Newark, N. J.

Answers.—(A) We refer you to the article on "Spark Coil Construction and Operation," in the May to August issues.



SPARK COIL CONNECTIONS

(B) Approximately 12 to 15 volts and five to six amperes.

(C) No, but we fail to see where any increased results would be had from this manner of connecting.

(D) Either the Leyden jar or glass plate kind will answer.

Wave Length; Condensers

Questions.—(A) How is a wave length measured? (B) Which are best, Leyden jars or a common layer condenser with 50 sheets of tin foil 5 by 6 inches?

Answers.—(A) The proper measurement of wave length is usually found by use of a wave meter, which is especially calibrated for this purpose. A rough method that is prevalent at the present is to multiply the aerial length by four. Considering that the height of the aerial is 50 feet the wave length, according to this rule, would be 200 feet.

(B) This depends on the purpose for which the condenser is to be used. If for use across the vibrator contacts of a spark coil, the paper type would answer, but across the secondary in the closed circuit set the Leyden jar should be used, as the paper type could not withstand the high voltage current.

Coherer; Leyden Jars

Questions.—(A) Will a receiving set embodying a coherer fastened to a slowly revolving toy motor shaft, so as to dispense with the decoherer, a 150 ohm standard telegraph relay and a sounder, work on a line about a mile long, with a one-inch spark coil at the transmitting station? Coherer made of brass tube about two inches long, filled with powdered antimony. (B) Can I increase my sending distance any by bridging two small Leyden jars across the secondary circuit, or would it be better to have them in primary circuit? (C) Does an aerial necessarily have to be made of many bare wires strung between two poles, or would a lightning rod serve the purpose if severed from the ground?—E. K. O., Essex, Mass.

Answers.—(A) Coherers have been made in the manner you describe, but none have ever proven successful. The ordinary metal filing coherer will answer, as it is easy to construct and handle. With a set built up with a one-inch spark coil at the sending end, a 150 ohm relay at the receiving end, you should be able to work up to about one-half mile, considering that the aerial is about 40 feet in height.

(B) To increase the sending efficiency, the Leyden jars should be bridged across the secondary terminals and spark gap. All spark coils are equipped with the condenser across the vibrator contacts, therefore, it would be useless to connect the jars at this point.

(C) No, but for more efficient results we would recommend an aerial of this type. The lightning rod scheme would answer for short distance use, but can not be recommended.

Coil and Aerial Dimensions

Questions.—(A) How large a coil will be needed for sending wireless messages a distance of two miles over the resident portion of this city? (B) How high an aerial? Would it work successfully with an aerial under 35 feet high? (C) Would the coil used be efficient for experients with X-ray tubes? (D) Would a 75 ohm relay be sensitive enough?—C. C. H., Indianapolis, Ind.

Answers.—(A) We refer you to the article "Spark Coil Construction and Operation" May to August issues. A two inch coil built up as described would probably be of sufficient capacity.

(B) The aerial should be at least 50 feet high. The 30 feet aerial might answer, but the higher one is recommended.

(C) No.

(D) Yes, provided a well made sensitive coherer were used.

Rheostat; Detector

Questions.—(A) How can I construct a 300 ohm regulating rheostat? Kindly show diagrams. (B) Where can I purchase silicon? (C) What metal can be used in a detector in the place of silicon?—M. E. S., San Francisco, Cal.

Answers.—(A) You fail to state the use for which the rheostat is intended. If for use in a wireless telegraph receiving circuit as a potentiometer, build up by winding $2\frac{1}{2}$ pounds of No. 22 S. S. C. German silver wire on a circular wood frame that is three inches in diameter. The frame is now mounted on a suitable base and one of the leads connected direct to a binding post. A portion of the winding is scraped bare all the way down the frame, and a sliding contact counted so that connection may be made with the different turns. The sliding contact is connected to a binding post mounted on the base.

(B) Apply to some of the dealers advertising in this magazine.

(C) Carborundum, Molybdenite, etc.

Wireless Sending Parts

Questions.—(A) Could I use a regular Morse telegraph key in sending messages with a 12-inch spark coil? If not, what kind of key should I use? (B) Can you give me any information of how to build a tuning coil to be used in tuning in most stations around San Francisco? (C) I am using an aerial 70 feet high; two horizontal wires each 100 feet long. Would that do satisfactory work at a distance of 250 miles? (D) Could I use a relay to work a sounder in above distance?—R. J. Loewe, Visalia, Cal.

Answers.—(A) Yes, but we would suggest that you get one with somewhat heavier contacts.

(B) Make the tuning coil as follows: Make a cylindrical insulating frame, wind around the outside 115 turns of bare, tinned copper wire, No. 18; turns 3-32 inch apart. Provide sliding contacts to work up and down the frame so as to touch any of the turns of wire.

(C) Yes, for receiving.

(D) A liquid detector and telephone receiver should be used.

Winding a Spark Coil

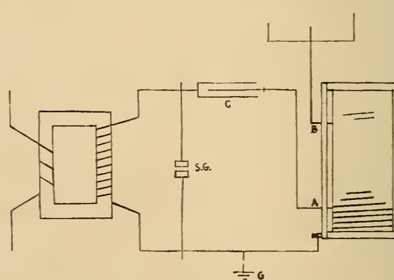
Question.—I have a core four inches long by $\frac{3}{4}$ inches in diameter. Please tell me how much wire to use, the kind and also the length of spark possible. —A. H., Meadville, Pa.

Answer.—For general details see serial "Spark Coil Construction and Operation." For your coil use five ounces of No. 18 wire on the primary, and three-quarters of a pound of No. 36 on the secondary. This should give a quarter inch spark. The secondary need not be wound in sections. For the condenser use 25 sheets of tinfoil 3x$1\frac{1}{4}$ inches. This coil will operate well on four volts and two amperes.

Transmitting Tuning Coil

Questions.—(A) Please give me dimensions of a transmitting tuning coil that can be used with a $\frac{1}{4}$ K. W. transformer? (B) What does 100 meters wave length mean in speaking of a receiving tuning coil? (C) How is a transmitting tuning coil used? —L. R., Madison, Ill.

Answers.—(A) A good, simple sending coil can be made by securing a wooden or paper drum about eight inches in diameter by 12 inches long and winding it with 30 turns of No. 32 copper ribbon $\frac{1}{8}$ inch wide. The turns should be equally spaced and shellacked. After the coil is thoroughly dried, a bare place about $\frac{1}{2}$ inch wide, should be scraped along one side of the coil. Two



TUNING COIL CONNECTIONS

wooden disks $8\frac{1}{2}$ inches in diameter and one wood strip 14x$\frac{1}{2}$x$\frac{1}{4}$ inches should be made next. The ends are screwed on and the strip placed over the bared place on the coil. A binding post is connected to one end of the winding while the other two connections are made by inserting two pieces of spring brass, bent in the shape of a V, under the wooden strip. (See diagram.)

(B) A tuning coil having a wave length of 100 meters is one having turns enough to respond to a wave 100 meters long. A coil of this size is not of much practical use, as all commercial stations use a wave longer than 100 meters.

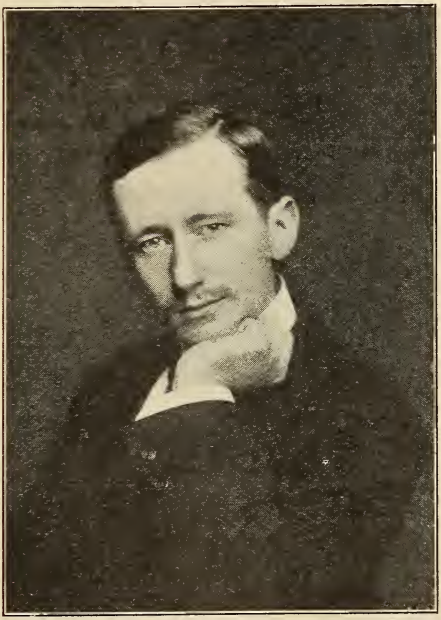
(C) See drawing. Put (A) on about four turns, then adjust (B) to where a hot wire ammeter, in series with the aerial, gives the maximum reading. The proper working place can be found by a little experimenting.

Electrical Men of the Times

GUGLIELMO MARCONI

Marconi did not invent the wireless telegraph, as is popularly believed. He, however, performed the great service of making the first practical application of wireless telegraphy to commercial uses. In other words, Marconi is a human benefactor by actually leading the way in the development of a new art which is becoming increasingly useful to man in its practical applications.

Wireless telegraphy is simple in its fundamental principle. It involves the erection of a receiving instrument or station and a transmitting instrument or station, both electrically grounded to the earth from and to which messages may be sent through the vibratory ether. No insulated conductor is necessary, but an electrical connection with the body of the earth. The message is sent flying out of the transmitter by the generation of an electrical spark, like a lightning flash, in a storm of contending elements, to be caught up by the antennæ or feelers of the attuned receiving instrument. But it took a Marconi to even dare to suppose that these ether vibrations, which others had discovered, could be generated and controlled.



Guglielmo (William) Marconi was born only thirty-four years ago, in the Italian city of Marzabotto, near Bologna, of an Italian father and an Irish mother. His father gave him a Roman heritage, providing strength for his conquests of nature. His mother was a highly cultured woman, a talented musician and member of the celebrated Guinness family of Dublin.

He became interested and began experimenting in electricity as a boy, and he was given a good school and college education. He was but fifteen when be began to devise instruments to show that an electric wave, if started in any given direction, will follow an undeviating course without need of a wire or other conductor. He continued his electrical work from his love of it, and he received his greatest reward on that memorable day, December 12, 1901, when he received at Signal Hill, Newfoundland, three little clicks, the dots of the letter "S", signalled by pre-arrangement rom the coast of England, two thousand miles across the waters of the Atlantic.

The inventor is a man of medium stature, high strung, yet deliberate and of great nervous and mental activity. His capacity for work is best measured by his signal achievements, in his mastery over opposing forces. He is a man of science and imagination as well as an inventor, and, moreover, a practical business organizer, being the controlling head of the Marconi Wireless Telegraph Company now operating for the conduct of business in the United States and leading countries of Europe.

Marconi is a quiet man, of a keenly sensitive disposition. He doesn't speak much. But he uses the power of directed thought upon the work in hand. He overcame great material obstacles, laboring faithfully into mastery at last, and a new application of knowledge has been made to add strength and zest to the life of man.

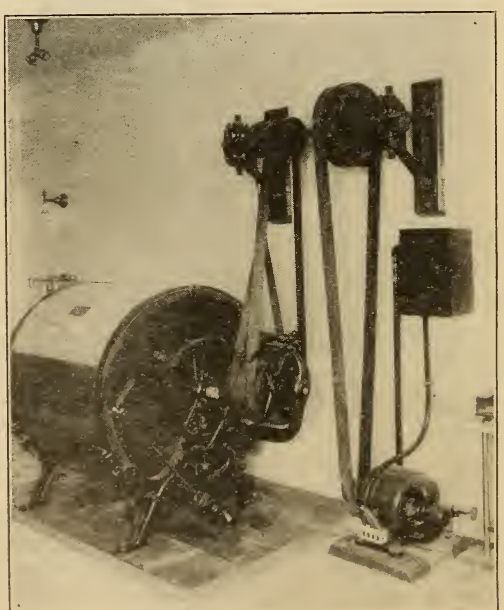
ELECTRICITY IN THE HOUSEHOLD

A Modern Residence Laundry

The servant problem has been talked about, it has been written about and cartooned about; and it is still with us. But there is one kind of servant that never gives any trouble, is ready on the instant, never takes a day off at the wrong time and never "gives notice." That servant is electricity.

No department in the household perhaps gives rise to more heated discussions or is such a hotbed of rebellion as the domestic laundry; that is, under the old conditions. But now that electricity can be made to perform, with minimum labor, what was once the drudgery of housekeeping, one of the bones of contention has been removed.

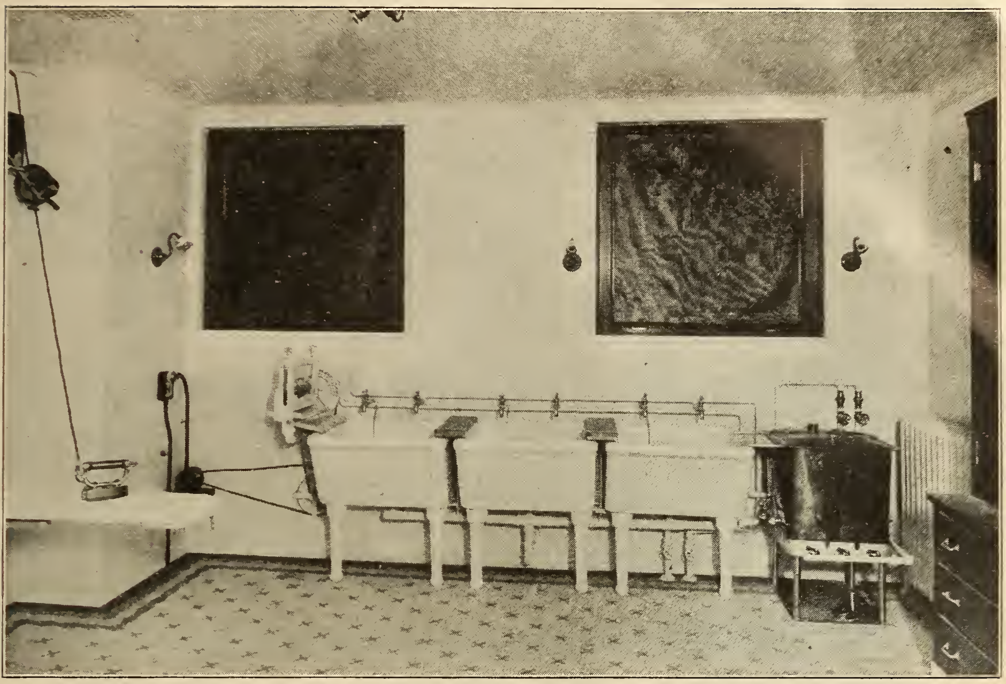
The three pictures which are shown here illustrate what a modern residence laundry should be. Introduce a servant to a neat basement apartment so equipped and the chances are you will not hear, in abrupt but expressive language: "What! Do the laundry work? Not for mine."



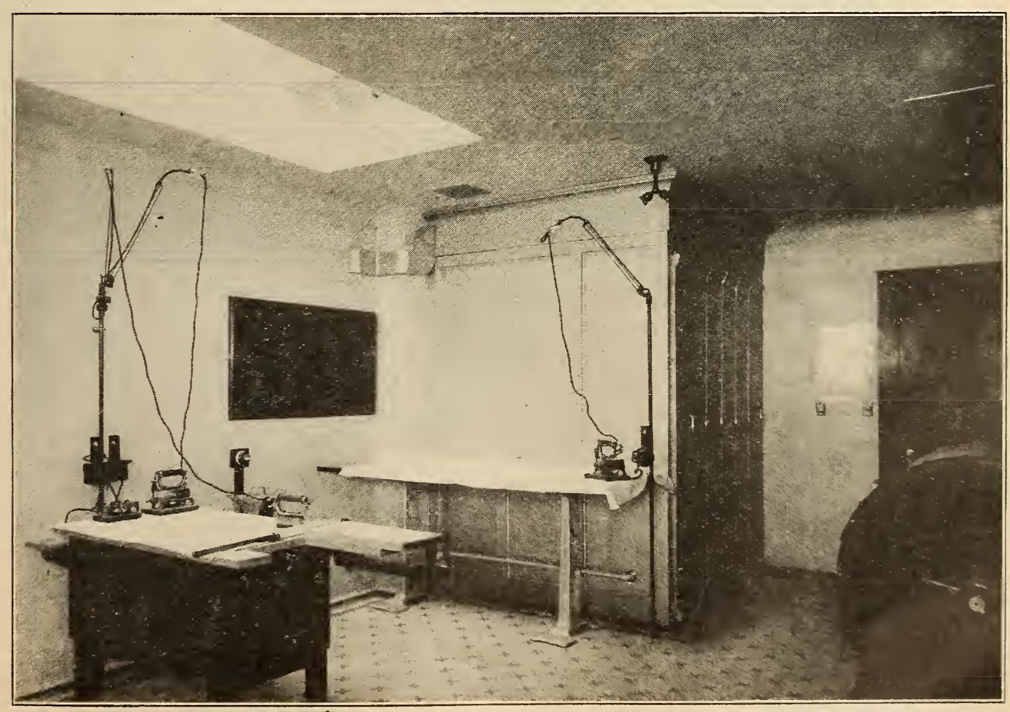
MOTOR OPERATED WASHER

As far as possible every operation is performed by the magic current. The revolving washing machine is run by an electric motor and is started going by the simple throwing of a switch. When the clothes are clean they are transferred to the rinsing tanks of shining enamel, with hot and cold water always available. After passing through the tanks there is waiting at the last one an electric driven wringer ready to perform, at another turn of a switch, another of the old time disagreeable and tiresome tasks.

Then there are artificially heated drying cabinets to take the place of the dust and soot laden "four winds," and last of all the electric irons for all kinds of work from coarse articles to the finest ruffles. The arrangement of these irons is very convenient. The conductors which bring the current from the lighting circuit are brought up through tubes and are then carried out on flexible arms.



RINSING TANKS AND MOTOR DRIVEN WRINGER



ELECTRIC IRONING APPARATUS

Advantages of Vacuum Cleaning

Discovery of germ life and its effect on health was one of the greatest steps in medical science. The discovery, isolation and finally the method of combatting certain specific germs which caused some of the most dreaded diseases of the past, such as diphtheria for instance, has resulted in the reduction of the mortality of these diseases to comparative insignificance. This knowledge has also revolutionized surgery. No more striking example of the respect with which these foes of human life are held by the medical fraternity may be had than to go through a modern hospital. There are no wall paper, no carpets, no sharp corners in the walls or ceilings even, for everything is made to be scrubbed and sterilized and scrubbed again and again, with endless monotony, in the constant warfare with unseen inhabitants of the germ world.

In our own homes these precautions cannot all be taken without making rather dreary habitations. We like rugs and carpets, pretty pictures, tapestries, curtains and a hundred other things that catch and hold dust, and wherever there is dust there also are germs—countless millions of them. The only thing that remains, therefore, is to make constant war on dust and it is just there that the broom or carpet sweeper and the feather duster are hopelessly lacking in efficiency. They stir up any amount of dust only to leave it in a little different place till the next sweeping.

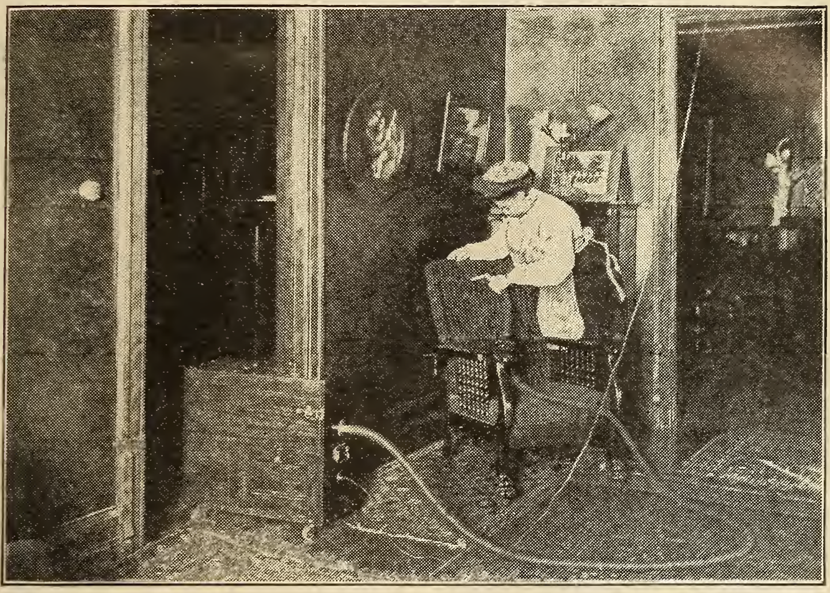
A few years ago vacuum cleaning came into vogue. At first we only saw it in connection with installations of considerable size, with gasoline engine and suction pump mounted on a truck in the street and with long lines of hose running up into the windows of the building undergoing the cleaning process. Then, as in almost everything else, electricity was called to the task and portable outfits were made which could be owned exclusively by the householder. All that is required in the operation of these devices is to attach the electrical conductor and plug to the lamp socket and turn on the current. The motor then operates the vacuum pump which is attached through a short hose to various "tools" adapted to clean carpets, upholstery, curtains, etc.

The pictures herewith show one of the newest types of electric vacuum cleaner in

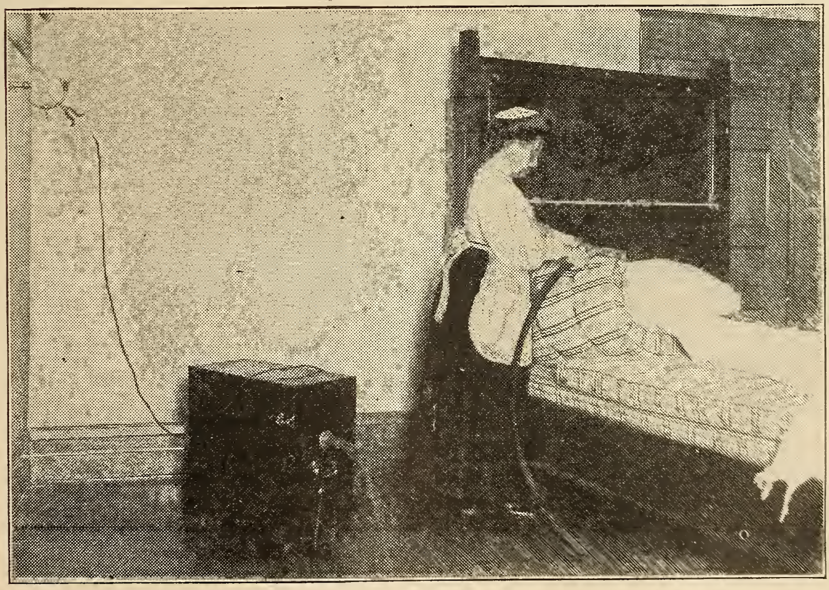
CLEANING CARPETS BY VACUUM PROCESS

operation. Mattresses may be renovated, upholstered furniture cleaned, dust sucked up through the carpet; all the refuse being drawn through the tube into a receptacle in the cabinet. Two cents worth of electricity an hour will operate it.

A range of from 0 to 12 inches of vacuum can be obtained with this machine. Twelve inches of vacuum means that if the suction were applied to the top of a tube standing with its lower end open in a dish of mercury the pressure of the outside atmosphere



DUST IS READILY REMOVED FROM UPHOLSTERY



DOES THE WORK OF A MATTRESS RENOVATOR

would raise the mercury in the tube to a height of 12 inches, or corresponding approximately to six pounds pressure. Twelve inches of vacuum is sufficient to draw the dust out of the heaviest carpets but will not injure the nap. For light work such as delicate curtains, etc., a less vacuum may be obtained.

Electric Lighting in Ornamentation

Houses of the present time contain many architectural features which lend themselves readily to ornamentation by electric lamps. Millwork plays an important part in the plans in the present time, and columns, newels, etc., are utilized at various points in rooms, halls, arches and arbors, where the brilliancy of electric lamps may have full play. Some modern homes are marvelous in this respect, and the business of de-

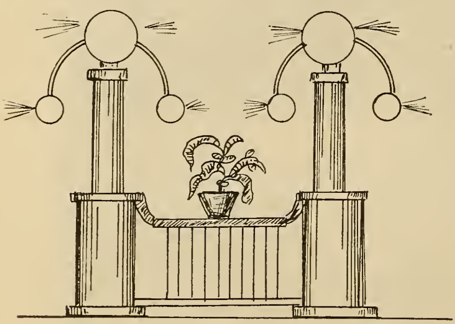


FIG. 1.

signing such features has almost reached the dignity of a profession.

In the construction of some of these combinations, the key-note is simplicity. In the designing of some others, the intricate plan is quite conspicuous. An attempt is often made to introduce grille work, scrolls, stars, etc.

Various tastes have to be accommodated. Hence, in some cases we find that the set-piece is of the order shown in Fig. 1. This stands prominently in a hallway. It serves as a lighting ornament. The hardwood columns are all well polished. There is a section of lattice work intervening, and the columns are furnished with the three light globes each. The wires extend along the floor line, then up the line of the posts to the lamps.

On some special occasions signs may be introduced at little expense, for church festivals, etc. In one instance, the archway under which the guests passed was arranged with three columns of pine wood on each side as in Fig. 2. The sheet metal

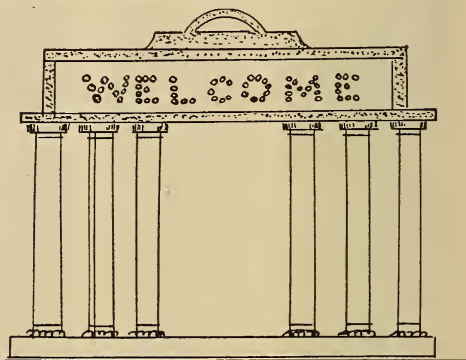


FIG. 2.

front sign was installed on a panel supported by these posts.

Sometimes the decoration involves the use of a single strong lamp on the top of a post as in Fig. 3.

Heavy timber work shows off to good advantage where there is good illumination.

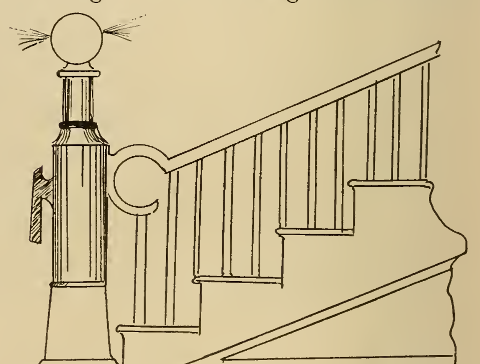
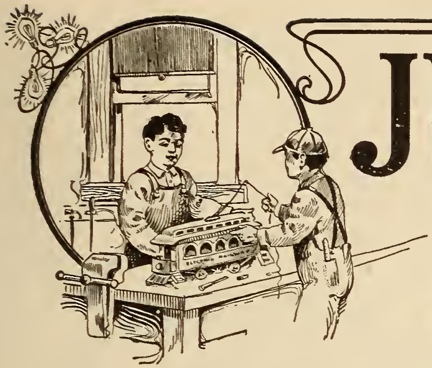


FIG. 3.

The tendency now-a-days is towards more light. This fact is noticeable in all parts of the country. The people are getting educated to a point where a more intense brilliancy is demanded. The owners of homes are not satisfied with merely a well lighted interior but wish to have a blaze of light streaming from the windows. Light is cheaper now than it used to be and it is not so essential that we curtail at every point. The man of the house who used to follow about turning off every possible light, now often lets them burn simply for the satisfaction and good cheer derived.



JUNIOR SECTION

Construction of Ring and Core-Type Transformers

By LOUIS H. ROLLER

Many persons find it difficult to see why alternating current, instead of direct, is used so extensively for light and power purposes. It possesses such peculiar characteristics, and to the amateur is so difficult, both of comprehension and computation, that it appears useless alongside of direct current. But the one feature of alternating current in which it excels direct, is the economy and ease with which it is transformed from one potential or voltage to a higher or lower one. So the experimenter who desires to work with alternating current, will find a transformer the simplest and most fundamental piece of apparatus with which to start.

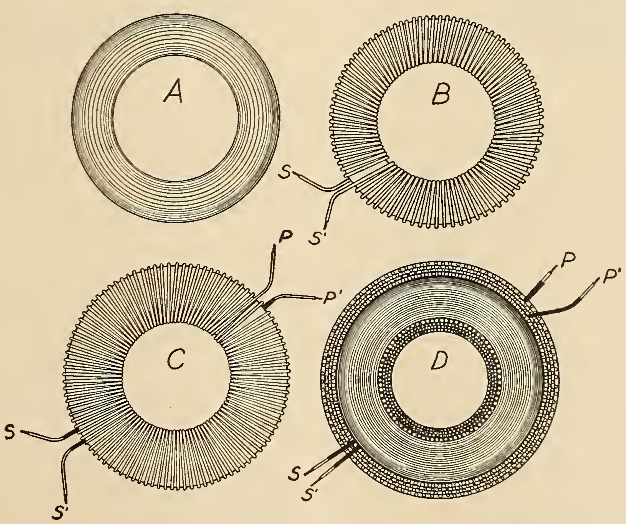


FIG. 1. STEPS IN CONSTRUCTION OF RING TRANSFORMER

Fig. 1 shows the steps in the construction of a ring wound transformer; (A) is the core of soft iron wire; (B) the secondary winding, and (C) the primary winding, both of copper magnet wire. (D) is a cross-sectional view of complete transformer.

The core may be considered as the foundation of the transformer, so its construction will be gone into in detail. Fig. 2, in two views, illustrates the winding of the core. Upon a cylindrical form about four inches in diameter and at least three inches long, made of wood pipe, or a tin can, a layer of heavy string is wound, its use being to release the wire from the form after winding. Over this string a layer of paper is put on, and then a few turns of the soft iron wire, which should not be larger than No. 20, are wound on. At this point the binding strings, (A), (B), (C) and (D), Fig. 2, should be slipped under the turns of wire already on, and the remainder of the winding finished. Then the binding strings should be tied up, and the release string pulled out, leaving the ring of soft iron wire loosely on the form. This ring is kept from falling apart during handling by the binding strings tied around it; to keep it together permanently, make it solid, and insulate it, several layers of cotton or friction tape are wound on tightly, and the core is finished.

This core should have about three square inches cross-sectional area, and will require about three or four pounds of soft iron wire. It should be as solid as possible, but need not be wound in perfect layers, nor need it be of one continuous piece of wire.

Now the secondary is put on the core. This winding consists of one hundred turns of No. 14 B. & S. double cotton-covered magnet wire, and is wound on as shown at (B), Fig. 1. About one pound of wire will be required for it. The primary consists of 550 turns of No. 20 B. &. S. double cotton-covered magnet wire, and is wound on the secondary, being insulated from it by a layer of tape. This winding will take about three layers, (C), Fig. 1, and will require about one and a half pounds of wire. Each layer should be insulated from its neighbor by taping, and a layer of tape over the whole winding will finish the transformer.

The easiest way to do this winding is to calculate the length of wire required, wind that much and a little more on a spool small enough to pass through the hole in the ring, and by passing the spool through and around, and carefully guiding the wire as it unwinds from spool onto core, no difficulty should be experienced in obtaining a good winding. The leads (S, S′) (P, P′) should be thoroughly taped where they lie next to other wires as they come out from their respective windings, and in putting in the windings care should be exercised to see that not a single turn of wire is short-circuited by defective insulation, as this will cause the transformer to heat up unduly, and perhaps burn out. The wires of an alternating current lighting circuit of 110 volts should be connected directly to (P, P′), and if these directions have been followed, an alternating current of twenty volts pressure may be taken from (S, S′). The size of the core permits this secondary current to be anything from a fraction of an ampere up to about 20 amperes, thus adapting the transformer to running small motors, and lighting a number of small lamps in multiple or series-multiple. The current in the primary varies in direct proportion to that in the secondary; thus, a five ampere current in the secondary will require almost one ampere in the primary at 110 volts, while 20 amperes in the secondary will require nearly four amperes in primary. Thus the cost of secondary current is proportional to the amount used.

The core type transformer operates on the same principle as the ring wound type and is similar in construction, the chief dif-

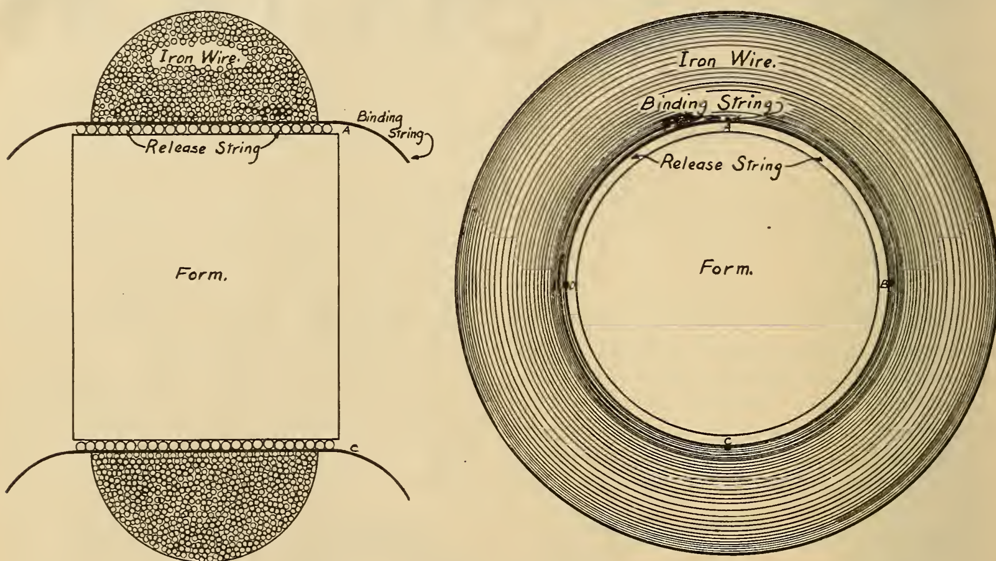


FIG. 2. WINDING OF THE CORE

ference being that its core is built up of sheets of soft iron, instead of wire. More tools and skill are required in its construction than in that of the ring wound, but it takes a great deal less time.

To make the core for this type of transformer, have the hardware man cut for you a pile of pieces of the very thinnest soft iron

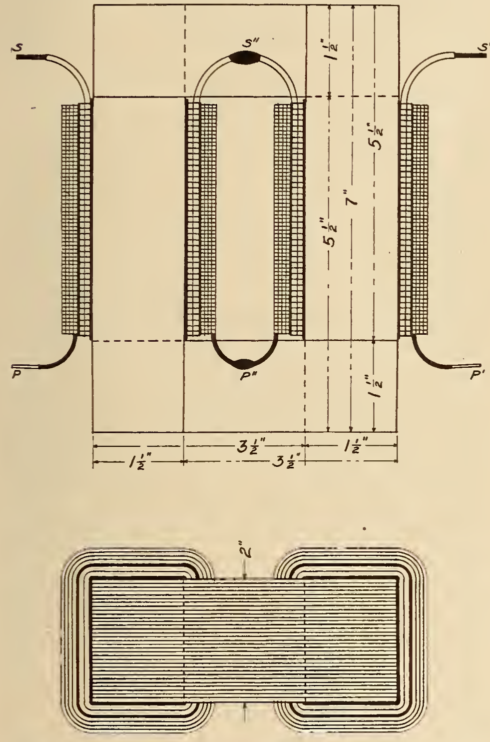


FIG. 3. STEPS IN CONSTRUCTION OF A CORE TYPE TRANSFORMER

sheet four inches high, 1½ inches wide and 3½ inches long, and another pile four inches high, 1½ inches wide and 5½ inches long. Then pile up the 5½ inch pieces in two bundles seven inches long and two inches high, by laying one sheet on another so it projects 1½ inches beyond it on one end, then the next sheet 1½ inches beyond that on the other end, and so on, until the bundle, when completed, will resemble a piece of wood with dove-tailed joints. When the bundles are made up, clamp them in a vise and wrap tightly with tape within 1½ inches from each end.

Fifty turns of heavy wire are wound on each bundle for the secondary, and 275 turns of lighter wire for the primary, making this winding the same as for the ring wound.

The two bundles are now placed side by side and the 3½ inch pieces for the yokes are slipped in the dove-tail ends, completing the transformer, as shown in Fig. 3.

Care should be taken in connecting the two primaries and the two secondaries together to see that the current will travel in the same direction around the core on each side.

Referring to Fig. 3, when (P, P′) are supplied with 110 volts, the voltage between (S) and (S′) is 20, and between (S) or (S′) and (S″) is ten. At the same time the primary winding may be used as an auto-transformer, and 55 volts taken from between (P) or (P′) and (P″).

To make the primary winding in either transformer for use on 220 volts, wind with 1100 turns of No. 23 B. & S. magnet wire, the secondary remaining the same.

How to Make a Direct Current Ammeter

Many amateurs would like to make their own instruments, partly on account of the cost of such instruments when purchased outright and partly for the love of construct-

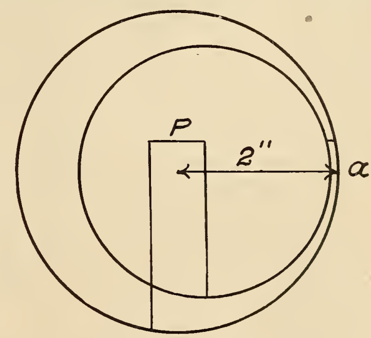


FIG. 1

ing, which gives one the shortest road to full understanding of the instrument. The ammeter described herein does not require any special tools or materials. When carefully made it is quite accurate for small direct current measurements.

To begin the instrument secure a good piece of soft sheet iron, commonly called stove-pipe iron. Set a pair of compasses at two inches and draw a true circle as shown in Fig. 1. Then draw another smaller circle with the center point about one-fourth of an inch to the right and about the same distance above the first center. The width at

(a) must be about one-fourth of an inch and will gradually taper to the heel. After drawing the other lines at (P), cut out with a pair of tin shears and the shape will then be as shown in Fig 2. at (N). Using this for a pattern cut out enough pieces to make a compact mass one-fourth of an inch thick.

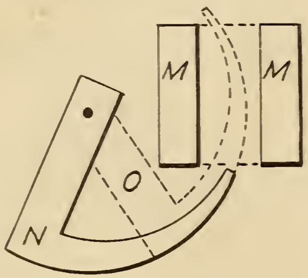


FIG. 2

These should be all clamped together in a vice and the outer edges all smoothed up at the same time until they are perfectly even and then with a soldering iron and acid carefully sweat the whole outside, making one solid mass. Next bore a one-eighth hole in the top of the shank for a little supporting shaft. Care should be exercised to get the hole at right angles to the surface.

Next secure a piece of steel wire that will make a snug fit in the hole just drilled. Cut it off one and a half inches long and bring the end to a perfect V point. This will require some pains and if the first time you do not succeed try again. As soon as a perfect point has been made it should be tempered glass-hard and smoothed up with very fine emery paper, placed through the hole in (P) and soldered there.

Next secure an old alarm clock. The balance wheel in these clocks runs in pivot bearings and as this balance wheel sets in the center of one of the brass side strips of the frame they are just what we want, as these strips will be 2¼ inches long and about three-eighths of an inch wide. These should be cut out and if it so happens that there are no holes in the extreme ends for screws they should now be drilled. Secure a good piece of wood for the back board and with small screws secure one of the strips to it as shown at (K) Fig. 3. Make a block of wood, well seasoned, as shown at (A) and this will want to be about 1¾ inches thick and should be thoroughly dry and well shellacked to prevent it ever absorbing moisture and warping. The scale block shown at (E) and (G) should be five inches long and of sufficient width to allow the cardboard scale to be glued to it, and about two inches thick. The pointer is cut out of thin sheet brass or copper and should be soldered to (D) and bent to the shape shown in the side view so as to come up over the scale block. This is done so that the scale will be near the glass when the instrument is boxed. The pointer can be made jet black by covering it with India ink and allowing it to dry slowly.

The coil (B) comes next and the size of the wire will be determined by the number of amperes that you wish the instrument to register. We will say that this one will be called upon at times to register 30 amperes. Therefore it must be wound with not less than No. 8, B. and S. gauge insulated wire. This coil is wound on a hollow iron cylinder, 1⅛ inches in diameter, and the coil should not be over 1¾ inches long. It should be wound carefully and evenly and it would be well to try say 25 turns. The coil should be carefully taped and placed in position and securely held there with the small brass strip running through it as shown by (R). Its position on the board is such that the curved part of the movable member will be drawn up into the hole in the coil as shown more clearly at (M), Fig. 2. This action takes place when current is sent through the coil (B) and is on the principle of the solenoid.

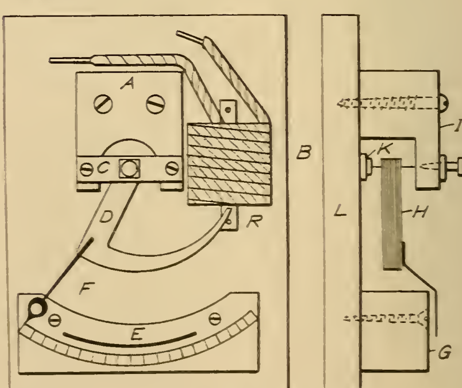


FIG. 3

It is supposed that the amateur to calibrate this instrument has the use of a standard instrument. If such is the case they both should be connected to the lighting circuit in series and with a water rheostat.

Slowly immerse the plates in the salt solution until the standard instrument has reached 30 amperes. Note where the pointer of this lies on the scale. If you have too many turns in (B) it will be over to the right too far, probably off the scale altogether. If there are not enough turns it will swing to the right but a short distance. If the latter is the case more turns of wire should be added, if the former, take off a few turns.

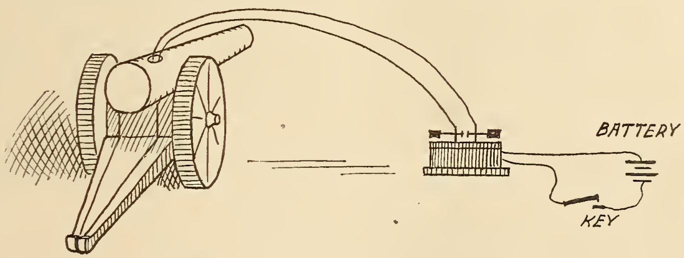
When the extreme limit of the scale is reached on 30 amperes, mark the point with a lead pencil. Then by means of the water rheostat vary the current so as to ascertain the 5, 10, 15, 20, and 25 ampere points on the scale. Mark these also. Finally, mark these five ampere spaces up into five equal divisions each, so that the scale will show one ampere divisions.

We are now ready to box the instrument which is a simple job. Provide a glass to go over the scale. Two heavy binding posts should be secured and the terminals of (B) should be carried one to each post. The instrument is now ready for use and will be accurate in proportion to the workmanship of the builder.

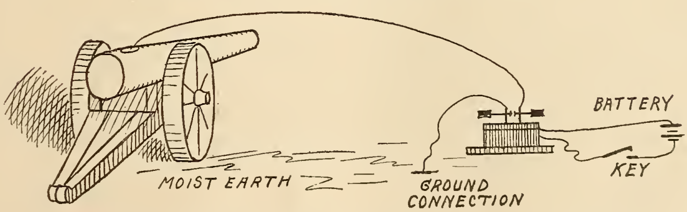
These instruments have their drawbacks as they must be used in a vertical position, the same as all gravity instruments, which can always be told by the pointer resting on zero when no current is on. The instrument should not be used near the powerful fields of a dynamo as this is apt to cause the readings to be far from true.

A Sane Fourth of July Celebration

On July 4th and 5th a group of boys of about 14 to 16 years of age got together to celebrate. They were firm believers in the "sane" Fourth, which has been advocated so widely throughout the country, and although they wanted to make some noise, as usual, they were determined to do so in a manner to prevent scorched faces, torn thumbs and other common forms of mutilation too frequently attendant upon Independence Day celebrations.



FIRING CANNON BY SPARK COIL



IT ALSO WORKED WITH GROUNDED CONNECTIONS

One of the boys was a wireless enthusiast and owned a very good spark coil and this was determined upon as a means of firing a cannon owned by one of the other boys, and the diagram shows how they accomplished the trick.

First they connected two rubber covered wires to the two terminals of the spark gap of the coil and led these to the cannon, which was several feet away, the coil being out of the danger zone. The cannon was loaded and the two ends of the wires were inserted in the vent, but not quite touching. When the key of the spark coil was pressed down, sending current from the battery through the primary of the coil, the spark, instead of jumping the regular spark gap, jumped across between the two ends of the wires in the vent, igniting the powder.

The boys were also successful in shooting off the cannon, at a distance of 15 feet, with a ground circuit as shown in the second illustration. One terminal of the coil was grounded. The other terminal was connected to a wire leading into the powder in the vent, but not touching the metal of the cannon.

QUESTIONS AND ANSWERS

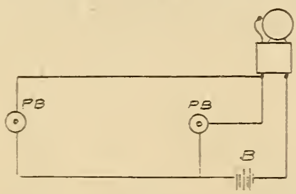
Readers of Popular Electricity are invited to make use of this department. State your questions as clearly and concisely as possible. No consideration will be given to communications which do not contain the full name and address of the writer

Bell Wiring; Double Pole Snap Switch; Keyless Socket

Questions.—(A) Please give diagram showing how to arrange a circuit to ring one bell from two push buttons some distance apart. (B) If a keyless socket has the lamp removed will the meter register any current? (C) When are double pole snap switches required on lighting circuits? (D) In wiring for annunciators should the main wire carrying the current from the battery to the various push buttons and annunciators be larger than the wires which run from the push buttons to the numbers on the annunciators? What size wire should be used?—J. W., Sudbury, Ont., Can.

Answers.—(A) See diagram.

(B) No. The center contact of the socket is of one polarity and the screw shell



BELL WIRING

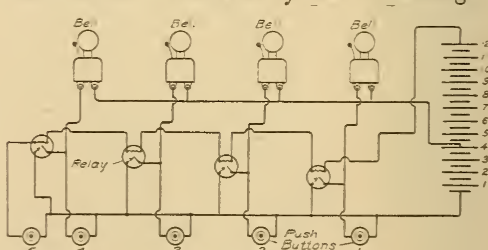
of the other. The circuit is complete only when the lamp is screwed in until its center contact strikes the socket's center contact.

(C) Chicago city rules say: "Switches must not be single-pole, except when the circuits which they control supply not more than six (6) sixteen (16) candle power lamps or their equivalent." Referring to double pole switches these rules under electric heaters say: "Switches must be double pole where the device controlled requires more than three hundred and thirty (330) watts of energy." In the National Electrical Code double pole snap switches are referred to under electric heaters as follows: "Switches must be double pole except where the device controlled does not require more than 660 watts of energy."

(D) For electric bells "annunciator wire" is much used. It is No. 16 B. and S. gauge copper wire insulated with two thick layers of cotton, wound in opposite directions, paraffined and varnished. By some, the extra cost of using rubber covered wire of the above number is so small that it is considered poor economy not to use it. The same size wire is used throughout.

Special Bell Circuit

In the answer to H. A. E. in the July issue a diagram was shown for the operation of four call bells at once by a fifth push button. While the system would work with the fifth push button as shown, all four bells would of course also ring upon pushing any of the other buttons unless switches (not shown in the diagram) were put in between the first four buttons on the upper common wire, to be opened on each side of the ringing button only when that particular button was to be used. Another way the first four buttons could be made to ring their bells independently, and at the same time ring the four bells with the fifth button, would be to use relays as shown at each of the stations. These relays are so arranged



SPECIAL BELL CIRCUIT

that upon pushing the fifth button the armatures will draw up and close the circuits to all four bells, but when the fifth button is not in use the bells may be operated singly by their individual buttons.

The diagram shows the relays connected in series. With this arrangement and low resistance relays, say 20 ohms in all, about 12 dry cells in series would be required for the operation of the relays, about four being sufficient for the bells as shown. The relays might also be connected in parallel in which case six cells would be sufficient.

Figuring Size of Wire

In the answer to H. C., Sedalia, Mo., July issue, the formula for circular mils contains the factor L, or length of wire in feet. This means the total length of the two wires of the circuit and in applying the formula should be taken as twice the distance traversed by the line. In the example given, the length of the line is 7920 feet and L, the length of wire in feet, should have been taken as 15,840 feet instead of 7920 feet.

Changing Motor from 133 to 60 Cycles

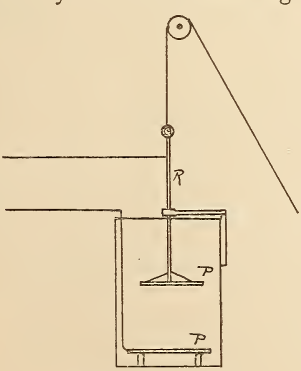
Question.—What is necessary to change an induction fan motor from 133 cycles to 60 cycles.—M. S. W., Linton, Ind.

Answer.—The iron cross section of the field for 60 cycles should be twice as great as for 133 cycles, a thing not easily complied with. The motor will run at only one-half its former speed. To make it run at its former speed it would be necessary to provide only one-half the present number of poles. Under this condition it would not be practicable to attempt to change the motor over.

To Make a Water Rheostat

Question.—Please give directions for making a 500-volt water rheostat.—J. L., Milford, Mass.

Answer.—The sketch shows in general a plan that may be used in making a water



WATER RHEOSTAT

rheostat. The vertical rod (R) may be adjusted by means of a pulley as shown. Use an ordinary barrel for your purpose. Provide circular iron plates (PP) 3-16 of an inch in thickness. At the bottom of the barrel place three or four porcelain knobs or three line glass insulators. Make connections as shown using stranded copper wire, rubber covered. Vary the resistance by adjusting the distance between the plates. By adding salt the current will be increased owing to the increased carrying capacity. Use clear water to start with. It is not usual to add more than two or three percent of salt. Salt is not good for accurate work, sulphuric acid being better, using very small quantities.

Transformer Connections

Question.—Referring to Fig. 3, page 56 of the May, 1909, issue, if the primary wires were delta connected and the secondary Y connected, what would be the voltage between phases?—A. H. M., Montreal, Canada.

Answer.—The primary leads as there shown are Y connected to the line and the secondary are delta. If, as you suggest, the primary wires are delta connected to the line, each of the three windings will receive 2,200 volts as in Fig. 1. Arranging the secondary as a Y connection, the secondary voltage will be $\frac{2200}{20} \times (\sqrt{3}$ or $1.73)$ giving 190.3 volts between phases.

Rating of Dry Cells

Question.—What is the voltage, current and internal resistance of the ordinary dry cell?—F. B. O., Chicago.

Answer.—No dry cell should be kept in stock longer than one year. The internal resistance of fresh dry cells varies from 0.1 to 0.7 ohm, and the E. M. F. from 1.3 to 1.6 volts. Dry cells of the ordinary size should not be used where a current of over 0.15 ampere is required.

Specifically, the following rating is given the cells named:

	E. M. F. Volts	Internal Resistance, ohms.
Leclanche	1.48	.3 to .5
Smee	1. to .59	.1
Nungesser (1900 Dry Battery)...	1.6	.1

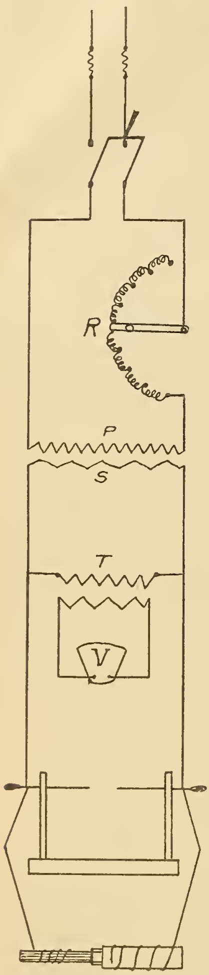
Reading a Meter

Question.—Please give directions for reading a electric light meter.—P. McD., Jefferson, Iowa.

Answer.—See article on "Measuring Electric Current" in the June, 1909, issue.

Puncture Test for Insulation

Question.—Will you explain the puncture test so that same may be applied to any high insulating material.—A. R. H., Portland, Ore.



PUNCTURE TEST

Answer. — The diagram shows how connections may be made to make a test. An alternating current generator or service wires may be connected to the primary of a step-up transformer, a rheostat (R) being placed in series with one side. From tests for high voltages we know that the following pressures will spark across needle points in air as shown in the figure:

Volts	Spark Gap in Inches
10,000	.47
20,000	1.0
30,000	1.62
40,000	2.45
50,000	3.55
100,000	9.6

In accordance with the above, the needle points are set so that a spark will jump across them when the voltage has been raised to the value at which it is desired to test the insulation. A voltmeter (V) may also be connected to a transformer (T) and its readings multiplied by the ratio of the transformer in order to check the accuracy of the needle setting and the high voltage.

Samson Cell

Questions.—(A) Please tell me what is necessary to recharge a Samson wet battery. (B) Is it necessary to short circuit this battery for 24 hours after recharging?—G. A. B., Spencer, Mass.

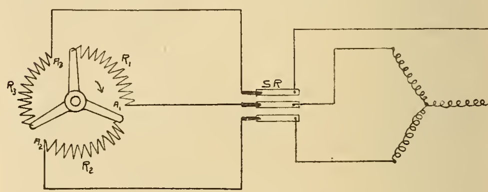
Answers.—(A) Four ounces of sal ammoniac in water enough to fill the glass jar outside the porous cup is sufficient, the jar being 4½ inches in diameter and 6 inches high. Boil the carbon for one hour in water.

(B) No.

Induction Motor Speed Regulation; Mercury Rectifier

Questions.—(A) Kindly give diagram of the ordinary induction motor showing method of speed regulation. (B) Explain the mercury arc rectifier. —C. T., Kansas City, Mo.

Answers.—(A) An induction motor tries to run in synchronism with the alternator except as losses due to friction, etc., check it.



INDUCTION MOTOR DIAGRAM

The diagram shows a Y-wound armature, with the three terminals connected to slip rings (S. R.). With the resistance arms in the position shown each winding has in series with it a resistance. When the resistances are thus placed in the armature circuit the slip must be large in order to make sufficient current flow to provide the necessary torque. Hence when these resistances are in, the speed of the motor is low. In crane work this method is common. With the arms resting on points (A1), (A2) and (A3) all resistance will be out of the armature and the full voltage will be impressed on the windings. Each arm is connected to the main line.

(B) See answer to S. N. in June, 1909, issue.

Single Phase Motor

Question.—How would you reverse the direction of rotation of a single phase, four pole, alternating current motor?—J. S. C., Keokuk, Iowa.

Answer.—An induction motor with only a single winding on the field, instead of two or more sets of windings differing in phase, connected to single-phase mains will not start of its own accord. If given a start it will come up to speed in whichever direction it is set going provided no load is applied.

Single phase motors, however, are often provided with two or three-phase windings for starting, and the pressure displaced or split in phase by introducing resistances and inductance in the circuit of these special windings. After the motor comes up to speed these resistances and inductances with their windings are cut out. Reference to some standard treatise on induction motors will give you further information.

Motor on 110 Volts; Connecting Batteries; Three-way Switches

Questions.—(A) Please explain how to connect a 6-volt motor in series with 16 candle power lamps on a 110-volt circuit. (B) Which is the best for running motors, four batteries in series and three series in parallel, or twelve batteries in series? (C) Give diagram for connecting two three-way switches. —R. Y. N., Tilton, N. H.

Answers.—(A) Place in one side of the circuit to the motor two standard 52-volt lamps. This will give six volts across motor terminals.

(B) It depends upon the voltage and current required by the motor. Knowing this, and also the voltage and current available from one cell of your battery arrange the connections according to the following rule. Connect in series the number of cells necessary to give the pressure required by the motor, that is, the voltage of one cell multiplied by the number of cells in series gives the voltage across the line to the motor. If more current strength is required place more series sets in parallel across the motor supply mains.

(C) See answer to W. W. H. in the February, 1909, issue.

Soldering Fluid Formula; Lead and Zinc

Questions.—(A) Will you give a formula for making a soldering fluid? (B) What is the difference between lead and zinc? (C) Will lead mix with copper in the form of an alloy?—J. A. H., Chicago, Ill.

Answers.—(A) The following formula for soldering fluid is suggested by the National Board of Fire Underwriters in the National Electrical Code:

Saturated solution of zinc chloride	5 parts
Alcohol	4 parts
Glycerine	1 part

Soldering fluid containing acid is not recommended because of the effect on the insulation of wires. For bare wire work, however, this may be made as follows: Take two ounces of muriatic acid; add zinc till bubbles cease to rise; add one-half teaspoonful of sal ammoniac and two ounces of water.

(B) Zinc is a common metal found in the form of ore combined with sulphide and carbonate. Belgium and the Rhenish provinces produce more than one-half of the world's supply, and the Belgian process is commonly used to separate it from the ore. Zinc blend or "black jack" (ZnS) and the carbonate ($ZnCO_2$) are its important ores. Commercial zinc always contains some lead and iron, and traces of sulphur, arsenic, and cadmium. With lead, zinc readily combines when the two metals are melted together, but on cooling the zinc forms an upper layer while the lead forms at the bottom. German silver consists of copper, zinc, and nickel in the form of an alloy. All brass is now made by melting together copper and zinc.

(C) Yes, bronzes or brasses which are harder than the pure metal being the result.

Vacuum Sweepers; Dry Batteries; Ground Connection

Questions.—(A) In a vacuum sweeper how is the dust kept from going into the suction part? (B) Can an old dry battery be recharged by passing a 110-volt direct current through it. (C) Can the ground wire for a wireless apparatus be connected to the gas pipe in the operator's house? My friend and I are not able to communicate, using this method. Do you think that is the trouble?—H. E. S., Detroit, Mich.

Answers.—(A) Explaining briefly one make of sweeper, a centrifugal suction fan is operated in a chamber by a motor, direct connected, the latter being outside the fan pocket. The mouth of the suction-portion running over the floor has a few inches inside, a wire sieve or screen which stops the coarser dirt, a drawer being provided into which it drops. The finer dust passes on through the fan and is blown into a cylinder or dust chamber. This chamber has a sort of cheese cloth arranged so as to form three concentric bags, the dust-ladened air being forced into the first, through this, then through the walls of the second bag and finally through the third cheese cloth wall. The air by this time has been cleaned or strained and comes out through many fine perforations in the walls of the metal cylinder. The cheese cloth sacks are so arranged as to be made of a single piece of cloth. In removing the dirt the cylinder is taken off the pipe leading to it and the top removed. The cheese cloth sacks are then removed and cleaned.

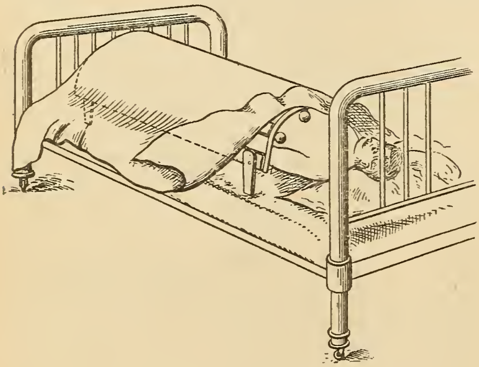
(B) No.

(C) Gas pipe is a good ground though not a safe one, unless the ground wire is connected on the street side of the meter. Your trouble must be elsewhere than in this ground. Water piping is considered the best ground.

NEW ELECTRICAL INVENTIONS

Electric Light Bath

The efficacy of strong light upon the body in the treatment of certain diseases is well known, its value being largely in the germicidal effect of the rays and the stimulation derived from the heat and radiant energy. Sunbaths we all know to be healthful, and



ELECTRIC LIGHT BATH

artificial light from electric lamps is used with almost the same results.

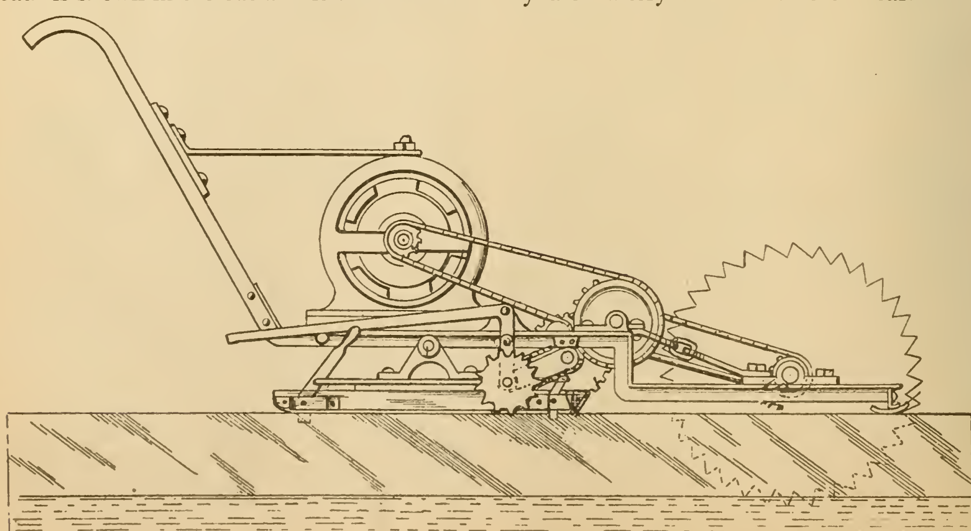
A new application of the electric light bath is shown in the cut and is the invention of Emmons Collins of Chicago, Ill. It consists of a half cylinder with interior reflecting surface studded with incandescent lamps. It is placed over the patient when lying in bed, the light being both radiated and reflected to the body, and at the same ime permitting massage treatment without the disarrangement of the apparatus.

Ice Cutting Machine

The unusual idea of applying electricity to the cutting of ice is embodied in a patent recently issued to Luna M. Macy of Adel, Ia. The diagram of this invention is self-explanatory. A motor is mounted on a sort of sled and by a system of chain and sprocket gears drives a toothed wheel for propelling the machine forward and a saw for cutting through the ice as it proceeds.

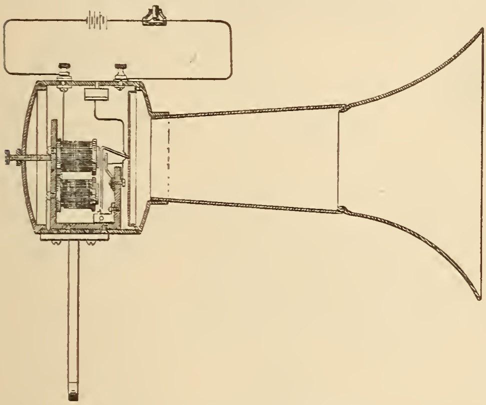
Electric Auto Horn

The diagram shows an electric automobile horn which is operated by the regular storage battery carried on the car for ignition purposes. On electric vehicles it is operated by the battery which drives the car.



ICE CUTTING MACHINE

In the base of the horn are two small electromagnets similar in principle to those of an ordinary buzzer or electric bell. An armature is mounted in front of the poles of the magnets and has a projecting member which moves the diaphragm of the horn back and forth. When current is switched into the electromagnet coils it energizes the pole pieces and causes them to give the



ELECTRIC AUTO HORN

armature a strong pull. This draws the armature up toward the pole pieces but in doing so the circuit to the electromagnet is broken, causing the pole pieces to become de-energized and to let go of the armature. The latter then flies back and closes the circuit repeating the operation. This occurs many times per second as long as the switch to the battery is closed, and causes the diaphragm to be vibrated back and forth with the armature, creating a loud sound in the horn.

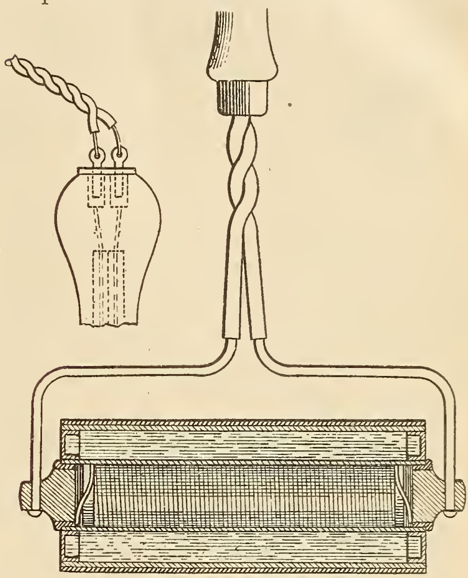
The apparatus is the invention of C. H. O'Brien of Augusta, Me.

Incubator Alarm

This invention relates to a thermostatic alarm. Inside the incubator is a thermostat which expands and contracts with the rise and fall of the temperature. This is connected by means of a system of levers to a circuit opening and closing device connected with an electric bell and battery. So sensitive is the device that should the temperature rise above or fall below that which must be maintained for the hatching of the eggs the bell circuit will be closed and the signal given. Perry S. Martin of Broadway, Va., is the inventor.

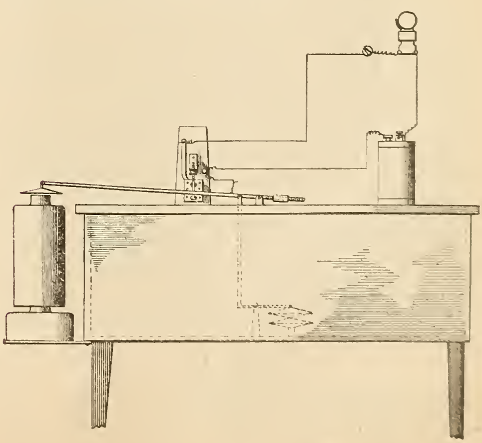
Electric Massage Device

A massage device, which embodies an electric heating element, is the invention of Nellie L. Coon of Rochester, N. Y. It consists of a massage roller with suitable handle. The roller is hollow, containing an outer compartment for water and an inner com-

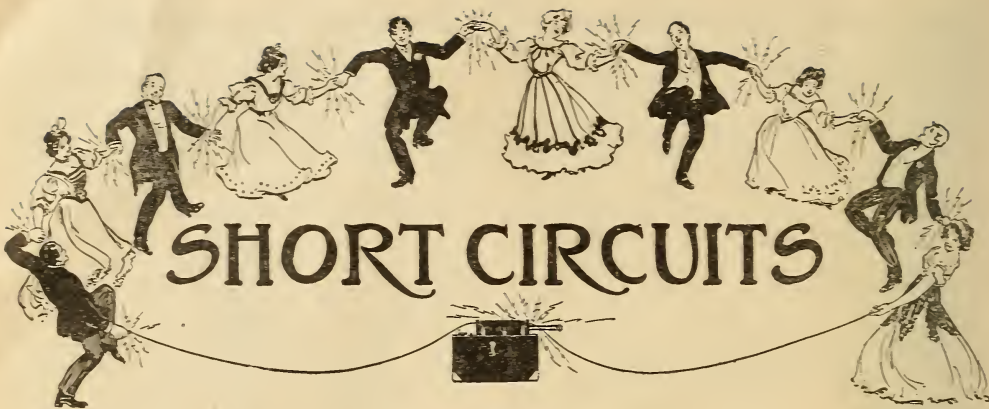


ELECTRIC MASSAGE DEVICE

partment for the electric heating element. When current is turned into the latter it is heated by the passage of electricity through a coil of very fine wire, and this heat is imparted to the water in the outer casing. The wires from the electrical source may then be disconnected and the water retains the heat for a considerable length of time.



INCUBATOR ALARM



SHORT CIRCUITS

The Shakespeare Club of New Orleans used to give amateur theatrical performances that were distinguished for the local prominence of the actors. Once a social celebrity, with a gorgeous costume, as one of the Lords in Waiting, had only four words to say: "The queen has swooned." As he stepped forward, his friends applauded vociferously. Bowing his thanks, he faced the king and said, in a very high-pitched voice, "The swoon has queened."

There was a roar of laughter; but he waited patiently, and made another attempt:

"The sween has cooned."

Again the walls trembled and the stage manager said, in a voice which could be heard all over the house, "Come off, you doggoned fool."

But the ambitious amateur refused to surrender, and in a rasping falsetto, as he was assisted off the stage, he screamed: "The coon has sweened."

* * *

A young girl once asked Mark Twain if he liked books for Christmas gifts. "Well, that depends," drawled the great humorist. "If a book has a leather cover, it is really valuable as a razor strop. If it is a brief, concise work, such as the French write, it is useful to put under the short leg of a wabbly table. An old-fashioned book with a clasp can't be beat as a missile to hurl at a dog; and a large book, like a geography, is as good as a piece of tin to nail over a broken pane of glass."

* * *

A Baltimore bank having a draft for collection on a firm in Florida, sent the draft forward for collection, and in reply received the following letter:

Dear Sir:—I wish to call your attention to the fact that I am no longer located at —— street, this city, and through force of circumstances, hard times, bad business, I am no longer the "Big Noise" of the firm whose name appears on this letterhead.

The firm whose officers, board of directors, office force and sales department consisted of the writer, has folded its lily-white hands across its virgin breast and turned up its pink toes to the daisies, and is solemnly studying botany, examining the dandelion's root and tender feeders of the forget-me-nots.

The firm name of —— is now of the past; no longer will its blithesome fog-horn voice be heard in the busy slaughter house of trade, and no more will the guileless jeweler be the mark of our rapacity and list price, with 60 per cent added.

We have entered the service of the —— Company, in which we are the "Slender Noise," but still able to be heard.

* * *

"Sawyer! Sawyer!" bawled the brakeman.

"Don't care if you did, smarty," said the young swain who had just kissed his girl. "We are going to be married next month anyhow, so it's nobody's business but our own."

"Now, children," commanded the austere instructor in advanced arithmetic, "you will recite in unison the table of values."

Thereupon the pupils repeated in chorus:

"Ten mills make a trust;

"Ten trusts make a combine;

"Ten combines make a merger;

"Ten mergers make a magnate;

"One magnate makes the money."

* * *

Dolly was out for a walk and met an old friend of her father.

"And how old are you, little one?" asked the old gentleman.

But Dolly was indignant.

"I'm hardly old at all; I'm nearly new," she answered, tossing her head.

* * *

An old negro had gone to a postoffice in Mississippi and offered for the mail a letter that was over the weight specified for a single stamp. "This is too heavy," said the postmaster. "You will have to put another stamp on it."

The old darkey's eyes widened in astonishment. "Will anudder stamp make it any lighter, boss?" he asked.

* * *

J. J. McGraw, the baseball expert, denied, at a banquet in New York, the marvels attributed to the spit ball.

"It's a good ball," he said. It fools the best of them. But when I hear some of the miracles put to its credit—well, then I think of Harriet Hare, of 'Frisco.

"I once read in a 'Frisco paper: 'Harriet Hare, of Nob Hill, got a needle in her waist two years ago, and only last week this needle worked its way out of the arm of a young Los Angeles rose farmer.'"

* * *

The lecturer warmed up.

"Let us follow civilization's torch," he cried. Before he could say more a little man in the back part of the hall suddenly bobbed into view.

"What is civilization's torch?" he shrilly demanded.

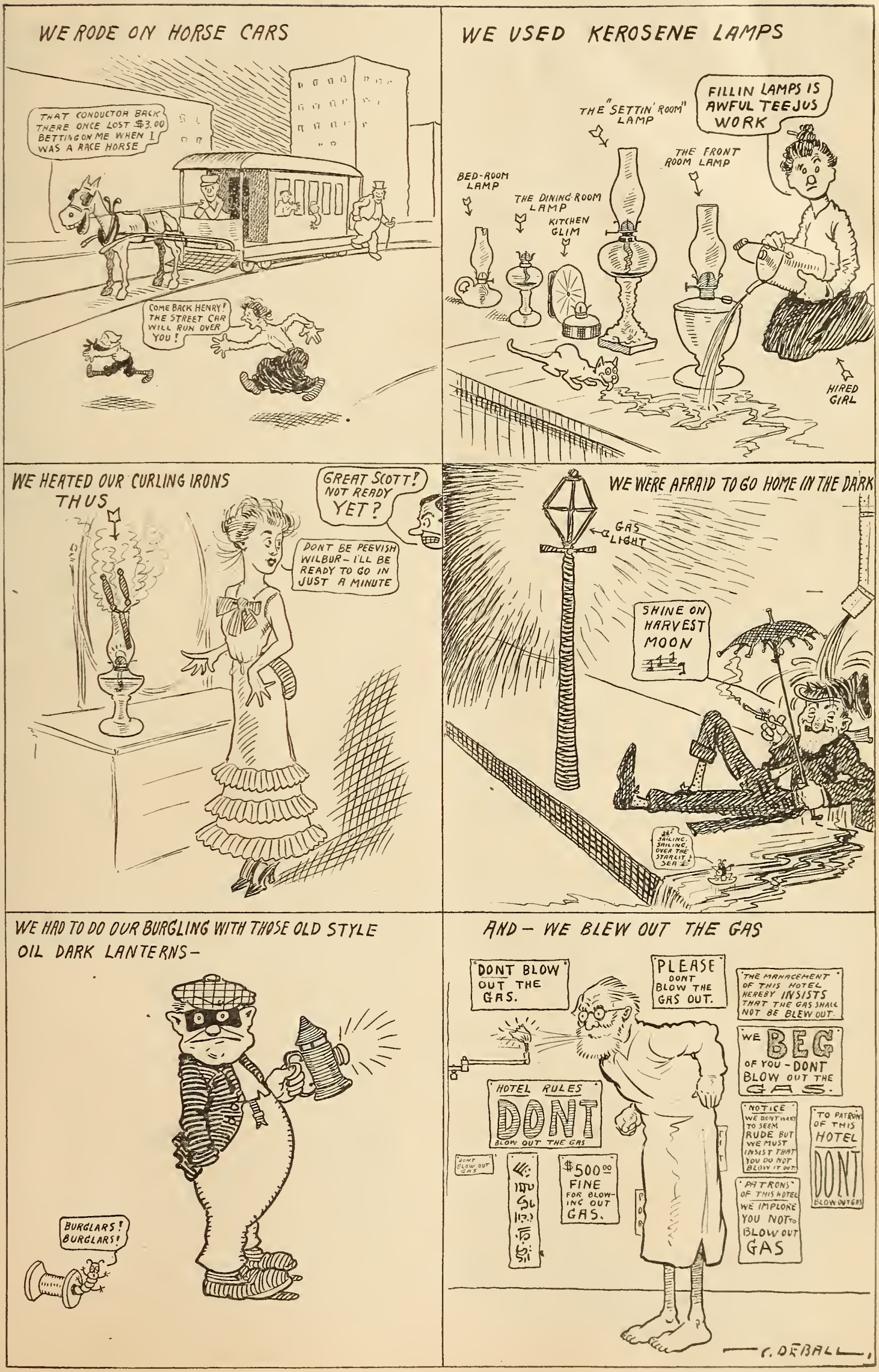
The lecturer was annoyed.

"Why, it's a-a-a—it's an expression."

"It ain't got nothin' to do with Standard Ile, has it?"

"No," the lecturer shouted back.

"Then you can go ahead with your lecture," said the little man as he disappeared from view.



WHAT DID WE EVER DO WITHOUT ELECTRICITY?

ELECTRICAL DEFINITIONS

Below are defined a few of the most common electrical terms. They are reprinted from month to month and will be of assistance in understanding the magazine text

Accumulator.—See secondary battery.

Alternating Current.—That form of electric current the direction of flow of which reverses a given number of times per second.

Ammeter.—An instrument for measuring electric current.

Ampere.—Unit of current. It is the quantity of electricity which will flow through a resistance of one ohm under a potential of one volt. The international ampere is the current which, under specified conditions, will deposit .001118 gram of silver per second when passed through a solution of nitrate of silver in water.

Ampere Hour.—Quantity of electricity passed by a current of one ampere flowing for one hour.

Anode.—The positive terminal in a broken metallic circuit; the terminal connected to the carbon plate of a battery.

Armature.—That part of a dynamo or motor which carries the wires that are rotated in the magnetic field.

Brush.—The collector on a dynamo or motor which slides over the commutator or collector rings.

Bus Bars.—The heavy copper bars to which dynamo leads are connected and to which the outgoing lines, measuring instruments, etc., are connected.

Buzzer.—An electric alarm similar to an electric bell, except that the vibrating member makes a buzzing sound instead of ringing a bell.

Candle Power.—Amount of light given off by a standard candle. The legal English and standard American candle is a sperm candle burning two grains a minute.

Capacity, Electric.—Relative ability of a conductor or system to retain an electric charge.

Charge.—The quantity of electricity present on the surface of a body or conductor.

Choking Coil.—Coil of high self-inductance which retards the flow of alternating current. See self-inductance.

Circuit.—Conducting path for electric current.

Circuit-breaker.—Apparatus for automatically opening a circuit.

Collector Rings.—The copper rings on an alternating current dynamo or motor which are connected to the armature wires and over which the brushes slide.

Commutator.—A device on a dynamo shaft for gathering the current from the various coils of the armature and sending it out over the line as direct current. On a motor it takes current from the line and passes it on to the armature coils.

Condenser.—Apparatus for storing up electrostatic charges.

Cut-out.—Appliance for removing any apparatus from a circuit.

Cycle.—Full period of alternation of an alternating current circuit.

Dielectric.—A non-conductor.

Dimmer.—Resistance device for regulating the intensity of illumination of electric incandescent lamps. Used largely in theaters.

Direct Current.—Current flowing continuously in one direction.

Dry Battery.—A form of open circuit battery in which the solutions are made practically solid by addition of glue jelly, gelatinous silica, etc.

Electrode.—Terminal of an open electric circuit.

Electromotive Force.—Potential difference causing current to flow.

Electrolysis.—Separation of a chemical compound into its elements by the action of the electric current.

Electromagnet.—A mass of iron which is magnetized by passage of current through a coil of wire wound around the mass but insulated therefrom.

Farad.—Unit of electric capacity.

Feeder.—A copper lead from a central station to some center of distribution.

Field of Force.—The space in the neighborhood of an attracting or repelling mass such as a magnet or a wire carrying current.

Fuse.—A short piece of conducting material of low melting point which is inserted in a circuit and which will melt and open the circuit when the current reaches a certain value.

Generator.—A dynamo.

Inductance.—The property of an electric circuit by virtue of which lines of force are developed around it.

Insulator.—Any substance impervious to the passage of electricity.

Kilowatt.—1,000 watts. (See watt.)

Kilowatt-hour.—One thousand watt hours.

Leyden Jar.—Form of static condenser which will store up static electricity.

Lightning Arrester.—Device which will permit the high-voltage lightning current to pass to earth, but will not allow the low voltage current of the line to escape.

Motor-dynamo.—Motor and dynamo on the same shaft, for changing alternating current to direct and vice versa, or changing current of high voltage and low current strength to current of low voltage and high current strength and vice versa.

Multiple.—Term expressing the connection of several pieces of electric apparatus in parallel with each other.

Neutral Wire.—Central wire in a three-wire distribution system.

Ohm.—The unit of resistance. It is arbitrarily taken as the resistance of a column of mercury one square millimeter in cross sectional area and 106 centimeters in height.

Parallel Circuits.—Two or more conductors starting at a common point and ending at another common point.

Polarization.—The depriving of a voltaic cell of its proper electromotive force

Potential.—Voltage.

Resistance.—The quality of an electrical conductor by virtue of which it opposes the passage of an electric current. The unit of resistance is the ohm.

Rheostat.—Resistance device for regulating the strength of current.

Rotary Converter.—Machine for changing high-potential current to low potential or vice versa.

Secondary Battery.—A battery whose positive and negative electrodes are deposited by current from a separate source of electricity.

Self-inductance.—Tendency of current flowing in a single wire wound in the form of a spiral to react upon itself and produce a retarding effect similar to inertia in matter.

Series.—Arranged in succession, as opposed to parallel or multiple arrangement.

Series Motor.—Motor whose field windings are in series with the armature.

Shunt.—A by-path in a circuit which is in parallel with the main circuit.

Shunt Motor.—Motor whose field windings are in parallel or shunt with the armature.

Solenoid.—An electrical conductor wound in a spiral and forming a tube.

Spark-gap.—Open space between the two electrodes of a spark coil or resonator.

Storage Battery.—See secondary Battery

Thermostat.—Instrument which, when heated, closes an electric circuit.

Transformer.—A device for stepping-up or stepping-down alternating current from low to high or high to low voltage, respectively.

Volt.—Unit of electromotive force or potential. It is the electromotive force which, if steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampere.

Volt Meter.—Instrument for measuring voltage.

Watt.—Unit representing the rate of work of electrical energy. It is the rate of work of one ampere flowing under a potential of one volt. Seven hundred and forty-six watts represent one electrical horse power.

Watt-hour.—Electrical unit of work. Represents work done by one watt expended for one hour.

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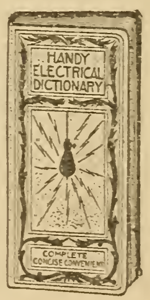

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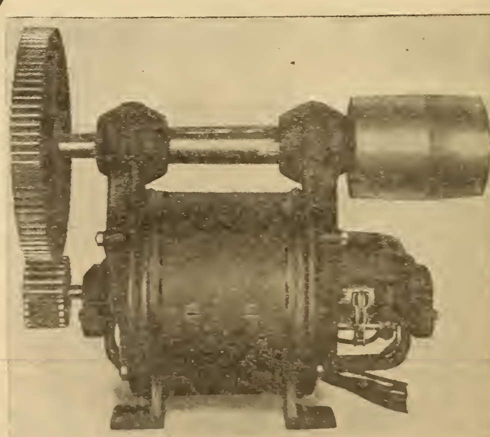

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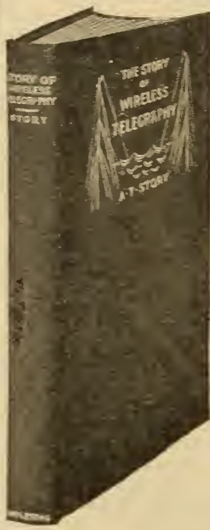

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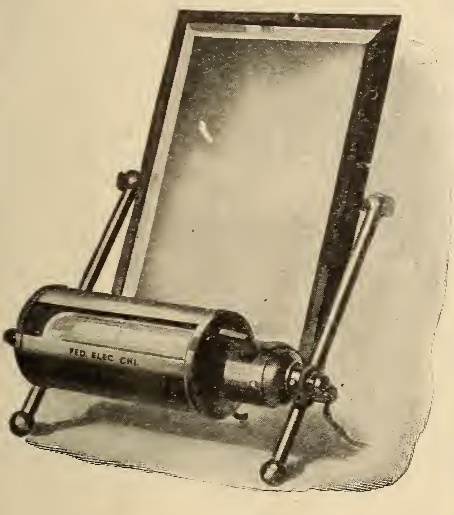

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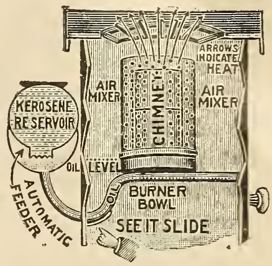

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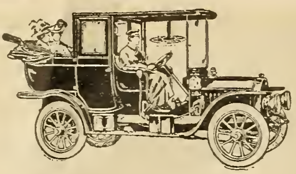

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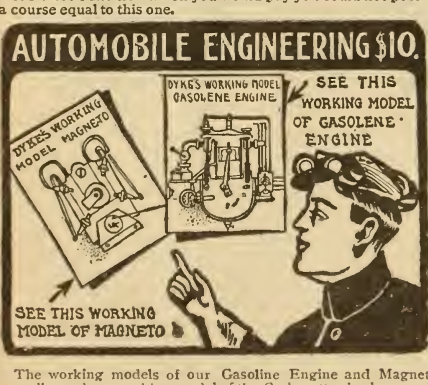

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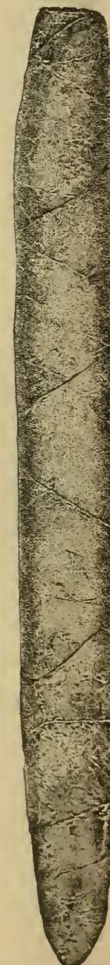

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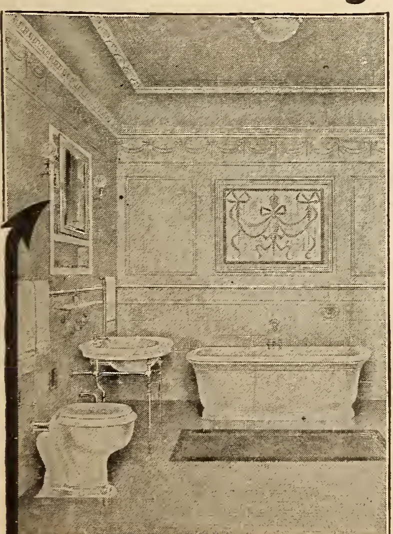

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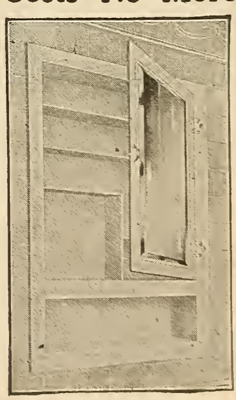


Style "A" Locker is made to recess into the wall and projects one inch from face of wall. It has a beveled plate mirror 16x24 inches and measures 19½x24½ inches inside. Below the mirror is an open shelf 19½x6 inches.

Style "B" is the same size and finish, made not to recess into the wall, but to be suspended on the wall.

Price of Style "A" **$8.00**
Price of Style "B" **9.00**

Without Mirror deduct $1.50
Without Open Shelf deduct $1.00

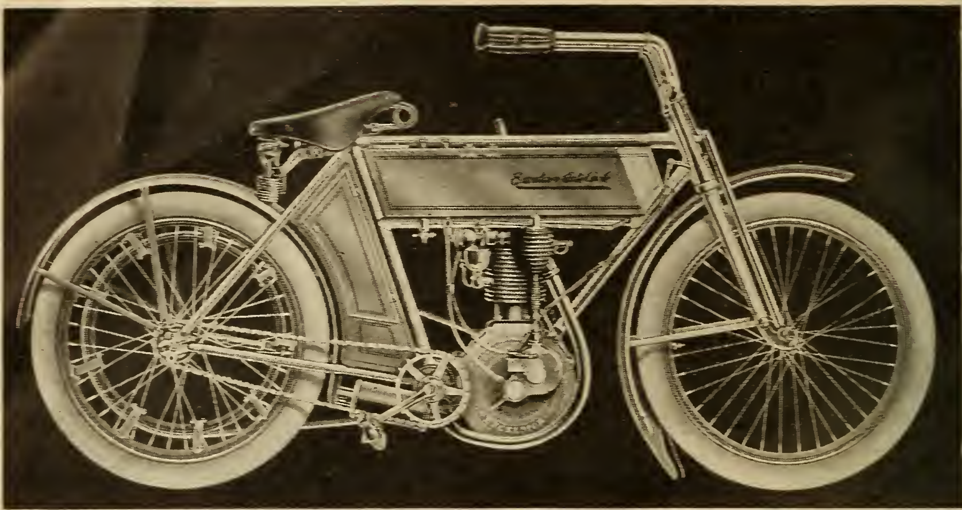
Order of your dealer. If he will not supply it send us the price and we will ship the locker direct to you, prepaying freight charges anywhere east of Missouri and north of Ohio rivers.

Send For Illustrated Circular

We are makers of the Hess Steel Furnace. Important booklet, "Modern Furnace Heating" Sent Free.

SEE THAT LOCKER

Hess Warming & Ventilating Co., 912 L Tacoma Bldg. CHICAGO



EXCELSIOR AUTO-CYCLE

THREE AND ONE-HALF HORSE POWER, $225

Always Makes Good. Always on the Job. More features of real practical excellence than all others combined. A demonstration is a most convincing argument. *Let Us Show You.*

EXCELSIOR SUPPLY CO.

1436-1438 Michigan Avenue
233-237 Randolph Street


Taking the Motosphere Treatment

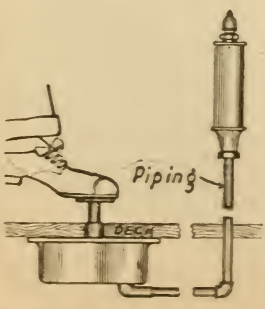
MARVELOUS CURES IN INDIGESTION, NERVOUS PROSTRATION, INSOMNIA, LA GRIPPE, RHEUMATISM, GOUT, SCIATICA, and COMPLAINTS ARISING FROM CONGESTION or SLUGGISH CIRCULATION.

The Motosphere is a new invention that changes electricity back to the original lines of force and concentrates them over the vital organs. Scientific, yet simple—it is vital energy concentrated; the essence of nerve force that revitalizes the blood and enables the system to throw off disease. Does not cost one cent unless it absolutely cures.

Send for booklet of testimonials and particulars.

The Motosphere Mfg. Co.

31 East 27th St., Dept. E. **New York City**



The "WORDY" Whistle for Motor Boats

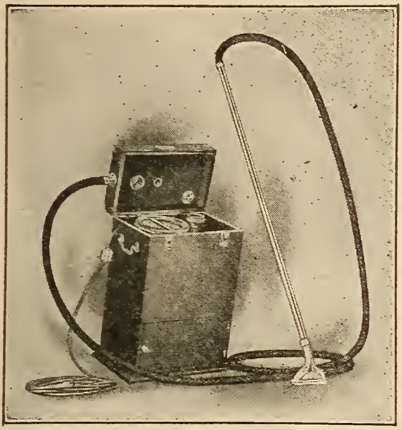
A foot-operated, all-brass, two-tone whistle. The Wordy Whistle consists of an air dash pot with a capacity of 27 cubic inches of air. It is self-contained and requires but five square inches below the deck. The whistle can be placed anywhere in the boat, wherever most convenient, and connected to the dash pot below the deck with standard one-half inch pipe connections. It operates with the foot independent of the engine. This is positively the latest device on the market and is fully guaranteed. It is dust, water and frost proof, and is vastly superior to any exhaust or battery whistle. Price $9.00 complete. Sent prepaid upon receipt of price or express C. O. D.

WORDINGHAM FOOT HORN CO.

211 Grand Aveune **Milwaukee, Wis.**

The "IMPERIAL"

A Portable Vacuum Cleaning Machine
combining efficiency, practicability and economy. Can be attached to any electric light socket.



EFFICIENT—Because it thoroughly accomplishes its purpose.
PRACTICAL—Because of its simplicity and compactness.
ECONOMICAL—Because of its minimum cost of maintenance and operation.

A Dividend Payer for Central Stations

Growing concerns and responsible parties wanted as agents. Exclusive territory given. Send for Catalogue and Particulars.

Price $100, Complete

EMPIRE VACUUM COMPANY
112 West 30th Street, New York

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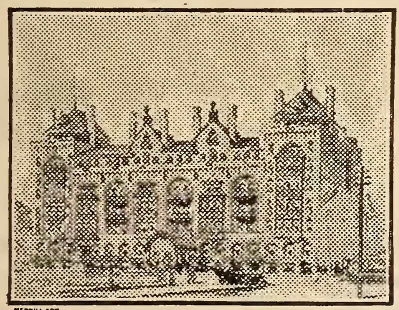

The Rittenhouse

The Rittenhouse is one of the most exclusive hotels in Philadelphia, catering to transient and permanent guests alike, making it a most desirable hotel for ladies traveling alone.

Rooms $1.50 per day and up
American Plan, $4.00 per day and up

Write for Booklet

J. C. HINKLE, Mgr.

The Best Book On 6% Bonds

We have written a book on Irrigation Bonds, based on long experience and intimate knowledge. Every investor, small or large, owes to himself its perusal. We want to send you a copy.

In the past 15 years, we have sold 70 separate issues of Drainage and Irrigation Bonds, without a dollar of loss to any investor. We are the largest dealers in these Reclamation Bonds, and they have become, in late years, our most popular bonds.

Irrigation Bonds are secured by liens on the most fertile farm lands in America. The value of the land is often more than four times the loan.

Some are municipal obligations, forming tax liens on the real property located in populous districts.

They are serial bonds, running from two to twelve years. Each year, as the loan is reduced, the security back of the rest is increased.

The denominations are $100, $500 and $1,000, so one may invest either little or much.

The interest rate is six per cent. No other large class of bonds, equally well secured, now pays an equal rate.

These bonds are bound to become more and more popular as they become better known. They are the utmost in six per cent bonds. Please send us this coupon today for our free book, so you may know the facts.

Trowbridge & Niver Co.

(Established 1893)

Municipal and Corporation Bonds

First National Bank Bldg. CHICAGO — **50 Congress Street BOSTON**
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Gentlemen:—Please send me your new Bond Book, "The World's Greatest Industry."

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This Splendid

Meister Piano

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Delivered to your own home in any part of America and freight charges prepaid—**for one month's unlimited trial.** If it is not the best piano at the price in existence, and you do not like it, we will take it back and **pay the return freight.** We merely want the chance to place this piano in your home so you can judge its merits for yourself.

No cash payment down. No interest. No extras. We pay the freight.

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A splendid educator for the children, a wonderful entertainment for all the family. Refining, elevating, instructive. Try it for 30 days free of all cost. A Rothschild 10-year guarantee bond with each instrument.

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and save you the big profits usually paid on pianos. Piano stool and scarf free. Send at once for our magnificently illustrated Meister Piano book. It's **Free.** It shows all grades of Meister Pianos in colors.

Rothschild & Company

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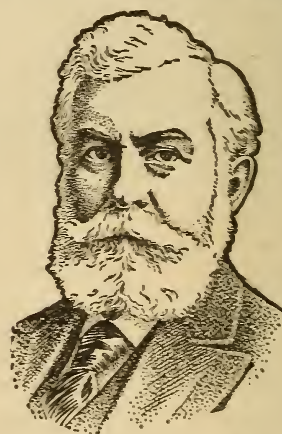
RHEUMATISM

I want to send every sufferer who reads this paper a pair of Magic Foot Drafts TO TRY FREE.

Send Me Your Address Today

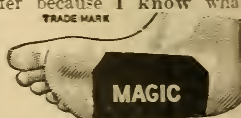
Write me. I'll send you a $1.00 Pair of Magic Foot Drafts, the great Michigan external remedy that is curing thousands, **to try FREE.**



Frederick Dyer, Corresponding Secretary

No matter where the pain, whether acute or chronic—muscular, sciatic, lumbago, gout—and however stubborn or severe, you will get the Drafts by return mail. Then after you get them and try them, if you are fully satisfied with the benefit received, send me One Dollar. If not, keep your money. **I take your word.**

I make this unequaled offer because **I know** what remarkable cures the Drafts **are performing—cures after 30 and 40 years** of suffering—cures after doctors and baths and medicines had utterly failed. Won't you try them? I am sure you'll be glad if you do, and you cannot lose a penny. Address **Magic Foot Draft Co., 940 F Oliver Bldg., Jackson, Mich.** Send no money. **Write today.**



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SELLS LIKE SIXTY
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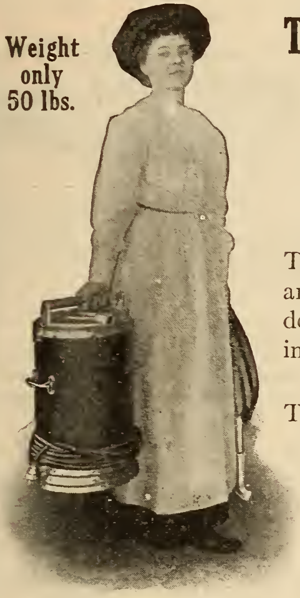
For Pumping, Cream Separators, Churns, Wash Machines, etc. *Free Trial*
1 to 25 Horse Power
Ask for Catalog—

GILSON MFG. CO. 900 Park St. Port Washington, Wis.

Weight only 50 lbs.



The Santo Vacuum Cleaner

The Mark of Perfection

IS BACKED BY

A Guaranty that MEANS SOMETHING

The Santo Electric Vacuum Cleaner was invented, developed, and perfected in our own factory, by our own workmen. Every detail of its construction is original with us. The title to this invention is therefore vested in us.

Like all articles of superior merit the Santo has its imitators. The Santo is the **original** round, portable cleaner. It can not be approached in efficiency, durability or completeness, by any other cleaner at any price.

Sold Under a Guaranty Bond

Instead of the verbal promises given with most cleaners and which are seldom worth anything, we give you a guaranty bond bearing our corporate seal and signature.

We agree and guarantee to replace without cost to you any parts proving defective in material or workmanship at any time, whether it be in one year, five years, or longer.

This guaranty means something. It insures you against loss and protects you in your right to use the Santo.

The Santo has been perfected after an experience of over 15 years and at an experimental cost of over $50,000. It is perfect—the final in vacuum cleaners, you can not buy more in a portable vacuum cleaner, even at five times the price.

Our cleaner is built as perfectly and of as fine material as the most expensive automobile. No tin, paper mache or other flimsy material enters into its construction. No wood except the hardwood top handle.

As a result of our experience we have determined the efficiency absolutely necessary to do perfect cleaning. Our standard as embodied in the Santo is as follows:

It will produce a maximum vacuum of 7 to 8 inches Mercury standard.

It has a calculated displacement of 25 to 30 cubic feet free air per minute.

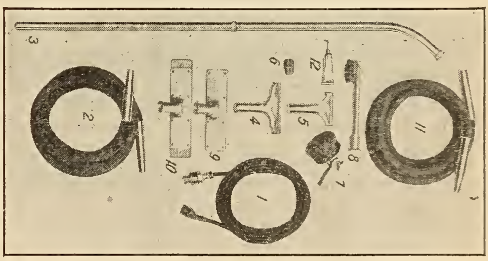
It may be operated continuously without stalling or overheating.

It does not require special heavy fuses, and will not endanger your wiring.

It is strictly within the limits set by Insurance Underwriters, viz., electrical consumption of not more than 200 Watts when operated at its full capacity.

Any electric cleaner having LESS efficiency than the Santo will utterly fail to meet your requirements.

The highest grade polished aluminum equipment ever furnished with a vacuum cleaner—nothing more to buy.



1—Electric cable for connecting cleaner to lamp socket.
2—Mercerized braid-covered vacuum hose.
3—Hollow renovator handle.
4—6-inch nozzle for thoroughly cleaning carpets, rugs, etc.
5—4-inch nozzle for portieres, upholstery, clothing, etc.
6—Rubber nozzle for tufted upholstery, corners, etc.
7—Wall brush, for walls, ceilings, mouldings, etc.
8—Book brush, for cleaning books, hats, furs, etc.
9—10-inch wood face nozzle for light and rapid sweeping.
10—12-inch nozzle, felt-faced, for sweeping floors.
11—Mercerized braid-covered blowing hose for drying hair, airing bedding, etc.
12—Tube of lubricant which eliminates greasy oil can.

The Santo cleans everything without removal. It makes your home spotlessly clean and dustless.

SANTO HAND POWER CLEANER

This little machine is a **real vacuum cleaner,** equipped with a powerful rotary pump which runs at a speed of 000 revolutions per minute. It is driven by a fly wheel. It does twice as much work as any other hand power cleaner and is the easiest to operate. Beautifully finished and weighs less than 30 lbs. Worth $50.00 but sells for $35.00.

BOOKLET FREE—The "Dustless Home" describes both our cleaners in detail. It is handsomely illustrated, interesting—complete. Your name on a postal brings it.—**Write today.**

KELLER MANUFACTURING CO., Dept. 2E, Philadelphia, Pa.

W. P. PRESSINGER CO., 1 W. 34th Street, New York City
Gen. Agt. for N. Y., New Eng. and N. J., north of Trenton

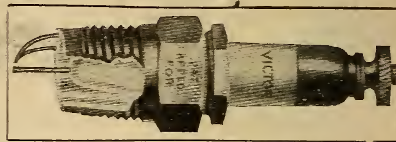
For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

PROVEN TO BE THE BEST THE INDUSTRY CAN PRODUCE FOR AUTOMOBILE, MOTOR BOAT AND AIRSHIP

The most satisfactory results are obtained from our specialties

The Radium Storage Battery has proven by actual test to be superior to the general line of storage batteries. It is built for long and continuous service and can always be depended upon. The jars are made of the best quality of heavy hard rubber with hard rubber covers which are removable, is equipped with patent fluid tight vents, and anti-splashers. The plates, post and all metallic connections are cast in one solid piece of pure lead. We guarantee this battery for two years.

6 volts, 40 amp	$18.00
6 " 60 "	22.00
6 " 80 "	30.00
8 " 60 "	30.00



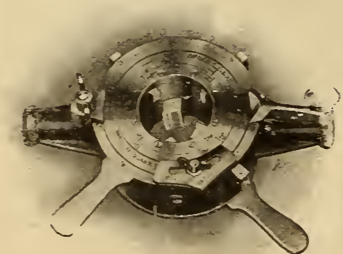
The Standard Spark Plug is the spark plug that allows every owner of a gas engine to forget spark plug troubles because of the special way the **Victor Plug** is constructed. The spark is produced at the center of compression where it is the most effective, while the inside of the **Victor Plug** is porcelain lined, making it a doubly insulated plug, thus lowering the chance for spark leakage and increasing the power of the explosion 10 per cent.

$1.00 each, 6 for $5.00

Discount to the trade

A postal card will get you bulletins P & E of these two articles
Write today

GENERAL ACCUMULATOR & BATTERY CO., - 168 2d St., Milwaukee, Wis.



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FOR THIS

OSTER DIE STOCK

Cutting 1-4, 3-8, 1-2, 3-4, 1 and 1 1-4" pipe

NO LOOSE BUSHINGS
OPENING DIES

SEND FOR COMPLETE CATALOG

THE OSTER MFG. CO., 2180 E. 61st Street, CLEVELAND, O.

We Can Help You Sell Electric Current

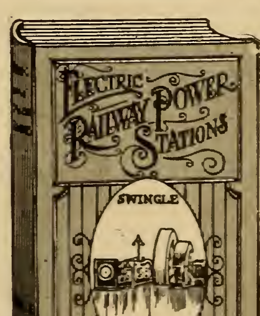
Our service consists in planning, writing, illustrating and placing Central Station advertising in newspapers. The value of our service is indicated by the fact that we are now engaged in the fourth consecutive year of advertising service for the Commonwealth Edison Company Chicago. We are just beginning our service for the New York Edison Company, and have recently completed contracts with other Central Stations. Our facilities are such that no matter where a Central Station is located, we can serve it quite as efficiently as though it were in Chicago.

Ask for Particulars

Wm. D. McJunkin
Advertising Agency
167 Dearborn St., Chicago

Electric Railway Power Stations

By Calvin F. Swingle, M. E.



Is a new work of large importance on a subject of vital interest. Treats in a plain practical manner, from the standpoint of the operating engineer, of the modern Central Power Station. Important topics of design and construction receive due attention, while the most reliable, thorough and up-to-date detailed information and data is given regarding installation, and the best, safest and most economical methods of operation in the production and distribution of electrical energy.

Covers fully the various types of machines, such as steam engines (both reciprocating and turbine), gas engines (and gas producers) applicable to Central Power Station work, and other forms of prime movers, as well as dynamos, switchboards, alternators and all other apparatus and appliances.

Contains 718 pages, with over 350 illustrations and 28 useful tables. Handsomely bound in rich, olive cloth.

Progressive engineers who desire to keep abreast of the times and advance in their profession cannot afford to be without this book.

Price, postpaid, $2.00. FREE for four paid, yearly subscriptions to Popular Electricity.

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Just consider what a wonderful convenience it would be to you to be able to take 10 to 30 months in which to settle for your purchases. Consider the advantage of being able to furnish your home completely and to enjoy **the full use of the goods while paying for them.** That's exactly what we offer you today—and it is by far the **most generous** credit service that was ever given by **any** home furnishing institution on the face of the globe. Remember, it matters not **where you live** or what your position or income may be, you are **perfectly welcome** to this most helpful credit service. **Use it freely!** Send only a **small amount** with your order, and then pay the balance **a little each month as you earn the money.** We charge absolutely nothing for this credit accommodation—**NO INTEREST**—no extras of any kind.

OUR 22 BIG RETAIL STORES

do a volume of business **greater** than that of **any other store or combination of stores on earth**—none excepted. We have furnished nearly 2,000,000 homes—have been in business **54 years** and stand today pre-eminent in our line—the **oldest, largest and best known** home furnishing concern on the American Continent. Capital and surplus larger than that of any other similar institution in the world.

PRICES POSITIVELY UNMATCHABLE

We can save you from 20% to 40% on any article you may need in your home. We can **cut under the prices** of any other firm in the business. You can't afford to place an order with **any** other concern on earth, until you have received our Big Catalogues—**simply can't afford to.**

☞ This Solid Oak Rocker

Is strongly constructed and beautifully finished, solid oak frame, hand carved, also massive carved heads, full spring seat and tufted back, upholstered in Nantucket leather which has the wearing quality of genuine leather. **TERMS—75c cash and 50c monthly.**

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CATALOG FREE

Our new fall **Furniture Catalogue** is the largest and handsomest book of the kind ever published. It is an immense volume, just filled with **unmatchable bargains** in everything to furnish and beautify the home, including furniture, carpets, rugs, draperies, crockery, sewing machines, clocks, silverware, and pianos, a portion of the goods being beautifully illustrated in colors. Our special **Stove Catalogue** is also an immense volume of world-beater bargains—positively the biggest values ever offered. Write for these two big catalogues at once—**write for them today.**

SATISFACTION OR YOUR MONEY BACK

Our guarantee of satisfaction is **not limited to 30 days**, but is given for an indefinite period. We refund money and freight charges on all purchases not entirely satisfactory. Our policies are broad, liberal and generous.

Cut out this coupon and mail it to us today.

Hartman Furniture and Carpet Co.,
223-225-227 and 229 Wabash Ave., Chicago, U. S. A.

☞ State whether you wish Catalogue of Furniture, Catalogue of Stoves, or Catalogue of *Furniture and Stoves*.

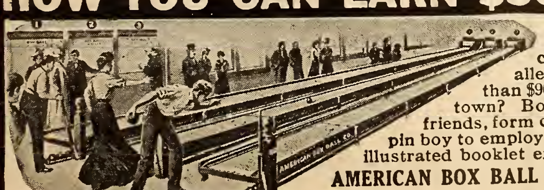
Please mail me Big Free Catalogue of ....

Name ....

P. O. Address 19

HARTMAN FURNITURE AND CARPET CO., CHICAGO, U. S. A.

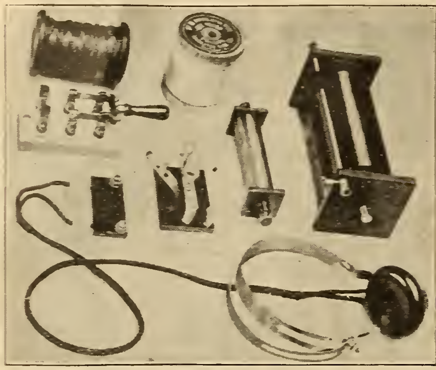
HOW YOU CAN EARN $300 OR MORE A MONTH



One box ball alley costing $150, took in $513 the first fifty-one days at Sullivan, Indiana. Two other alleys costing $365, took in $1,372.95 in five months. Four large alleys costing $840, took in $1,845.20 in fifty-nine days, more than $900 a month. Why not start in this business in your own town? Both men and women go wild with enthusiasm; bring their friends, form clubs and play for hours. Players set pins with lever—no pin boy to employ. Alleys can be set up or taken down quickly. Write for illustrated booklet explaining EASY PAYMENT PLAN. Send for it today.

AMERICAN BOX BALL CO., 1902 Van Buren Street, Indianapolis, Indiana

WIRELESS APPARATUS



This is the surprise we promised you. Our "Tri-mount Junior Receiving Set" (Type A) consists of the following:—

Single Slide Tuning Coil	$2.50
Micanite Fixed Condenser. .003 mfd	1.50
3 Adjustment Detector Stand	1.00
1000 Ohm Telephone, with 3 foot cord. Split Headband and 3 Phone Block	4.25
Double Pole Double Throw Switch	.65
400 ft. Stranded Antenna Wire	1.25
1 lb. Annunciator Wire	.35
Mounted on Baseboard, complete	.50
Cost, if bought separately	$12.00
OUR PRICE (delivered)	**10.00**

Every article in above set will be found to embody "Tri-mount Quality." It is a very efficient set and is sure to give satisfaction. Send for prices on anything you may require.
See our advertisements in previous numbers.

The Tri-Mount Wireless Supply Co.
R. A. CHANDLER, Manager
13B Irving Street BOSTON, MASS.

GUDEMAN & COMPANY

Artistic Electrical Decorations
114-118 East 23rd Street, NEW YORK, N. Y.

Electrically Lighted

FRUIT TREES

FERN DISHES

FLOWER BASKETS

FLORAL FESTOONS

and many other designs.

Miniature and Decorative Lamps
Christmas Tree Outfits

Our goods are on sale at
ELECTRIC SHOP
Michigan and Jackson Blvd., Chicago, Ill.

Write for descriptive catalogue

THE STEINER MOTOR

A HOUSEHOLD NECESSITY

The Steiner Family Motor Outfit is the greatest Household labor-saving device ever invented since Electricity has become generally used.

It does all the hard work that is tiring to the Housewife—invaluable on wash days —does all the hard work when preparing meals — a man-of-all-work during house-cleaning time. It will polish your silver, run your sewing machine, make Ice Cream, grind your coffee, chop your meat, etc., etc.

Anything around the house that is hard work for you. The Steiner family motor will do it and in 1-2 the time.

The above illustration is outfit No. 3 containing 1 Motor, 1 High-Grade Ball Bearing Wringer, 1 Clear White Washer, 1 Sewing Machine Attachment, 1 Polisher and Grinder, 1 Grater, 1 Ice Cream Freezer, 1 Meat Cutter, 1 Coffee Mill. ALL BEST GOODS OBTAINABLE, sold at a price that is within the reach of all.

Sent on 30 days free trial. Outfits No. 1 and 2 include the same Family Motor only there are not so many appliances.

Write for folder and price.

Over 1000 in Use

Agents can make big money selling Steiner family motor outfits.

Central Stations and Electrical Supply Houses write immediately for our proposition.

Steiner Mfg. Co., St. Louis, Mo.
2605 N. 14th STREET

Thordarson's Junior Bell-Ringer

Eliminates All Battery Trouble

Price $3.00

Suitable for residence door bells, buzzers, and all classes of light signal work.

Consumes no current. Will last a lifetime.

Approved by Board of Underwriters

Thordarson Electric Mfg. Co.

151-157 So. Jefferson St. CHICAGO, ILL.

ALCOHOLISM

EARL'S ANTÔL has established a most remarkably successful record in the treatment of the Liquor Habit. It is simple and convenient to take, it is pleasantly exhilarating in operation, it is most effective in results, and

THE COST IS A MERE TRIFLE

The Antol Treatment will not hamper you with inconvenient or embarrassing conditions, for you can carry these tiny capsules in your vest pocket and take them—**while attending to your ordinary business**—without consulting anyone or attracting the attention of inquisitive people.

I am so **absolutely certain** of the successful outcome of the Antol Treatment that I fearlessly

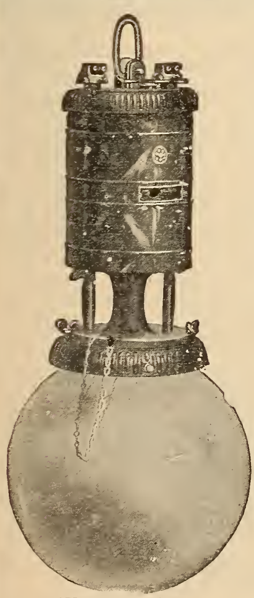
GUARANTEE

the return of your money in full, without question or comment, should you not be thoroughly satisfied with the result. I have also guaranteed—under the "Food and Drugs Act"—that Antol does not contain any Drug injurious to health, so just as soon as you have made up your mind

TO QUIT DRINKING

write for my **Free Booklet** on the Curious Manifestations produced by Light, Medium, and heavy Drinking; study therein your own particular symptoms, **and send for a bottle of Antol.**

Clip this notice out, for future reference, but **write now** for my Free Booklet. Address, **JOHN C. EARL,** Antol Laboratories, 660 Gates Avenue, Montclair, N. J., U. S. A.



Flaming Arc

Intense Light

Made by a Warner Flaming Arc attracts attention at a distance or close by.

¶ Admitted by all to be the strongest light yet produced.

¶ Lamp practically indestructible, and made of fireproof material.

¶ Made for multiple use on A. C. or D. C. and for Series on High Tension D. C. Series.

¶ Vertical Carbon 5-8x12. Only one to trim.

¶ First cost less, maintenance less, and service greater than any other lamp made.

Warner Arc Lamp Co.

Muncie, Ind. **Wilton, Iowa**

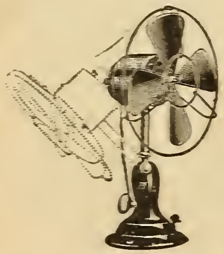
Fill in and mail.
Warner Arc Lamp Co., Muncie, Ind. Wilton, Iowa
Mail us catalog of your Flaming Arc
Name
Address

We Sell Anything Electrical

The largest Electrical Mail Order House in the Country. We sell you your Electrical Supplies **by Mail at Bargain Prices.**

Anything for the **Household, Office, Store, Factory,** also the Student and Experimenter. Large stock always on hand. Deliveries prompt.

Some of Our Specialties for September



Eclipse Socket Fans for Home Use

This is the most convenient Fan for the Office and Home. Can be turned at any angle, the stand remaining permanent—finished in brass—is an ornament to any home. Hardly any noticible difference on your **Electric Light Bill.** Keep the room Cool and Sanitary, price so reasonable that every home should be equipped with one.

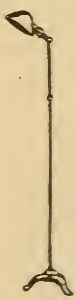
Stand has Swivel Motion: can be set to throw air at any angle, or used as a Bracket Fan. Price, 104 Volts, 60 Cycle............ $13.00
104 " 133 " 14.00

Direct Current Socket Fan

Combination Stand also furnished with this Fan at

$2.00 Extra

110 Volts, complete.. $10.00



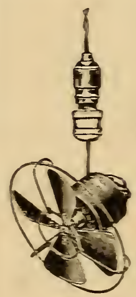
The Pacific Easy Chair LAMP

is without doubt the best Electric Portable ever manufactured. This Lamp is as portable as a candle-stick and may be placed wherever light is desired, irrespective of whether there is a table or a stand at hand or not. The light may be easily raised or lowered and an adjustable shade and a hinged joint at the socket, permit of perfect adjustment of the light for any class of work. By the use of this Portable, the light may be so arranged as to fall on the reading matter or work only, thereby shading and resting the eyes.

Price.................................. $5.00

Regarding this Lamp, Mr. W. E. Russell, president and treasurer of the Massillon Light, Heat and Power Co. of Massillon, Ohio, writes as follows:

"The No. 50 Easy Chair Lamp ordered for the writer's personal use arrived in due time, and is not only a fine fixture, but a GREAT SAVER TO POCKET AS WELL AS EYES. Please send me three (3) more."



8-inch Blade Socket Fan Motor

can be screwed into any ordinary lamp socket without any additional plug or socket.

The body of the Motor is made of aluminum and the trimmings are nickel finish. Total weight is $1\frac{3}{4}$ pounds. The price within reason of all. Ought to be in every home and office.

Prices 104 Volts, 60 Cycle $11.00
104 " 133 " 12.00

The Ever-Ready Dry Battery

This battery is beyond doubt the most efficient for Wireless Telephone or Telegraph work—does twice the work of other battries and lasts longer. Its square shape makes it most convenient for all kinds of work where the cells are exposed.

Electrical Experimenters should use the Ever-Ready.

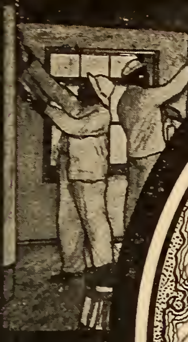
Ask us for our special price in quantities.

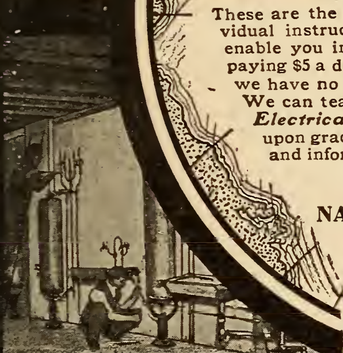
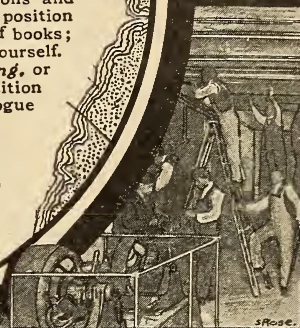
Price per cell..........30c each

We Are the Manufacturers of the Famous American Vibrator

Note—Let us quote you on everything Electrical. Send for our Free Catalogue.

SOUTHERN ILLINOIS ELECTRIC CO., St. Louis, Mo.



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These are the trades that we teach by practical and individual instruction under actual working conditions and enable you in two to three months to accept a position paying $5 a day and over. Tools take the place of books; we have no classes; it depends entirely upon yourself. We can teach you the *Plumbing, Bricklaying,* or *Electrical trades,* and assist you to a position upon graduation. Write to-day for free catalogue and information.

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Electricity

is the most wonderful and interesting scientific study of the age. Every boy, girl and grown-up should know about it. Our fascinating 112 page book just out makes it easy for you to learn.

We'll send you this new, enlarged catalogue on receipt of 6c. It contains a coupon which entitles you to a rebate of your 6c on first order of 50c or over.

Catalogue contains hundreds of Illustrations and descriptions of Voltamp electrical products—Wireless Instruments, Motors, Dynamos, Machine Models, Toys, Telegraph Instruments, Batteries, Meters, Coils, Switches, Geissler Tubes, Lamps, Flash-Lights, Telephones, Bells, Miniature Railways, etc.

A boon to the experimenter as well as the practical electrician.

Voltamp Electric Mfg. Co.,

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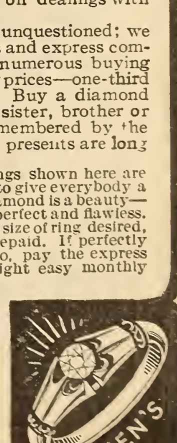

$45.00 MONTHLY PAYMENTS $4.50

YOUR CREDIT IS GOOD

with us. Any honest person can buy a diamond here, or any other article of jewelry from our complete stock, and pay for it on easy payments to suit one's convenience—one fifth down and the balance in eight monthly installments is about as preferable a way as any. No red tape inquisitive systems are used—it is a plain business proposition, based on dealings with honest people.

Our integrity and reliabilty is unquestioned; we refer you to all commercial agencies and express companies in the United States. Our numerous buying facilities give you the benefit of low prices—one-third is easily saved by dealing with us. Buy a diamond for yourself, your father, mother, sister, brother or sweetheart. It is an ideal gift, remembered by the one so dear to you after all other presents are long forgotten.

The ladies' and gents' elegant rings shown here are extra specials, reduced to $45.00, so as to give everybody a chance to buy advantageously. The diamond is a beauty—exceptionally white, guaranteed pure, perfect and flawless.

Send your name and address, with size of ring desired, and we will send you same by express prepaid. If perfectly satisfied, and we know you will be so, pay the express agent $9.00; the balance you pay in eight easy monthly installments of $4.50 each. These rings you see right here are worth, at any retail store, from $60.00 to $75.00

Our line of high grade watches, silver ware, etc. is complete. Our handsome illustrated catalog with many more money saving prices and exquisite descriptions of exquisite jewelry is free for the asking. Write right away.

WM. E. RENICH CO.

Diamonds, Watches, Jewelry

124-130 State St. Chicago, Ill.

Six Months to Pay For Good Clothes

$12.95

For this Splendid All-Wool Suit—made in the latest style. Your choice of cloth.

$3.35 Cash

$1.60 Monthly

This Suit will be sent on approval.

Dress in Clever Style

Our free Fall Style Book shows photographic plates of the swellest suits and overcoats for fall and winter wear. We want to send it to you.

With it we send samples of all-wool clothes in thirty desirable patterns. We buy nothing but all-wool cloth. Every yard is guaranteed.

We also send a tape line with simple instructions for taking your measure. We will fit you perfectly, as we have thousands of others.

This book quotes prices on high-grade clothes which are astounding. You never saw clothes like these sold so low. You have probably paid at least $18 for such suits as we sell for $12.95. The reason lies in our enormous output.

Any suit or overcoat, made in any cloth we show, will be sent you on approval. We guarantee the workmanship, the price and the fit. If not entirely satisfactory, send the garments back, and all your first payment will be returned.

We sell on six months' credit, without any security and without any interest. Our credit prices are exactly the same as for cash. You can pay a little down and a little each month, and dress just as well as the best dressed man you know.

We ask a chance to please you once, and secure your permanent trade. Please send this coupon—send it today—for our free Fall Style Book and samples.

THE CLEMENT CO.
385 Franklin St., Chicago

Mail me your Style Book—free

Name ______________________

Address ______________________

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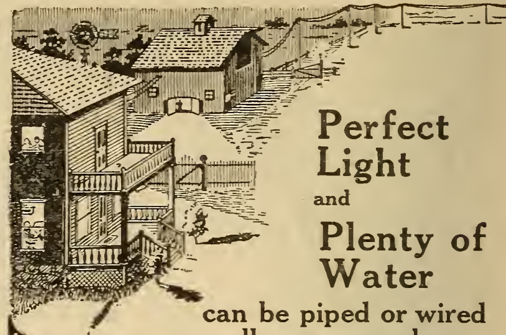


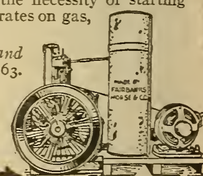
Perfect Light and Plenty of Water

can be piped or wired all over your place

A Fairbanks-Morse Electric-Light Outfit

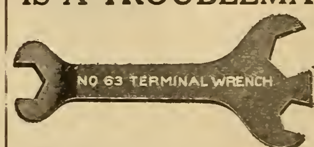
Will give you all the light, water and power you need for your farm, country place or store at a surprisingly low cost. Engine can be left running for hours after starting without attention, and stopped by pressing a button. The safest, most convenient, and healthful light known. It is restful to the eyes and does not consume the life-giving oxygen in your rooms as the lamps or gas. Same engine runs pumps and other machinery. It is usually desirable to install also a storage battery, so that lights can be used at any hour, night or day, without the necessity of starting the engine each time. Engine operates on gas, gasoline, kerosene or distillate.

Cut out complete advertisement and send for special catalog No. C A 1163.



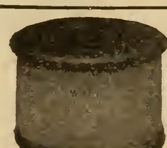
Fairbanks, Morse & Co.
Chicago, Ill.

KLEIN'S TERMINAL WRENCH IS A TROUBLEMAN'S FRIEND



This No. 63W Wrench is especially adapted for use on terminal nuts, receivers, transmitters, and binding posts, etc. There are three different side openings, with dimensions as follows: $\frac{3}{8}$ inch, $\frac{5}{8}$ inch, and 7-16 inch, which will engage either square or hexagonal nuts. One end is bent at an angle of 45 degrees, to allow its use in confined places. Total length, 2 13-16 inches. The cost is so small, and the convenience so great, that one of the wrenches should be in every Electrician's Tool Kit. Mailed to any address for **17c.** Have you one of our latest catalogues? Send 3c in stamps for a copy.

MATHIAS KLEIN & SONS, Station U. 3, Chicago. Ill.
Manufacturers and Jobbers of
Electrician's, Linemen's and Construction Tools



Wire, Coils and Cordage

NORWAY IRON WIRE for cores, **COTTON, SILK** and **ENAMELED MAGNET WIRE**, heavy and fine sizes for primary or secondary windings, receiver coils or coils of any kind.

COILS wound to your specifications.

BELL WIRE and **ELECTRICAL CORDS** for every purpose.

The above furnished at lowest prices in small quantities for wireless telegraph or experimental purposes, or in large quantities for manufacturers.

Write for prices to Dept. E.

BELDEN MANUFACTURING COMPANY
194 Michigan Street - - CHICAGO, ILL

Protect Your Tungsten Lamps With a

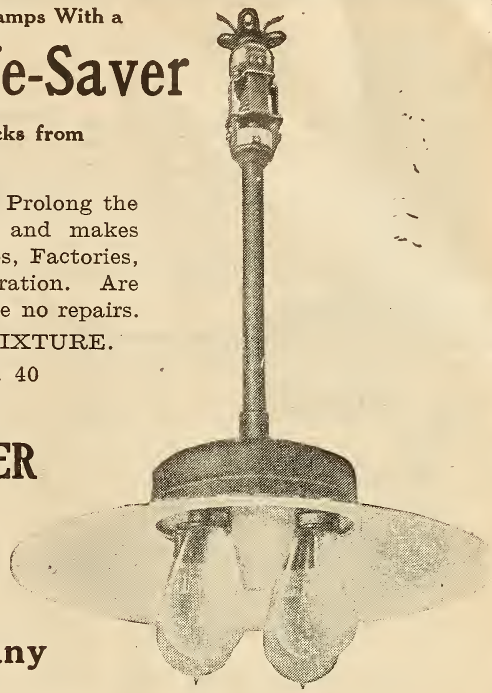
Tungsten Life-Saver

Prevents Injurious Shocks from Vibration

TUNGSTEN LIFE-SAVERS Prolong the Life of Tungsten Lamps, and makes possible their use in Shops, Factories, Etc., where there is vibration. Are easy to install and require no repairs.

FIT ANY STANDARD FIXTURE.

BULLETIN No. 40



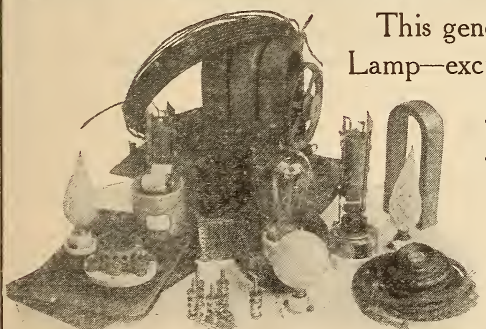
TUNGSTEN SHOP CLUSTER

An inexpensive cluster made of steel, with plain black finish, equipped with an 18 inch steel, porcelain enameled shade and Tungsten Life-Saver.

BULLETIN No. 42

American Arc Lamp Company
SPECIALTIES DEPARTMENT
Manufacturers
KALAMAZOO - - MICHIGAN

This Complete Electrical Experimental Outfit for $5.00



This generator (weight 6½ lbs.) will light a 16 C. P. Lamp—excite coils, test through 10,000 Ohms. Other Supply Houses ask Six Dollars for this Machine alone. Just the thing for testing department or experimental bench. Also

1—Motor with Pulley.
1—Relay wound with silk wire 100 Ohms.
2—Miniature Incandescent Lamps.
2—Miniature Sockets for Lamps.
1—Box Swedish Iron Filings.
1—Permanent Magnet.
1—Electric Bell.
1—Coil Wire. 1—Switch.
1—Push Button.
1—Laboratory Test Lamp and Socket.
1—200 page Compend of Electricity.
1—250 page Electrical Dictionary.
4 Pair—Electric Magnets (all different).
1—Solenoid Magnet (1¼ lb.).

SPECIAL—Genuine Swedish Iron Filings 25c per box prepaid.
Generators alone $3.

FREE—Cut this corner and send it to us with your remittance before Oct. 15th and we will send you in addition to the outfit a six-point Induction Coil, with platinum point vibrator, worth $2.00.

Western Electric Salvage Co.
597 So. Washtenaw Avenue, CHICAGO, ILL.

We Want To Tell You How

You can save not only the dealer's profits but his excessive charges for installation and repairs by dealing direct with the manufacturers. You can keep in your own pocket at least one-third the retail price of a heating plant. Let us tell you all about the

We Put Every Cent of the Dealers Profits into Your Pocket

Jahant Down Draft Furnace

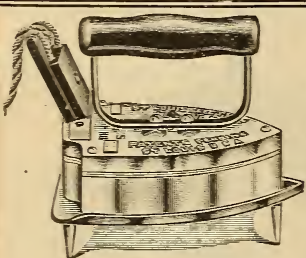
Only $10 down and $10 per month, with freight prepaid east of the Mississippi River.

This wonderful furnace has proven its superiority above all others during the last **30 years.** It is without doubt the very best heating system for your home. It **saves** from 1/3 to 1/2 in fuel bills, because the patented "down-draft" burns hard or soft coal—wood or lignite—without cinders or clinkers, giving full heating value of every particle of fuel. Needs less attention than any furnace you ever saw. A strong "Guaranty Bond" goes with every Jahant, which allows you **a 360 days free use of the furnace.** You run no risk, as we supply special plans, full directions and give **free all necessary tools,** so that any man who can drive a nail can successfully install a Jahant.

No matter what make or system of heating you are considering, let us tell you more about the many conveniences and good points of our furnace: it's economy, it's healthfulness and how you can save money.

Write today for our book.

The Jahant Heating Co., 200 Mill St., Akron, Ohio.



Our No. 305, 6-lb. Standard

When you have weighed out every detail after a searching canvass and have come to the final summing up—your decision—you will buy

PEACEMAKER ELECTRIC IRONS

EVERY POINT COVERED

They are built to meet this decisive moment, and win.

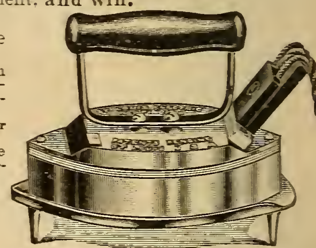
WE CAN SHOW YOU

A thirty days' trial will tell you all, save the life of the iron.

We have sold thousands of **Peacemaker Irons** which have been in continuous use—nine hours per day—more than two years, without the necessity of repairs, and are still in service.

We will ship you, charges prepaid, any **Peacemaker Iron** weighing under 8 lbs. for $4.00.

If you are not satisfied after 30 days, return the iron at our expense, and your money will be refunded or the charge cancelled.



Our No. 307, 6-lb. Double Pointed

ST. LOUIS ELECTRIC HEATINC CO.

ST. LOUIS, MISSOURI

A "SANITARY" Water Supply System

"IT'S AUTOMATIC"

Water under pressure marks the greatest difference between the city residence and the country or suburban home. Our "Sanitary" Water System will furnish ample

WATER UNDER PRESSURE

for all purposes at a very small first cost and an extremely low cost of running.

They are operated by gas engine or electric motor.

Catalogue free,

If your plumber can't supply you, write and give us your name.

THE SANITARY PUMP COMPANY

17 So. Canal St., Dayton, O.
42 Broadway, New York City, N. Y.
58 Dearborn St., Chicago, Ill.
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Will You Accept This Business Book if We Send it Free?

Sign and mail the coupon below. Send no money! Take no risk!

One hundred and twelve of the world's master business men have written ten books—2,079 pages—1,497 vital business secrets, ideas, methods. In them is the best of all that they know about

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A 9,059-word booklet has been published describing, explaining, picturing the work. Pages 2 and 3 tell about managing businesses great and small: pages 4 and 5 deal with credits, collections and with rock-bottom purchasing: pages 6 and 7 with handling and training men; pages 7 to 12 with salesmanship: with advertising, with the marketing of goods through salesmen, dealers and by mail; pages 12 to 15 with the great problem of securing the highest market price for your services—no matter what your line: and the last page tells how you may get a complete set—bound in handsome half morocco, contents in colors—for less than your daily smoke or shave, almost as little as your daily newspaper.

Will you read the book if we send it free?
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The System Co., 151-153 Wabash Ave., Chicago

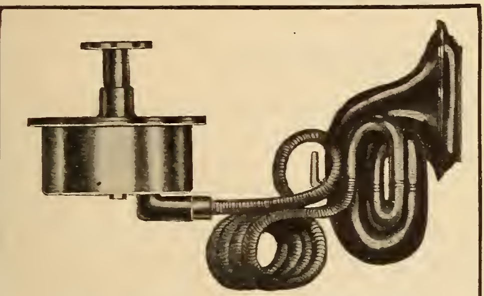
If there are, in your books, any new ways to increase my business or my salary, I should like to know them. So send on your 16-page free descriptive booklet. I'll read it. 178-9

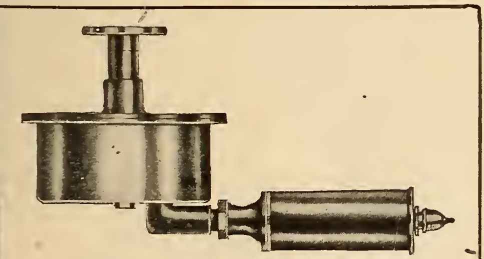
Name ____________________

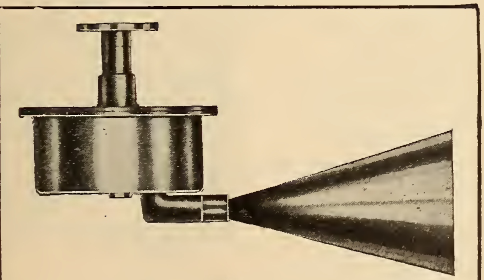
Address ____________________

Business ____________________

Position ____________________


Use It with the Regulation Auto-Horn


Or Apply the Beautiful Two-Toned Whistle


Or if You Want the Most Unearthly Noise
This Is It

Increase Your Honk 300%

The Wordingham Foot Horn is the very latest departure in Auto Signals and can be operated by the heel or toe of the driver *independent of the engine*, leaving both hands free.

Not being operated by the engine exhaust the metal is not corroded by gas and the time and expense of installation is insignificant.

An air dash pot, all brass, with a capacity of 27 cubic inches, which is dust, water and frost proof. Attached underneath the foot-board; *requires but five square inches.*

There are three distinct types:

(1)—It may be applied to the ordinary auto horn with the usual flexible tube, no more bulbs to crack, leak and tear, or be at the mercy of the mischievous boy. Price $7.50.

(2)—Or it is furnished complete with a beautiful two-toned whistle. Price $9.00.

(3)—For those who desire a noise never before produced the unchokeable reed horn is supplied. It will wake the dead. Price $10.00.

These advantages of indestructibility, simplicity, tone variety and foot operation can be secured at a cost less than that of the ordinary horn. Let us send you full particulars. Sent prepaid upon the receipt of price or express C. O. D.

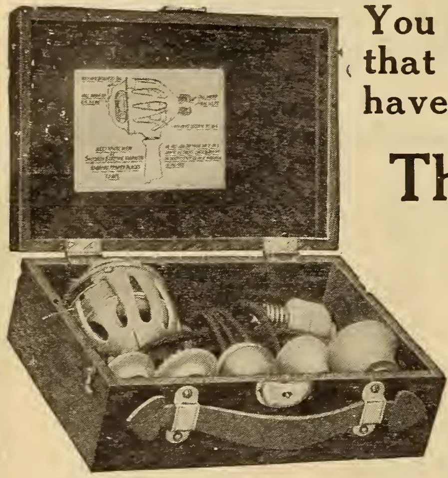
We also want a few first class rated agencies.

WORDINGHAM FOOT HORN CO.

209 Grand Avenue **Milwaukee, Wis.**

VITAL POWER

You get the enjoyment out of Life that nature intended you should have, if health prevails.



Swedish Electric Vibrator No. 5

Operates on any electric light current, anywhere, direct or alternating.

The only massage Vibrator that gives the **TRUE** Swedish rotary movement, fast, medium or slow. Noiseless in its operation, mechanically perfect and with ordinary care will last a lifetime.

$25.00

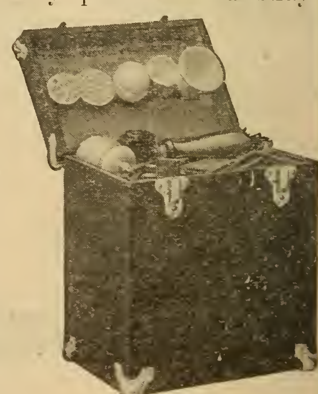
The Swedish Electric Vibrator

will cultivate your system up to the top notch standard; it will CURE nearly every ailment; it will give you VITAL POWER; it will throb and thrill you into a tireless human engine with POWER to think TWICE AS CLEARLY and DO twice as MUCH. When you come in from a hard day's work, it will SOOTHE, REST and REVITALIZE you from head to foot; it will cause your blood to go LEAPING and BOUNDING through your veins and arteries; cause the flow of nerve fluids to saturate the innermost nerve. You can actually feel disease and weakness being driven from you and NEW LIFE and power being generated.

The 50,000 penetrating, revitalizing strokes per minute convey to the flesh a very peculiar vibration, unlike any sensation you ever realized. It SETS LOOSE in the blood and lymphatic vessels all stray and impure matter that CLOG UP the capillaries. These impurities are poisoning and weaking your system and need only to be RATTLED LOOSE, combined with blood so that it can and will be TAKEN OUT OF THE BODY through the excretory organs.

It takes a big, illustrated book, with charts and diagrams and instructions in PLAIN ENGLISH to SHOW and TELL HOW OUR VIBRATOR will cure any ailment, correct any physical condition. We will send it to you FREE. Our Great Expert will write you a special letter of advice on ANY male or female disorder, disease, or condition, FREE of charge, if you will write us a history of YOUR or YOUR FRIEND'S case. Don't neglect to write us today.

Our Vibrator runs with batteries or any electric light current; works in the farm home as well as where they have electric lights, comes in an elegant, portable case, including six cells of powerful electric batteries, and all the different applicators. Full and complete instructions accompany each outfit. So simple, a child can safely operate it. Electric shock absolutely impossible. Write now for the big, FREE book. We pay all express charges on Vibrators.



Swedish Electric Vibrator No. 2

Operated by its own powerful dry batteries, equally as effective as the No. 5, but for the use of those not having access to the electric light current.

$15.00

Swedish Electric Vibrator Company

611-621 Farragut Avenue **CHICAGO, ILL.**

Washday Bugaboo Banished

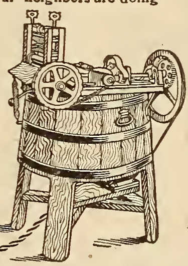
Simply turn on the power and *forget* that the wash is being done. All the nerve-racking, muscle-straining, back-breaking, day-long toil of weekly washdays gone forever.

The ELMO Power Washer

makes this seeming fairy tale possible— a *new idea* washer that beats all other washers in every single detail that makes a washer worth having.

Mechanical perfection is attained by strengthening the weak points of ordinary washers and improving the best features. The "back gear" driving principle is a marvel of ingenuity and *runs on less power with greater rapidity* than any other washing mechanism. When your neighbors are doing their washing your clothes will be on the line and you will be ready for callers.

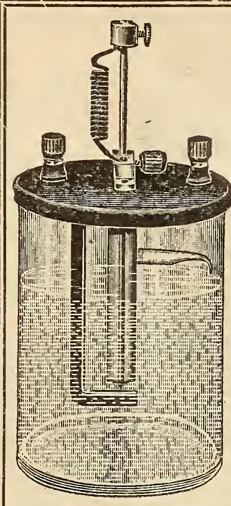
The Elmo has the only reverse wringer ever put on any washing machine.



How a Penny Pays for the Wash

It costs only a cent an hour to run The Elmo Power Washer. We tell you the whole story in a neat book. May we send it to you? Your name and address bring it. Write today.

THOMPSON BROS. CO.,
Dept. 66 Grinnell, Ia.



THE GERNSBACK ELECTROLYTIC INTERRUPTER

has been declared to be the most efficient interrupter of modern times. This interrupter has been described in the August issue of Popular Electricity, page 245, where particulars may be found. Figure No. 2 shows spark obtained of a 2″ coil on a 6 volt battery. Figure No. 3 of the same coil on 110 volts with the Gernsback interrupter. A **FLAME** one quarter inch thick is obtained such as you never saw before. Efficiency of coil is increased fully 500%. No resistance necessary, hook up the interrupter in series with the coil and 110 volts for operation. Coils from ¼″ up to 12″ spark length are used successfully with the new interrupter. Price complete $2.50. Send two cent stamp for our wonderful 120 page electrical cyclopedia containing immense quantity of information especially **WIRELESS.**

FIG. 2

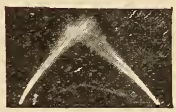


FIG. 3

ELECTRO IMPORTING CO.
86B W. Broadway, N. Y.

"Everything for the Experimenter"

Don't Buy Gasoline Engines

Until You Investigate the "Master Workman"

a two-cylinder gasoline, kerosene or alcohol engine, superior to any one-cylinder engine; revolutionizing power. Its weight and bulk are half that of single cylinder engines, with greater durability. Costs less to Buy—Less to Run. Quickly, easily started. Vibration practically overcome. Cheaply mounted on any wagon. It is a combination portable, stationary or traction engine.

THE TEMPLE PUMP COMPANY, MFRS.

Send for Catalogue — Meagher and 15th Sts. Chicago — This is Our 56th Year

New Vest Pocket Flashlight with a Tungsten Lamp and Refillable or Dry Battery, only **75c**, postpaid, or with 2 extra batteries, **$1.00.** Net Catalog full of bargains for stamp. Discount to Dealers.
ELECTRIC NOVELTY CO., Mfrs. and Imp.
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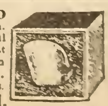

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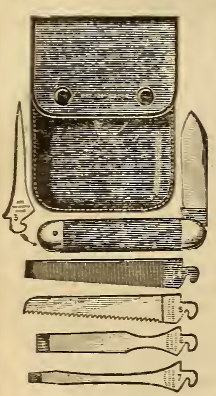

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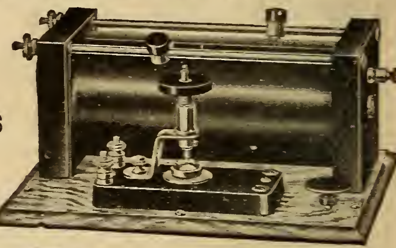

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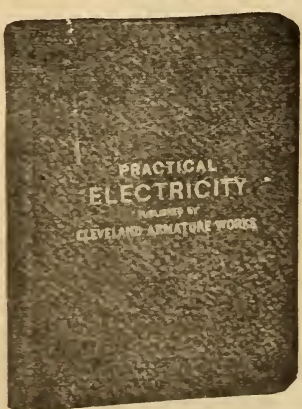

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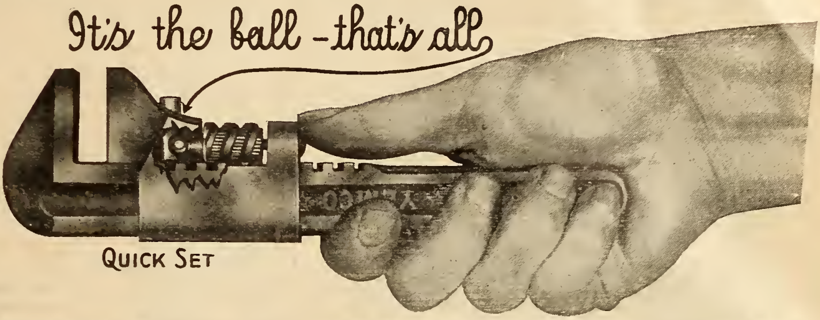

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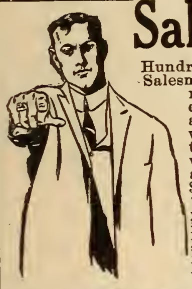

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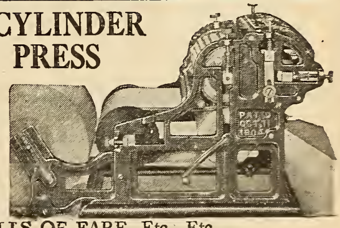

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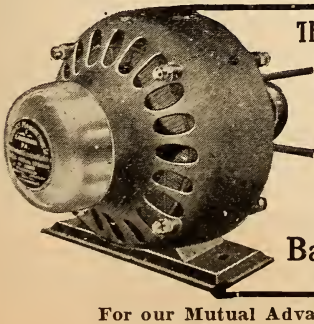

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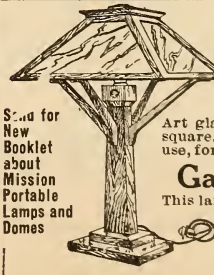

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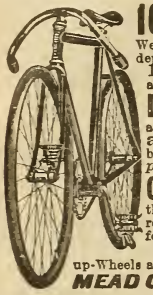

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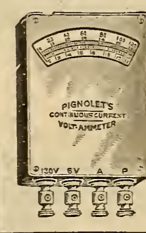

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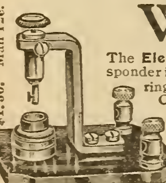

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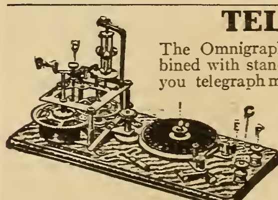

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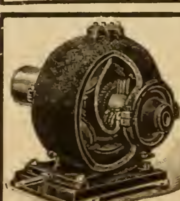

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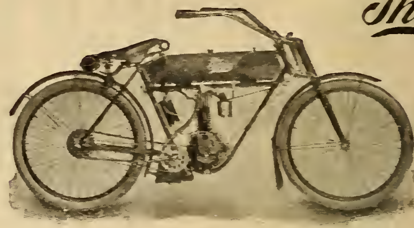

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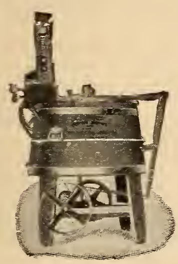

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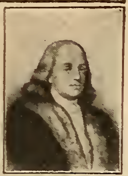

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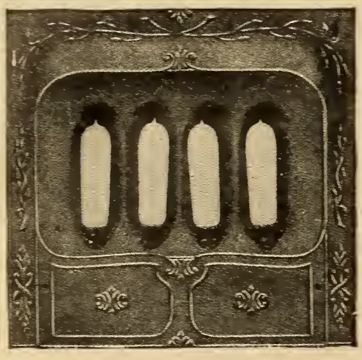

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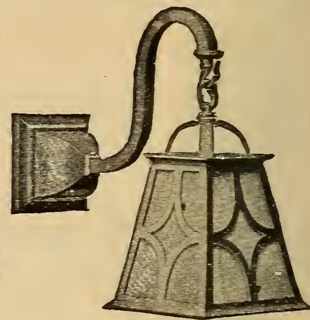

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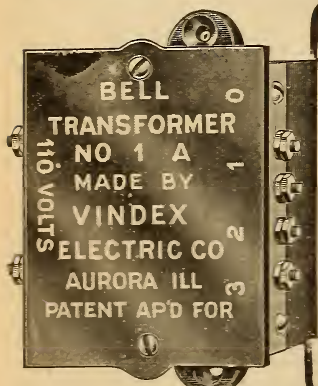

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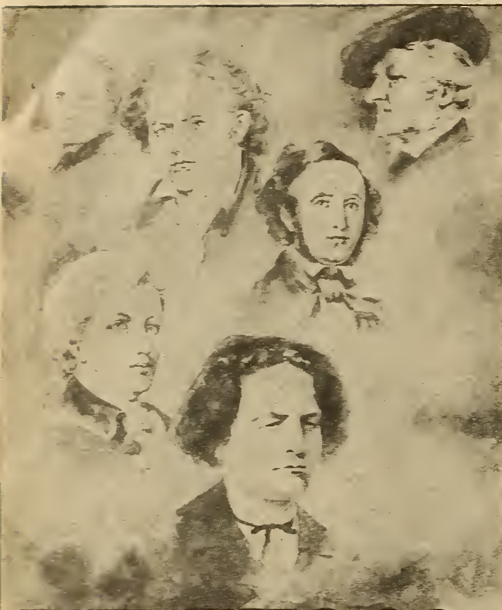

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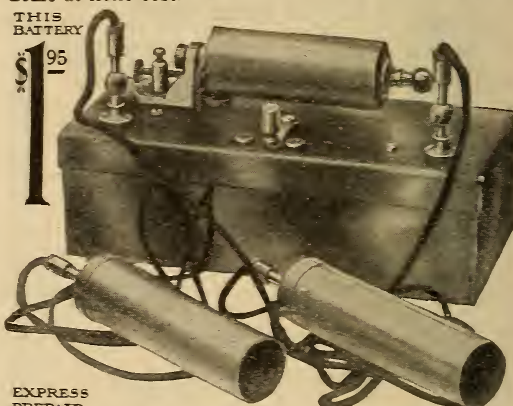

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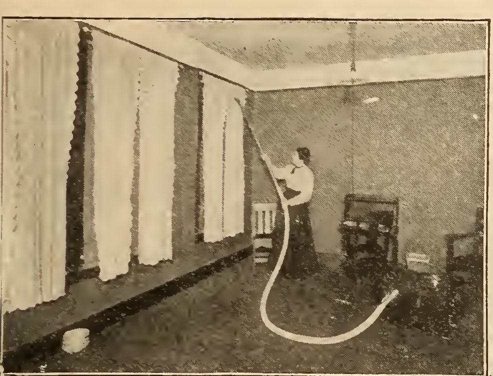

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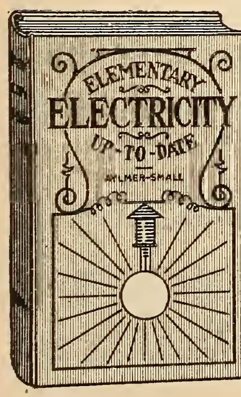

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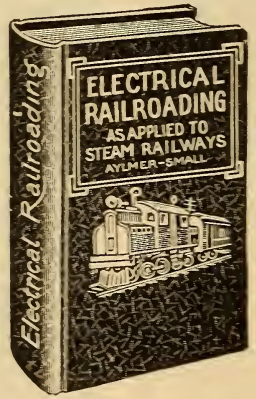

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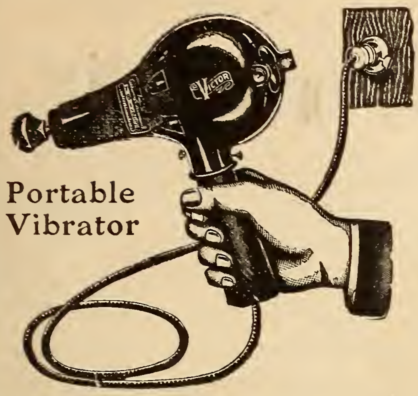

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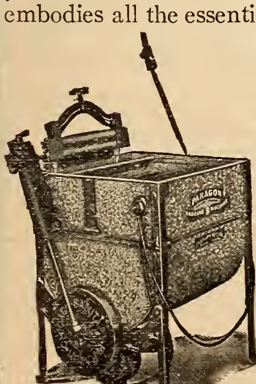

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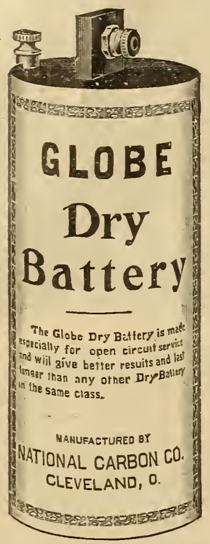

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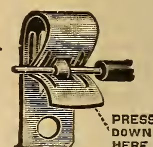

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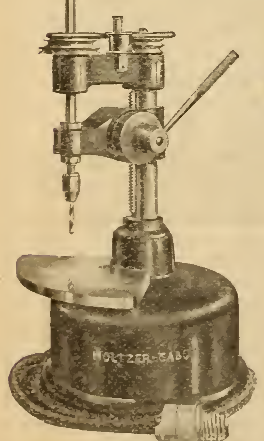

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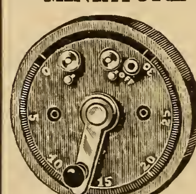

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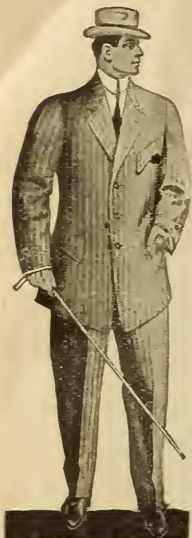

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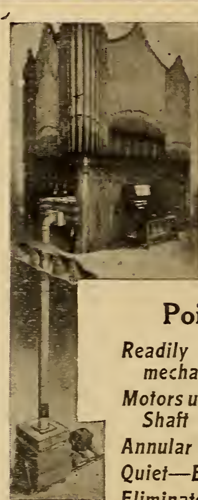

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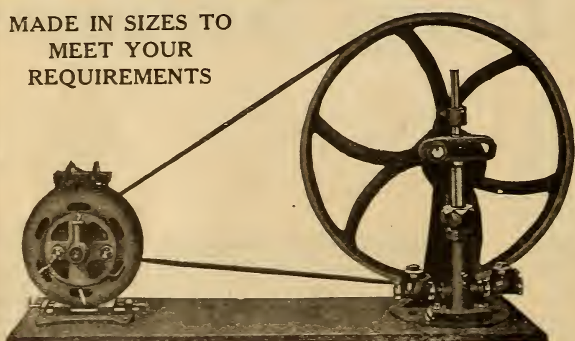

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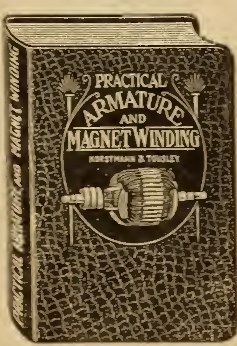

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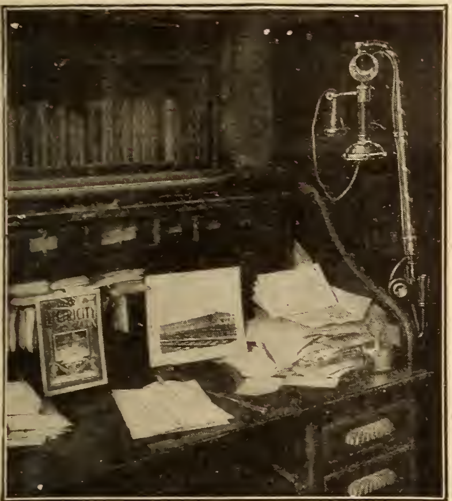

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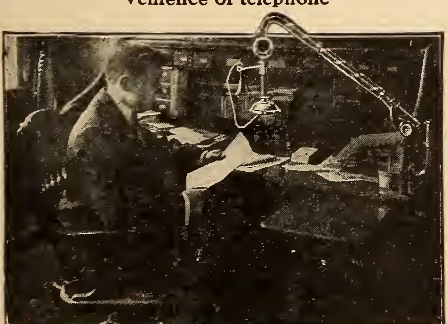

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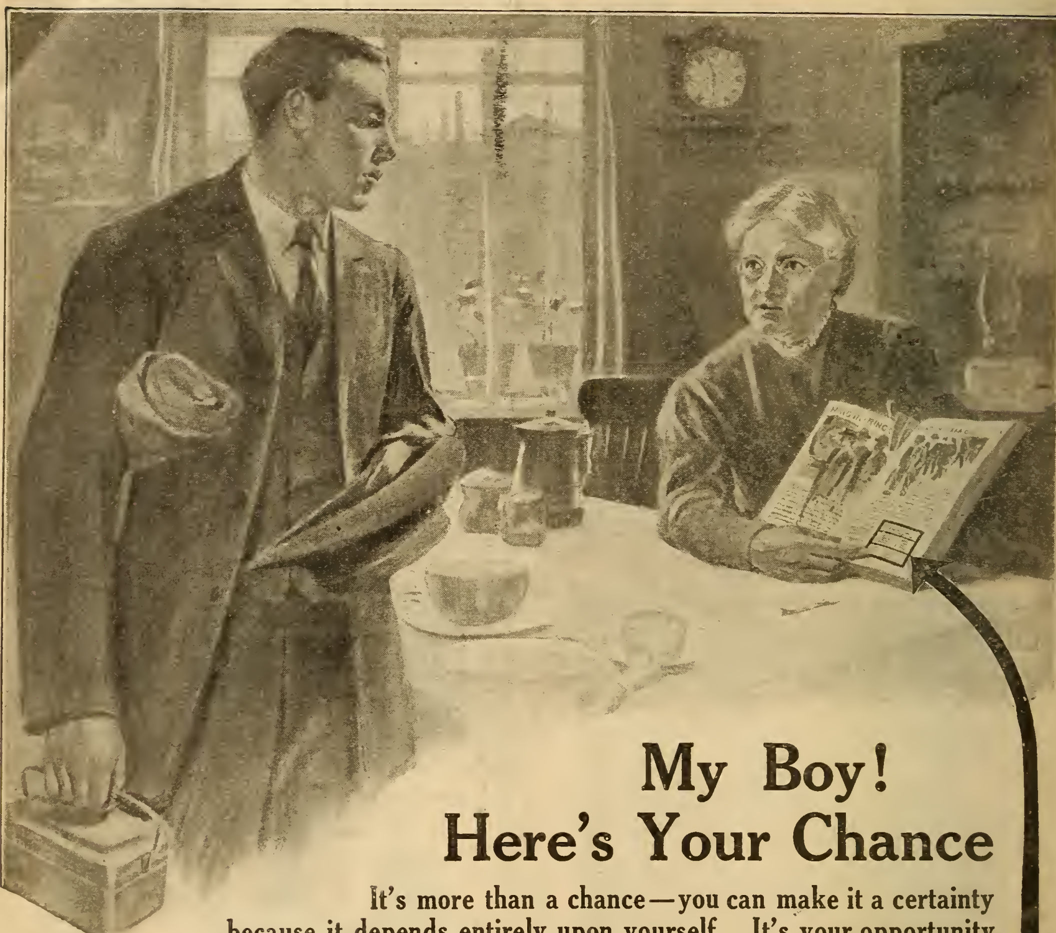

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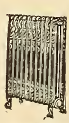

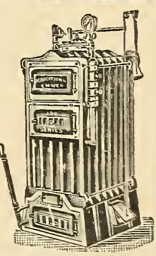

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