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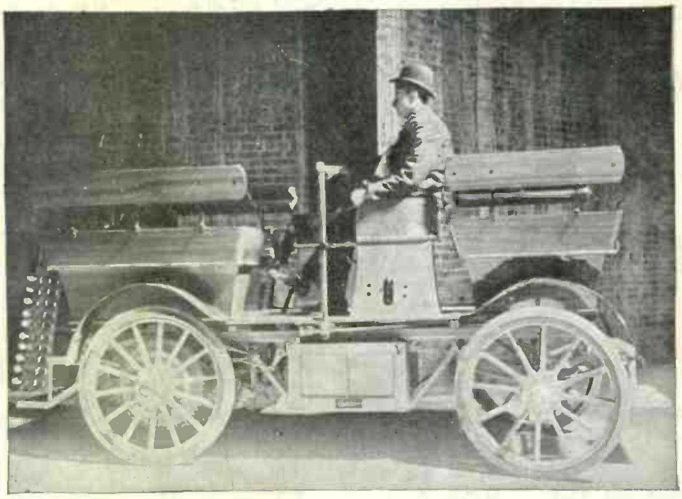
IN THIS ISSUE { INVENTIONS OF EDISON
ELECTRIC LIGHTS AND MODEST PURSES

POPULAR ELECTRICITY

Trade Mark

IN PLAIN ENGLISH



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CHAUFFEUR TO THE SENATE

Vol. II. MAY 1909 No. 1.

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POPULAR ELECTRICITY

IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. II. MAY 1909. No. 1.

CONTENTS

ISSUED MONTHLY BY POPULAR ELECTRICITY PUBLISHING CO., Monadnock Block, Chicago, Ill.

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PUBLISHER'S PAGE

INVENTIONS OF EDISON

In this issue Joseph J. O'Brien gives a classification of the inventions of Edison. "Future fame" he says, "will rest largely on the art test, and not on the military test, and by this test Edison is greater than Caesar." Though the truth of this statement may be evident to some, there are many who have very little conception of the great scope of Edison's work. They think of him, perhaps, as the inventor of the electric incandescent lamp or of the phonograph—his greatest productions. But they do not know that his inventive genius has been felt in the fields of photography, glass production, fruit preserving, ore manipulation, electric traction, office appliances and a great many others. In short, Mr. O'Brien's classification shows that Edison's work has extended into 18 groups of main arts under which are 103 sub-divisions of main arts, the total number of separate patents being 858. These figures are astonishing, and the classification altogether makes very interesting reading.

BOUND VOLUMES

Calls for back numbers of the first volume of Popular Electricity have been insistent, although, unfortunately, we have been unable to fill many of the orders owing to the fact that several of the editions have been exhausted. That requests are still coming in for copies as far back as No. 1, Vol. 1 indicates that many are seeking to complete their volumes with a view to binding them up into permanent form for future reference. We are sorry that we cannot comply with all these requests, but we can be of assistance to some who are particularly anxious to preserve complete files, as we have a limited supply of bound volumes containing the first 12 numbers. These will be supplied at a moderate price—first come, first served.

Those who desire a complete index to the first volume may obtain one upon request. Regular subscribers have already received them, but as they were not included in the newstand edition there are no doubt many regular buyers of the magazine who have complete files to which the index will be a valuable addition.

IS EVERYBODY HAPPY?

To make Popular Electricity a magazine interesting and valuable to old people and young people, to the electrical engineer and the layman, in short, to the whole reading public interested in any shape or manner in electricity, has been the aim of its publishers. That success has been found in this attempt is abundantly proven by the mail that comes to this office every day of the year. Here are a few examples:

The president of a large electric light plant in Iowa says: "We have no doubt that after the subscribers get in the habit of taking your magazine they will continue to do so, as there is no question but what it is a good magazine and interesting to the old as well as the young." The secretary of a large telephone company writes: "Personally I value the magazine very highly and wonder that you are able to get so much good information for the money as you are doing." This from a member of an electrical supply company: "Now we have at least ten men, that I know of, in our employ who are subscribers for your magazine, and we consider it one of the best magazines of its kind that we have been able to get hold of."

From the general readers come such expressions as these: "Popular Electricity is the best electrical magazine I ever read; I read quite a number;" "Your magazine I cannot praise too highly. There are so many meaty things on Electricity (on which I am very weak) that touch me in a hungry, tender spot, that I am like the boy with the mixed bag of nuts. Don't know which I like best, all good." "I have just finished reading the January issue of Popular Electricity (the first one I have had the pleasure of reading) and will say that it is the best thing I have ever read on the subject."

RENEWALS: The date on the wrapper of your magazine shows the issue with which your subscription expires. No additional copies will be mailed after the expiration of a subscription, except upon renewal. Since each issue is printed a month before the date which it bears, renewals should be sent in at least four weeks in advance, in order that no copies be missed.

You should own an Electric Iron

EVERY ELECTRIC-LIGHTED HOME should have its Hot Point Electric Iron. This is true whether you do your own ironing, or servants do it, or it is sent out

The Hot Point Electric Iron is absolutely safe—no risk to user or property. It attaches to any light socket—simply take out the light bulb and screw in the plug at end of flexible connection.

The current is carried into the iron by the switch plug at rear of iron. As soon as this is inserted the iron begins to heat. In two or three minutes you begin to iron and iron continuously.

In a few minutes more the iron will get so hot that you can pull out the plug (requires almost no effort) and iron for some time without further current. When the iron begins to cool, put back the plug for a few minutes.

It is as easy as that.

The stand is attached to rear of iron. Simply tip iron up on the heel when not in use. The handle never gets hot (no holder). The point of the iron is always hot—therefore you iron right up into the pleats and folds; and work with the entire face of the iron.

No heat in the room—no soot or dust—no fuss or bother. Simply iron when you want to, in any room in the house.

The 6 pound Hot Point Electric Iron will do the heaviest domestic work. And the lightest—because you have absolute control of the temperature. There are two models. Both fully guaranteed against electrical troubles.

The handsomest—the sturdiest—the most efficient electric iron. Costs only 3 to 5 cents for an hour of continuous ironing, which means as many pieces ironed as in an hour and a half with any other method.

Two Models—Standard and Automatic.

All we have said above applies word for word to both the **Standard** and the **Automatic** Hot Point Iron.

The **Automatic** Hot Point Iron is exactly the same as the **Standard,** except that we have added a device which automatically switches off the current before the iron becomes overheated. Should you forget to pull out the switch plug when leaving this iron, the automatic device will attend to it. Fire risk entirely done away with. Our **Automatic** is the only electric iron with an automatic temperature control. The only absolutely safe iron.

How to Get A Hot Point Electric Iron.

IN hundreds of cities the Lighting Company distributes Hot Point Electric Irons to its customers.

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The AUTOMATIC is not made smaller than 6-lb. The STANDARD—4, 5 or 6-lb. We recommend the 6-lb. for household work.

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Every Iron Fully Guaranteed.

A number is stamped on every iron at the factory, and a record kept of that iron. It is guaranteed by us to the Lighting Company or Dealer. They guarantee it to you. This covers defects in material and electrical trouble of every kind.

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This is but one of the many advertisements we are running. We want to turn orders in your town to you. Order samples at wholesale, subject to 3 days approval. State number you will be able to use and we will name special quantity price. Give voltage.

PACIFIC ELECTRIC HEATING CO.
ONTARIO, CAL. CHICAGO, ILL. (Address nearest office.)

Please send me further particulars about Hot Point Electric Irons.
Send me charges prepaid, 1 Standard Hot Point Iron, $5.00
" " " 1 Automatic Hot Point Iron, 6.00
(Draw pencil through one not wanted.)
Enclosed is check in payment of same.

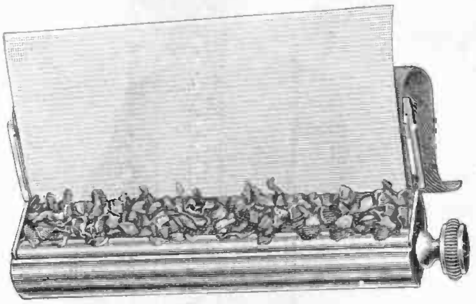
Name..

Street.............................Voltage............

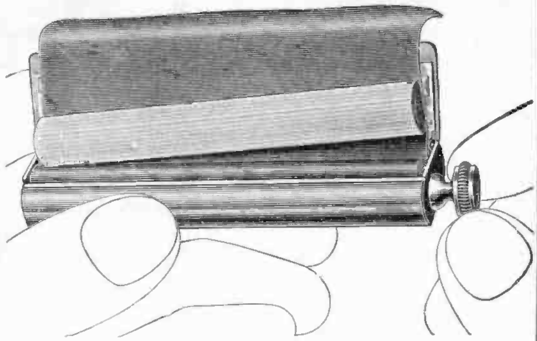
City.......................State.......................

I enquired about it of.................................

Cigarette Rolling Made Easy



(Patented)
Place tobacco and paper as shown above.



Close cover, moisten paper, turn knob and cigarette is finished, as shown.

Quicker than by hand—No waste of tobacco—Perfectly formed
Actual saving more than pays for machine in short time

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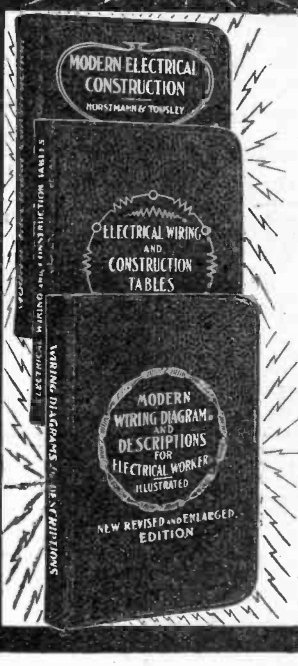

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Describes everything used in general practice; bells, burglar alarms, batteries, dynamos and motors, meters, automobiles, arc and incandescent wiring, telephones, testing, trouble, etc. ¶ Fits the owner for any kind of electrical work.

Each diagram and explanation complete in itself, not requiring any previous knowledge of the subject to be able to understand it.

A complete collection of diagrams covering every class of construction with which the electrical worker will be brought in contact.

A book that can be carried on the job. ¶ Settle disputes and arguments.

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$$\sqrt{[(E.X.P.F.)+(I.X.R.)]^2+[(E.X.I.F.)+L.]^2}=E'$$

To do intelligent work you must use this ofrmula to find the size of wire needed or consult the tables in this book. In the past most people have guessed.

This book gives tables by which the proper size wire may be found without the use of mathematics. The tables do all the figuring.

Trigonometry, algebra and the extraction of the square root are not necessary with these tables. ¶ Over 100 pages of tables. Single, two and three phase; any distance, any loss, any power factor, any voltage, any efficiency, 25, 60 and 125 cycles.

All that are needed; none that are not needed. ¶ Will save, in time saved, their cost nany times over. ¶ The tables showing the proper size wire to use according to the Underwriters' table of carrying capacity minimize the possibility of costly errors.

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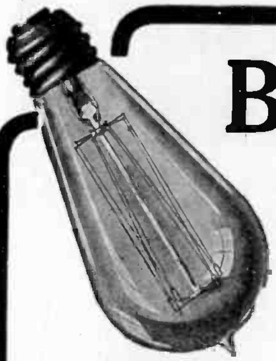

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At an angle—pendant —horizontal or upright.

The 25 watt and small bulb 40 watt styles will fit any shade or fixture suitable for 16 c. p. carbon filament lamps. Equal life on either a. c. or d. c. circuits. The color of the Sunbeam Tungsten is so clear and fine that pale blue and pale pink can be distinguished under the rays of this lamp as readily as by sunlight.

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25-watt regular	$0.85	$0.90	100
40-watt small bulb	1.00	1.05	100
40-watt regular	1.10	1.15	50
60-watt "	1.40	1.47	50
100-watt "	1.75	1.85	24
250-watt "	3.50	3.70	12
No. 1 Meridian 40-watt	1.50	1.50	24
No. 2 Meridian 60-watt	1.75	1.75	24

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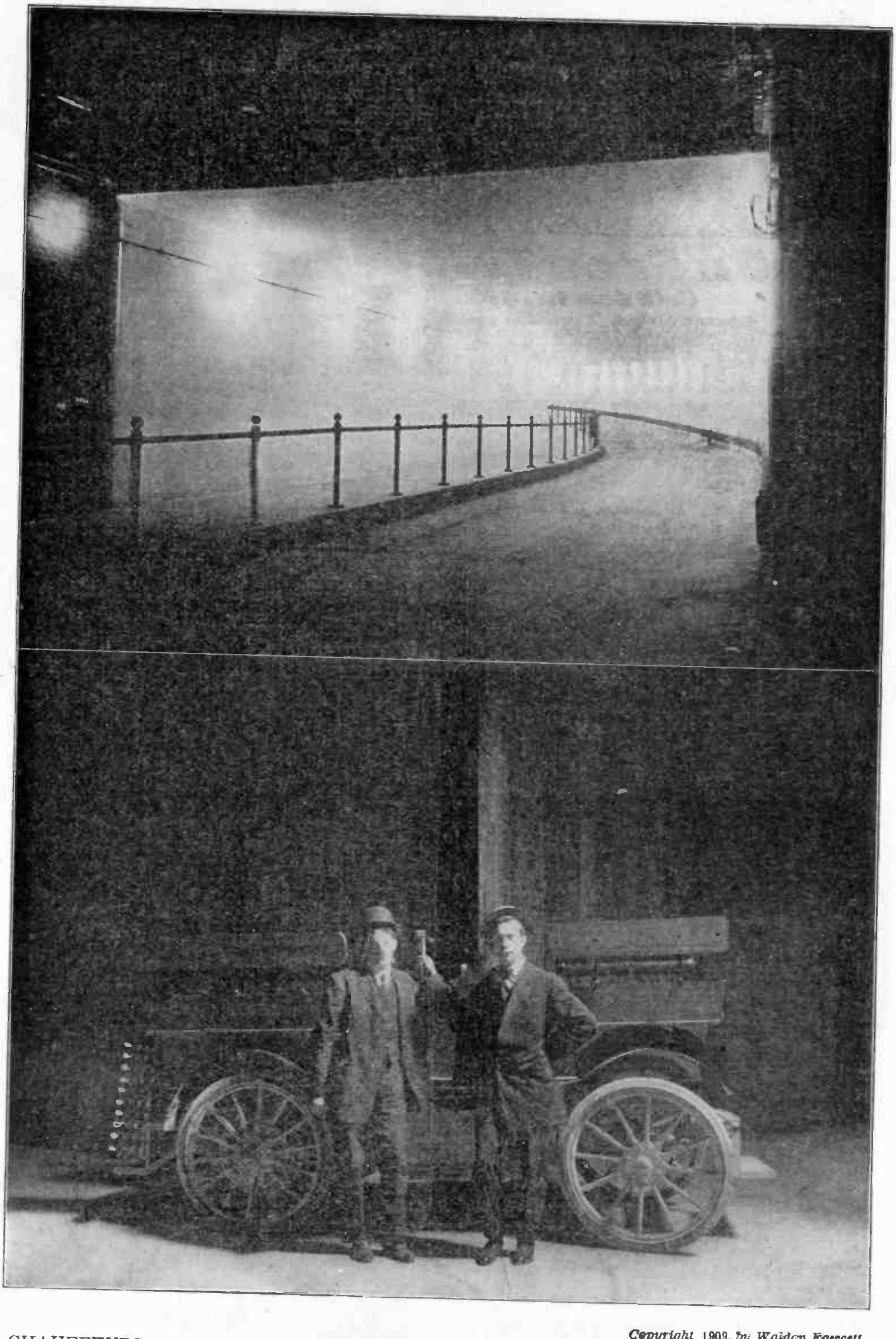


CHAUFFEURS TO THE UNITED STATES SENATE AND THE TUNNEL THROUGH WHICH SENATORS RIDE.

POPULAR ELECTRICITY
IN PLAIN ENGLISH

VOL. II | MAY 1909 | No. 1

HOW SENATORS RIDE TO WORK.

BY WALDON FAWCETT.

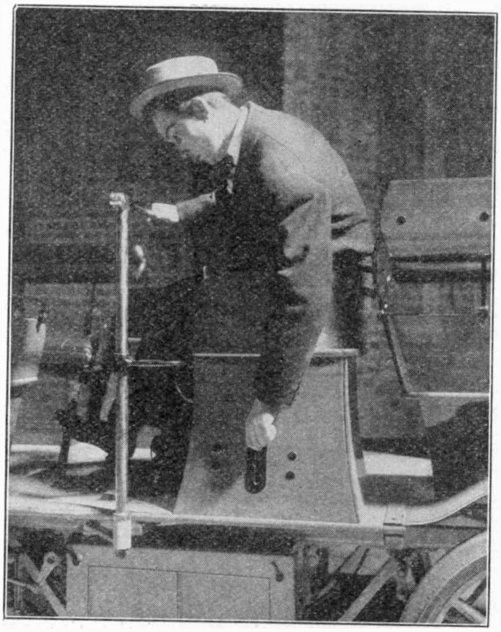
The oddest automobile line in the country has recently been placed in operation in the capital city of the nation. Indeed, it is more than this. It may safely be said that it is not only distinctive among all installations of commercial motor cars but is quite the most novel transportation system of any kind in the world. The vehicles that comprise its rolling stock are unique, and finally, it has for passengers the most distinguished body of men that regularly ride on any such semi-public conveyances.

This innovation is an electric motor car line that connects the United States Capitol and the recently completed Office Building of the United States Senate, operating in a subway nearly one-third of a mile in length. In this electric-lighted tunnel are in operation electric automobiles of special design which regularly make the trip from terminal to terminal in one minute or less, carrying ten or eleven of the nation's lawmakers, or friends and constituents who may have business with them.

At present this most up-to-date of motor car lines is in operation only between the Capitol and the Senate Office Building, but it is planned to shortly extend the underground transportation system and have a similar line of cars operating between the halls of Congress and the new Office Building of the House of Representatives, which is located about as far distant from the Capitol as is the Senate Building, but in the opposite direction. The tunnel by which the House of Representatives Building is accessible from the Capitol is a duplicate of the S-shaped "tube" leading to the Senators' working quarters.

Work began several years ago on the two marble office buildings—each costing $3,000,000—for the use of the Senators and Representatives, respectively, these, the largest office structures in the world having been made necessary by the limited amount of space in the Capitol proper, which limitations, taken in conjunction with the constant increase in the number of legislators made it impracticable for more than a fraction of the whole number of Congressmen to have their private offices in the big white-domed building. Almost from the moment that it was decided to build a huge "annex" on either side of the Capitol there was discussion as to the best means of conveying the lawmakers quickly between their office buildings and the Capitol. Obviously an up-to-date system must be devised for it is frequently necessary for Congressmen to make a quick trip in order to vote on a bill upon which a roll-call is demanded or meet other like urgent contingencies.

The first decision reached by Mr. Elliott Woods, Superintendent of the Capitol, was that the various buildings must be connected by tunnel, for, in the vicinity of the Capitol, as elsewhere, Washington is a city of magnificent distances and Capitol Hill is particularly exposed in inclement weather. The tunnel provided, there arose the problem of transportation within the "tube." Various solutions were proposed, including moving



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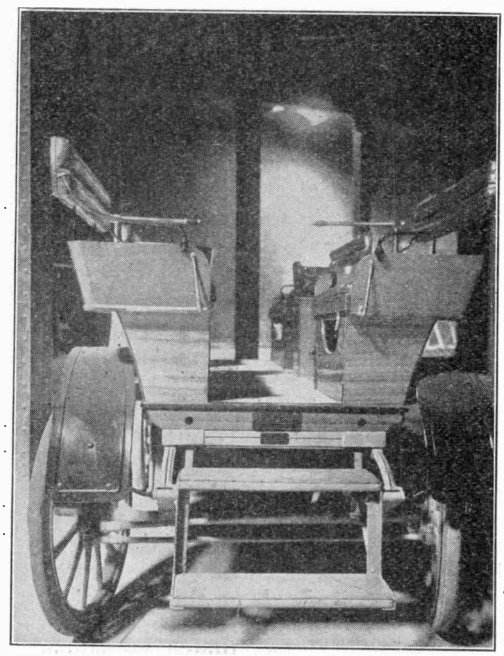
SIDE VIEW OF ELECTRIC VEHICLE.

sidewalks and miniature electric cars operating on a double-track system. Finally, however, after full investigation the officials gave their preference to a line of automobiles, electrically operated. These traverse a concrete roadway which is of sufficient width for two of the machines to pass at any point in the tunnel. A sidewalk, protected by a heavy iron guard rail, extends the length of the tunnel, parallel to the roadway, and pedestrians may get aboard the motor cars at any point in the tunnel, although it is expected that the autos will not make stops between the terminals except under unusual circumstances.

The motor cars, which derive their propulsive energy from five-horsepower storage batteries, were built for a contemplated speed of 12 miles per hour. It has been found that in actual service the average elapsed time required for a round trip is two minutes. The journey from the Capitol to the Office Building is made in 40 seconds, but nearly twice as much time is consumed in the return trip, owing to the fact that the entire journey is up-grade, and more especially by reason of the circumstance that the cars are, in effect, running backward on the return journey. Owing to the limited space at the terminals and a desire to keep these novel shuttle-cars in continuous operation, the cars are not turned upon completion of each trip. Thanks to the special design of the car with seats along the sides, this mode of operation entails no inconvenience upon the passengers, but when the drive wheels are in front it is more difficult to steer and the chauffeur operates at a slower speed, which, combined with the slight grade, lengthens the time of the journey to the Capitol over that of the trip in the opposite direction.

The exigencies above mentioned were in great measure responsible for the design evolved for these new Capitol motor cars, which are radically different from anything else ever manufactured. To adopt a homely simile, this new style auto might be compared to two dog carts, placed end to end, and linked by a platform on which is the operator's seat, or rather seats, for there have been provided for the chauffeur two individual seats on opposite sides of the car and facing in opposite directions. When the end of a run is reached the driver changes seats and is thus constantly fac-



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END VIEW OF ELECTRIC VEHICLE.

ing to the front, although the machine is not turned around.

Six passengers can be accommodated in the seats at one end of the car and four passengers in the seats at the opposite end. In "rush hours" a passenger can always be accommodated in the vacant operator's seat (if he is content to ride backward) thus bringing the capacity up to eleven, excluding the chauffeur. The bodies of the Capitol autos are finished in a smart tan tint and upholstered with brown leather, a color scheme that was selected as harmonizing with the plastered walls of the tunnel.

The motor cars for the Capitol cost in the neighborhood of $5,000 each, and it is contemplated that eventually four of them will be in operation between the Capitol and the Senate Office Building and probably a greater number between the Capitol and the Representatives' Building, owing to the fact that nearly four hundred Representatives, and an equal number of private secretaries and clerks to the Congressmen must be provided for as regular patrons.

The charging of the batteries of the Capitol motor buses is done at night, and it is not necessary to remove either the vehicles or the batteries from the subway for this purpose, the charging being done at the electric power plant which supplies light, elevator power, etc., to the Capitol and Office Buildings, and which is in the basement on the level of the subway.

FIRE ENGINE WARNING SIGNAL.

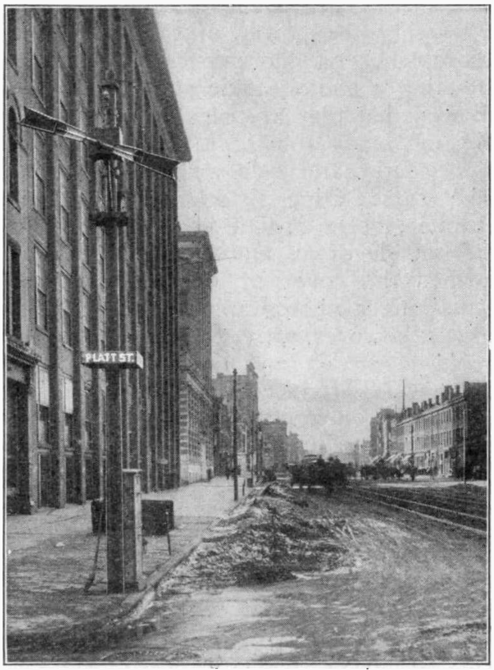
Fire engines, as they come rushing out of the barn drawn by half frantic horses, are not easily controlled. They emerge from the doors so suddenly that street cars passing in front of the barn cannot be stopped in time. So sometimes there are collisions.

In order to warn motormen when such danger is liable to occur an ingenious signal is used in Rochester, N. Y., at the corner of Platt and State streets, where there is a fire engine station. The picture shows the signal, which has two vanes. The view is down State Street, while the engine house door is on Platt street, not shown in the picture.

When the fire apparatus leaves the fire engine house the horses run over a contact maker, which is placed in the floor just ahead of the front wheel, and this completes a circuit in the signal box, starting the semaphore arms in rotation. The signal is so timed that it will run for about two minutes continuously, and then stop automatically, thus giving time for the fire apparatus to cross State Street in safety.

Mounted in the end of the semaphore arm are incandescent lamps which show red for night service.

Current for tripping the signal is taken from the 110-volt lighting circuit,



FIRE ENGINE WARNING SIGNAL.

while the current for whirling the signal is taken from the trolley.

Another signal which is installed at Main Street E. and Stillson Street, consists of a device for shutting off the trolley current at some distance on each side of the danger point. It acts on nearly the same principle as a circuit breaker and is contained in a box suspended between the trolley wires. It is tripped by the wheels of the fire-engine, as in the previous case.

ELEMENTARY ELECTRICITY.

BY PROF. EDWIN J. HOUSTON, PH. D. (PRINCETON).

CHAPTER XIII.—THE X-RAYS.

Reference has been made in the preceeding chapter to the fact that by making the portion of the walls of a Crookes' tube against which the cathode rays strike, a thin plate, or, as it was also called *window*, of metallic aluminium, Lenard succeeded in causing some of the cathode rays to pass out of the tube into the air. These rays, called the Lenard rays, are luminous for a short distance from the aluminium window.

Lenard discovered that these rays carry a small charge of negative electricity, possessing the power of causing phosphorescence or fluorescence, as well as affecting a photographic plate. He also showed that they are capable of passing through many substances opaque to ordinary light, and even went so far as to take some faint shadow pictures of opaque or semi-opaque bodies placed on the outside of an aluminium plate that formed the cover of a light-tight box containing a photographic plate. These effects, however, were so feeble that they failed to attract any marked attention. They were produced by Lenard in the year 1894, or considerably after the observations by Plucker, Hittorf, Goldstein and Crookes referred to in the last chapter.

It was not until a later date, 1895, that attention was called to a somewhat similar phenomenon produced in the neighborhood of that portion of a cathode tube against which the rays strike. This discovery, made by Prof. W. C. Röntgen, of Wurtzburg, Bavaria, was regarded by the scientific world as of such importance that its announcement created the greatest excitement, and in a few weeks led to the repetition of the experiments at practically all places that had received information concerning them.

Röntgen had been making some observations on phosphorescence. Knowing the power of the cathode rays to excite this variety of radiation, he had in his laboratory a Crookes' tube through which electric discharges were passing. He had darkened his laboratory; and, in order to prevent the light produced by the Crookes' tube from passing into the room, had carefully covered the outside of the tube with several thicknesses of black paper.

Among some of the substances in which Röntgen had been exciting fluorescence was a sheet of paper covered with a chemical salt known as tungstate of calcium. Happening to place this sheet of paper in the neighborhood of the Crookes' tube, he was greatly surprised to observe that it suddenly began to emit fluorescent light. Assuming, as a matter of course, that the light from the Crookes' tube was escaping through cracks or openings in the black paper, he carefully examined the tube and again arranged its covering until he was convinced that now at least no light could escape. To his surprise, however, the fluorescence of the tungstate-covered paper continued. He was, therefore, forced to the conclusion that there had been produced in the Crookes tube, by the bombardment of the cathode rays against the glass, an entirely new variety of radiation that possessed in a marked degree not only the power of passing through substances ordinarily opaque to light, but after such passage of also producing both fluorescence and phosphorescence, as well as affecting a photographic plate.

For want of a better name Röntgen proposed the name of the X-rays, or the unknown rays, for this peculiar variety of radiation. The selection of this name was in accordance with the usage in algebra of representing an unknown quantity by the letter X. This name, X-rays, has been generally retained in science, although the rays are frequently known, after their inventor, as the Röntgen rays.

It will be observed that unlike the Lenard rays, the X-rays produce no immediate effects on the eyes. If, therefore, an active Crookes' tube were covered with blackened paper, so far as the sight was concerned, there would be no way in which the presence of the X-rays could be observed by the unassisted eye. If, however, a fluorescent substance were placed in their path, it would immediately become luminous. In a similar manner a photographic plate is also instantly affected.

As already remarked, the cathode rays are not produced until a certain high vacuum is reached. The additional discovery was made shortly afterwards that when this high vacuum exceeded a certain value, the amount of X-radiation produced was greatly decreased.

It may occasion some surprise that Lenard's discovery of rays that were able to pass through substances opaque to light and produce fluorescence, phosphorescence and photographic effects, so signally failed to arouse the attention of scientific men as was occasioned by Röntgen's discovery. There was, however, this difference. Lenard discovered an effect, so faint in its intensity that it could only be observed in the immediate neighborhood of the aluminium window. It was therefore without any practical value. Röntgen's discovery, on the contrary, was of a radiation of such intensity in its penetrating power, that it was capable of producing its curious effects at considerable distances from its source.

When Röntgen demonstrated that the X-rays possessed such penetrating power that they could readily pass through inch boards of wood, a thousand pages of an ordinary book, or two packs of playing cards, and still be able to produce fluorescence, phosphorescence, or photographic effects, it is not surprising that the announcement instantly commanded the close attention of the entire scientific world. Not only because there was something apparently uncanny in the ability to see what was otherwise invisible, but especially because in addition to this, it was found that the X-rays possessed the wonderful power of readily passing through the flesh, blood and soft tissues of the human body, so as to permit its bony skeleton as well as some of its internal organs to be examined. The world at large recognized that these rays would afford a wonderful aid in medical diagnosis. Therefore the discovery attracted universal attention.

Suppose, for example, as represented in Fig. 86, that a screen consisting of a sheet of paper or other substance transparent to X-rays, covered with a fluorescent substance, such as tungstate of calcium, or platino-barium-cyanide, is placed at the larger end of a stereoscope with the fluorescent surface turned towards the inside. Then if one hand of the experimentor is held outside the box near the fluorescing plate, or as it is called the fluorescent screen, and his eyes placed at the opening in the smaller end, a picture will be seen on the screen of the bones or other opaque integuments of the hand when X-rays are permitted to fall on the outside of the hand

In a similar manner, if, as repre-

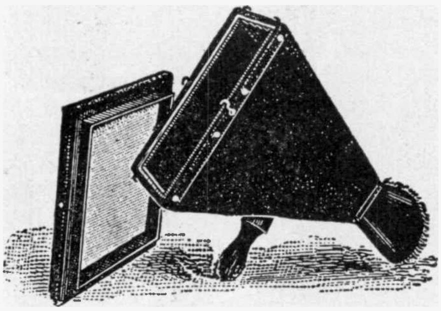


FIG. 86. PLATINO-BARIUM-CYANIDE SCREEN.

sented in Fig. 87, X-rays are passed in a nearly dark room through the human body as represented, and a large screen covered with a fluorescent substance is placed near the back of the person standing in front of the source of X-rays, there will be seen on the screen, the fluorescent surface of which is turned from the body, a shadow picture of its skeleton and other semi-opaque parts.

In this picture the X-ray tube is shown with the X-radiation thrown from one-half of its surface, and its terminals connected with the terminals of an electro-static induction machine provided with Leyden-jar condensers.

The fluorescent pictures above referred to exist only while the rays are passing. It is easy, however, to produce permanent pictures. To do this it is only necessary to employ a sensitive photographic plate, wrapped with several thicknesses of blackened paper so as to be thoroughly opaque to ordinary light and placed on a table with its sensitive surface upward below an excited X-ray tube, as shown in Fig. 88, so that the rays may fall freely on the paper. Before the current is passed through the tube the hand is placed as shown on the paper, between the sensitive surface of the plate and the X-ray tube. Under these circumstances, only those portions of the plate are affected where the rays pass freely through the flesh, blood and other transparent tissues, while the bones, and other opaque or semi-opaque tissues cast shadows on the plate. Consequently, the negative so produced is employed for printing a picture. Such a picture of the foot and shoe is seen in Fig. 89.

It will readily be understood how great an aid an X-ray photograph, like the above, would afford a surgeon in locating the presence of a foreign body like a pistol ball, a needle, pin, or other body, that had been accidentally introduced below the surface.

In the above example, the high-pressure electric source employed for the operation of the X-ray tube is a Ruhmkorff induction coil capable of producing a 15-inch spark through free air.

The intensity of the effects produced by X-rays varies not only with the character of the vacuum in the X-ray tube, but also with the intensity of the electric discharge. If, however, too great a bombardment of the cathode rays is permitted to fall against the wall of the tube, the glass may be rapidly melted, thus destroying the tube. In order to avoid this, instead of permitting the cathode rays to fall directly on the wall of the glass tube they are caused to strike against a piece of highly refractory metal such as platinum, placed opposite the cathode. Such a piece of metal is called an anti-cathode, and can

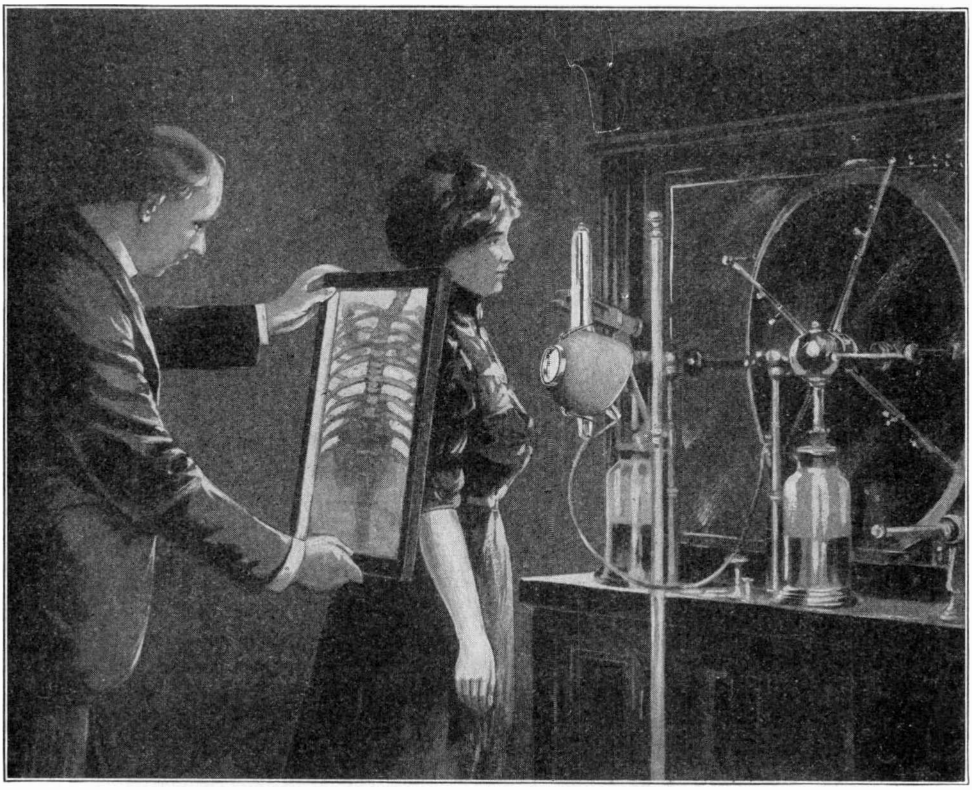


FIG. 87. AN X-RAY SHADOW PICTURE.

safely be exposed to a bombardment that is capable of raising its temperature to incandescence. An X-ray tube provided with an anti-cathode contains also a cup-shaped terminal that focuses the rays on a point on the surface of the anti-cathode, thus insuring a sharper shadow picture than if the X-rays were thrown off from an extended surface.

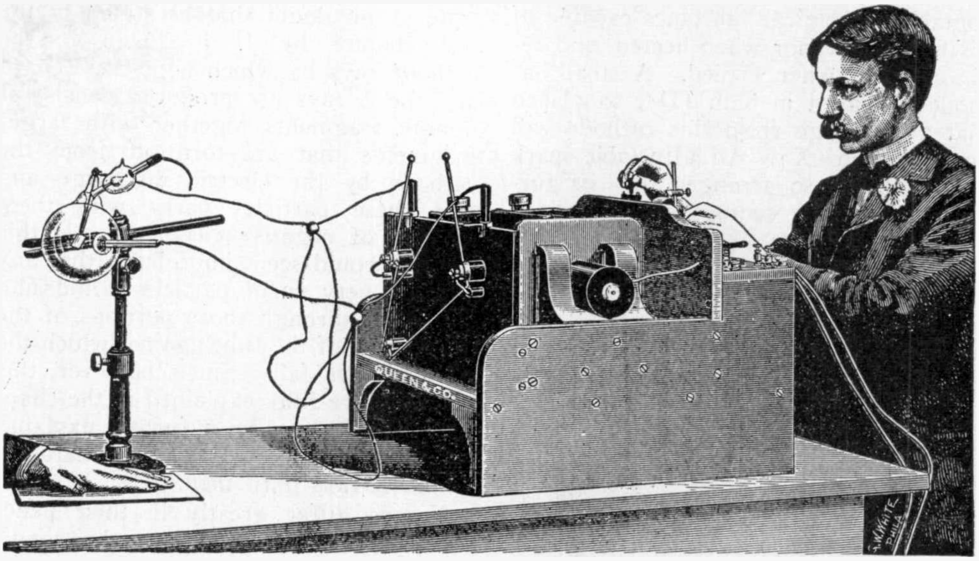


FIG. 88. TAKING A RADIOGRAPH OR X-RAY PICTURE OF THE HAND.

Various forms have been given to X-ray tubes. In some, arrangements are provided whereby the extent of the vacuum may be regulated, thus permitting the most effective vacuum to be readily obtained; for, it can be shown that after a somewhat prolonged use the vacuum in the tube increases to such an extent as to render it practically inoperative unless a gradual leakage may occur into the tube.

The Queen self-regulating X-ray tube represented in Fig. 90, is suitable only for use with the currents like those obtained from an induction coil or a static induction machine. In consists of a large bulb (B) that forms the X-ray tube proper, and a smaller bulb (D) communicating with (B), so arranged that it can automatically lower the vacuum in (B) should it become too high to produce X-rays. The construction and operation of the self-regulating X-ray tube are as follows:

The X-ray tube proper (B) is provided with a cathode (C) composed of hammered aluminium in the form of a concave reflector of such dimensions that the cathode stream is focused on the anti-cathode (A) or anode formed of platinum. The outer end of the cathode is represented at (K).

(B) is exhausted to such a high vacuum that initially no discharge will pass

FIG. 89. A RADIOGRAPH OR X-RAY PICTURE.

through it. The bulb (D) on the contrary, is exhausted to a low Crookes vacuum. A small pear-shaped bulb (X) communicates with the bulb (B) and contains a chemical substance capable of giving off a vapor when heated, and reabsorbing it when cooled. A small cathode is placed in bulb (D), so placed that a discharge from this cathode will heat the bulb (X). An adjustable spark point (P), is so arranged that its further end can be swung to any desired

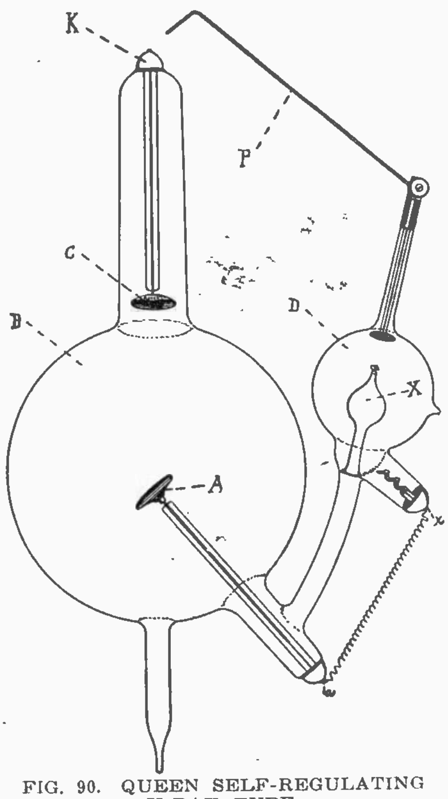


FIG. 90. QUEEN SELF-REGULATING X-RAY TUBE.

distance from the terminal of the main cathode (C) at (K).

When the self-regulating tube is first employed the discharge cannot pass through the bulb (B), on account of its high vacuum, but readily passes from (K) to (P) through the bulb (D). Heating the bulb (X) it causes vapor to be given off from the substance it contains. This vapor entering the main bulb (B), lowers its vacuum so as to permit the cathode rays to be discharged from the cathode (C), which falling on the anti-cathode (A) cause it to become a source of X-rays.

The exact nature of the X-rays is unknown. There would appear to be little or no doubt that as stated in the last chapter by J. J. Thomson, the cathode rays by which both the Lenard and the X-rays are produced consist of minute fragments together with larger fragments that are torn off from the cathode by the electric discharge and that these particles carry with them charges of negative electricity. If this is so it would seem improbable that any but the very small particles could find their way through those portions of the glass walls of the tube against which the cathode rays fall. Since, however, this will be more fully explained in the chapter on radio-activity, a further explanation will be deferred as to the character of the X-rays until then.

X-rays differ greatly in their penetrating power according to the condition of the vacuum of the X-ray tube and the electric pressure employed for its operation. The penetrating power, however, and the ability to produce X-ray photographs, will vary with the distance from the tube. Neglecting losses by absorption provided they are produced from a point source, the penetrating power will be inversely as the square of the distance.

The most sharply defined X-ray photographs are produced when the rays come from a point rather than from a surface.

As regards the character of the sensitized plate employed in X-ray photography, it has been found that certain emulsions are especially sensitive to this form of radiation, so that the best results are obtained by the use of plates especially prepared for the purpose.

Care must be taken to avoid too prolonged an exposure of the body to an active X-ray tube for this character of radiation, like sunlight, possesses the power of setting up a severe inflammation that may result in suppuration and sloughing of the tissues. A curious difference, however, exists between the position of the parts affected by sunburn, the name given to such inflammations when caused by sunlight, and X-ray burns or dermatitis, or that caused by exposure to X-rays. Sunburns are limited to the outer surface of the body. X-ray burns affect principally a portion of the surface of the bones called the periosteum. This is to be expected, since the flesh and other tissues covering the bones permit the X-rays to readily pass through them, and fall almost as freely on the bones as if all the flesh and blood had been removed, and the bones were directly exposed to the radiation.

X-ray burns are often exceedingly severe, and may necessitate the removal of an arm, or a leg, or even cause death. What makes it all the more difficult to avoid such burns is the fact that a comparatively long time generally elapses between the exposure and the setting in of the inflammation. For example, several weeks may elapse before the inflammation shows itself. With proper care, however, X-ray examinations and X-ray photographs can be made by comparatively short exposures, so that no serious results to the patient need occur. It is different, however, with the operator, who is apt to suffer severely from overexposure. When, however, care is taken to protect the body by shields of lead plates, and to avoid unnecessary exposure to direct radiation from the X-ray tube, no serious results need occur.

(To be continued.)

STRIKING ELECTRIC SIGN.

The electric coffee sign shown in the picture is so realistic that it would almost give you a thirst, so to speak. The sign is 21 feet wide and 32 feet high, and is erected on a prominent corner in Atlanta, Ga.

The border is outlined by three rows of lights—red, white and green—the colors changing about 20 times a minute. The immense letters of the wording, "Luzianne Coffee" have also three rows of lights, red, white and green, and, together with the border, are flashed consecutively red, white and green, and then all colors at once. Lights in the remainder of the lettering are all white and burn continuously.

The picture on the sign represents an ante-bellum "Mammy" pouring her coffee and a bank of lamps are so arranged and operated by flasher, that the steam which is continually arising from the cup and pot gives a beautiful cloud effect, while the stream of coffee being poured from the pot is plainly visible. The sign contains 1,350 two-candlepower incandescent lamps.

STRIKING ELECTRIC SIGN.

ELECTRIC SWINGING DOOR.

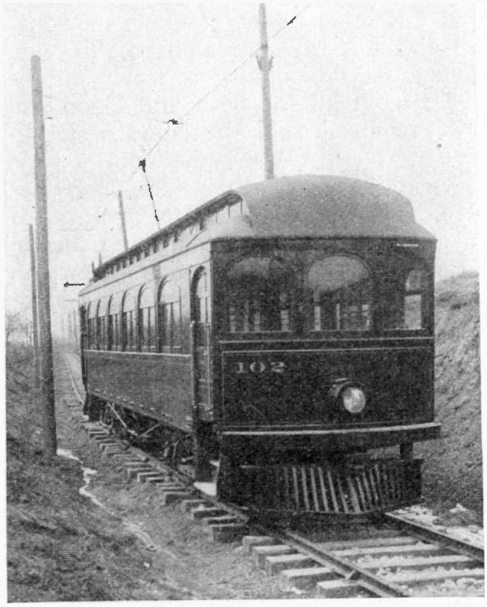
Revolving doors leading into the Hotel Astor in New York are now operated by electricity instead of by hand. A doorman whose duty it used to be to swing the glass doors by main strength, now does his work with no greater exertion than is needed to press a button.

He stands in the hotel lobby some distance from the doors. In his hand he holds an electric button attached to a wire. The other end of the wire is connected with the door swinging apparatus. When anybody approaches the doors from either the street or the lobby side the doorman presses the button and the doors swing round.

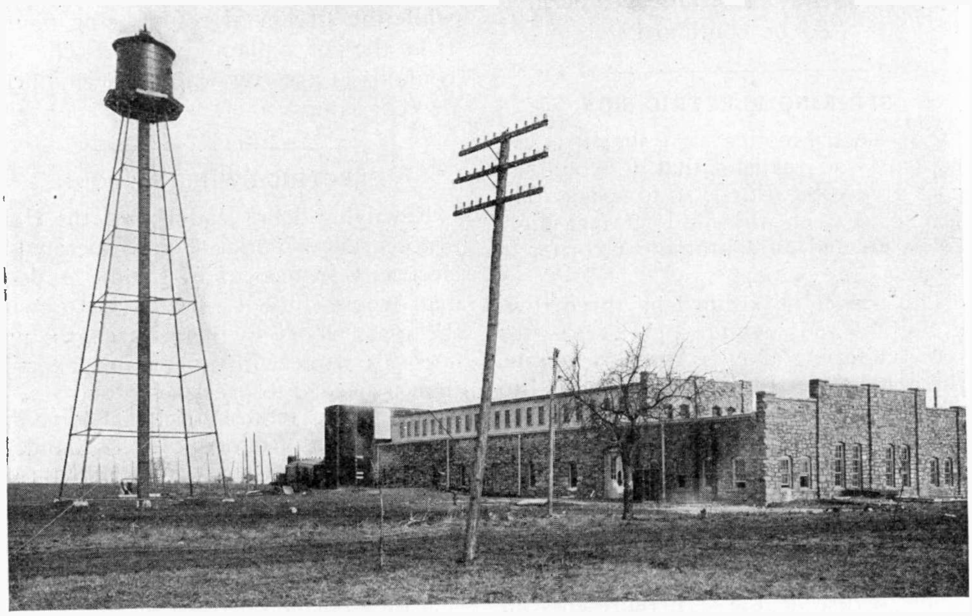
GASOLINE CARS SUPPLANTED BY ELECTRICITY.

There is an interurban railway 20 miles in length extending from Kansas City, Mo., in a southwesterly direction to Olathe, Kan., that is of more than usual interest from the fact that it affords an example of the abandonment of the gasoline-operated motor cars, which attracted considerable attention a few years ago, in favor of the straight overhead electric trolley system. For several years the road was operated with the gas-electric system of motive power, in which each motor car is a complete power station, with gasoline engines driving electric generators, supplying, in turn, electricity to operate the motors. But it was decided, after careful consideration, that the straight electric system offered advantages in economy, attractiveness to the public and reliability of operation, and so the road was "electrified," the electric service going into operation the first of this year.

No unusual conditions presented themselves in planning and building the electrical equipment. The line extends from the intersection of Thirty-ninth Street



MISSOURI AND KANSAS INTERURBAN RAILWAY CAR.

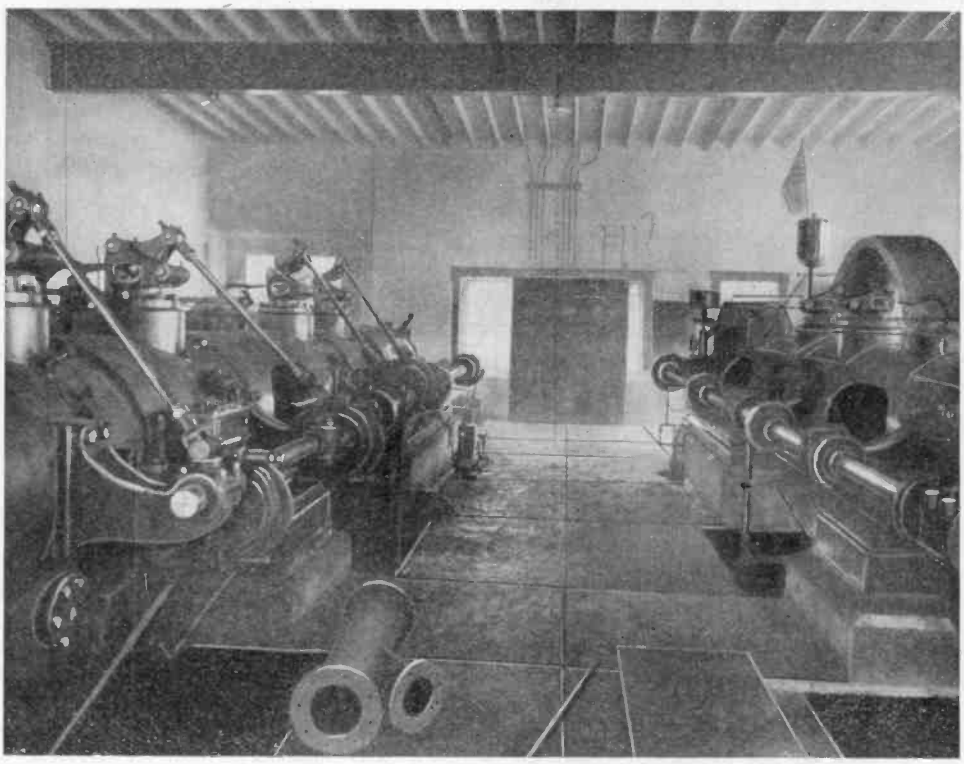


POWER HOUSE OF THE MISSOURI AND KANSAS INTERURBAN RAILWAY.

and the state line in Kansas City, where it is connected with the local street railway system, along a ridge known as the Old Santa Fe Trail, through the villages of Overland Park and Lenexa to Olathe. There are no bridges and no grades steeper than 1½ in 100, except at a hill near Olathe, where the grade is 4 or 5 in 100. The tracks of the Missouri and Kansas Interurban Railway Company, which built the road, are laid on private right-of-way exclusively, with 70-pound rails and white-oak ties.

The ordinary 600-volt direct-current system is used. Power is supplied to the line by a power station at Overland Park, about seven miles from Kansas City. Electricity is generated by two dynamos of 260 horsepower each, driven by gas engines direct coupled. The gas supply is obtained from gas wells on the company's property, and there is also a connection with the mains of the company furnishing power gas to Kansas City. The electricity is fed directly into the overhead trolley wire, without "feeders," which are usually employed in electric railway work. This wire is of copper and is of the size known as No. 0000. It is suspended from brackets on poles on the tangents or straight stretches of track, but on curves the cross-suspension system is used; that is, poles on each side of the track support cross wires, to which the trolley wires are attached.

As the power house is about thirteen miles from the Olathe end of the line, there is a considerable "drop" in the electromotive force or electrical pressure. Owing to the considerable current used and the comparatively low pressure at the start, the 600 or 625 volts at the power house is not more than about 440 volts at the end of the line, the loss being represented by energy consumed in overcoming the resistance of the large copper wire for this distance. And it is just at this point, too, that the voltage should be at its highest in order that the motors may work at their greatest efficiency in climbing the



GAS ENGINES FOR DRIVING RAILWAY DYNAMOS.

hill. It may be explained that the power plant was not placed at the midpoint of the line because the car-barns were located on the company's property at Overland Park in the time of the gasoline cars.

To overcome this "drop" a storage-battery station is in operation near the Olathe end of the line. This is arranged to "float" on the line, as the engineers express it. The line pressure, 440 volts, is used to charge the battery, which is discharged as needed at 600 volts. Of course, as something can not be made out of nothing, the voltage is "boosted" at the expense of some current, but as amperes are plentiful and volts are what are needed, the arrangement is entirely satisfactory.

Prominently shown in the exterior picture of the power house and car barns at Overland Park is an elevated water tank. This is part of the water-supply system. A motor-driven pump forces water from a spring about 2,000 feet distant up into the tank, whence the water is distributed about the plant as needed. The gas engines in the power plant are water-jacketed to keep them cool, and from this tank the circulating water is obtained.

The passenger cars used on this line are large and handsome. They are 44½ feet long and will seat 52 persons, 12 in the smoking compartment. Four 40-horsepower motors, on two trucks, propel each car. The cars are designed to operate in one direction only, and the motorman's cab is arranged at one side of the front end of the car. This gives passengers a practically unobstructed view through the front of the car, at the same time securing maximum seating capacity and a front exit.

From the Kansas City terminal the cars are operated for a distance of about three miles to the center of the city by the Metropolitan Street Railway Company of Kansas City. The business of the interurban road has been greatly increased since the electrification.

EXPERIMENTS WITH HIGH-VOLTAGE CURRENT.

BY H. L. TRANSTROM.

Two different effects are produced at the terminals of a high-voltage transformer which are very interesting to study. In the first illustration, the discharge resembles a flame as from a burning match but much larger.

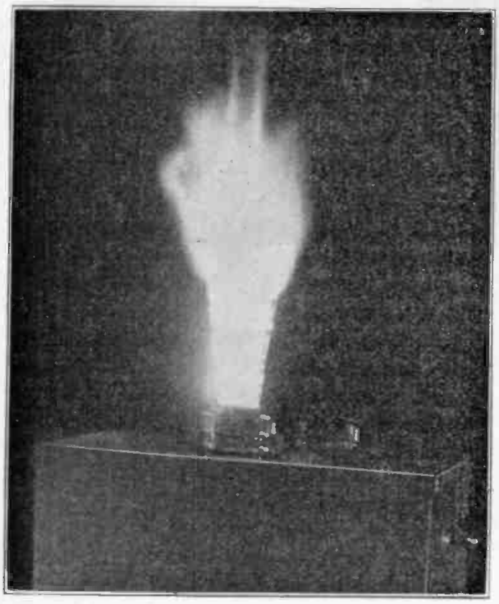
When the terminals are charged to the full voltage, and the discharge is not allowed to pass, it is called static, meaning that the charge is in a state of rest. The voltage is then at the maximum, but as soon as the pressure breaks down the high resistance of the air, the air is heated to incandescence which lowers its resistance to a few ohms. The voltage correspondingly decreases to a fraction of the voltage which existed before the resistance of the air-gap was broken down. The flame is very hot and assumes a yellow color because of the presence of sodium in the air. If the terminals are composed of copper the flame is bluish and the cotton covering gives it a reddish tinge.

The characteristic inverted V-shape of alternating discharges of a high voltage transformer is due to the heating of the particles of air which causes them to rise, drawing the flame upwards to a height of several inches, depending on the voltage, amount of current flowing and the shape of the terminals. The "horn" lightning arrester is based on this principle, two terminals of heavy copper wire being set quite close together at the bottom but spread apart at the top so that the draft of air blows out any arc that may form by the line current after the lightning has passed through it to the ground.

If a condenser, such as a leyden-jar or any high voltage condenser is shunted across the terminals, the flame discharge ceases and assumes a more startling form. The flame discharge is practically noiseless and gives a very ordinary light, but the condenser discharge produces a roar like a miniature thunder clap and yields a dazzling light very much like lightning. To the eye each discharge appears to be a single spark, but it has been proved, when analyzed by a very rapid picture taking device, that it is made up of several sparks alternating with almost inconceivable rapidity.

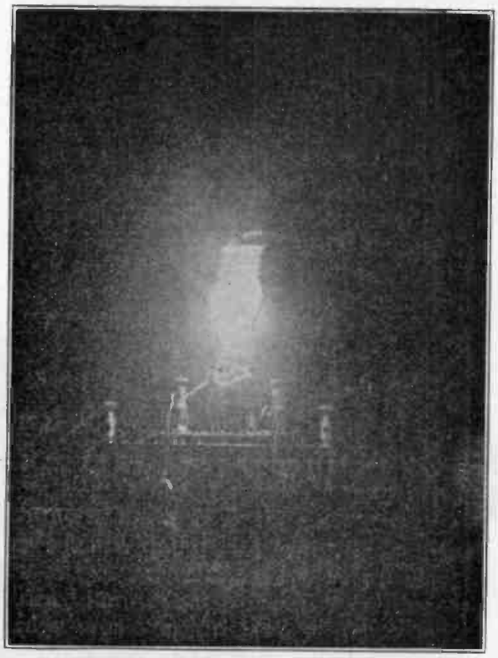
To understand this consider the action of the pendulum. When given its initial energy, necessary to raise it to one side a certain height, and then released, it drops to its position when at rest but does not stop there because of its inertia, swinging to a height almost as great in the opposite direction and then back and forth, each succeeding swing a little shorter than the one preceding until it comes to rest at a vertical position. The reason it comes to rest is that the friction of the pivot and the air resist its motion, otherwise it would continue to swing indefinitely.

The electrical inertia is vastly greater than the inertia of the pendulum, so when the condenser surfaces are given their initial charge from the secondary of the transformer, they discharge through the high resistance air gap, from the positive



CHARACTERISTIC V-SHAPED DISCHARGE.

plate to the negative. The former, because of its inertia, overdischarges and causes the negative to become positive and the positive, negative. If the air gap is not too long the plates will again discharge only in the opposite direction, repeating this until the charge cannot bridge the air gap. Each discharge is a little weaker than the one preceding, as were the strokes of the pendulum, due to the loss of energy dissipated by the light, heat and sound.



DISCHARGE WITH CONDENSER ACROSS TERMINALS.

The longer the pendulum the less frequently will it swing, and the larger the capacity of the condenser, the less the frequency of the discharges, therefore a small condenser gives a higher freqency than a large one.

When one charge has been dissipated in the spark the transformer again charges the plates to a high voltage and the discharge is repeated.

If the condenser is small enough and the air-gap through which the spark jumps short enough, the condenser can be charged and discharged several times during one alternation of the transformer. If the discharge of the condenser is permitted to pass through a suitable coil of wire in series with the spark gap and a secondary of suitable construction is placed in a proper position to it, we have what constitutes a Tesla coil and induced high frequency current.

EARLY ELECTRIC LOCOMOTIVE.

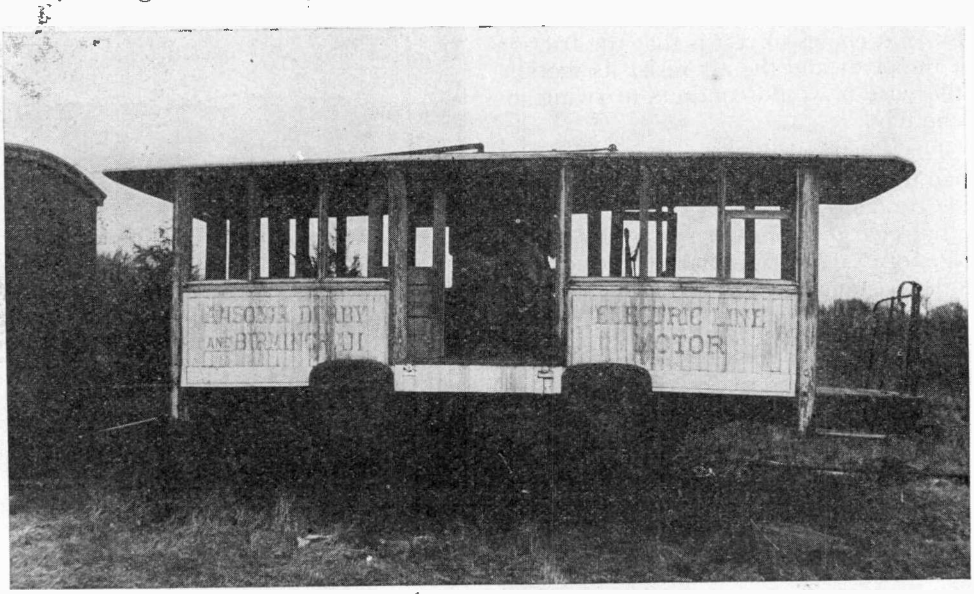
One of the first electric locomotives put in operation for commercial purposes is shown in the picture. It was constructed in Wisconsin and shipped to Derby, Conn., and there put into immediate use for the hauling of freight between the towns of Ansonia and Derby, and was the only means of hauling freight or expressage from the busy manufacturing town of Ansonia to the Derby docks, the marine shipping point for the Naugatuck Valley.

The Naugatuck Valley Steamboat Company used to ply between the cities of New York and Derby, furnishing means for conveying freight between the manufacturing towns of the valley and all commercial points, and this freight was hauled by trucks drawn by horses until electric transportation was installed.

The motor car was among the first of its kind to be built, and the motor was constructed very clumsily, occupying a large portion of the car. The remaining space was devoted to the controling apparatus, brakes, etc. The motor car and trailers were constructed very low, owing to the necessity of passing beneath some low bridges or trestles; and this made it impossible to stand erect in them. The first run was made on the morning of April 30, 1888, from Ansonia to Derby.

Soon after the freight service was inaugurated it was found that the railway company could operate passenger service to replace the horse cars that were plying between Birmingham (now Derby), East Derby and Ansonia, so they had a car constructed of a somewhat similar design to that of the freight service, only the motor was mounted in one end of the car, and the rear was used for passengers. To the motor shaft was attached a union, meshing into a large gear; this gear was mounted upon a steel counter shaft, carried by broad bearings solidly attached to the bottom of the motor, so that the center of the motor shaft was always true with the counter shaft. Attached to this were two sprocket wheels which in turn were connected to two sprockets of larger dimensions and attached to the front axle, the means of propulsion being a steel chain between the sprockets. The motors were of 15 horsepower and the cars would run about 40 miles an hour on level ground.

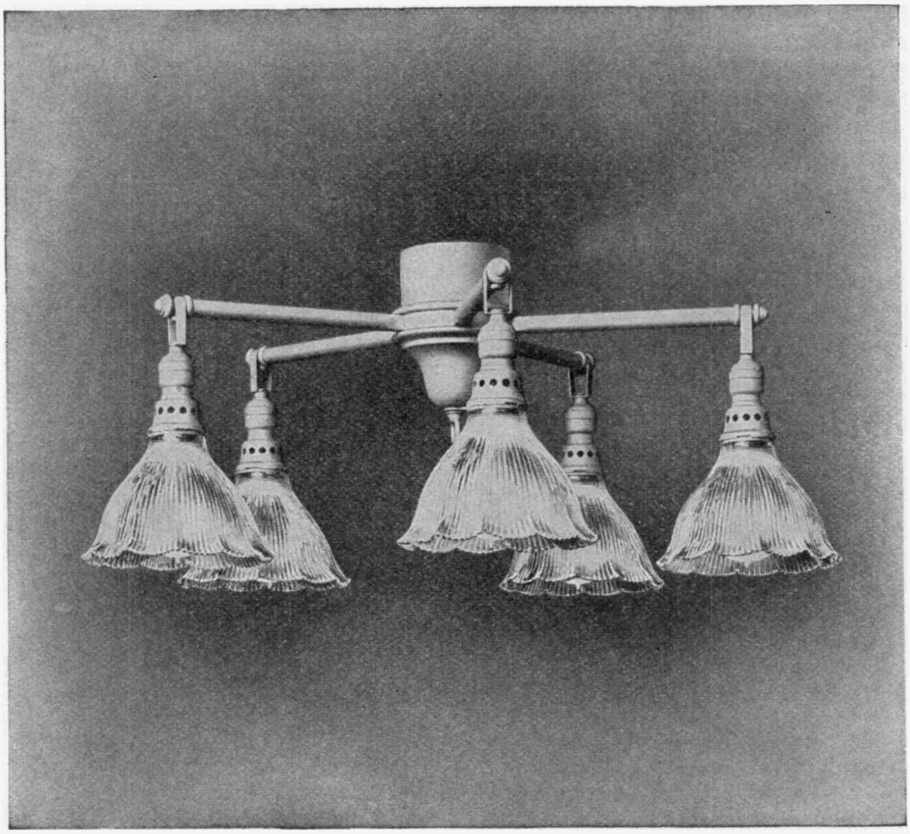
One of these historical motor cars, as shown in the illustration, is now on exhibition at Pine Rock Park, Connecticut.



EARLY ELECTRIC LOCOMOTIVE.

THE TUNGSTOLIER.

The tungsten lamp is here to stay for the simple reason that it gives a near approach to sunlight at a current consumption of 1¼ watts per candlepower. But the lamps cannot be put up in a haphazard manner. Some have tried to do this to their sorrow. They have taken old-fashioned fixtures and tried to shorten them and hammer them into shape to way a tungsten should hang. These requirements are very well attained in the "tungstolier," an example of which is shown in the picture. The particular type illustrated is what is known as the folding tungstolier, that is, its arms work on hinges and may be closed up like an umbrella. It may therefore be shipped and stored in a small, compact package. When it is put into service its arms pro-



THE TUNGSTOLIER.

fit the requirements of the new lamp, with the result that the final cost has been greater than to have installed suitable fixtures at the start.

The principal requirements necessary to obtain the most efficient service from tungsten lamps are prismatic reflectors properly to diffuse and distribute the powerful light; a properly designed fixture to carry the lamps and reflectors, and a simply and substantially constructed link to suspend the lamp in a vertically downward position, which is the ject outward and give a firm and rigid support. The sockets for the lamps, which also carry the shades, are then hung to the arms. The fixture comes already wired, it being only necessary to connect the wires in the stem to the outlet wires and to fasten it to the ceiling.

There are more than seven million telephones in regular service in this country and during the past year more than 7,500,000,000 messages were sent over the wires.

TRAINING A FIRST-AID CORPS.

How many men know how to act when a live wire is sizzling and sputtering around the sidewalk? Who among us could jump to the rescue of some unfortunate who has stepped on a current - carrying third rail? Neither live wire or still more lively rail are likely to suspend business while an expert is sent for, and it is someone's duty to act quickly in such an emergency if lives are to be saved. But saving another's life at the expense of one's own is a sacrifice that does not appeal to the average citizen and visions of sudden death by the method that is becoming the popular one for sending murderers to the great beyond are disturbing factors to the greatest hero among the spectators of an electrical horror.

The demon of the dynamo, however, loses much of his power to paralyze would-be rescuers when knowledge steps in to point the way to safe as well as quick action in rescuing victims of such accidents. This is regarded by the directors of our great railway systems as so self-evident a fact that concerted steps are now being taken to establish a national society of first aid to electrical victims. It is hoped that the work now in progress will in time become so widespread that never will a live wire get loose on one of its rampages or the third rail grip an unsuspecting wanderer in the forbidden paths of our railway lines without some bystander having sense and presence of mind sufficient to do the right thing at the right moment and with sufficient celerity to effect a rescue.

The work has been progressing so quietly that few are aware that this new "first aid" movement is in progress. The

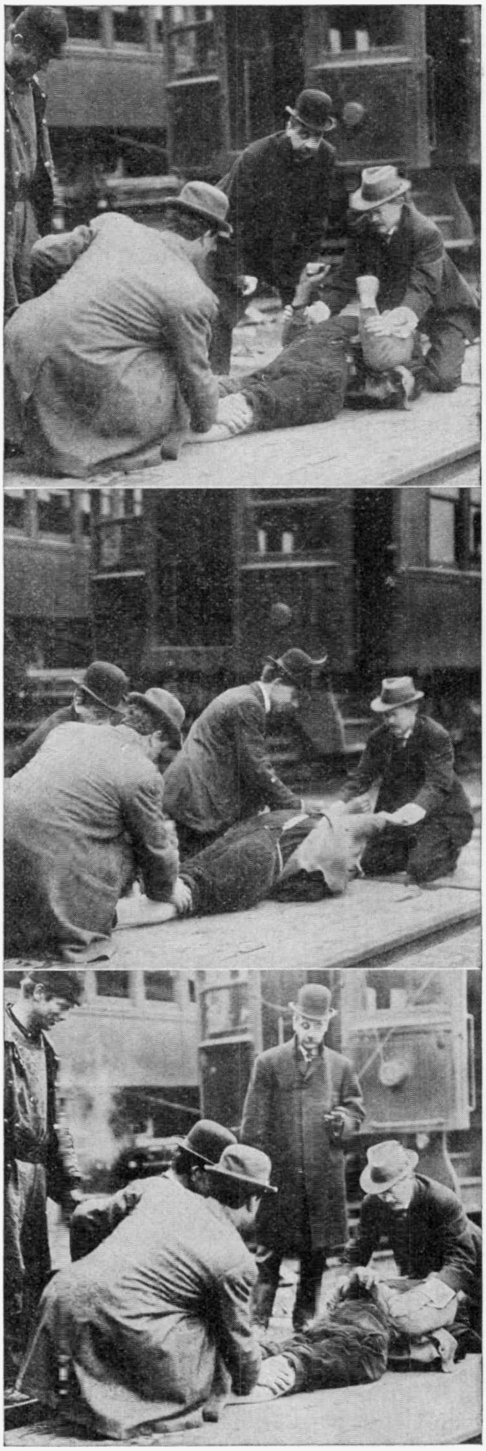
HOW TO REMOVE A VICTIM FROM CONTACT WITH A CHARGED WIRE OR THIRD RAIL.

railways have had expert lecturers going the rounds of work shops and yards, gathering the men in their dinner hour or whenever there is a good chance for an audience and teaching them systematically how to deal with electrical accident cases.

One of the first lessons imparted, naturally, is how to tear the victim of a live wire or third rail accident from the clutch of the terror that lives in the metal. To take the live wire first: The men are taught that the way to detach this wire from the body of the man who has been shocked into helpless unconsciousness is for two of the bystanders to pull off their coats and twist them into a rope. One coat will do if the job of making a rope of two is likely to take too long. The two men run to the scene of the accident, holding between them the rope of coats. Passing this over the wire they can pull it away from the man on the ground without receiving any shock themselves. While they hold the wire away the victim can be dragged from the scene of danger. The coat idea is only advanced because a coat is the handiest thing to use. There is no time to run for a rope. A man can peel his coat off in a second, and having learned the lesson it will occur to him to do this at the first intimation of the need of a rescue.

In the third rail accident the men are told that if they will approach the victim with some caution and grasp him by the slack of his coat he can be dragged from the deadly rail without danger to the rescuer. Or he can be pried from the embrace of the current that is taking his life by means of a wooden bar or any piece of wood that is long enough for the purpose.

It is assumed by the lecturers that the victim will fall across the rail, for almost all third-rail accidents happen this way. A man stepping on the rail drops like a log and naturally drops right into the jaws of death. Now it does not follow that third rail contact kills at the first shock. The voltage is not sufficient to instantly render lifeless a strong and healthy man. It will kill a weak man, in all probability, at the first shock, but even in his case there is a possibility that



METHODS EMPLOYED IN RESUSCITATION FROM ELECTRIC SHOCK.

quick action may save him. In the past the unlucky individual wo has stepped on this concealed death trap has remained there to be shocked to death. In the future it is hoped there will be some "first aid" expert at hand to prevent such a calamity.

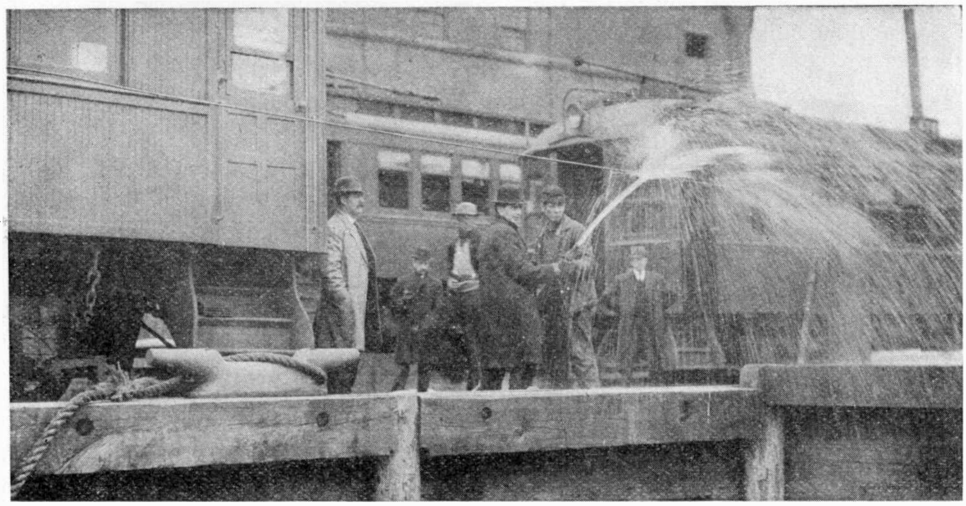
The methods to be used in rescuing victims of electrical accidents are not all that is taught at these first aid lectures. The men are instructed how to go to work when the unconscious man or woman lies prone and still and apparently lifeless. Quick treatment in such cases is as necessary as it is when some swimmer has been dragged unconscious from the waves.

Some of the accompanying pictures, showing a lecture in progress, illustrate the methods of treatment very plainly. The patient is first placed on his back with a coat under his shoulders to permit the head to fall back. His clothing is loosened at the neck and his sleeves and trousers rolled up. While one man is doing this another is examining the man's mouth to see if the tobaccco he may have been chewing at the time of the accident has not slipped down his throat, or his false teeth, if he wears them, are not choking him. If ice is handy this is rubbed on the spine.

Another man during this time can be moving the arms of the patient in the proper way to restore respiration. The arms are brought from the side of the chest to a line straight with the body until they meet over the head. Then they are brought sharply down again. The next movement is to bring the arms in a straight line to the side of the walls of the chest. Then they are pressed over the lower ribs to expel the air drawn in by the previous operations.

An additional lesson, one that has no connection with the saving of life, but which is important to the men who work where live wires are, is the teaching of the use of a hose during a fire.

Many of the men who work in the danger zone know that when a fire breaks out there is not only the risk of contact with broken live wires to be feared, but that the mere playing of a hose on a live wire will give a man a shock that is far from pleasant, to say the least. The men are taught during the lectures how closely they can approach with a hose the vicinity of a live wire. At a distance of seven feet five inches the current from a live wire has not enough power to harm a man who is at the end of a hose from which water is pouring on the wire. If he approaches cautiously he can come within two feet of the wire with the hose pipe without encountering dangerous current, provided his heart is sound.

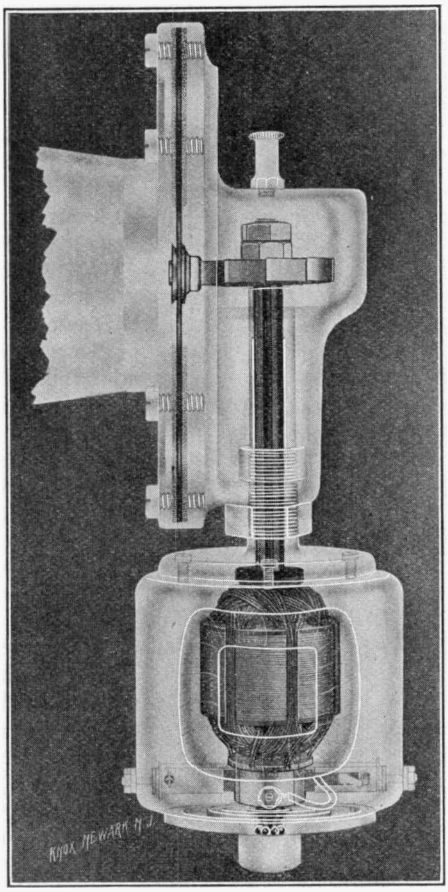


TEACHING THE USE OF A HOSE IN THE NEIGHBORHOOD OF LIVE WIRES.

The lectures are a regularly recognized part of the railway work, paid lecturers being employed to educate the men. Those men who learn how to be electrical "first aiders" pass the knowledge on to their associates, and so the work is spreading fast and satisfactorily.

KLAXON—THE X-RAY OF SOUND.

"A creation in discord" is an appropriate phrase to apply to that strange, penetrating and most startling tone combination produced by the Klaxon, the latest automobile warning signal. In appearance the Klaxon is not unlike the ordinary automobile horn, but it is much different inside, being operated by an electric motor instead of air.


INTERIOR MECHANISM OF THE KLAXON.

One of the illustrations shows the interior mechanism. In the base is a small motor on a vertical shaft which revolves at a tremendous speed. On the upper end of the shaft is a toothed wheel, the teeth striking a knob attached to a vertical diaphragm situated in the horn part. The vibration of the diphragm produces the sound—the most unusual and startling roar that ever greeted human ears. It is only necessary to push a button and turn on the current from the battery which operates the motor. The small illustration shows the exterior of one type of the Klaxon with wires to connect it to the battery.


KLAXON HORN COMPLETE.

The note of the Klaxon drowns every other sound in its vicinity. It cuts through fog readily, and carries to great distances in fair weather. For this reason it is an ideal motor-boat signal. It provides for a long-drawn or sharp-short note and starts or stops instantly. You can install it on either side, in any position you wish, and operate it from any section of your boat.

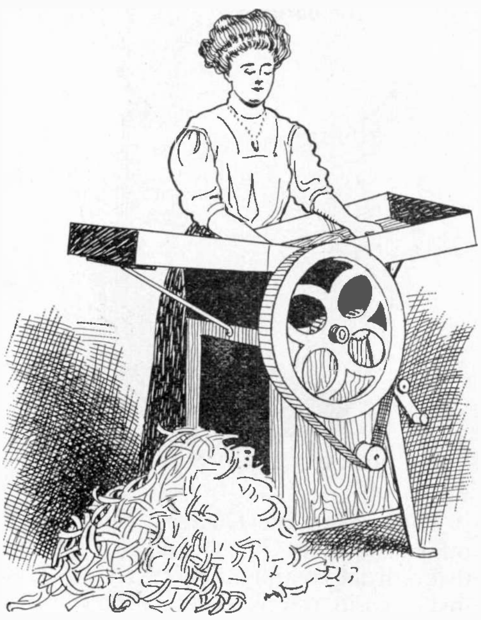
NEW ELECTRIC FURNACE PRODUCT.

A new material has recently been produced in the electric furnace to take the place of platinum for heating elements in electric cooking and heating devices. The new product is called silundum, and is produced by subjecting carbon to the vapor of silicon. The result is a silicified carbon which is similar to silicon carbide and has many of the same properties. It resists temperatures of 1,600°C. and does not oxidize, nor is it affected by acids. As a conductor of electricity its resistance is said to be several times greater than that of carbon.

DESTROYING STREET CAR TICKETS.

Traction companies are much interested in a new ticket destroying device which runs by electric power and literally "chews up" used tickets by the thousands, converting them into a salable product in the shape of waste paper, to be sold to paper mills or for packing purposes.

This machine is so simple that it can be operated by an office boy or girl. While in operation it occupies a space of two feet by four feet. The feeding boards or tables are hinged and may be dropped down out of the way when not in use. There are two of these tables enabling two operators to feed at the same time, thereby increasing the capacity.



TICKET DESTROYER.

Enclosed in the bottom of the frame is a ⅝ horsepower motor, the operation of which will not be attended by any disagreeable noise in the office. Sixty circular knives of high grade steel 11/32 inch thick are placed on two parallel shafts geared together by cut gears. Each knife is interchangeable. In case of injury to any one of these knives by a piece of metal passing between the rolls, it can be replaced at very small cost.

STANDARD ELECTRIC TIME SYSTEM.

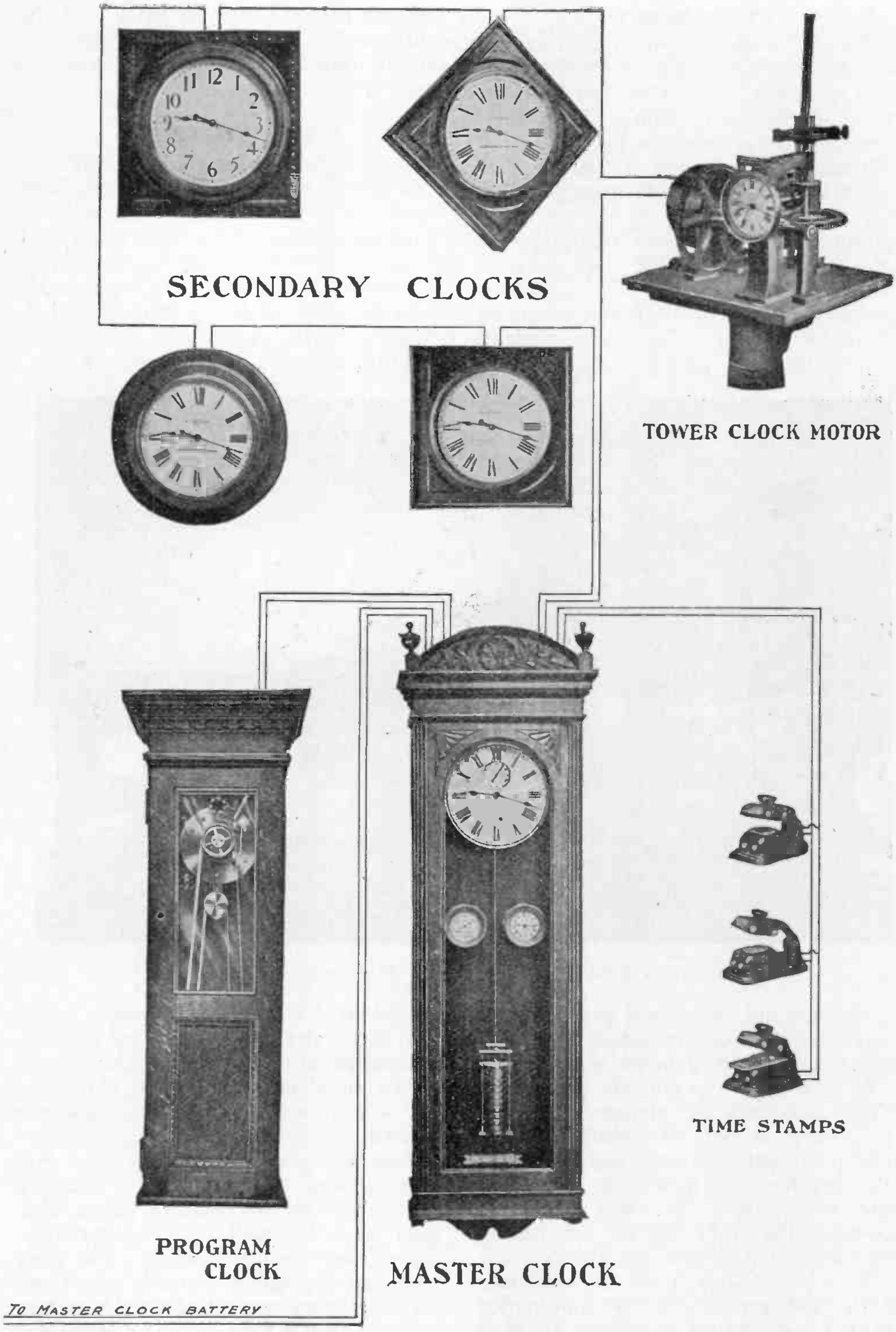
Punctuality is essential to discipline, system and economy in all departments of life. To aid people to be punctual electricity is used in scores of ways, but even the people in whom these various systems are designed to stimulate promptness do not understand their mysterious working.

A modern electric time system consists essentially of a perfectly made, electric, self-winding master clock, which performs the dual function not only of keeping very precise time itself, but of controlling electric impulses to various other time keeping devises of which the system is composed.

The illustration shown herewith represents, diagrammatically, a master clock from which radiate electric circuits controlling time stamps; secondary clocks, which keep the exact time of the master clock, a tower clock motor for operating the clocks in a tower or steeple, and a program clock, which is sometimes used in schools. Electrically operated whistles may be added to the system and many other applications will suggest themselves.

One of the most interesting features of the system is the program clock, which may be used for a great variety of purposes, such as automatic signal work and the automatic starting and stopping of machines. This program clock drives paper ribbons which are perforated for the hours and minutes that signals should be given and thus permit electric circuits to be made through the perforations to the signal apparatus, as the ribbons slowly unwind. One program clock may control from one to eight independent and distinct circuits of signals with any number of bells on each circuit. Furthermore, the program clock is capable of automatically changing the program from day to day by cutting out a program on Sundays or giving any combination of programs that may be desired.

These program clocks have found many useful applications in schools for ringing signals for the dismissal of classes, changing of study periods, etc. There is, however, a wide, economic field for them in industrial work,



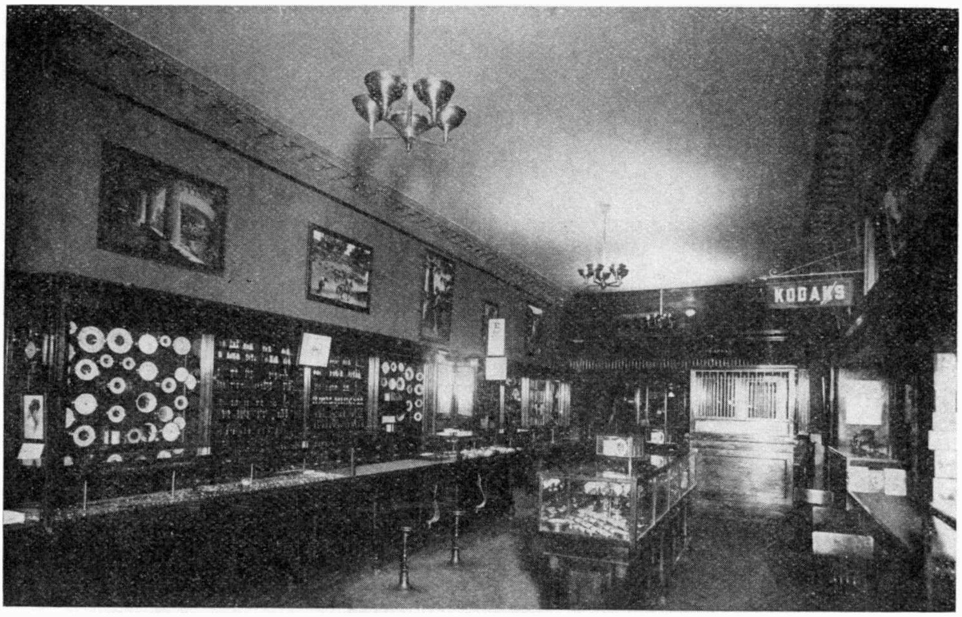
SOME APPLICATIONS OF THE STANDARD ELECTRIC TIME SYSTEM.

EYE COMFORT.

The new method of indirect illumination, called the "I-comfort" (eye comfort) system, which was described in the December issue of Popular Electricity, is now made in what is known as the "adaptable" form; that is, the peculiar inverted reflectors are so arranged that they may be attached to the ordinary lighting fixtures without changing the latter, thus making the new system "adaptable" to the old. The system is meeting with favor in many instances where heretofore it has been difficult properly to illuminate the working plane, as in counting rooms and places where large clerical forces are employed. It is said that by this system the glare on the books and papers is entirely eliminated.

The accompanying picture shows the "I-comfort" system of lighting applied to a large optical goods store. Adaptables are here used on what were old-style electroliers, the new reflectors throwing the light up on the ceiling from whence it is reflected evenly.

The chief claims made by adherents of the indirect system of illumination are that it not only removes the cause of eye distress and frequent headaches, thereby conserving the bodily energy, but that it lessens the tendency to irritability, and one working under such conditions must be physically and mentally better at the day's end.



INDIRECT ILLUMINATION IN OPTICAL GOODS STORE.

A NEW ILLUMINANT.

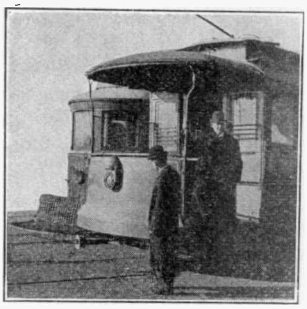
Plates of aluminum alloy used as electrodes form a new kind of electric lamp that is said to promise efficient and economical lighting. Trial was made with an alloy much used for motor castings and containing 90 per cent of aluminum, the remaining 10 per cent being chiefly copper and tin, with some manganese, iron and zinc and traces of silicon. Immersed in a solution of common borax such electrodes stand a current gradually brought up to 250 volts. The current causes the electrodes to glow like white hot iron in water without the sparking of pure aluminum, and with a lowered voltage an opal colored light was produced giving the effect of a building lighted with many concealed lamps. Beyond 200 volts small, shifting sparks appeared over a white surface. The glow resembles the light sometimes seen about wires carrying current of very high tension, but in this case there is a static discharge of electricity through the thin film of aluminum oxide coating the plates.

SIGNAL TO PREVENT CAR ACCIDENTS.

A prolific source of street car accidents is for a person to alight from the rear platform, pass around the rear end of the car and step onto the next track right in front of a car coming from the opposite direction and necessarily hidden from view until too late. Its bell may be clanging, but so also may be eight or ten others in the vicinity of a busy corner, and in the rush and turmoil it is so easy to be thinking of other things besides a mere street car.

A device which will prove efficient in preventing this particularly prevalent form of accident has been thought out by Mr. A. O. Nichols of Omaha, Neb. It consists of a signal bell mounted on the rear of the car and operated with a push button by the motorman up in front. When the latter sees a car approaching on the parallel track while his own car is standing still, he rings the signal bell as long as there is any danger. This calls the attention of people passing the rear end of the stationary car to the approach of a car on the other track. The bell casing also bears, in plain letters, the following: "Look Out for Car on Other Track," which is illuminated at night by an electric lamp.

EXTERIOR VIEW.


SIGNAL IN OPERATION.


INTERIOR VIEW.

ELECTRIC CURRENT CONSUMPTION IN NEW YORK.

The New York Edison Company has about 65,000 customers on its lines extending over Manhattan Island and the Borough of the Bronx. Current is fed through 81,000 meters to an equivalent of 6,000,000 lamps. The electric motors taking current from the company figure up about 186,000 horsepower.

ALL DAY SERVICE IN SMALL CITIES.

Time was when electricity was used almost entirely for lighting purposes. During the hours between dusk and daybreak the electric lighting plants ran the generators at their greatest capacity to take care of the thousands of lights burning in the streets, the shops and factories, the offices and homes. But as soon as old Sol peeked above the eastern hills the electrical engineer in the power house opened a switch and the arc lamps in the streets instantly went out, though the red hot tips of the carbon electrodes glowed for a few seconds in the morning light. In a few minutes more another switch was turned and the lights for the houses and buildings were turned off and the great generators soon stopped with no work to do during the daylight hours. The engines stopped running, the machinery stood motionless, the fires were banked, the steam pressure went down, while the engineer and his assistants killed time in cleaning up the different machines and polishing the brass fixtures, or went home to sleep.

But electricity has found so many new fields of employment in the past few years, and has come into such general usefulness in the shop, office and household by day that nearly every public electric power plant in towns of any size at all is now running day and night. The time has arrived when the power plants can earn nearly as much during the day as they do during the night. The electrical energy which was exclusively used for lighting purposes in the past is now recognized as the ideal source of power and an important factor in the heating world.

INVENTIONS OF EDISON—A CLASSIFICATION.

BY JOSEPH J. O'BRIEN.

Edison and invention are two words that have become almost synonymous in the minds of millions. As America has led the world in the volume of invention, so Edison has led in the volume of inventions produced by individuals.

Out of millions of experiments with nature things and with man things this nation has been developed into its present state of greatness. All the wonderful industrial arts of our time are the results of human experience organized by human experiments and developed into the organized knowledge of human science. The experiment is the instrument of invention and the product of experiment is art. Without art man would have remained uncivilized. Civilization, then, is the social effect of art, and since art is the product of invention, civilization is the elaborated effect of human invention.

Future fame will rest largely on the art test and not on the military test, and by this test Edison is greater than Cæsar. A great deal of exaggeration and a great deal of misrepresentation concerning the inventions of Edison have been indulged in. The scope of his work has been carried beyond truthful bounds by some, while it has been seriously underestimated by many writers who occupy positions of authority. In the Encyclopedia Americana it is stated: "More than three hundred patents have been issued on his inventions." This statement was 50 per cent wrong at the time it was published.

Other men have invented more complicated machines than Edison has; other men have solved tremendously difficult inventive problems. But in the volume of output; in the persistency of endeavor; in the brilliancy of experimental resolution, Edison stands forth as the inventor-leader of our time and our period—the wizard of experiment. It was Edison who subdivided the elusive electrical current, in the face of negatively figuring mathematicians, and brought the incandescent lamp out of the field of laboratory speculation and into that of commercial use and success. An achievement which is of infinitely greater importance to the world than the erection of time wearing pyramids of little utilitarian value.

The production of a successful incandescent lamp demanded efficient current generating machines, efficient distributing systems, efficient control systems, and practical manufacturing and business methods. The problem was not merely one of carbonizing bamboo and durable lamp construction, but of economical, gas-competing illumination. Accordingly the entire field of seen possibilities was overhauled by the inventors, with Edison, the master experimenter in the lead. The influence of the successful incandescent lamp upon the entire field of electrical endeavor has never been fully established, but it is now recognized that the science of electrical engineering owes its greatest stimulus to the development of the successful incandescent lamp, which is made up of a bulb having a vacuum and a high resistance conductor therein. The incandescent lamp not only brought about the development of the science of electrical engineering and gave rise to whole industries embracing billions of invested capital, but rendered possible the modern stage, the wonders of which we are only beginning to see.

It was Edison who invented the continuous photographic film which has now been elaborated into an ever expanding art of photographic illustration. This art has brought a world of knowledge to every class and compelled the reform of opinion-ribbed art notions. This art has brought distant cities and peoples to our feet and made world-study a pleasure to the most indifferent. The moving picture theaters are now an established amusement feature of every city, and it is estimated that over forty million tickets are sold each week. Who can estimate the influence of this work upon the minds, hearts and relations of men? We cannot even appreciate it as yet.

John Philip Sousa says that the phonograph gave us "canned music."

Certainly. So did photography give us "canned" images and movements. So did type give us "canned" knowledge and "canned" history. In fact this work of canning things, of canning records, images, memories, tones, songs, voices, movements, events, forms a very vital part of the work of civilization. Since it is by art man advances it is by man's efforts in preserving and experimenting with art that art advances, and the advance of both involves the transmission of intelligence.

In order that the general scope of Edison's work might be better understood I have classified the patented inventions of Edison, and for the first time here give the general results of this classification in the following table. This classification does not attempt to give all of the many details of Edison's inventions, but does give the reader an accurate idea of the fields into which Edison has worked with results.

NAME OF ART.	MINOR ART.	PATENTS
Electrical Power Machinery.	Generators, Motors, Regulators, Governors, Machine parts.	123
Electrical batteries.	Storage batteries, Generating Batteries, Thermo-electric batteries, Processes of manufacture, Manufacturing aids, Battery parts, Gas manipulation.	64
Measurement of Electricity.	Meters, Controlling temperature of.	17
Distribution of Electricity.	Systems of distribution, Conductors, Fuse blocks, Junction box, Lightning arrester. Converters.	60
Electrical Communication.	Telegraphy, art of, Telegraph circuits, Telegraph instruments, Telegraph instrument parts, Telephony, Telephone instruments, Telephone circuits, Telephone parts, Signaling, Signaling instruments, Signaling boxes.	178
Electrical Illumination.	System of electric light, Incandescent lamps, Arc lamps, Fluorescent lamp, Filaments, Manufacture of filaments, Manufacture of lamps, Vacuum pump, Carbonizer, Thermal regulator, Safety conductor, Lamp parts, Electric chandelier, Conductors, Cut-outs.	190
Electric Traction.	Electric railway, Electric locomotives, Propelling mechanisms, Railway systems, Turn tables, Trolleys, Insulation, Handling cable cars.	22
Phonographs.	Phonographs, Blanks, Phonograph parts, Phonograph dolls, Manufacturing blanks, Manufacturing tools.	98
Electroplating and Electrometallurgy.	Metal plating, Tools for plating, Electrolytic composition, Electric welding, Metabolizing iron.	11
Ore Manipulation.	Magnetic ore separators, Method of ore separation, Magnetic ore controlling, Grinding Machines, Ore conveyors, Screening, Crushing machines, Extracting ores, Mixers, Briquet making, Composition brick, Compressing dies, Making cement, Cement kilns, Cement, Drier	65
Photography.	Kinetoscope, Kinetographic camera, Kinetoscopic film.	4
Office Appliances.	Electrographic vote recorder, Autographic printing, Typewriting machines, Addressing machines, Autographic stencils, Stencil pens.	9
Journal Bearings and Gearing.	Expansion pulleys, Lubricating journal bearings, Shafting, Vehicle wheel, Dustproof bearings, Dustproof swivel gearing, Magnetic belting.	9
Glass.	Process of making glass, Apparatus for making glass.	3
Compressed Air.	Reheating compressed air.	2
Wire drawing.	Method of drawing wire.	1
Fruit preserving.	Vacuum fruit preserving.	1
Weighing.	Automatic weighing apparatus.	1

SUMMARIES.

Total groups of main arts.................... 18
Total subdivisions of main arts..............103
Total number of patents..................858

The above classification is the first of its kind that has ever been published and deserves particular consideration for this, if for no other reason. It places in a concrete shape the inventions of Edison and enables the layman to readily ascertain what fields the "Wizard" has invaded with patent results. The electrical character of Edison's work is seen at a glance. Telegraphic work led to the vote recorder, to the stencil pen, which in turn opened up the way for various office appliances, and to the larger field of telephonic invention. Telephonic work led to phonographic work, while general work with the electromagnets led directly to the magnetic ore separator. The magnetic ore separator opened up the field of mining and cement, which now promise some new wonders. The electric lamp led to generators, distributing systems, meters, regulators and manufacturing processes. As a by-product of vacuum work we have Edison's contribution to the art of fruit preserving by means of a vacuum. The generation of electrical energy and the commercial exploitation of that energy compelled work on storage batteries, which work continues without interruption.

The entire work of Edison presents a consistent evolution of things electrical in nature or in relation, and if one attempts to trace this work beyond the years of our time he will find it leading to the workshops and laboratories of Europe; to the "dancing frog" of Galvani; the "electric pile" of Volta; the magnet of Sturgeon; the discoveries of electro-magnetism; dynamic generation, and the differences between insulators and conductors. Without the magnet and the battery Edison could not have built up his magnificent work and it is to Europe that we owe these vital contributions.

CONTROL OF MOVING PICTURE ARCS.

Arc lamps for moving picture machines operate on approximately 35 volts and 40 amperes. Now 35 volts is away below that of the usual lighting circuit, which is about 110 volts. Therefore, the arcs cannot be operated directly across the light wires without the use of a device called a rheostat. The latter contains a lot of iron wire of high resistance connected in series with the arc lamp to keep too much current from flowing through the latter. But the rheostat itself consumes current which costs money, and besides, gives out a lot of heat which is uncomfortable in the close quarters usually occupied by the operator.

A device designed to eliminate the rheostat is called the Compensarc, shown in Fig. 1. This is on the order of a transformer to reduce the voltage of the lighting current to a value suitable for the arc lamp. Unlike the ordinary transformer, however, it is provided with various adjustment features to maintain the arc of a constant strength and uniform quality so essential to the production of clear and steady pictures.

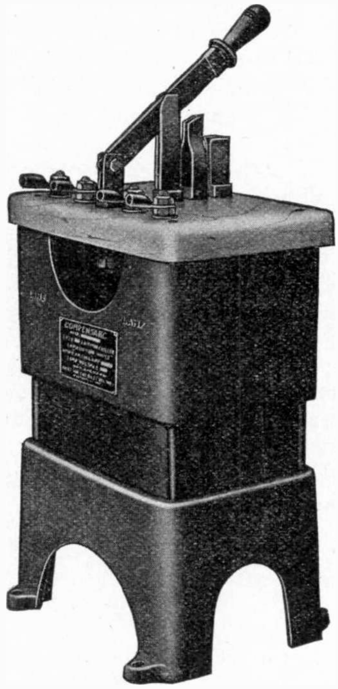


FIG. 1. THE COMPENSARC.

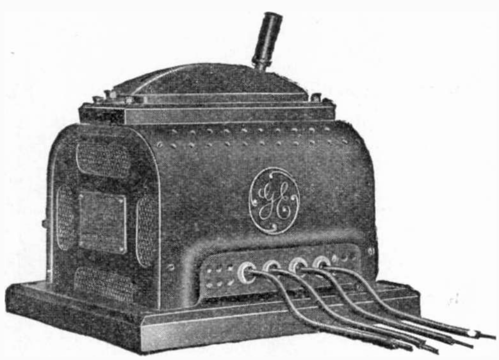
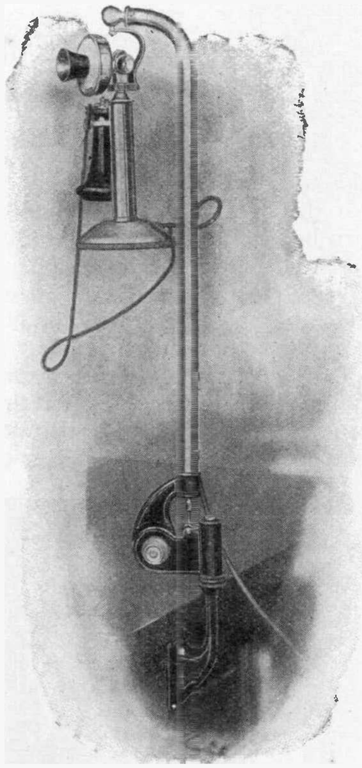


FIG. 2. ECONOMY-ARC.

Another apparatus known as the Economy-arc, Fig. 2, is also a saver of light bills. The regulation made possible by this device overcomes varying conditions such as result from different densities of films and different distances between lamp and screen. For the convenience of the operator the attachment wires are brought out through porcelain bushings in the casing, and each pair is marked, one "line" and the other "lamp," so that wrong connections cannot be made.



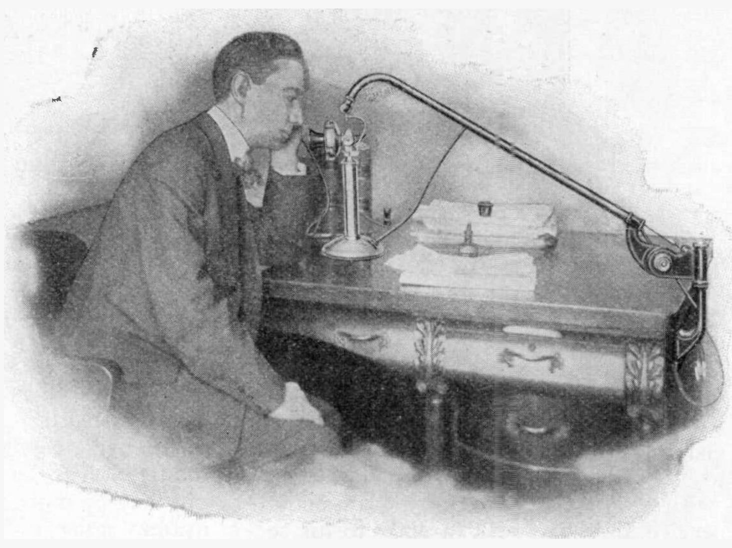
RADIO ADJUSTABLE TELEPHONE HOLDER.

RADIO ADJUSTABLE TELEPHONE HOLDER.

The Radio adjustable telephone holder is the latest invention of Kempster B. Miller and Samuel McMeen of the firm of McMeen & Miller, telephone engineers. It is adapted to any make of desk telephone and can be mounted on a desk or table or on the wall or floor. By a simple and easily adjusted device which clamps around the upper part of the telephone the latter is flexibly suspended from the arm, always in a vertical position. The arm in turn can be moved around in any position, up or down or sidewise and will stay perfectly balanced in any position.

Some of the advantages of this unique holder are the following: Permits one telephone to serve four people without getting up from their desks; when not in use the telephone is off the desk and out of the way; can be used standing up or sitting down; holds the instrument always in a vertical position unless the user desires to tilt it while talking.

The convenience of a movable holder for the telephone can only be appreciated after it has been in actual use. The ordinary desk telephone, with its usually tangled cord, will occupy about a square foot of desk space and is always in the way. An unlucky move will often push it off onto the floor, and the result is a broken mouthpiece if nothing more serious.



RADIO TELEPHONE HOLDER IN USE

THE DICTOGRAPH.

The Last Word in the Conservation of Business Energy.

BY JOSEPH B. BAKER.

How to conserve the time and attention of the overdriven executives of the modern business world is a serious problem. In the great organizations of today the utmost efficiency of operation must be attained. This iron condition of success has a particular bearing in the matter of the countless written and oral communications of all kinds that are carried on. In the life-and-death struggle of competition, every day is a day of battle in which he holds the supreme command. Should not the contact between the giving of his orders and their intelligent obedience be as direct and close as it can possibly be made?

Let us examine briefly the different ways that the busy executive ordinarily has at his disposal for impressing the decision of his master mind upon others, to be by them transmuted into action.

First, for things requiring immediate service, he may speak directly to his secretary, managers, or other assistants, in the same room, or he may press a button to summon them from another room. Second, for things that need not be done on the instant, he may dictate instructions to a phonograph for writing or execution later. Third, for things not needing to be written for him, he may pick up a telephone and talk with people in his own building, in other parts of the city, or in distant cities.

All these three ways of imparting the mind of the executive involve wasting his time and attention; they are little leaks of his valuable dynamic energy scattered through his day of five to seven hours, and making a large aggregate loss.

PRESIDENT OF A LARGE COMPANY DICTATING THROUGH THE DICTOGRAPH.

The first way is the most wasteful. Suppose he needs his secretary, acting as his personal stenographer. If he prefers to have the secretary constantly nearby, in his private office, there is direct communication to be sure, but this time-saving may be more than offset by the intermittent noise of her typewriter. But if she is in an adjoining room there is the time she takes in coming into the office in answer to the call—including the few seconds consumed in gathering up her note-book and pencil, and perhaps also taking a letter out of her machine, arranging her papers, or making a memorandum. Whatever the time is, an irreducible minimum of seconds is lost in this way which is an unconscious irritation to the executive, who "wants what he wants when he wants it."

The second way—the use of the phonograph—is helpful to some extent, and has a field of usefulness. But the utter lack of the human element is often objectionable; and the only way the machine saves a man's time is by enabling him to give his dictation at his convenience without requiring the presence of the typist.

The intercommunicating telephone system is a time-saver, but has no application to dictation. From the viewpoint of the busy executive it has the serious objection of holding him up pretty completely from other activities for the time being.

How can all this waste of time and energy in the machinery of business communication be abolished? For the busiest man, carrying the heaviest responsibilities, the clock goes 'round just as fast as for the idlest and least burdened. Is not some better, freer route to the minds and hands of his assistants possible?

The solution of the problem is the Dictograph, an instrument which eliminates all the "lost motion" between the executive and his subordinates by establishing immediate oral communication with them without the ordinary transmitter to be talked into, or a receiver to be held to the ear. Impressing his mind is reduced to the simplest conceivable process—mere unencumbered vocal utterance.

The Dictograph, as it appears on the executive's desk, consists of a small box containing an extraordinarily sensitive transmitter and a loud-speaking receiver. An ear-piece receiver is also provided. On the front of the box are a number of simple electric switches and signals. That is all there is to the "master station."

Even less pretentious are the "substations" which are installed on the desks of the subordinates and each of which is connected by wire to the master station, where it terminates in a switch and signal. The sub-station consists only of a transmitter and an ear-piece receiver. The latter may be held against the ear by a head-band, like that used by telephone operators, so as to leave both hands free to manage note book and pencil.

In using the Dictograph no "Central" is necessary. In fact the manipulation is so simple as to leave almost nothing to describe! The executive does everything by direct vocal utterance, without having to approach a telephone instrument, in fact freed entirely from the paraphernalia of the telephone. A simple movement brings the subordinate's ear and voice to receive and acknowledge instructions spoken in an ordinary tone. To dictate a letter, for example, one touches one of the little levers on the Dictograph box. This signals the stenographer, and her reply emanates from the box just as though she were actually sitting beside one's desk, though in reality she is sitting at her own desk in another room. One then proceeds with the dictation, speaking right out into the air in the customary way, every word being heard and taken down by the stenographer at the other end of the wire. If the dictator wishes, he may get up from his chair and walk about the room while dictating, speaking part of the time with his back turned; yet every syllable is caught by the stenographer through the sensitive electric ear on her employer's desk. Should secrecy of reply be desired, he may silence the loud-speaking receiver and use the ear-piece instead.

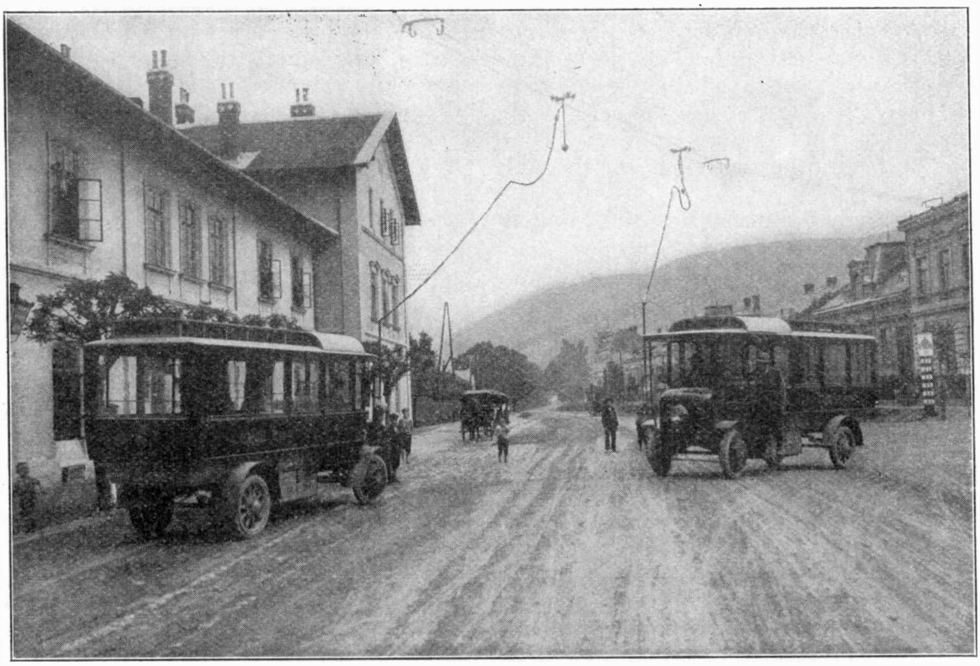
A demonstration of the Dictograph gives to a busy man a vivid realization of how many of his ideas have been evaporating, how much of the freshness and vigor of his letters have been lost. Then there is the secrecy attained. The physical presence of a stenographer or other persons in the private office has a dampening effect under some circumstances. Many a business deal has gone awry because the principals felt unable to talk freely.

Where this system is installed conferences may be held over the wire without any of the conferees leaving their desks. The system lends itself no less admirably to more formal conferences. A master station on the board-room table at a Directors' meeting enables any of the directors to speak with any one in the establishment—to obtain needed information, receive messages, etc. — without leaving his associates, or losing touch with the proceedings.

The apparatus, which is made by the National Dictograph Company of New York, has already been installed in several prominent banks, trust companies and large commercial institutions in New York, Chicago and elsewhere.

TRACKLESS TROLLEYS OF VIENNA.

By trackless trolleys are meant electric buses or automobiles which follow the pavements or country roads as an ordinary road vehicle but which derive their current from an overhead trolley wire, as in the case of a street car which runs upon rails. They have not been operated with success in this country, but in Europe there are a number of systems in use which are apparently economical, due, no doubt, to the excellent road beds that there prevail. One interesting line of this character is at Weidling, near Vienna, Austria, and is 2.3 miles long, with gradients as great as 7 per cent.



TRACKLESS TROLLEY OMNIBUSES.

There are five trackless trolley cars or omnibuses in service, each carrying 21 passengers. About 100 miles are run daily from 5 o'clock in the morning until midnight. With three cars running, 2,700 passengers are carried without difficulty on Sundays. Only 10 seconds are required for interchanging the trolley cables at the meeting of the cars, this being done at any point on the line.

It is maintained that the two 20-horsepower motors on these omnibuses may be overloaded to double their usual output, in emergencies, without getting dangerously hot. The cars weigh only 2.5 tons each, and this small weight, compared with the load carried, has an important bearing on road surface wear, rubber tire wear, and consumption of current.

This trackless trolley system is the invention of Ludwig Stoll of Vienna, and among the strong claims made for the system are its simple, rapid, silent and smooth running, as well as its freedom from breakdowns and interruptions of service.

Current is collected by a little wheeled arrangement which runs along on the trolley wires and from which flexible conductors depend, conducting the current to the car. There are two trolley wires, one positive and the other negative.

It is stated that the trolley runs with little or no sparking, the wheels running on ball bearings, and the pull of the cable acting upon a very short lever-arm. The center of gravity of the trolley is very low, so that there is no deviation of the trolley in spite of strong transverse pull, the conducting cable being long enough to follow the car. There is an upper sliding knot tied up on the pendulum weight, as shown in the illustration, and stretched by means of a spring from the latter. There is also provided a cable roller with 30 or 40 feet of cable which is let out or rolled up by means of a spiral spring.

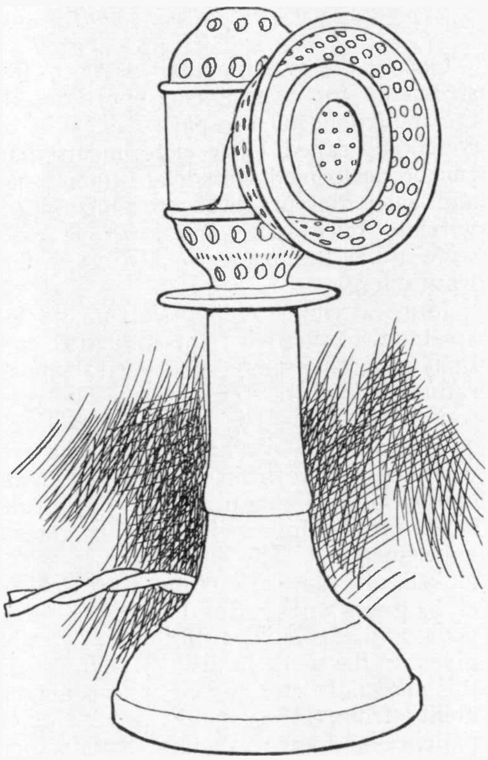
By the use of these two appliances the car is allowed to run on the whole width of the roadway, to turn out in overtaking or meeting automobiles or other vehicles and accommodate itself to every form of traffic. When two trackless trolley cars meet the motormen simply interchange the trolley cables by detachable contact boxes, this being a decided advantage over a single track electric railway on which much time is lost in waiting at passing points.

EARTH CURRENTS.

Great local differences in the electrification of the earth are known to exist, and a German engineer suggests that with better knowledge it may be possible to make mining for electricity as profitable as digging for coal or metals. In experiments in two comparatively shallow borings, he has obtained weak currents between a small rod of brass or iron immersed in the water of the pit and a similar rod buried near the surface. He urges that contractors, mining companies and others take up the problem, and perform such experiments as testing the current between a 60-foot copper cylinder at the bottom of a boring of thirty thousand feet or more and a similar cylinder buried in moist ground at the surface, also investigating the charges to be obtained from long iron pipes buried in the ground.

CIGAR LIGHTER.

No doubt the desk telephone, which is so indispensable in all offices, suggested the unique design of the cigar lighter shown herewith. This lighter is made with a substantial base and the heating element is contained in a projection on the side which looks very much like a telephone mouthpiece. The wires from the lamp socket lead into the base and being flexible permit the lighter to be moved around readily over the counter or showcase.



CIGAR LIGHTER.

To demonstrate that the electric chair does not kill, but makes victims comatose, it is said that a New York man, Charles Quill, allowed 1,800 volts to pass through his body. Quill was not injured in the test.

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.

SPARK COIL CONSTRUCTION AND OPERATION.

BY VICTOR H. LAUGHTER.

PART I.

One of the most popular electrical instruments for experimental purposes is the induction coil or spark coil, as it is commonly called. The experiments that can be performed with it are numerous, and since the practical introduction of wireless telegraphy, it has come into wide use as the means for setting up the wave energy.

More attempts are possibly made by amateurs to construct the induction coil than any other piece of electrical apparatus and with poorer results. The reason is obvious. The induction coil requires careful work, and parts which are designed to work in conjunction with one another to obtain results. This rule is not usually followed out by the casual experimenter. The insulation is overlooked, and the various parts are selected by guess work. Results are of course poor, and the builder of the coil finally gives up the work in disgust. However, this need not deter anyone with ordinary ability from taking up the work, for if patience and care are used satisfactory results may be obtained.

As the same plan of construction is followed out with all spark coils, only one size will be described here, but dimensions of the other sizes will be given. The amateur may then construct any other size by following out the same general plan.

The spark coil complete constitutes the following parts: Iron wire core; primary winding; insulating tube; secondary winding; vibrator, and condenser The complete parts as connected up for use are shown in Fig. 1, in which (A) represents an iron wire core, (B) the primary winding, (C) the insulating tube and (D) the secondary winding. The complete vibrator is made up of parts (G), (M) and (F). (H) is the condenser and (I)the battery. Before going into the construction it would be advisable to study out the action which takes place in a spark coil in operation, as this will give a clearer idea of the parts

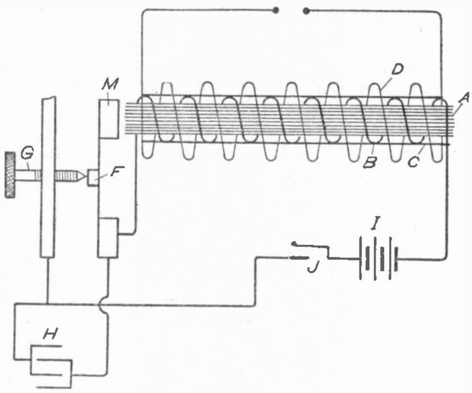


FIG. 1. GENERAL CONSTRUCTION OF A SPARK COIL.

involved. We have the core (A) which is a circular bundle of soft iron wires. Over the core is wound the layers of heavy wire known as the primary winding, and over the primary a large number of turns of small wire known as the secondary. The two windings are insulated from one another by the tube (C). The primary winding leads down to the battery at (I) and to key (J), and from the opposite side of the key (J) to the metal post which supports the screw (G). The screw (G) is platinum tipped and rests against the second platinum contact (F), which is mounted on a brass spring strip bearing the soft metal disk (M) fastened on the end. This strip as shown is connected to the remaining terminal of the primary winding. The secondary terminals lead up to binding posts mounted on the top of the coil case.

When the key (J) is closed the current circulates from the battery (I) around the windings over the iron core and completes the circuit through the contacts (F) and (G). The electrical current flowing through the primary winding sets up magnetic effects in the core, which extend out in invisible lines through the secondary winding. As the disk (M) is of soft iron it is susceptible to magnetic effects and will be attracted towards the coil (A). The disk in its forward movement pulls the spring which breaks the circuit at the contact (F). The current now ceases to flow, and as the core is magnetic only as long as the current flows, the pull on the disk is released, allowing it to fly back to its original position only to repeat the operation over again. At each "make and break" a pressure of several thousand volts is induced in the secondary winding, this action being due to the high ratio of the secondary to primary turns. The current induced in the secondary flows to the terminals and jumps the spark gap. The length of the spark gap the current will jump is largely determined by the adjustment of the "make and break" device, commonly called the vibrator. The condenser (H) connected across the vibrator contacts serves a useful purpose. The spark at the contacts would be very large and hot and would soon melt the platinum if it were not for the fact that the condenser takes up this spark in the form of a charge and in turn discharges back into the primary winding.

Now that the operation of the coil and parts used have been described, the actual construction will be taken up.

In view of the fact that the amateur prefers a coil that can be used for nearly all ordinary laboratory work, one of the four-inch size will be described. A coil of this size can be used for wireless telegraphy up to a distance of 10 to 20 miles, and for X-ray work, lighting Geisler tubes and numerous other purposes.

CORE.

The core is usually one of the most neglected parts of the coil, whereas, it is one of the most important features. The desired feature of the core is that it should be made of very soft and small iron wire, cut to the exact length, with as many pieces forced into the bundle as possible. In all cases the wires should be well annealed. The reason for using a large number of small wires for the core, in place of a solid iron body, is that a core of the first named type is capable of taking on and losing the magnetic effects much quicker than a core of the same metal in a solid body. That is, the solid core would not take on and unload the magnetic effects as fast as the vibrator worked, which would result in a weak and stringy spark. We have this same action in a condenser in a slightly different sense, which will be explained later. A core built up of a large number of small wires is said to be of the laminated type, and we find the principle of lamination extended to other electrical instruments.

A core for the coil in view should be 10 inches long, 1⅛ inches in diameter, built up in a circular bundle of soft iron wires. In view of the important part the core plays and the difficulty experienced in building it up, the writer would recommend that the amateur buy it complete, as the cost will not exceed 50 cents. However, some may prefer to perform the actual construction. First get a sufficient quantity of No. 22, well annealed, soft iron wire to form a bundle 1⅛ inches in diameter, the wires being previously cut to the proper length and made straight. To form the core first roll a tight flexible paper tube to the desired diameter and glue. Fill the tube as full as possible with the core wires and roll with pressure between two boards. This will cause the wires to cling more closely together. Remove the tube and force in more wires, continuing the operation until the tube is full and has taken on a circular shape. Next wrap the tube from end to end with unwaxed shoemaker's thread, making the respective turns fit evenly and neatly together. Over the thread is now wrapped about 15 layers of thin porous tissue paper, and the whole boiled out in a half and half mixture of paraffine and beeswax, for at least 30 minutes, or until all bubbles cease coming to the surface.

The primary winding is made up of

two layers of No. 14 single cotton covered magnet wire wound on the core continuously to within ¾ inch of each end. A lead about four inches long should be left unwound to connect to the vibrator and battery. The respective turns of the primary winding should be made as neatly as possible, for kinks, etc., will to a certain extent impair the working efficiency.

The completed core and primary winding is illustrated in Fig. 2. When completed as shown the boiling out process is gone through again.

THE INSULATING TUBE.

The insulating tube for the small size coils up to 1½-inch sparks can be made

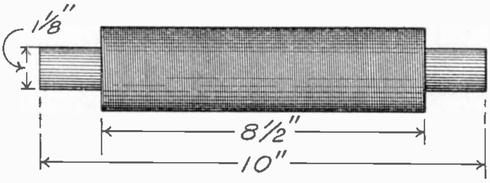


FIG. 2. COMPLETED CORE AND PRIMARY WINDING.

by winding several layers of paper to a tube of the desired size and boiling out with paraffine. But for the larger sizes a tube of hard rubber is recommended. The insulating tube for our proposed coil should have a total length of 9½ inches, 1¾-inch inside diameter, and 2⅛-inch outside diameter. The tube, however, should make a neat fit over the primary winding, and if any additional space remains between the two, fill in with paraffine.

THE CONDENSER.

While it will be some time before we come to the point where the condenser is put in actual use, since the drying out process takes several days, it should be constructed at the present time so that when the rest of the work is finished the condenser will be ready for use.

The condenser will require about 3,000 square inches of tin foil as the total area. The sheets can be cut up in 6 by 8-inch sizes, as this will reduce the number of sheets, over a smaller size. However, any other size can be used. As the sheets will run 48 square inches to the sheet this will necessitate 64 such sheets, giving a total of 3,072 square inches of foil, allowing the extra number of inches for losses involved in cutting and assembling.

The dielectric or insulating medium which separates the foil sheets from one another should be selected with care. A good grade of thin bond paper cut in sheets of 8 by 10 inches makes an excellent insulating medium.

For building up of the condenser a baking pan about 12 inches wide, 14 inches long and two inches deep will be needed, also four pounds of paraffine wax, and a common squeegee print roller. Sixty-four strips of foil 1 by 3 inches are cut, to be used for the connecting strips of the respective foil sheets.

The pan is placed on a stove and the paraffine heated until it is in a boiling state. It is advisable to place the pan containing the paraffine in a second larger pan, with water poured around, as this will prevent the paraffine from becoming overheated and catching fire.

A number of paper bond sheets are now placed in the pan and boiled for about 30 minutes. The sheets are removed and held up by the different corners so that the superfluous wax will run off as evenly as possible. Lay the sheet down on some flat smooth object and place on it, in the center, a sheet of the foil. This will allow a one-inch margin around the edges. One of the foil connecting strips is now placed on, in such a manner that one inch rests on the foil sheet, and one inch clear of the paper. The squeegee print roller is run over the foil with some pressure, which makes the paper and foil adhere more closely together and forces out the superfluous wax. This operation must be carried on while the wax is still soft.

The next sheet of paper is taken from the wax pan and made to fit over the first and the foil sheet as neatly as possible. The second foil sheet is placed on and rolled down as before, but the connecting strip is led out to the side, opposite from the first. That is, if the first strip leads out to the left-hand side, the second should lead out to the right-hand side. This is made clear by reference to Fig. 3. The heavy black line (A) represents the insulating medium, and the line (C) the foil and connecting strip.

Owing to the fact that condenser capacity should be varied until the best results are had, the condenser should be divided up into banks, and more or less of these banks are cut into the circuit until the point has been reached where the spark is flowing across the terminals with the maximum value.

A very good division can be made by dividing up the condenser into two banks

FIG. 3. GENERAL PLAN OF CONDENSER.

of 16 sheets each, one of eight and two of four. This will give a large regulation and allow the condenser to be used for other purposes than across the vibrator contacts of the spark coil.

Considering that the 16 sheets have been built up according to the method stated, the condenser is ready to be mounted. However, it should be clamped between two boards with considerable pressure, and left over night. This will close up all air spaces, which to a large extent are responsible for punctures across the foil sheets.

As the exposed ends of the foil strips are very delicate and liable to be broken when handling, thin brass strips one inch

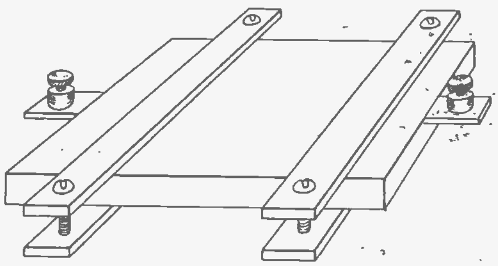


FIG. 4. COMPLETED CONDENSER.

wide and two inches long should be folded over the exposed portion, and holes punched through and binding posts screwed therein.

The condenser is now placed between two thin oak boards, which neatly cover the surface, and additional strips placed over and screwed together at each end, which will clamp the boards tightly in place. The completed condenser is illustrated in Fig. 4. The total number of banks can of course be clamped together in this manner, and this is recommended where it is desired to mount the whole in one case.

After the building up of all the different banks, a case is provided in which the whole number can be placed, and the plug contacts mounted on top so that the different adjustments can be quickly made by the operator. A convenient and simple method for making the plug connections is shown in Fig. 5 (aa) represents two of the banks built up of 16 sheets each, (B) one of eight sheets and (CC) two of four sheets. As will be noted the leads from one side of the condensers are all connected to one wire in common and connection for the opposite side is made

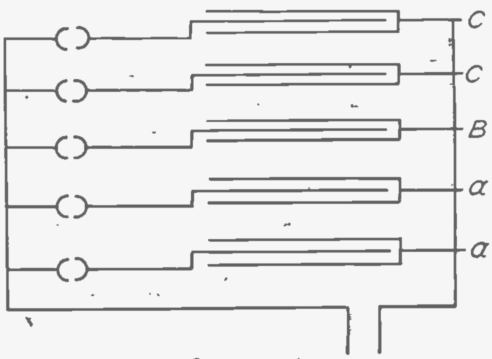


FIG. 5. CONVENIENT METHOD OF MAKING PLUG CONNECTIONS.

by inserting plugs in the various plug contacts. The exact method of mounting is left to the builder's needs and means. By following this general plan the amateur should have no difficulty in constructing a condenser for any size coil, as any changes to be made in the size of the parts, from the dimensions given, would in no way affect the working efficiency.

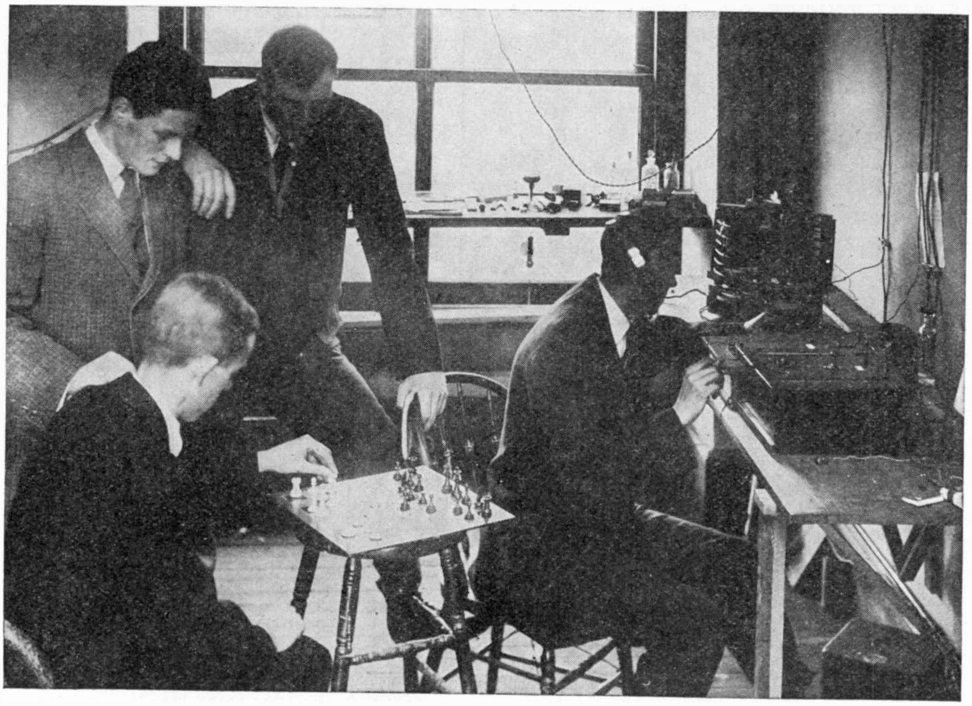
For small size coils the rolled type of condenser is sometimes used. The construction of such condensers is very simple. Two long strips of foil are placed over one another with a strip of paraffine paper between, and rolled up into a solid body with terminals left out for connecting. However, this type is not as efficient as the type previously described. The condenser, as previously stated, in this respect resembles the iron wire core.

To give efficient results the condenser should be capable of taking on and discharging the sparks at the vibrator contacts as fast as the latter operates. Where the rolled type is used it takes a long time for the condenser to absorb the spark, and a certain amount of the energy leaks through and is lost during the cycle. With the alternate layer type the charge and discharge is made rapidly and a better spark is had.

(To Be Continued.)

WIRELESS TO LINK AMERICAN UNIVERSITIES.

Princeton leads the way in a new project the object of which is to link by wireless the principal colleges and universities of the country. Princeton has an outfit, set up in Science Hall, which is the first of a chain of these up-to-date equipments that will make it possible for a conversation to be carried on with other seats of learning when they have equipments. An inter-collegiate chess series might be conducted through the air, students could exchange views on athletic matters and questions of import to the debating societies and other scholastic organizations, all without the expense of a telegram or the delay of communicating through the medium of the mail.



CHESS GAME PLAYED BY WIRELESS.

One afternoon a chess game by wireless was carried on between the students of Princeton University and the experts of the ships at the Brooklyn Navy Yard. Naval men are keen players of the game, for the leisure that is found at sea is encouraging to the development of chess students. The game was carried on entirely by wireless and was followed with lively interest by spectators at both stations.

When the other colleges have installed the wireless outfit, chess by this means will become a regular feature of the competitive program of the universities. There is no difficulty in the way. During the game referred to a student who was a "wireless" expert sat with the receiver at his ear and called off the moves as fast as they were made. The method was far quicker than the cable game, for the moves were recorded by wireless to a man who sat a few feet from the board and by him were passed on verbally to the player.

"The future program," said a student who has been largely instrumental in rigging up the wireless plant at Princeton, "is to have a receiving station at the athletic field so that the results of athletic games can be made known instantly, and reported during the progress of the game, by the students themselves. This wireless station will be a permanent thing. At all big games we now have the regular telegraph installed so that the spectators can be kept informed of the progress of events at other grounds that are interesting, but there are minor days when the telegraphic machinery is not there to give us this information, and with our own plant we can keep posted on everything that goes on without having to depend on outside sources.

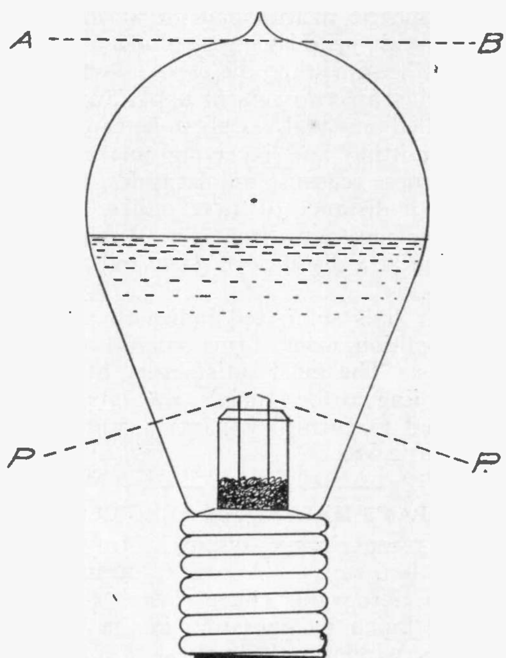
"If there are important events in progress at Franklin Field, for instance, and it is not possible for many of the men to attend them, those interested in the results can gather at the hall in which our wireless is placed and keep in touch with the situation every minute without any expense to themselves or the college. What a boon this will be only college men know.

"We are longing for the time when other universities will have their wireless outfits working. At present we practice on the ships in New York harbor, on our friends of the Navy Yard, and with any operator that we catch idle. There are numbers of ships in harbor whose operators are glad to get in conversation with anyone to while away the tedious hours, and we exchange conversation with these chaps, and occasionally pick up one who plays chess. But there is a growing feeling of resentment among the regular operators against idle wireless men who throw conversational messages on the air. It interferes more or less with the carrying on of legitimate wireless business and the air is becoming so surcharged with these 'Good morning, have you used Bear's soap?' messages that there is talk of legislation to protect the regular companies.

"For this and other reasons we are looking forward to the time when the inter-university conversation by wireless will be an accomplished fact. Then we shall drop the Jack Binnses of the harbor and converse only with our own."

HOW TO MAKE AN ELECTROLYTIC DETECTOR.

One of the things which a "wireless enthusiast" is always looking out for is a good detector, and it will be found by experience that the electrolytic gives the



ELECTROLYTIC DETECTOR.

most satisfactory results. Here is the description of one which gave the writer very good results, being very inexpensive yet efficient:

Take a five-candle power lamp globe and break the tip off as shown by the dotted line (A B) in the cut. Smooth off any rough edges with an alcohol lamp and break off the fine filaments and turn the platinum points in till they are about one-sixteenth of an inch apart. Now screw the globe into a wall bracket and screw the whole on to a suitable base.

Next fill the globe about two-thirds full of a solution made by dissolving one part sulphuric acid to four parts water. Connect up as you would any electrolytic detector. Under ordinary conditions the detector will work very well.

F. ERSKINE HENEY.

3,000-MILE EQUIPMENT FOR WASHINGTON.

The new wireless tower and equipment at Washington, D. C., will have a radius of 3,000 miles. So say the specifications upon which bids are made by the various wireless construction companies. The specifications also state that the messages are not to be interrupted by atmospheric disturbances or by interference with neighboring stations.

At the same time the department asked for bids for two sets of apparatus to be installed on naval vessels to be capable of transmitting and receiving messages at all times, seasons and latitudes, to and from a distance of 1,000 miles, and to receive messages from the Washington station at a distance of 3,000 miles at all times.

The bids submitted indicated a lively competition, seven firms submitting proposals. The most satisfactory of these, according to the officials, was one which offered to furnish apparatus and tower for $182,600.

JAPAN'S MARVELOUS AEROGRAMS.

A recent press dispatch from San Francisco says: "Across 4,700 miles of ocean, aerograms have been received from Japan by operators in the United States wireless telegraph station in this city. Although they have been unable to reply to the call from over the seas, they have watched with growing interest the efforts of the Japanese to get into communication with the United States through other means than the cables and ships.

"This marks a record for receiving wireless messages. It was nearly four months ago that James Watkins, chief operator, and R. Lawrence McLaurin, the night operator, were surprised one night to catch strange signals from apparently a great distance seaward. Japan, with more powerful sending apparatus than is found in any other wireless station in the world, flashed her signals through almost a sheer 5,000 miles. But Japan does not know her voice was heard and will not until this news is sent to the land of the mikado.

"For weeks and weeks the Japanese had been calling and Operators Watkins and McLaurin heard, but could make nothing of it. Honolulu heard, too, and at the same instant, by comparing notes. The two stations reached the conclusion that the signals came from Japan."

WIRELESS QUERIES.

ANSWERED BY V. H. LAUGHTER.

Spark Coil Design.

Questions.—(A) I would like to know if a 1⅛ inch core, 15 inches long, will be large enough for a spark coil, with eight miles of No. 36 wire in the secondary and two layers of No. 16 wire in the primary. (B) What current in volts and amperes would run same? (C) What size spark would I get? (D) If the core and primary winding are not right, would like to know what to use to get the best efficiency from the coil.—A Reader, Napa, Cal.

Answers.—(A) Yes.

(B) A battery giving 12 volts will operate the coil satisfactorily. Figuring the diameter of single cotton covered No. 16 wire as .055 inches and the average diameter of cylinder wound as $(1.125 + .055)$ 1.18 inches, approximately 146 feet of wire (two layers) having a resistance of .58 ohms is used. $\frac{E}{R}$ or $\frac{12}{.58}$ gives C equal to 20.5 amperes. But a point often misunderstood is that $\frac{E}{R}$ gives a larger current than enters the primary, because a large reduction is made by the self-induction of the primary coil. We can hardly go farther into this question in this department.

(C) About a three-inch spark with a condenser of 150 sheets, 9 by 9 inches.

In Questions and Answers Department, November issue, 1908, see answer to question (B) of A Reader, Seattle, Wash.

(D) Little data and few formulas and rules are recorded to give the relation between transmitting power, dimensions, and constants for coils. In practice each manufacturer experiments until he finds the conditions necessary for his particular purpose. A closer compliance to what standard data is available, allowing one inch of core to project at each end to reduce magnetic leakage, would be to use two layers of No. 14 wire on the primary and five pounds of No. 33 wire on the secondary.

Four Inch Spark Coil.

Question.—Will you kindly tell how to make a four-inch jump spark coil, with dimensions and size and amount of wire.—J. C. R., Leominster, Mass.

Answer.—Length of core, 14¾ inches; diameter of core, 1½ inches; primary wire, No. 12 B. & S. gauge, two layers; secondary wire, No. 33, ten pounds. Condenser: 200 sheets, 9 by 9 inches; battery voltage, 16. See "Construction of a Two-Mile Wireless Outfit," November issue, for further hints.

Spark Coils.

Questions.—(A) In winding a one-inch spark coil with number 32 wire instead of 36 what will be the difference? (B) Does a telegraph set have to be equipped with a relay and how is the relay used? (C) How much wire is used to construct a gas lighting spark coil? E. F. R., Rahway, N. J.

Answers.—(A) The spark will be reduced in length to a large extent but this will be especially valuable for use in wireless telegraphy.

(B) The telegraph relay is not absolutely essential to a short distance telegraph set but it is a very necessary addition for long distance work. It is used to open and close a local circuit containing a sounder, and is operated by the very slightest current coming in over the main line.

(C) Gas lighting coils are divided into a number of different types and it would be necessary for you to state your question more clearly before we could give you an answer.

Receiving Ability; Detectors.

Questions—(A) From how far would the following outfit receive: Auto-coherer; 1,000 ohm receiver; 60 foot aerial, and tuning coil? (B) Which is the best silicon of electrolytic detector?—K. W. W., Fort Scott, Kans.

Answers.—(A) Up to 50 or 100 miles.

(B) The electrolytic is the more sensitive.

Sending Helix.

Questions—(A) How is a sending helix made and what is the principle? (B) If a one-inch coil is immersed in oil how much current can safely be used with it and what kind of oil should be used?—C. R. K., Little Rock, Ark.

Answers.—(A) The sending helix can be made by winding 10 turns of No. 6 bare copper wire on a frame 10 inches in diameter and 10 inches in height. The respective turns offer a high choking effect to the high tension currents and will allow of a large range of regulation to be had within a short length.

(B) A coil can carry so much current and no more. Immersing the coil in oil would in no way make the primary turns more conductive. However, the better the insulation the more perfect the coil will be from the electrical standpoint.

Condenser; Interrupter.

Questions—(A) Which are the best, Leyden jars or paper condensers on the primary of a four-inch coil? (B) Is it necessary to use Leyden jars in the secondary circuit to fatten the spark for wireless work? (C) Explain the mercury interrupter and how it works? Could it be used with the battery current? (D) Would No. 14 aluminum wire do for use in constructing a tuning coil? (E) Could you tell me the nearest wireless station to Chicago?—F. H., Chicago, Ill.

Answers.—(A) A Leyden jar is the more efficient type of condenser, but for use across the vibrator contacts in the primary circuit, the paper type will answer and is usually employed.

(B) Yes, either a Leyden jar or some other type of high frequency condenser.

(C) Mercury interrupters are of many different types and to describe the various kinds would require more space than can here be given. One of the most common types consists of a vibrating contact operated by motor which works in and out of a pot of mercury. Such interrupters can be used with batteries as well as with power circuits.

(D) Yes, but the size is rather large. We would recommend No. 22 tinned copper wire.

(E) Detroit.

Sensitiveness of Receiving Apparatus.

Question—Would the receiving set described on page 635 of your February issue pick up messages from the commercial stations three and four hundred miles from Cincinnati?—H. S. B., Cincinnati, Ohio.

Answer.—We hardly think that this detector would pick up messages from stations this far away. With a suitable aerial and a liquid detector this would be possible.

Receiving Distance.

Questions—(A) How far should I be able to receive with the following equipment: Zincite and copper pyrites detector, tuning coil, 40 foot aerial, condenser and telephone receiver? (B) What size spark coil is necessary to send up to five miles and how can I make it? (C) Kindly give me the directions for making a 20-mile wireless set.—E. K., Washington, D. C.

Answers.—(A) From 25 up to 100 miles.

(B) We refer you to the article, "Construction of a Two-Mile Wireless Outfit," in the November, 1908, issue, which described a coil that will send up to five miles under good conditions.

(C) A twenty-mile wireless set would constitute a tuned sending and receiving equipment, using a liquid detector and a four-inch coil which will be fully described in the serial on spark coils beginning in this issue.

Condenser and Detector.

Questions—(A) What is the purpose of a condenser? (B) Can the fine wire in a detector be any other than platinum? (C) How can an induction coil be constructed cheaply? (D) What is a coherer used for.—J. N., Wappingers Falls, N. Y.

Answers.—(A) The condenser is used to cut down the static interference, and to a certain extent increases the strength of the received signals.

(B) Other kinds of wire are being employed at the present for special experimental work, but the platinum is to be recommended.

(C) We refer you to the series of articles beginning in this issue under the title, "Spark Coil Construction and Operation."

(D) The coherer is used to detect wireless waves.

Electrolytic Detector.

Question—How many volts are needed to work an electrolytic detector in series with two 75 ohm telephone receivers?—E. I. W., New York.

Answer.—The voltage necessary to operate the liquid detector is exceedingly low. A dry cell giving one volt will answer.

Condenser.

Question—Is a condenser absolutely necessary in a wireless sending apparatus? If so, for what purpose will an ordinary one made from a brass tube answer?—W. G., Chicago, Ill.

Answer.—A condenser is not necessary in the sending end unless the set is of the tuned circuit type. We would not recommend a condenser made from a brass tube for use in the sending circuit. However, it could be used in the receiving side to an advantage.

A. B. C. Receiving Set.

Questions—(A) Can a telegraph sounder be used in place of a receiver in connection with the A. B. C. receiving set? How many ohms should the telephone receiver have? (B) How high should an antenna be to send up to three hundred feet with the one-half inch spark coil? (C) How many dry cells can be used on a one-half or three-fourths inch spark coil?—R. B. McC., Jenkintown, Pa.

Answers.—(A) A telephone receiver only can be used. Any type of telephone receiver will answer.

(B) From 30 to 40 feet high.

(C) Not over four or five should be used.

Telephone Induction Coil.

Questions—(A) I have a battery telephone coil and would like to know if it could be used in connection with wireless telegraphy. (B) I have two coils that belong on an electric light tester. Would these be of any use? (C) What would be the distance a ¼ inch spark coil could send messages if connected with a 50-foot aerial?—J. L. D., Cambridge, Mass.

Answers.—(A) The coil you have on hand would be useless in wireless telegraphy. It is too small to try to change it into a spark coil and too large for a receiving transformer.

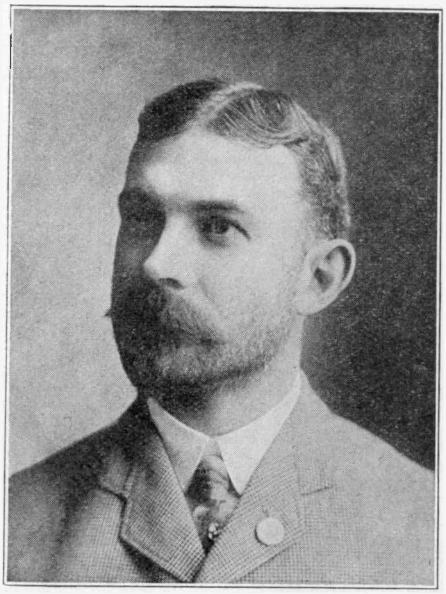
(B) No.

(C) Up to one-fourth mile under good working conditions.

ELECTRICAL MEN OF THE TIMES.

HENRY L. DOHERTY.

A pioneer exponent of the "new business idea" in electric central station practice is Henry L. Doherty of New York. To be so identified with a movement of the most far-reaching benefit to the central station business might well be cause for great pride on the part of any man. But no man, perhaps, can "stand prosperity" and the praises of his fellow men better than Mr. Doherty. He is unspoiled by success, for he has a level head.



Henry Latham Doherty was born in Columbus, Ohio, in 1870. His education was of the self-acquired variety and most practical in its nature. When twelve years of age he entered the employment of the Columbus Gas Company and remained there, in various capacities from office boy upward, until 1896, when he went to Madison, Wis., as manager of the Madison Gas and Electric Company.

In 1897 Mr. Doherty became a member of the National Electric Light Association, at that time devoted to technical work, and at best rather an easy-going institution. It was Mr. Doherty's idea that such an association should be more than a mere body for the discussion and preservation of data and records of physical developments. He believed that it should be made a moral force to sustain its members in their efforts against competition and to devise new ways and means for educating the public in the use of electricity and to assist the central stations in their plans to secure new business intelligently. His efforts in the association did not at first meet with favor, for he was young and the older members rather resented his aggressiveness. But he gradually found supporters until finally, in 1901, he was elected to the presidency of the association, and from that day its real success began. With one bound Mr. Doherty became practically dictator of the organization and indisputable leader of the majority, and the mandates that were issued by the association became assertive and forceful.

The story of Mr. Doherty's work in Denver, where he placed the Denver Gas and Electric Company on a sound basis, raising it from the position of a heartily despised corporation to that of a subject of great municipal pride, is well known, and has been told in a previous issue. But this is only one example out of many instances in which he has rehabilitated the affairs of a broken down light company and made it a potent factor in the upbuilding of a city. As a result he is now the moving spirit in a large number of lighting companies throughout the country.

All through his successful business career Mr. Doherty has been a firm believer in advertising for the building up of central station business. And his conception of advertising is by no means a narrow one, but a great, broad gauge plan whereby the people are brought to know of the advantages and economies of electric current through systematic educational campaigns, through public and private demonstrations, newspaper advertising, direct advertising, lectures, electrical shows and expositions, and a hundred and other ways which his able lieutenants might devise.

ELECTRICITY IN THE HOUSEHOLD

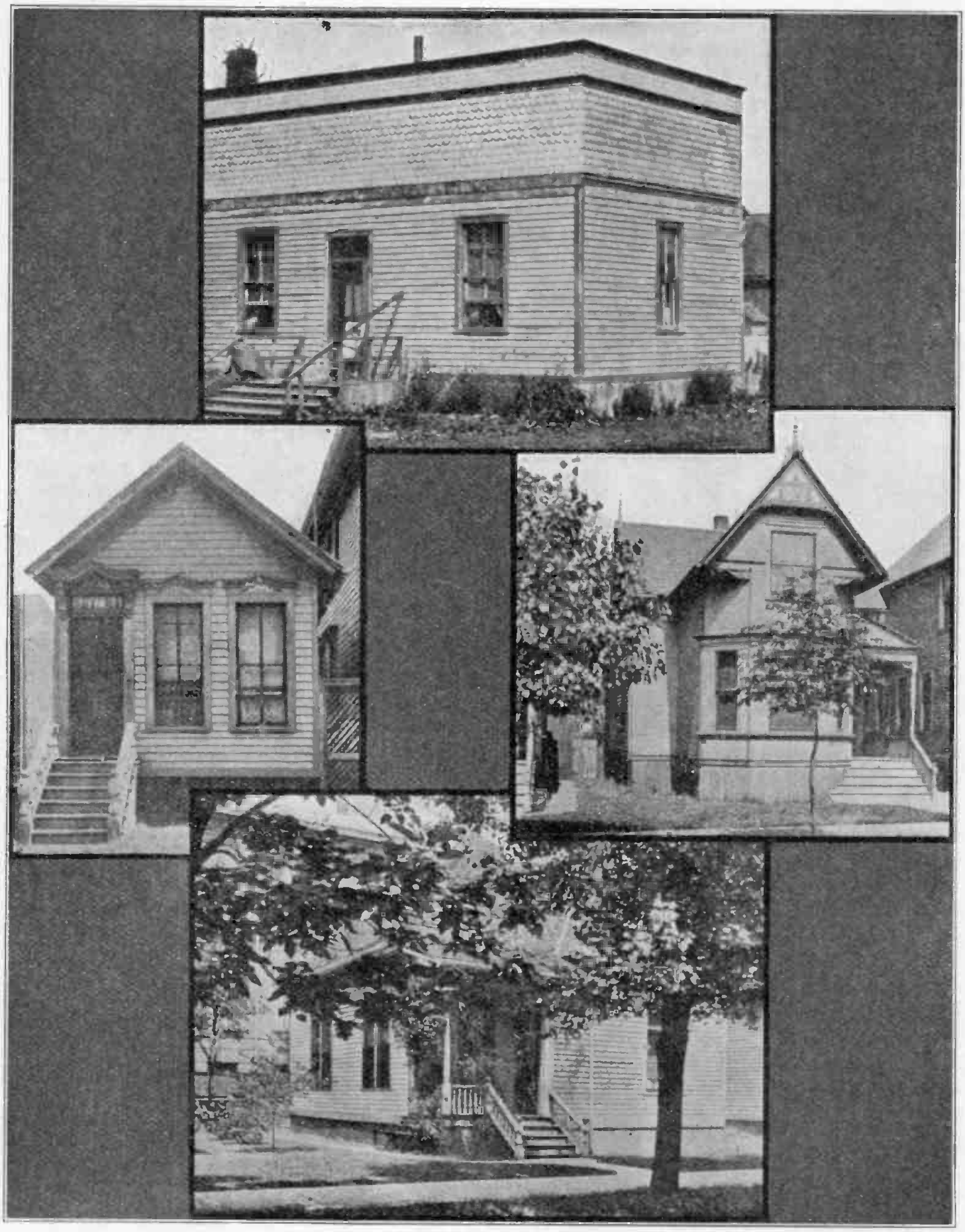
IS ELECTRIC LIGHT TOO DEAR FOR MODEST PURSES?

BY WILLIAM KEILY.

"Give a dog a bad name and hang him," is an old saying, and it is exemplified by the fact that many persons still labor under the delusion that the cost of electric lighting in the home is so high as to be prohibitive to all except the well-to-do. It is not strange that this is the case, for in the early days, and up to say 10 years ago, the ideal illuminant was, indeed, comparatively expensive, and its use for residence lighting was urged on the undeniable ground of quality rather than price.

People generally do not realize, however, the really wonderful development in the art of producing and marketing electricity which has been made in the last decade. The improvement is not only in the design of electrical machinery, to prevent losses; not only in betterment of the means of transmitting the current, for the same purpose; not

IN EVERY HOUSE ON THIS STREET ELECTRIC LIGHTS AND FLAT IRONS ARE IN USE.



THESE ARE MODEST HOMES. EVERY OWNER FOUND ELECTRICITY NOT ONLY CONVENIENT BUT AN ACTUAL ECONOMY.

only in the use of high-efficiency lamps and reflectors, which produce two or three times as much light for the same consumption of current; not only in the remarkable economies effected by modern prime movers (the machines which drive the generators of electricity), such as steam turbines and gas engines; not only in the greatly extended use of waterpower—but more than all these causes, even, the change is due to the education and enlightenment of the electric-light man himself.

The average manager of a public electric-lighting plant is no saint. He is just a "hustling," hard working American business man who is trying to get the best possible return from the property in his charge. But he takes a broader, more serious view of the relation of a public-service corporation to its public than he once did. He strives to please the people, not to antagonize them. And in selling electricity he has discovered that it pays best to produce his product in large quantity to secure the advantage of low cost of production; to sell large quantities to attain the heavy load on the station which this policy makes necessary, and to sell at low price to secure the big demand.

This may seem to be a self-evident business proposition, but in the central station industry it is not so simple as it appears. There are troublesome questions of "load factor," interest charge on idle machinery, "maximum demand," "readiness to serve," extensions of lines (especially important where only underground construction is permitted), cost of customers' meters, cost of house wiring, etc., which cannot be gone into here, and these make the fixing of equitable electric lighting rates a perplexing problem indeed. But the general tendency, as the men and methods in the electric lighting business improve, is toward cheaper prices. In Chicago, for instance, the rates for electricity are now only about 40 per cent what they were 10 years ago.

At 10 cents a kilowatt-hour electricity is considered to be about as cheap as gas for lighting, and in many places electric energy can be bought, even by the small consumers, at a lower price than this. Often there is a primary rate higher than the figure given and a secondary rate considerable lower, and the cottage or small-apartment customer can secure the advantage of the lower rate by a wise use of his lights, which the central station company will be glad to explain to him, for it enables the company to make a better use of its facilities and to stand ready to serve more customers. Sensible co-operation between customer and company is mutually advantageous.

In many small towns there are no gas plants, and here the electric light competes with kerosene lamps. This is true too in workingmen's homes in larger cities. Electricity has proved itself able to meet this challenge, and in households where every cent counts. One reason for this is that of late years kerosene oil has constantly risen in price, while electricity has decreased. Another is that the labor and inconvenience of keeping up the oil supply and filling and cleaning the lamps is to be added to the cost of the oil.

Four rather haphazard examples of what is actually being done in supplying electricity to the homes of people of scanty or moderate means under commercial conditions in towns and cities in the Middle West may be given. It is to be noted that in every case the current sold is generated by steam power.

In Cadillac, Mich., the central station company has 300 customers on its books (or had last August, when the statement was made publicly) whose wages do not exceed more than two dollars a day. These workingmen can afford electric light and the company can afford to sell it to them, or of course it wouldn't do it. The company gets from $9 to $15 a year from each consumer of this class.

Dubuque, Iowa, has an up-to-date electric lighting management, and here a carefully prepared educational campaign has been carried on to convince householders of moderate means that electricity is not to be regarded as a luxury for the rich. During the last eight months more modest homes have been equipped electrically than during any previous period of several times that duration. Here it is found that the possibility of using the electric flatiron is a great attraction toward the electric service. Where housewives do their own ironing, they find the electric flatiron a great labor-saver. It is significant that in East Dubuque, a small suburban village of workingmen's houses, there is proportionately more residential lighting (electrical) than in prosperous Dubuque, across the river.

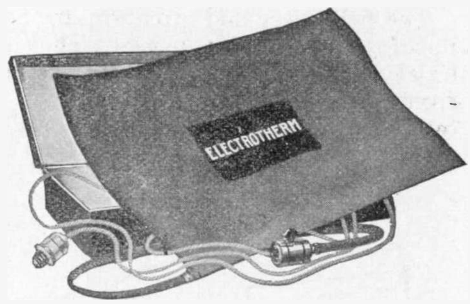
Residence lighting has always been an important branch of the business of the electric lighting company in Detroit, which is to be expected, perhaps, in that city of beautiful homes. The rapid growth of the business, however, dates only 10 years back. Now there are over 12,000 residence customers of all classes. In this city a large number of cottages as well as more pretentious houses are electrically lighted. This business is taken from kerosene competition. Usually the cottage householder who uses electric light in Detroit owns his own home. This city has many districts consisting of rows of small houses, called terraces, where each cottage is owned by its occupant. Such owners prefer electric light because of the saving in maintenance of wall decorations and ceilings. Several large property holders specify in their rental leases that electricity shall be used exclusively for lighting by the tenants. This policy was adopted without action on the part of the central station company. The average monthly bill for residence electric lighting in Detroit is $2.32.

Chicago has about 30,000 householders living in small houses or apartments who are customers of the electric lighting company. In an ordinary seven room apartment perhaps 20 lamps will be installed, although the number varies to suit individual requirements. Formerly a minimum monthly payment of one dollar was required, but this is no longer asked, and many bills are made out for less than that sum. But, taking the general run, the monthly cost of electric light in the small homes of Chicago may be said to range between $1.15 and $2.50 net. There has been a great increase in this class of business within the last few years, stimulated by steadily decreasing rates for electricity.

Of course the price of electricity varies widely in different localities, affected by local conditions. Some managements are less anxious for residence business than others. Some, using the "white coal" of waterpower, are able to sell electrical energy more cheaply than others who have to burn coal hauled perhaps a long distance. The prevailing rate of interest on money, cost of labor and several other things, such as the character of the community served, whether industrial or otherwise, all have their influence on the commercial price of electricity to small residence users. But it is believed that the facts and figures given in the dispassionate survey of the situation made in this article show that, in most places, the man who can afford to pay from 75 cents to $2.50 a month for the lighting of his home can have the use of electricity, with its great advantages of healthfulness, cleanliness, cheerfulness and convenience.

THE ELECTROTHERM.

The Electrotherm is a light, flexible pad composed of wires insulated and protected with asbestos and designed to perform the function of the old-fashioned hot water bottle. It is arranged for attachment to an ordinary electric light socket, and when so connected, the pad offers sufficient resistance to the current to produce a constant and absolutely uniform degree of heat as long as the current is turned on. A regulating switch



THE ELECTROTHERM.

is provided by which a low, medium or maximum degree of heat may be obtained at will, by simply turning the key.

In pneumonia cases the value of the Electrotherm is especially apparent for the reason that the most potent influence in the treatment of this disease is bodily application of a steady, continuous heat.

In consequence of resulting danger from the disturbance of the patient, and the change in temperature caused by changing the application when a hot water bottle is used, physicians have reluctantly been compelled to forego this most efficient influence. In such cases the Electrotherm is indispensable, obviating as it does, all these objections and furnishing the only method for an application of a regulated heat for an indefinite period.

CONSTRUCTION OF A LAMINATED MOTOR.

BY MILFORD J. WHINNEY.

I have constructed the electric motor here described, and have found it to work admirably. It is a unique little machine embodying as it does a laminated field and armature.

The field piece and armature are built up of 30 sheet iron pieces. The material for this purpose may be obtained from a tinsmith, or by heating old tin cans until the solder melts, when they may be pulled apart and straightened forced into it. Cut out the disk carefully with an ordinary pair of scissors, and file off any burr that may remain around the hole. Use this as a pattern for laying off the remaining 29 pieces.

Having cut 30 pieces, now bind them together with twine, to hold them in place until the wire is wound on. Turning now to the field magnet, Fig. 2, lay off as per drawing and cut 26 pieces as shown by the solid lines and four pieces

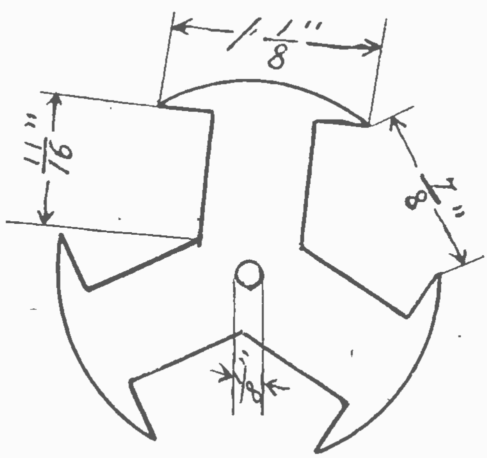


FIG. 1.

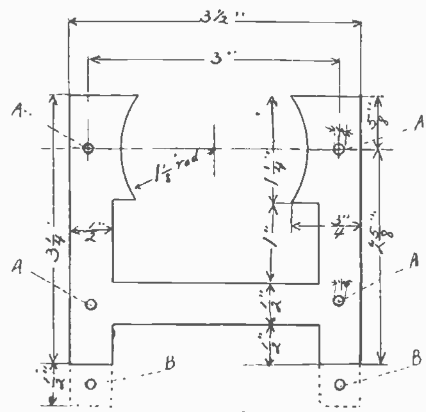
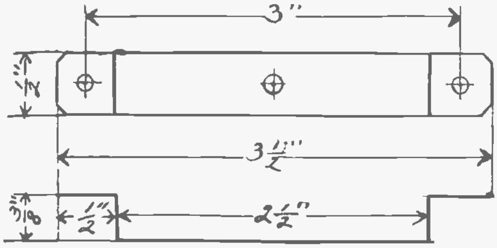


FIG. 2.

into flat sheets, as the so called "tin" of which cans are made is simply sheet iron coated with tin, and will answer the purpose. Carefully lay out an armature disk, the shape and size shown, Fig. 1. In one of the sheets, punch a small hole accurately in the center and enlarge by reaming with the tang of a file until a one-eighth inch wire nail can just be with the extensions shown by the dotted lines. These extensions are afterward bent out at right angles and form ears for securing to the base-board.

Assemble the sections of the field by putting two pieces with the extensions, on each side of the 26 pieces, then clamp the sections in a vise and drill four one-eighth inch holes in them at (A, A, A, A), Fig. 2; also drill a one-eighth inch hole in the extensions at (B, B). The field sections are now bolted together with four small one-eighth inch bolts passing through the holes (A, A, A, A).

The bearings, Figs. 3 and 4, are cut from heavy sheet brass. The holes for



FIGS. 3 AND 4.

the armature shaft should be of such a size as to allow it to revolve freely but with no shake. The holes in the ends are the same diameter as those in the field pieces, one-eighth inch.

The armature is assembled by forcing the disks onto the shaft, Fig. 5, which is

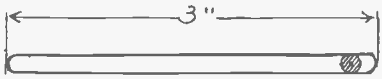


FIG. 5.

made from a wire nail one-eighth inch in diameter and three inches long, the head having been cut off and the ends nicely rounded.

The commutator is made of a piece of wood as shown in Fig. 6, the hole either being drilled through or burned

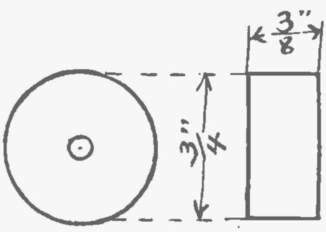


FIG. 6.

with a red-hot wire so that it is a tight fit on the shaft.

The commutator segments, Fig. 7, are cut from thin sheet copper or brass and fastened to the wooden cylinder by bending down the lugs. Leave about one-sixteenth of an inch between each segment.

The brushes are cut from the same sheet copper or brass as in Fig. 8, and are fastened by small screws to the brush holder, a wooden block made to

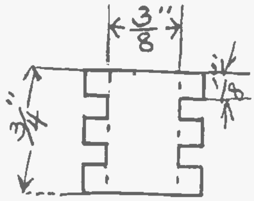


FIG. 7.

the shape and size shown in Fig. 9.

Now wind the field magnet with about one-half pound of No. 18 gauge single cotton covered magnet wire, first wrapping a layer of writing paper around the

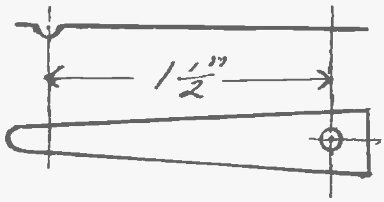


FIG. 8.

sharp corners. Five layers of wire are enough, and a free end three inches long should be left at the beginning and end of the winding for connections, one end

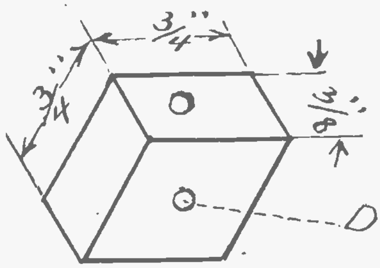


FIG. 9.

is connected to a binding post and the other to the lower brush when the motor is assembled.

Having finished winding the coil, cover it with one layer of adhesive tape, as this helps to protect it.

Wind the armature as shown in Fig.

10, first wrapping on a layer of paper. Wind each pole with four layers of No. 22 single cotton covered magnet wire, winding always in the same direction. Connect the inside layer of one winding to the outside layer of the next, continuing thus until there are three connections, each consisting of two wires (A) and (B), Fig. 10, which must be scraped for a distance of about one inch from the ends and twisted together, as shown at (C). Then connect the three twisted ends, one to each of the three segments of the commutator, by a drop of solder.

Then assemble the motor by fastening the bearing strips to the field with the small bolts passing through the holes (A. A, A, A), Fig. 2, also put a few washers or short coil of bare copper wire

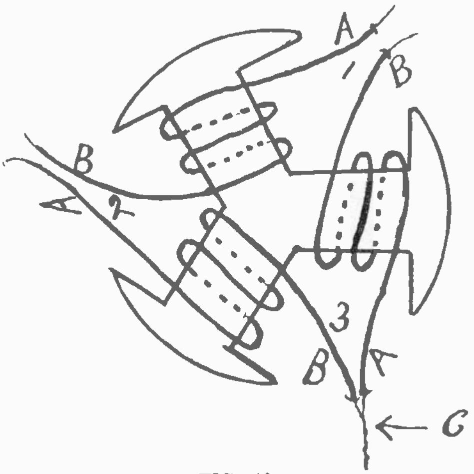


FIG. 10.

on the shaft to keep the armature in place between the pole pieces.

The brush holder, Fig. 9, is fastened to the front bearing, Fig. 3, by a small bolt passing through a hole made in the bearing, and one made in the wood block at (D), Fig. 9.

Having assembled the motor and properly connected it the circuit will be through the field coil to the lower brush, then through the brush and commutator segment around the armature, out through the opposite segment and brush to the battery.

Two cells of battery will run the above motor at a good rate of speed, but with a few more cells more power may be obtained.

COST OF OPERATING ELECTRIC APPARATUS.

Experimenters who use electric light current often desire a means of determining the cost per hour of operation of a certain piece of apparatus. If direct current is used, this is a simple matter, since direct current ammeters, as are used for batteries, are cheap and easy to procure. But alternating current ammeters are expensive and complicated, and therefore not available in modest laboratories. Happily there is a way, used by the writer, by which the cost of alternating current may be determined, and which does not require any extra apparatus. It is by means of the lighting company's meter.

All, or nearly all, alternating current meters have an opening in front, under the dial, through which the armature or rotor may be seen. This rotor makes a certain number of revolutions per minute in proportion to the amount of current used, and when no current is being used by the consumer, the rotor is stationary.

First of all the number of revolutions per minute that the rotor makes when a known current is being used must be counted; then the apparatus, the cost of operation of which is to be determined, is connected up, and the revolutions per minute of the rotor counted again. The ratio of the speed in the latter case, to the speed in the former, is the same as the ratio of the two costs, and since the cost in the former case is known, that in the latter may be computed.

To give a particular example. The writer's meter, a five ampere integrating watt-meter, has a rotor which makes four revolutions per minute when one 16 candle-power lamp is burning. Since a 16 candle-power lamp costs one-half cent per hour (at the rate here prevailing), taking one-half ampere at 110 volts, those four revolutions per minute correspond to one-half cent per hour. When a small motor was operated, through resistance, on the 110-volt current, the rotor of the meter made twenty revolutions per minute. The ratio of speed was twenty to four, or five to one, and since this is the ratio of cost, the current cost five times one-half cent per hour or two and one-half cents per hour.

LOUIS H. ROLLER.

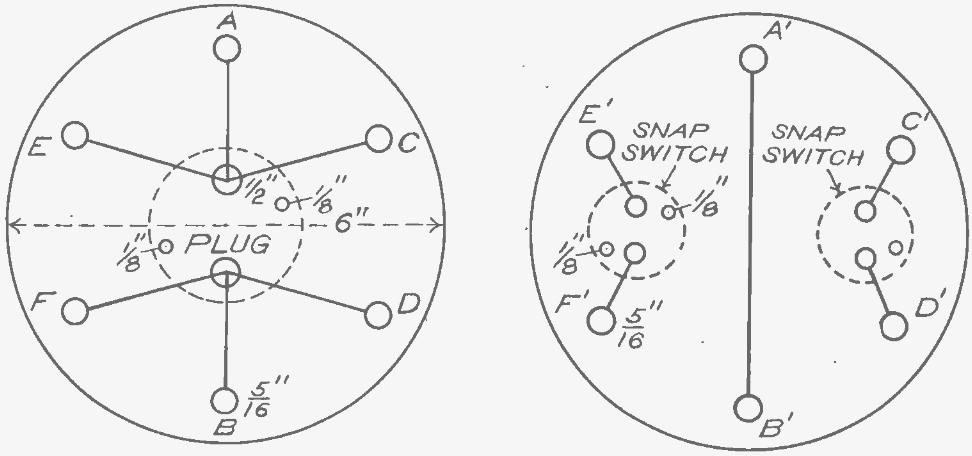
HOME-MADE ELECTRIC HEATER.

BY P. J. O'GARA.

A home-made electric heater which is nearly as efficient as a factory made heater may be constructed by any ingenious boy. The material necessary for its construction is not expensive and only a few tools are needed.

Procure six porcelain bushings 18 by 13/16 inches and wind each one with 25 feet of No. 26 "Climax" resistance wire. The turns should not be allowed to touch each other, and may be kept apart by putting on a thin coat of plaster of Paris on one side. It is not necessary to entirely cover the wires with it. Cut out two disks of tin or other thin sheet metal six inches in diameter, and punch six 5/16 inch holes at equal distances and within ¾ inch of the outside edge. Also punch holes through which to lead out the wires, as well as others for the attachment of the plug and snap switches. Then cut out two disks of asbestos the same as the metal disks. The diagram of these disks is shown in Figs. 1 and 2. Cut off six lengths of 5/16 inch rod iron 20 inches long and thread these lengths at both ends for about one inch. Then assemble the parts as shown in Fig. 3. The attachment plug is shown at the right while the two snap-switches are at the left. The terminals of the three upper coils should now be brought out and fastened under the upper contact of the plug; and the three lower terminals should in like manner be brought out to the lower contact screw. The upper and lower coils should have their other terminals connected together right across the end. The nearest pair of coils should now have their left hand terminals connected to the snap-switch; and the farther pair should in like manner be connected to the other snap-switch. With this arrangement three heats may be obtained by turning the snap-switches on or off.

After the plug and snap-switches have been connected with the coils, two tin disks the same diameter as the other disks are fitted over the ends and held in place by small machine screws. These are not absolutely necessary, but they cover up the nuts which hold the parts together, making the apparatus have a more finished appearance. Cut a piece of asbestos just long enough to fit in between the two heads, and wide enough to just cover the three lower coils. This



FIGS. 1 AND 2. ARRANGEMENT OF PLUG AND SNAP SWITCHES IN ELECTRIC HEATER.

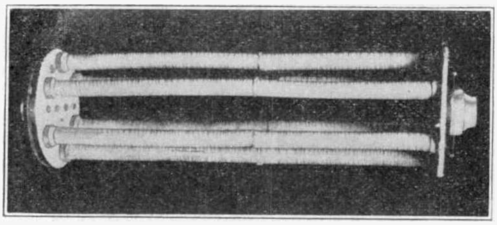


FIG. 3. HOME-MADE ELECTRIC HEATER.

is necessary in order to protect the floor from excessive heat, since the heater rests in a horizontal position. As shown in Fig. 4, a protective covering made of a piece of perforated sheet metal 20½ inches long and 19¼ inches wide is now fitted over the coils, and held in place by the bolts which also attach the legs to the heater. The legs are made of ⅛ inch strap iron bent into the form shown in Fig. 4. Since the bolts, which attach the legs to the cover, also pass through the bottom sheet of asbestos, there is no chance of the coils slipping out. In case the perforated sheet metal cannot be obtained at a hardware, store there are always discarded sheets to be found at a flour mill, where perforated zinc screens are used for milling purposes.

This heater is constructed for a voltage of from 110 to 120, which is the ordinary voltage of most incandescent lighting circuits. When turned on full the heater consumes about 600 watts, or that of 12 incandescent lamps. With the two snap-switches turned off, it takes about 200 watts, or one-third the total capacity. Attachment is made to the ordinary lamp socket by means of a piece of lamp cord and a plug.

In case that it is desired to wind the heater for 220 volts, each coil should be wound with No. 29 "Climax" resistance wire having the same length as before.

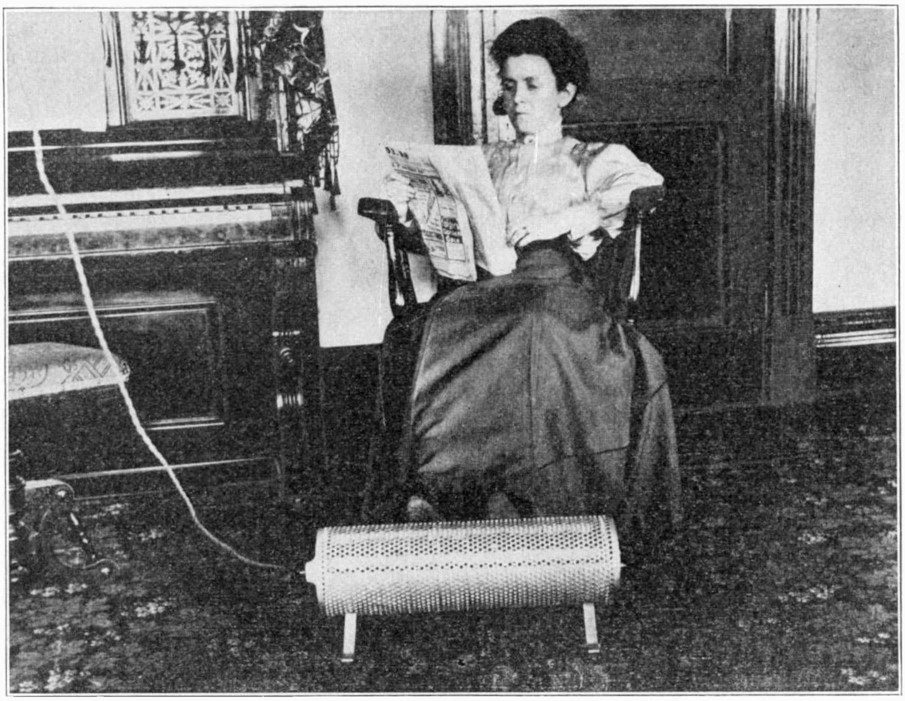
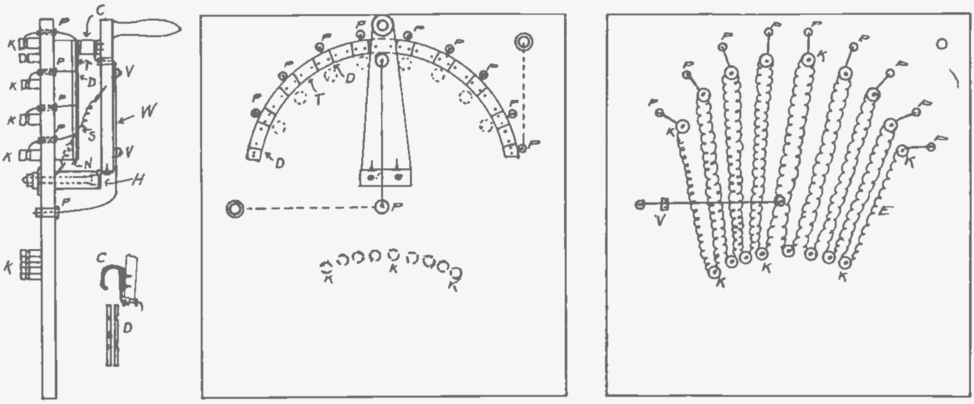


FIG. 4. ENJOYING THE COMFORTS OF THE ELECTRIC HEATER.

GENERAL PLAN FOR A HOME-MADE RHEOSTAT.

This rheostat can be made by anyone having a few carpenter's tools. The frame and fittings may be varied to suit the current regulated, and worked out in accordance with the plans. A hardwood panel of the required size lined with ⅛-inch asbestos on the back should be provided to support the resistance coils (E). The panel should be mounted 12 inches from the wall on metal brackets. All screw heads should be countersunk. The following material is needed: Porcelain knobs (K); porcelain bushings or loom (P); strip of ¼-inch asbestos (N); ¼-inch asbestos board (T); two copper plates (D), ⅛-inch thick; strong steel spring (S); common door hinge (H); copper straps (C);



Side View. Front View. Back View.

GENERAL PLAN FOR HOME-MADE RHEOSTAT.

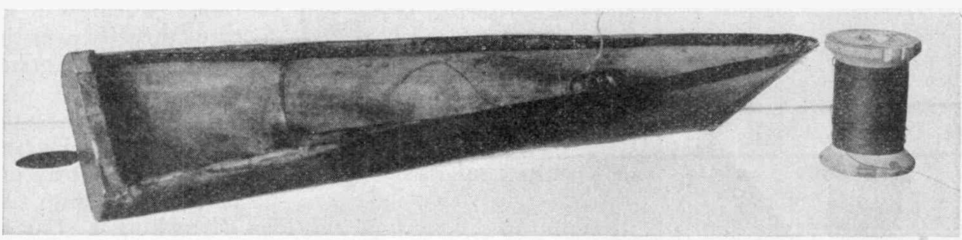
porcelain cleats (V). Enough hardwood should be provided to construct the revolving part under hinge (H), the arc of the circle for contacts (D), and the arm and handle.

As seen in the back view, the distance between the upper and lower knobs (K K) may be increased or diminished to provide room for the necessary wire resistance. When the arm is on the contact (D) the circuit is open. The arm should have a hardwood peg as a stop at starting and running positions and also an additional peg to hold the arm in the running position. This part of the device may be arranged to suit the ideas of the builder.

Eight steps are provided in cutting out the resistance. Use Ohm's law, $C = \frac{E}{R}$ to determine C at each step, E and R being known. For convenience in figuring wire resistance, it may be noted that the resistance of copper wire is 10½ ohms per circular mil foot; iron wire, 6 times as much; nickel, 8 times, and German silver, 13 times as much.

SMALLEST ELECTRIC LAUNCH.

Probably the smallest electric launch ever constructed is the one shown in the picture. It is the handiwork of a boy 18 years of age, John Elliott Jenkins, of Chicago. Young Jenkins is studious almost to the extent of being retiring, and is never so happy as when let alone and allowed to satisfy his craving for electrical experimental work. He has constructed a great many ingenious devices, but the electric launch is the most skilfully executed of them all.



SMALLEST ELECTRIC LAUNCH.

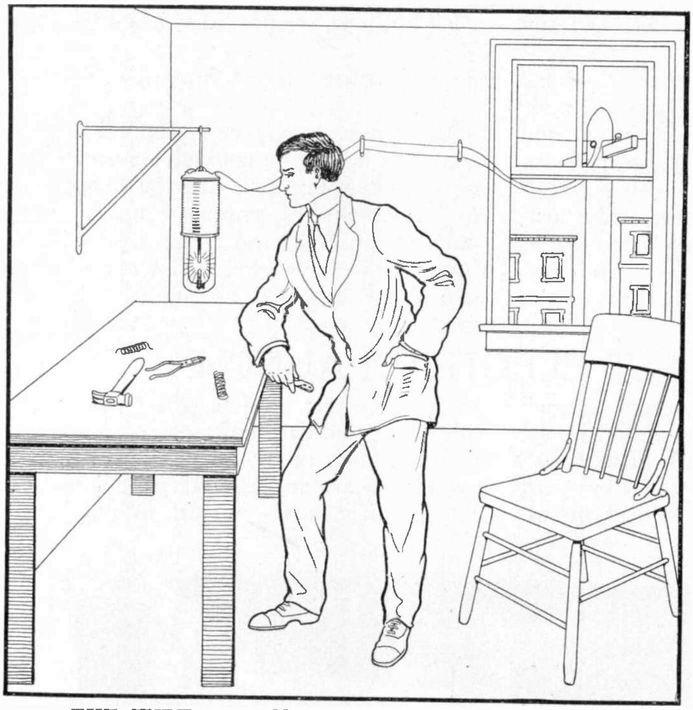
The launch is 7½ inches long, with a 1⅝-inch beam and a depth of 1¼ inches. The picture shows its size as compared with an ordinary spool of thread. It is made principally of shellaced paper, with a few little bits of wood here and there for stiffening. The propellor shaft is part of a hat pin, with tiny blades carefully mounted, and this shaft is driven by a most curious little motor only three-quarters of an inch high and with wires almost as fine as hairs. The armature of this motor is about half as big as a good sized hazlenut. But for all this, the boat will run, although it is so small that it cannot carry its own battery, unless a very small special one be built for the purpose.

SWITCHBOARD STORIES.

WHY HARVEY MOVED.

BY C. TUELLS.

Harvey Jackson was truly in love with his work. He had just completed his college course of four years at one of our eastern universities, and was now starting in to get his practical experience in the largest electrical manufacturing concern in the world, where he was receiving the munificent sum of 18 cents an hour. Eighteen cents an hour did not seem much to Harvey after his brilliant years at college, especially as it was coupled with 10 hours a day of steady and sometimes very hard work. But experience was what Harvey was after and he was getting it every hour—with the 18 cents an hour thrown in.



THE WIRE TAPPING WAS A GREAT SUCCESS.

The city of Lynn wasn't a large city, consequently Harvey experienced little trouble securing a room in the center of the business section, still keeping financially within his limited means. His first months of experience were spent in the arc lamp department of the manufacturing concern where for a while he was kept busy breaking up old lamps, after which he went to the testing bench and later up to the experimental room. The experimental room was a veritable wonderland to Harvey and it was not long before his inventive genius began to crop out. His time at the shop was mostly taken up with routine work, but he used to spend his evenings developing his new ideas in his little down-town room, which was located directly over the largest dry-goods store in town.

One day at the shop, while Harvey was trying out an experimental lamp, he conceived the idea of making a style of lamp that would use less current and give much more light; so that evening in his little room he started in to investigate his idea. With the aid of some old lamp parts and the shop scrap-barrel and a few evenings of persevering work he had his model lamp completed and all ready to test, but, blinded by his enthusiasm, he had overlooked the fact that an arc lamp could hardly be a success on a low voltage and much over-worked incandescent circuit, so, though his lamp was now ready, it was useless unless he could get a higher voltage circuit on which to try it out.

Dejectedly he sat looking out of the window, thinking how his success was being nipped in the bud, when his eye caught the series arc light wire directly under and within reach of his window. There is an old adage that reads, "Fools rush in where angels fear to tread"—Harvey tapped the wire. The tapping was a great success, mechanically if not morally, and the brilliant rays from his highly successful lamp completely drowned his guilty conscience. It was necessary for him to keep his blinds closed so that the intense light would not attract attention from passers-by in the street below, but that was easily done, and for many nights he experimented with and perfected his new idea.

One pleasant Saturday evening soon after his invention was developed he was trying to still further increase the efficiency of his lamp, when suddenly (to this day Harvey can't explain how) he accidentally opened the circuit or else grounded it.

Harvey's room was immediately plunged in darkness; so also was the whole street traversed by that particular line. Some one immediately sent a rush call to the electric light company and soon the emergency wagon was thundering down the street towards the dry goods store—and Harvey. The young inventor began to figure how things were coming out and hastily threw open the window and started to disconnect his tapping wires, but he was just in time to be too late, for, as he was removing his second wire a vigilant lineman spied him as he pulled it into the window.

It didn't take Sherlock Holmes' power of deduction to trace the trouble to Harvey's room by way of the window, and soon a store manager, a lineman and a policeman were having an extremely personal interview with a much embarrassed young man, which resulted in his paying a twenty-five dollar fine in the local court next day, and indirectly in the appearance of a sign in the fatal window which read—"To let."

LYNN MARSH, THE BOY TELEGRAPHER.

At 11 years of age Lynn Marsh is one of the best telegraph operators along the line of the Baltimore & Ohio South-Western Railroad. He has been handling the key ever since he was nine years old. He isn't in charge of an office, but his father, W. W. Marsh, is the agent and operator at Winton Place, and Lynn often "sits in" for his father, handling the key like a veteran.

"I started to learn telegraphy when I was nine years old and I expect to be the best telegraph operator in the country

LYNN MARSH AT THE KEY.

when I grow up," declares the youthful knight of the key.

The boy operator is known by nearly all the telegraph operators along the line of the railroad and they all like to take "stuff" from the key of the young expert. Lynn has worked a newspaper wire for an eight-hour turn, but he prefers the click of the railroad message to that of the newspaper story.

The war department has confirmed the report that ex-President Roosevelt is carrying to Africa with him two rifles whose sights are equipped with small electric lights to enable accurate shooting at night. These sights are the invention of a Chicago man, and are at present undergoing an exhaustive trial by the war department.

QUESTIONS AND ANSWERS.

Readers of Popular Electricity are invited to make free use of this department. Knowledge on any subject is gained by asking questions, and nearly every one has some question he would like to ask concerning electricity. These questions and answers will be of interest and benefit to many besides the one directly concerned. No consideration will be given to communications that do not contain the full name and address of the writer.

Electrolysis of Water.

Questions.—(A) Is there any definite way to figure the amount of hydrogen gas liberated from water by a known current of electricity? (B) What voltage is the best for the decomposition of water? (C) How are the oxygen and hydrogen gases carried off and compressed? (D) Will you show how such apparatus may be constructed? C. C. V., Pittsburg, Pa.

Answers.—(A) One ampere-hour will set free 12.8 cubic inches of oxygen and 16.3 cubic inches of hydrogen.

(B) Water slightly acidulated with sulphuric acid decomposes with the application of three volts. The real decomposition of pure water has been found to begin at 1.08 volts.

(C) The generated gas may be carried by pipes into a bell receiver having the lower end immersed in water similar to the storage tanks used by illuminating gas companies. The bell may be weighted to secure the desired pressure. Pipes leading to the bells should be equipped with stop valves.

(D) Many different apparatuses particularly of German make have been patented but we do not know of any large plant in commercial operation in this country. We are informed that two or three plants are in operation in Europe. Apparatus for laboratory purposes is shown in Fig. 1, and consists of a glass U tube and a rubber connection to the reservoir (R). By raising and lowering (R) various pressures of (H) and (O) may be obtained. The electrodes (P P) are of sheet platinum. The leading-in wires are of the same metal. The liquid used should be by volume, six parts of water and one part sulphuric acid. This will produce oxygen rich in ozone. The above apparatus or similar outfits are sold by firms supplying schools and colleges with laboratory material. Figs. 2, 3 and 4 give a general design of a commercial outfit said to have been successfully operated in Germany. The whole resembles a filter press. In the designs, (E) is a lead plate acting as a double electrode, (D) is sheet asbestos forming the electrode

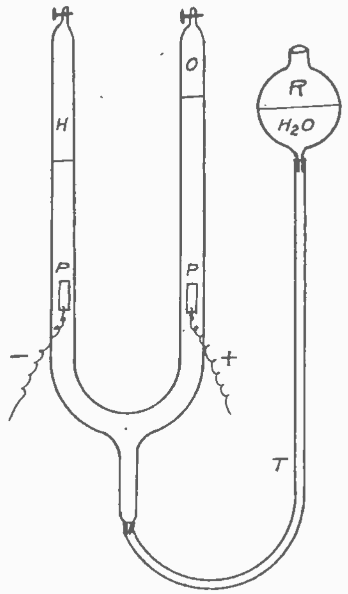


FIG. 1. LABORATORY WATER ELECTROLYZER.

spaces, and at the point where the lead plates would come in contact pieces of rubber are laid on the asbestos. Supply pipes should be of iron or lead with couplings and cocks of bronze. The whole apparatus must be well insulated from the ground and from metal connections to gas pipes. Tests to determine this should be made. The pipes (H) and (O) run to their respective electrode chambers, (H, H, H) and (O, O, O). Each plate, Fig. 4, has at the top and bottom in its thick edges, two holes, (H, O) and (W, W_1). The water pipes connect with the funnel supply. Plates, rubber sheeting and asbestos are held together by a hand wheel device shown in dotted lines. Every alternate plate respectively is connected to the +

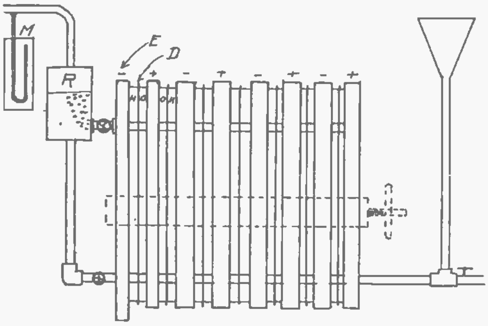


FIG. 2. WATER ELECTROLYZER—SIDE VIEW.

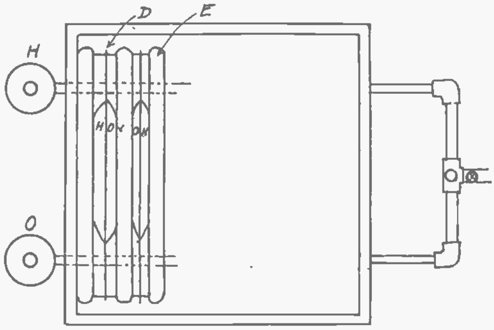


FIG. 3. WATER ELECTROLYZER — TOP VIEW.

and — side of the supply circuit by connections which should be provided but not here shown. Pressure in both leading-off pipes should be kept the same and manometers (M) placed as shown.

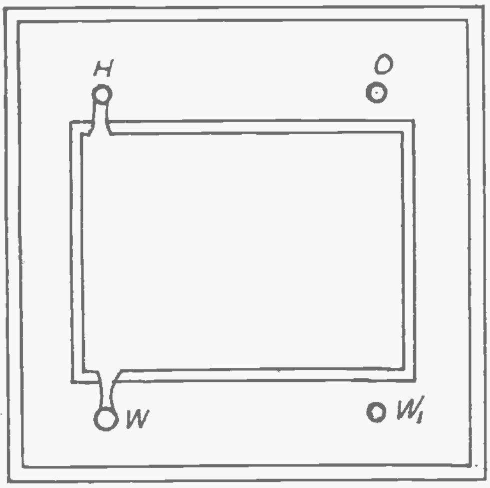


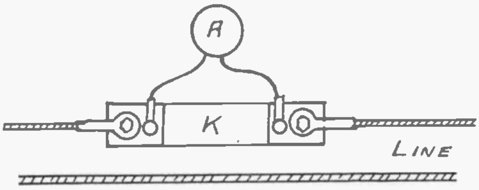
FIG. 4. SINGLE ELECTRODE OF WATER ELECTROLYZER.

The gas when used for medical purposes may be purified by passing it through a red hot porcelain tube. The purity of the gas may be also tested by leading a little of it through a rubber tube into a test tube filled with water and inverted in a dish of water. As soon as gas has displaced the water a match may be lighted under the mouth of the tube. Hydrogen burns quietly. Oxygen should not ignite. If the apparatus takes too little current, test the voltage between the plates. If a chamber shows no pressure a short circuit may have occurred. If the voltage is high the chambers may be empty, possibly by stopping up the channels.

Ammeter Shunt.

Question.—How are ammeter shunts calculated?—F. F., Milwaukee, Wis.

Answer.—The diagram shows the connections for a shunt ammeter. (K)



AMMETER SHUNT.

is a conductor in series with one side of the line and having a low temperature coefficient. Hence the drop in voltage across (K) is proportional to the current passing. (A) is a low reading sensitive voltmeter which measures this drop. If the resistance of (K) is .002 ohms and the instrument reads .5 volts, by Ohm's law $C = \frac{E}{R}$, or $\frac{.5}{.002} = 250$ amperes. Shunts and ammeters are built to measure certain maximum currents and are so named.

Telephone Receiver Wire.

Question.—How much and what size wire should be used to wind a telephone receiver pole?—E. A. R., Rockford, Ill.

Answer.—The resistance of a single pole receiver is about 75 ohms. Use 180 feet of No. 36 B. and S. gauge, or 114 feet of No. 38 single cotton covered wire. In double pole receivers the resistance of each coil is about 50 ohms for each coil. Use 120 feet of No. 36 wire or 75 feet of No. 38 wire.

Transformer and Motor Connections.

Questions.—(A) Please give diagram for connecting a three-phase alternating current motor to service, the primary being 2,200 volts and the secondary 110 volts. (B) How many transformers should I use?—W. C., Sulphur Springs, Ark.

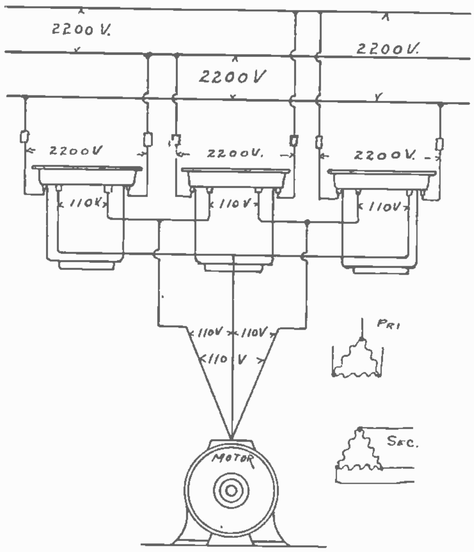


FIG. 1.

Answers.—(A) In making the following calculations it has been assumed that the ratio of transformers in all three diagrams is 20 to 1. The connections shown in Fig. 1 are more commonly used than any of the others. The primaries as shown are delta connected. The pressure in the primary of each transformer is the same as the pressure on the mains, and the secondary pressure is one-twentieth of this. By this method it is plainly evident that if one transformer blows its fuse or breaks down, the other two will be able

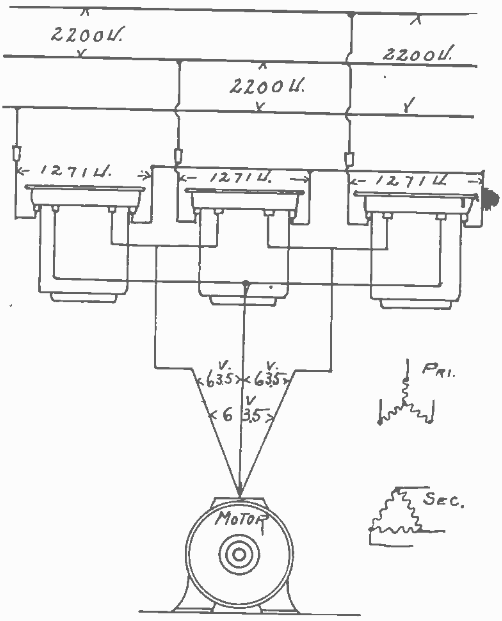


FIG. 3.

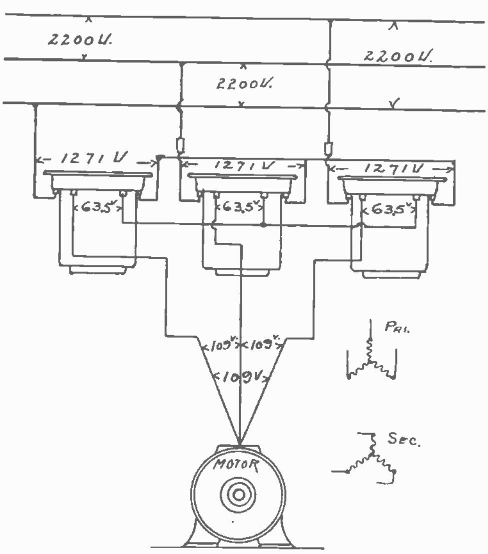


FIG. 2.

to carry the load with safety if it is reduced somewhat.

In Fig. 2 the primaries and secondaries are Y connected as shown. In this method the voltage in the primary of the transformer is the voltage of the mains divided by the square root of 3 or 1.73. The pressure across the secondary main equals the pressure of the secondary of one transformer multiplied by 1.73. The advantage of this way of connecting is that the voltage across the primary coils is less than the line voltage, which is a very important consideration in the matter of insulation when transformers are connected to very high voltage mains. The same advantage is gained also when the connections are made as shown in Fig. 3.

(B) The number of transformers shown in each diagram answers your question.

To Make a Commutator; Switchboard Connections; Lightning Arrester.

Questions.—(A) How would you make commutator segments for a small dynamo? (B) Will you give diagram showing how to wire a generator switchboard? (C) where and how are lightning arresters connected to outgoing lines? W. S., Concord, N. H.

Answers.—(A) Referring to Fig. 1, two cylinders (H) of hard wood may

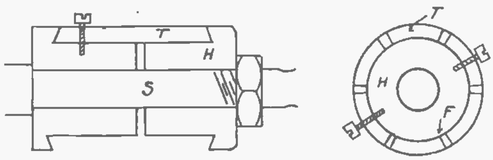


FIG. 1. CONDENSER.

be bored and turned as shown. The ring (T) of which commutator is made may be placed on the cylinder, made in halves so this can be done. The whole is driven on a lathe mandrel (S) and the

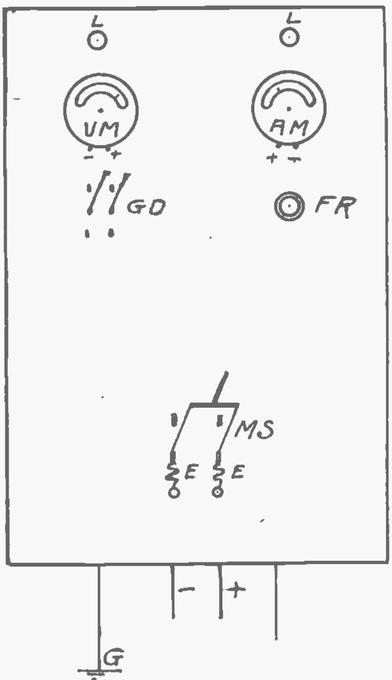


FIG. 2. D. C. SWITCHBOARD—FRONT.

nut shown, tightened. After turning and making the segments by sawing, the cuts (F) should be filled by strip mica or hard wood strips.

(B) Figs. 2 and 3 show front and back view of a switchboard in which (E, E) are fuses on leads from the generator, (G D) is a voltmeter ground detector equipped with single-pole double-thrown knife switches, (G) is ground for same. Voltmeter connections are shown with fuses (which should not be over six amperes) protecting the voltmeter

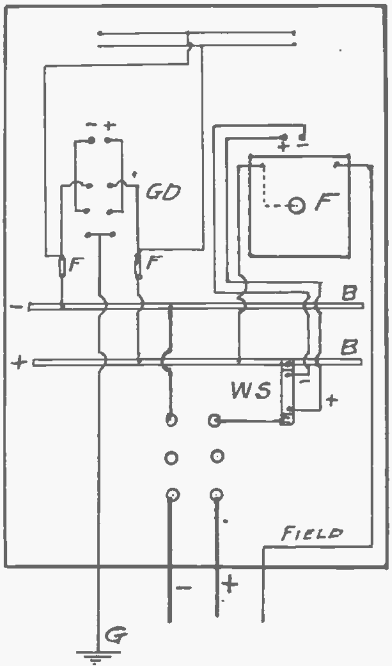


FIG. 3. D. C. SWITCHBOARD—BACK.

and two pilot lights (L, L). The ammeter is connected to a Weston shunt (W S). The shunt field rheostat (F) is shown as connected from the positive bus (B), and through this the field current is controlled. The other end of the field wire after passing around the cores is connected to the negative brush at the machine.

(C) Fig. 4 shows connections (D, D) for lightning arresters. These points should be chosen near the place where the wires enter the station. The choke coils (C, C), owing to the supposed high frequency of the lightning discharge and the self-inductance of the coils, choke back the discharge, the same passing preferably down through the arresters to ground. The arresters should be located away from the board. Not less than No. 6, B. and S. gauge copper wire

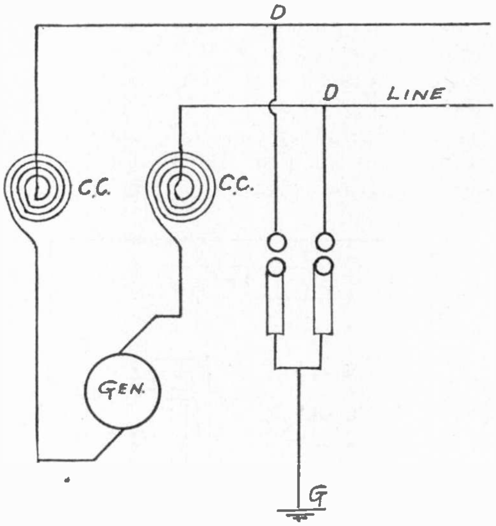


FIG. 4. LIGHTNING ARRESTER CONNECTIONS.

should be used, runs being free from kinks, coils, and sharp turns. The ground wire from the arresters should not be run in pipe. The ground plate should be fairly heavy sheet copper plate having at least four square feet of surface, buried in damp soil or soil kept so artificially. The ground wire should be riveted and soldered to the ground plate.

Magneto Generator.

Questions.—(A) Could I make a battery motor out of a telephone generator? (B) If I made a dynamo out of a telephone generator by putting a commutator on it, would I have to rewind the armature?—C. E. P., Smithshire, Ill.

Answers.—(A) Magneto generators ordinarily give from 60 to 75 volts. To run one at the high speed usual as a motor would require too many cells. A commutator would be necessary and the armature would have to be rewound for low voltage, six or eight volts. The permanent magnets also vary in flux produced. In a given generator, therefore, turning at a certain speed, the voltage will depend upon the number of turns of wire in the armature. Find by experiment how many turns of wire on the armature will give six or eight volts on an open circuit, then use the largest wire which this number of turns will allow.

(B) Not if you want 60 or 75 volts and a small current.

A 125-Cycle Motor on 60 Cycles; Winding Armature.

Questions.—(A) In the December, 1908, issue of Popular Electricity I read how to change a motor running on 125 cycles so it would run on 60 cycles. I used 150 feet of No. 23 wire on each pole piece. The fan operates, but at slow speed, and also vibrates with a humming noise. (B) How would you wind a drum armature having 36 slots?—W. W., Chicago, Ill.

Answers.—(A) The latter part of the answer to J. E. D. in issue referred to answers part of your question. The humming is due to parts of the motor being "in tune" with the frequency or alternations.

(B) Wind as follows:

Coil No.	Starts in Slot No.	Ends in Slot No.
1	1	18
2	19	36
3	7	24
4	25	6
5	31	12
6	13	30
7	3	20
8	21	2
9	27	8
10	9	26
11	33	14
12	15	32
13	23	4
14	5	22
15	11	28
16	29	10
17	35	16
18	17	34

Arc Lamp Resistance.

Questions.—(A) What size of German silver wire and how much of it will be needed for resistance in an arc lamp using ⅜-inch by 12-inch carbons? (B) For a flaming arc?—T. W. P., Chicago, Ill.

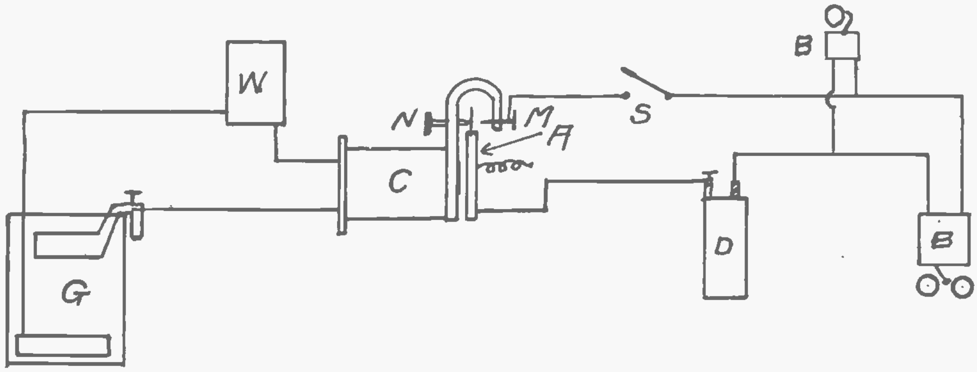
Answers.—(A) A constant potential direct current enclosed arc lamp requires about 80 volts at the arc and four amperes on a ⅜-inch carbon. A resistance of eight ohms, or one and one-third pounds of No. 14 German silver will give the necessary resistance for 12-inch carbons.

(B) A constant potential direct current flaming arc lamp is adjusted for 45 volts at the arc and a consumption of 10 to 12 amperes. A proportional decrease in resistance as noted in (A) is required.

Burglar Alarm Circuit.

Questions.—(A) Kindly explain how I may arrange a burglar alarm so as to have one large outside bell, one small inside bell and a switchboard for the equipment. (B) What are considered an electrician's helper's tools? H. G. B., Jersey City, N. J.

Answers.—(A) The diagram shows connections for a closed circuit alarm, windows (W), relay (C), and gravity battery (G). Armature (A) is normally held in contact with point (N). If circuit (W G C) is broken, relay (C) releases (A) and the spring causes contact to be made at (M) which is insulated from (N). If switch (S) is closed bells (B) ring until circuit (W G C) is closed or (S) opened. (S) and (C) could be placed on a neat wooden board and the position of (A) would indicate the condition of window circuits.



BURGLAR ALARM CIRCUIT.

(B) We do not know that any certain tools are so designated, but other things being equal the electrician's helper would be most efficient if he has the following: One rule, 2 foot; one clawhammer, No. 13; one blow lamp; one B. and S. pocket wrench, No. 4; one screw-driver bit; one set (2) Champion screw-drivers; one large screw-driver, 12 inch; one ratchet brace, No. 33; bits, 1/4, 3/8, 1/2, 5/8, 3/4, 7/8, 1 inch; one Clarke expansive bit, 7/8 to 3-inch; one gimlet bit; one wood countersink; one extension drill; 3/8 inch, length 24 inches; one long or extension gimlet; one cold chisel, 3/4 inch; one wood chisel; one brick drill; one pair line pliers, 8 inch; one splicing clamp; one soldering copper, No. 3; one plumb bob; one hack saw, 10 inch; one saw, 20 inch.

Magnet Coil Winding.

Question.—Please tell me how to make a magnet coil that I may connect across 110 volts, the coil to be only one inch long. C. M., Richmond, Ind.

Answer.—Wind a bundle of iron wires with two layers of oiled paper. Upon this wind 1,000 feet of No. 30 silk-covered wire. The current through the coil when across a 110-volt circuit will be about one ampere.

A Closed Circuit Cell.

Question.—How can I make a wet, closed circuit cell other than a bichromate cell? J. A., Council Bluffs, Ia.

Answer.—The Gordon cell is made as follows: Provide a glass on porcelain jar six inches in diameter and eight inches high, with a tin or fiber tight fitting cover. In this jar suspend by an iron rod, insulated through the cover, a tin cylinder pierced full of small holes. Fasten to the outside of this cylinder down near the bottom three porcelain supports to hold and insulate a ring of zinc. To this zinc fasten a rubber covered wire and bring this wire up through cover. Brass connectors may be fastened to the upper ends of the iron rod and rubber covered wire. These are the battery terminals. Fill the jar with six pints of water and slowly add 1 1/2 pounds of caustic soda. Now immerse the cylinder containing 2 3/4 pounds of oxide and around which is the zinc ring. Pour a little parrafine oil on the surface and securely fasten the cover in place. This cell gives a steady current of two amperes at seven-tenths volts or five amperes at five-tenths volts. Copper oxide, zinc, and caustic soda are required to renew the cell.

Telegraph Key and Relay.

Questions.—(A) How can I make a telegraph key? (B) How can I make a relay of high resistance?—J. L. B., Elizabeth Port, N. J.

Answers.—(A) Fig. 1 shows the working parts of a telegraph key. The circuit through the key may be traced

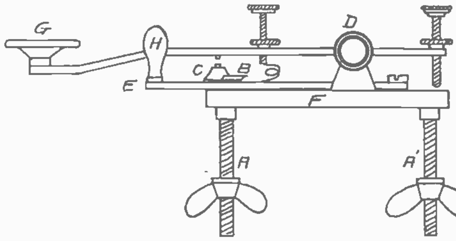


FIG. 1. WORKING PARTS OF A TELEGRAPH KEY.

from leg (A) to anvil (C) which is insulated by a hard rubber bushing and plate from base (F). With the key pressed down the current passes to trunnion (D), to base (F), and to leg (A'). (E) is a circuit closer by which the frame (F) through a metal strip (B) closes circuit through the anvil (C) and leg (A) when key is not in use. Connections are made to legs (A) and (A').

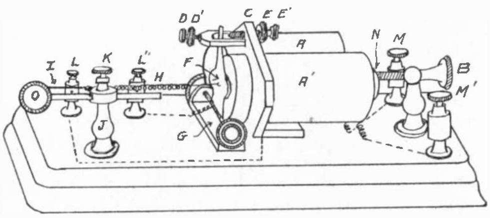


FIG. 2. TELEGRAPH RELAY.

The contact points are platinum, and (G) and (H) are of hard rubber. The rest of the instrument is of brass.

In Fig. 2 of a telegraph relay (A A') are the coils surrounding two soft iron cores, connected by a yoke (N) at one end, and adjusted by set screw (B), (A A') being adjustable through frame (C). The soft iron armature (F) operates on a trunnion held in place by a brass base (G). (D D') and (E E') are adjustment screws with lock nuts, (D D') being tipped with hard rubber. A sliding rod through (J) held in place by a set screw (K) controls the tension of the spring (H) when (O) is adjusted. Parts except as noted are of brass, the whole being mounted on a wooden base. Connecting wires are run in grooves in this base. Binding posts (M M') are connected to the line. (L L') are connected to a local battery and sounder, the circuit of which is closed by the armature. The coils (A A') are usually enclosed in hard rubber cylinders. Regarding the building of the coils, divide between two spools 2,900 feet of No. 30 B. and S. gauge wire. Place in each coil a soft iron core connected at one end by a yoke. Join the coils together so that if stretched in a straight line along the yoke forming a bar magnet, the wire will be wound in the same direction throughout. Together these coils will have a resistance of 300 ohms approximately.

Arc Lamp Rheostat.

Questions.—(A) I have a rheostat on an arc lamp taking about 45 amperes. The wire in the rheostat is German silver, No. 10 B and S gauge. The coils are exposed and after some twenty minutes' run the coils get red hot, causing a breakdown about once a month. Could I inclose this rheostat in an oil proof air tight box filled with crude petroleum to prevent heating and breakdown?

(B) Would the oil serve to cut my resistance down?

(C) Would there be any danger of fire?

(D) Will you give a diagram of a transformer stepping 110 volts down to 55 volts and capable of delivering 40 to 60 amperes?—W. A. McD., St. Louis, Mo.

Answers.—(A) No. 10 German silver wire (18 per cent nickel) has a carrying capacity of 8½ amperes. Increase the size of the wire and in the same proportion increase the length. This will keep the resistance the same as now, but increase the carrying capacity. It is not advisable to cool the rheostat with petroleum.

(B) No.

(C) The Fire Underwriters' laboratories do not approve the oil cooled rheostat because they believe it increases the fire hazard.

(D) The specifications for the design of a transformer such as you suggest hardly come within the scope of this department.

Effect of Lines of Force.

Question.—I have a galvanometer made of a coil of wire, inside of which is a pocket compass. When I connect this galvanometer across the primary of an induction coil having a make-and-break contact the needle will gradually commence to revolve. What is the cause? M. B. G., New York City.

Answer.—When a current is passed through a coil of wire, magnetic lines of force are built up inside the coil. Any magnetic metal inside this coil will try to place itself in the path of these lines longitudinally. In the case you describe the magnetic lines are made and then die out because the interrupter on the coil makes and breaks the circuit. When the circuit is made the needle seeks to place itself along the path of the lines, which lines immediately disappear, leaving the needle to swing on around until the next pull is impressed upon it. The speed is regulated by the speed of the make and break.

Winding Small Drum Armature.

Questions.—(A) Armature, 2⅛ inches in diameter and 2⅞ inches long. How much and what size wire should I use to get 50 volts, armature to be drum wound? (B) Does a six-segment commutator require 12 slots in the armature?—A. Curtis, Cleveland, Ohio.

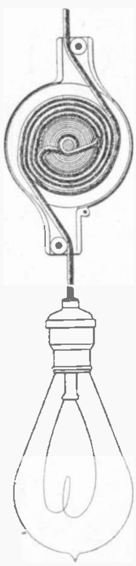
Answers.—(A) With field coils in shunt, provide 12 slots and 12 segments, the slots being ¼ inch wide by ¼ inch deep. Use 14 ounces of No. 22 wire on armature and 2¾ pounds of No. 24 wire on the field coils.

(B) There may be six, 12, 18, or so on, slots (some multiple of six) in the armature.

NEW ELECTRICAL INVENTIONS.

ELECTRIC LIGHT FIXTURE.

A device for raising and lowering electric incandescent lamps has been patented by William Amstalden of Amador City, Cal. As shown in the cut it contains a drum which winds up and unwinds the cord. The drum is provided with a spring and ratchet arrangement, similar to that of a curtain roller, which permits of the lamp being adjusted at any desired height.



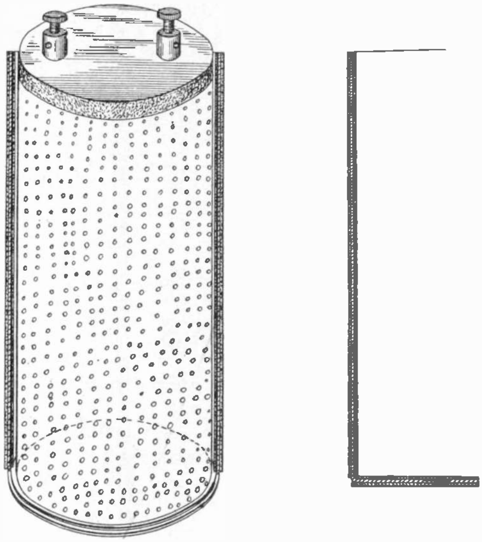
ELECTRIC LIGHT FIXTURE.

RENEWING DRY CELLS.

It is well known that dry batteries commence to deteriorate from the time they are made and that therefore it is always a matter of uncertainty in purchasing a cell whether it will continue to be efficient for several months or only for a few days. At the present time, as soon as the voltage of such a cell falls below a certain amount, the cell must be discarded and a new one bought. The purpose of an invention made by H. B. Ramey of Alexandria, Va., is to enable such a cell to be revivified with very little trouble and slight expense so that its period of usefulness will be extended for a length of time at least equal to that for which it could be used if put in service immediately after its manufacture.

The invention consists, broadly speaking in applying to the exterior of the cell a casing carrying a dry electrolyte which, upon the application of moisture, sets up a chemical action with the exterior zinc surface of the cell and, the latter being perforated, causes electrical action to be again produced.

The casing or cup consists of an external waterproof casing and an internal absorbent lining. A sheet of the absorbent paper of the proper size, to form a cylinder of the desired diameter, is impregnated with a solution containing ten parts of muriate of ammonia, four parts of bichromate of potash and ten parts of



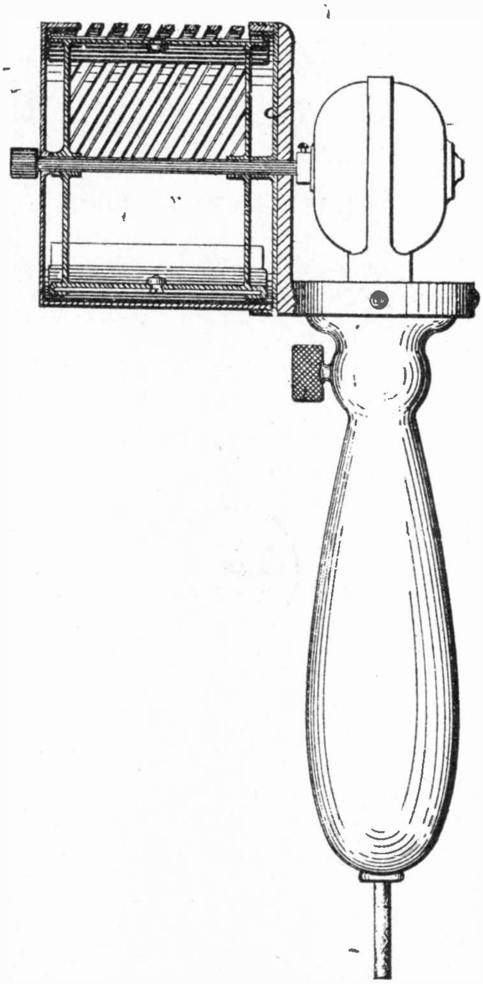
RENEWING DRY CELLS.

chloride of sodium. This sheet is then dried, preferably by passing it between rollers which serve to incorporate the chemicals firmly and to extrude the excess of water, and is wrapped around a wooden cylinder of appropriate diameter. It is then coated externally with a waterproofing paste. Around this is then wrapped a coating of Manila paper, the end of the cup being formed by placing a disk of similar paper at the end of the cylinder in the inside and folding the sheet of Manila paper over it.

The usual external casing of paper is next removed from the cell and the zinc surface cleaned. After wiping off the surface the zinc is perforated in a number of places with a small sharp instrument and the coal tar in the top of the cell is removed by tapping around the edge with a hammer. The cell is then placed within the prepared cup and the top is filled with clean water, preferably rain water. Chemical action will then immediately be produced between the outer surface of the zinc and the electrolyte contained in the porus lining of the cup and the terminals of the cell will show practically the same voltage as it did when it was new. By replenishing the water from time to time, say once a month for example, the life of the cell can be prolonged for a considerable time.

ELECTRIC SAFETY RAZOR.

The latest application of electricity to be suggested is an electric safety razor, and Luigi Brunacci of New York, N. Y., has secured a patent on the idea. The device, as shown in the cut, consists



ELECTRIC SAFETY RAZOR.

of a handle, on the end of which is mounted a very small electric motor whose shaft projects through a barrel-like casing. On the shaft inside the casing are mounted revolving arms which carry two razor blades, the keen edges of which just skim the interior surface of the casing. Diagonal slots are cut through the casing and as the latter is passed over the face the hairs protrude through the slots and are cut off by the blades.

BOOK REVIEWS.

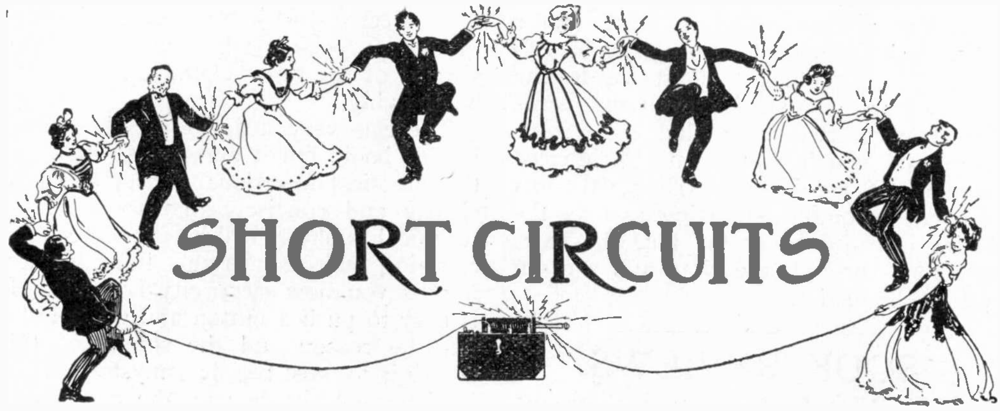
HARPER'S HOW TO UNDERSTAND ELECTRICAL WORK. By William H. Onken, Jr., and Joseph B. Baker. New York: Harper & Brothers, 1908. 359 pages, with 171 illustrations. Price, $1.75.

Far off in the distant West the sun beats down on the snowcapped mountains. Rivulets of water flow down the sides, joining others on their way, until at last the swelling tide is met by a wall of steel and concrete. Fighting against this man-made barrier, the water at last finds a small opening leading to a canal which winds its way along the mountainside. Suddenly it comes to a precipitous height and plunges down through steel tubes to the power house far below. Emerging from its narrow prison the maddened water seeks to escape, and in its outward rush it brushes aside the blades of the massive water turbine attached to an electric generator. A switch is thrown and the next instant a million lights spring into being in cities over 200 miles away. Along the route of the transmission lines hamlets, villages, towns and cities feel the pulse of this resistless energy. Let that pulse stop beating and all progress is stopped.

How to understand this new and wonderful force—electricity—is a problem which is now occupying the minds of people in the ordinary walks of life. A few decades ago it was only the most venturesome engineers who were seriously studying the subject; a few generations ago only some dozens of pioneers in science contemplated it seriously. Of all the theoretical and experimental work that has been done in these years and which will be done in the future, little will be understood by the layman. But to become conversant with the practical things which are now being done electrically is the desire of every intelligent person who wishes to keep abreast of the times in the age in which he is living.

There is very little of the theoretical in this book, but it answers so many of the practical questions in electricity so clearly and concisely that to the non-technical public it will be found both interesting and instructive. For instance, it tells you how electricity is made. It is easy to push a button and get a light, but the reason and the source of this power is to most people a mystery. Then in the same simple way the application of this power to lighting, heating, transportation, farming, mining, etc., is explained.

ILLUMINATION.—Another field of business endeavor has been invaded by a trade paper, and, with the appearance of the initial number of Illumination, which is just now being circulated, a new publication that will cater to the interests of those engaged in the field of lighting and fixtures is launched. The initial number presents a very striking appearance, and the sub-title gives an additional clew to the nature of the publication—"A Magazine of Light." In the first number, Mr. E. G. Cowdery, manager of the People's Gas Light and Coke Company, writes his ideas of "Gas as an Illuminant." Emily Calvin Blake, a well-known magazine writer, begins a series of articles dealing with the early history of the various means of lighting. Waldon Fawcett tells for the first time the story of the use and development of the new illuminant, "Lusol," which is being extensively experimented with by the French government. Lem F. Parton, who has just returned from an extended tour throughout all of South America, takes up this interesting portion of the western hemisphere and shows where there are great possibilities for the location of power and lighting plants. In the make-up the magazine presents a very unique and high-class appearance. It is well edited and well printed, and if appearance counts it should prove to be a winner. H. B. Shontz is manager and Wesley A. Stanger is editor. The home office of the magazine is in the Monon Building, Chicago.



Willie Vet—"What's an army endurance test, ma?"

Mother Vet—"Living with your pa the first few days after he gets his pension money."

* * *

I shot an arrow in the air, it went in the distance, I know not where, till a neighbor said that it killed his calf, and I had to pay him six and a half ($6.50). I bought some poison to slay some rats, and a neighbor swore it killed his cats; and rather than argue across the fence, I paid him four dollars and fifty cents ($4.50). One night I set sailing a toy balloon, and hoped it would soar till it reached the moon; but the candle fell out on a farmer's straw, and he said I must settle or go to law. And that is the way with the random shot; it never hits the proper spot; and the joke you spring that you think so smart, may leave a wound in some fellow's heart.

* * *

Never having taken a sea trip, Mr. Cobb one day conceived the idea of making a voyage to New York. Accordingly he sailed from Boston in a small schooner.

The first day out a storm was encountered and Mr. Cobb became violently sick, but after several hours he mustered up courage and strength to look out upon the troubled waters.

As he looked from the side of the little ship up the trough of the sea, it seemed very smooth to him. The captain's cutting of the waves was "senseless," he told himself.

But as this mad steering continued, the unhappy passenger finally crawled out, on hands and knees, to where the captain stood at the wheel, and raising his voice above the din of waves and wind, shouted:

"Man, man, keep in the ruts, keep in the ruts!"

* * *

A young theologian named Fiddle
Refused to accept his degree.
"For," said he, "'tis enough to be Fiddle
Without being Fiddle D.D."

* * *

"Oh, I couldn't love him!"

"Why not?"

"He wears a wig!"

"The very idea!"

Then the dear creature removed two rats, some puffs, a coronet braid, a pompadour and a switch, and sat down to peruse a novel.

* * *

Mother (indignantly)—"You naughty boy! Stop pulling that poor cat's tail."

Little Innocent—"I'm not pulling it. I'm only holding on. The cat is doing the pulling herself."

* * *

"Well, good-bye, dear!" said Mr. Trueboy to his beloved spouse. "I must go and dictate those letters—twenty-six of them—so you mustn't expect me home very early."

"All right," was the response. "But I wish you wouldn't work so hard."

Half an hour later Mr. Trueboy entered his club and sat down, with three others, at a card table.

"Just a moment, you fellows, before the first hand is dealt. I've got to keep my word with my wife. One of you just take down what I dictate: 'A b c d e f g h i j k l m n o p q r s t u v w x y z.' There! Those letters are off my mind!"

* * *

A recent church notice in Manchester, England, read: "A potato pie supper will be held on Saturday evening. Subject for Sunday evening, 'A Night of Agony.'"

* * *

"I had to sell my auto, but I haven't missed it yet."

"How's that?"

"You can get most of the sensation by cleaning rugs."

* * *

Old Mr. Flaherty was a general favorite in the little town where he lived.The doctor was away during the early part of the summer and did not hear of the old man's death. Soon after his return he met Miss Flaherty and inquired about the family, ending with:

"And how is your father standing the heat?"

* * *

Johnny's mother gave him two five-cent pieces—one for candy, the other for the Sunday-school collection.

Light-hearted, he was tossing the coins in the air on his way to the church, when suddenly one eluded his grasp and disappeared through a cellar grating. Down on his knees he peered into the dark pit, only to realize his loss. Then looking thoughtfully, first into his hand, next at the cellar steps, he remarked: "Well, there goes the Lord's nickel!"

* * *

"Why are you so sad?" an acquaintance asked a young man whose aunt had just died. "You never appeared to care much for the poor lady." "I didn't," said the youth dolefully; "but I was the means of keeping her in a lunatic asylum during the last five years of her life. She has left me all her money, and now I've got to prove that she was of sound mind!"

* * *

Breathes there a man with soul so dead who, when outdoors he pokes his head on days like these, says not, "I wish I had the time to take a fish?"—Washington Herald.

Oh, yes; I know a chap who is so blooming lazy that, gee whiz, he has no fond desire to roam, but drinks the "bait" and stays at home. —Houston Post.

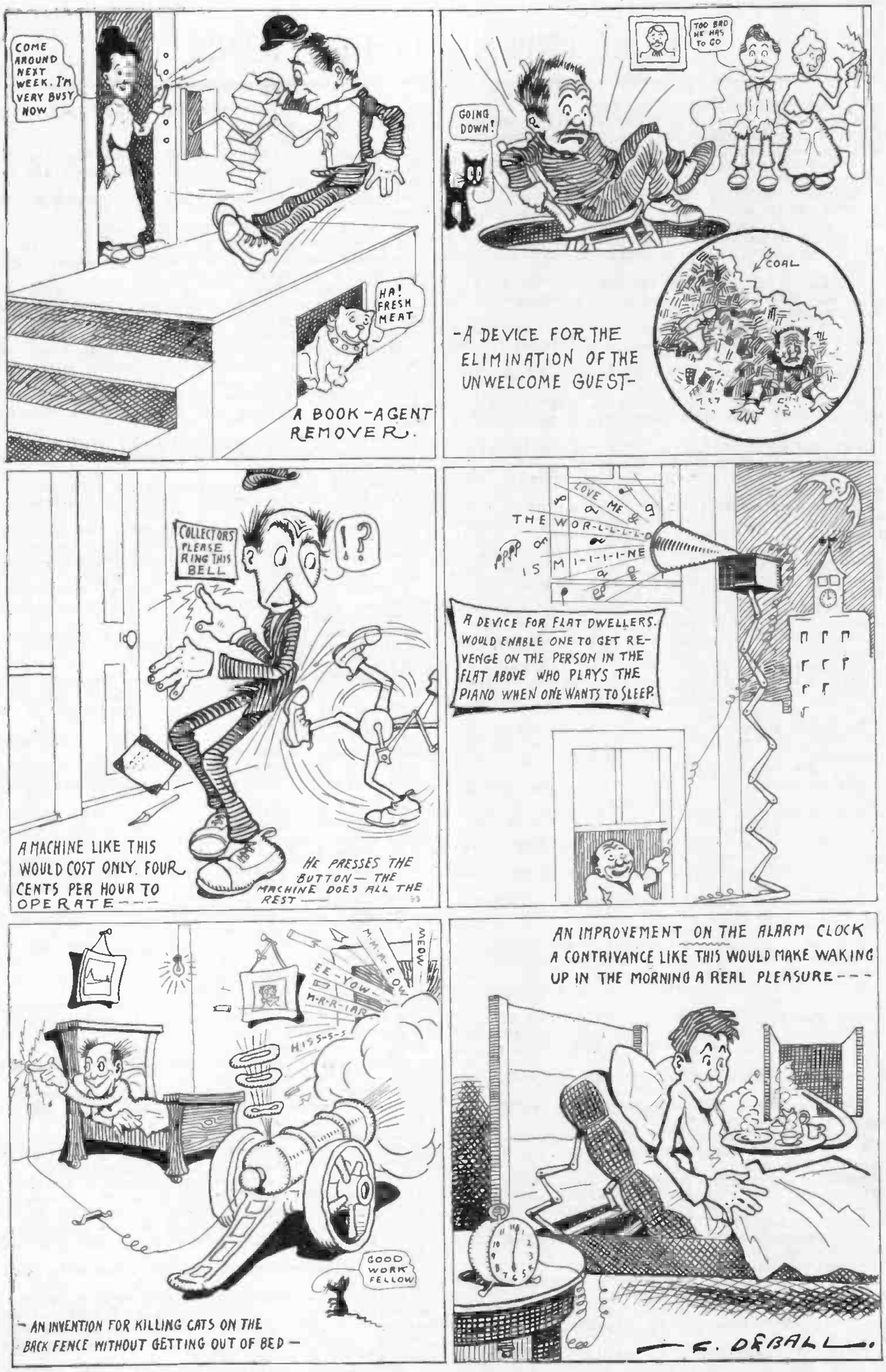
* * *

Alpine Hotel Manager (to the man who has the telescope for hire)—"The Kaiser is coming here to-morrow. Be careful to say nothing to him about the majesty of the mountains."

* * *

A sign hung in a conspicuous place in a store in Lawrence reads:

"Man is made of dust. Dust settles. Are you a man?"



HELPFUL HINTS FOR ELECTRICAL INVENTORS.

ELECTRICAL DEFINITIONS.

Accumulator.—Storage 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.

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.

Branch Conductor.—A parallel or shunt conductor.

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 out-going 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.

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 for changing the direction of electric currents.

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.

Diamagnetic.—Having a magnetic permeability inferior to that of air.

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.

Electroscope.—Instrument for detecting the presence of an electric charge.

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 or system.

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.

Galvanometer.—Instrument for measuring current strength.

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.

Multiple Circuits.—See parallel circuits.

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.—Space between the two electrodes of an electric 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.

Voltage.—Potential difference or electromotive force.

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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(CONTINUED.)

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It is not a mere stain. It is a deep seated dye—sinking into the pores of the wood and bringing out the beauty of the grain. When finished with Johnson's Prepared Wax you have a permanent finish of real beauty and most artistic effect. We want to give you these three packages at once, absolutely free. You can either send us your name and address on a postal or in letter requesting them or use coupon below printed for your convenience.

Johnson's Wood Dye comes in 14 Standard shades:

No. 126 Light Oak	*No. 130 Weathered Oak*
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No. 140 Manilla Oak	*No. 121 Moss Green*
No. 110 Bog Oak	*No. 122 Forest Green*
No. 128 Light Mahogany	*No. 172 Flemish Oak*
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Half-pints 30c; pints 50c. Johnson's Prepared Wax 10c and 25c packages. Also sold in large sizes. For sale by all leading paint dealers. Send coupon today to

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"The Wood Finishing Authorities"

Please Use This FREE COUPON

I accept your offer of Free Booklet Edition PE-5 one sample bottle of Johnson's Wood Dye, shade No.......... one bottle of Johnson's Electric Solvo, and a sample of Johnson's Prepared Wax.

Name..

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I usually buy my paint at store of

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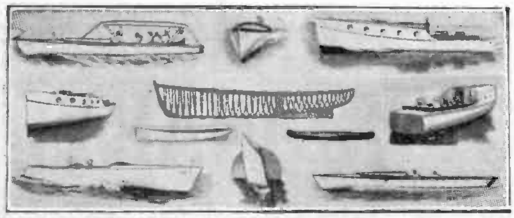

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Any one can put together my knock-down boats or build a boat from my paper patterns. If you want to know how it can be done.

Send for my 1909 Catalog No. 22 today

It shows 100 new models.

I can supply you with the framework for your boat, shaped, machined, every piece fitted and ready to put together, for less money than most lumber dealers charge for suitable rough lumber.

Today there are more boats built by inexperienced amateurs using my system, than by all the boat factories.

I can save you (1) the boat builder's profit; (2), labor expense; (3), big selling exp'nse; (4), ½ of the freight. Figure it out yourself.

YOU TAKE NO RISK
I absolutely guarantee that you will be perfectly satisfied with everything you purchase of me, or your money will be instantly refunded.
C. C. Brooks.

I can save you two-thirds on high grade Mission furniture shipped knock-down, in sections, not in pieces.

Put the K. D. Sections Together Yourself

As you receive it—with cushions made ready to drop in place. Just six joints to put together.

Every piece is of selected solid oak, massive, simple, always in good taste, and of a style that never changes.

C. C. BROOKS, Pres., BROOKS MFG. CO.
4205 Ship Street, SAGINAW, MICHIGAN, U. S. A. Est. 1901.
Originators of the Knock-Down System of Boat Building and Home Furnishing.

Do You Hear Well?

The Stolz Electrophone—A New, Electrical, Scientific and Practical Invention for those who are Deaf or Partially Deaf— MAY NOW BE TESTED IN YOUR OWN HOME.

Deaf or partially deaf people may now make a month's trial of the Stolz Electrophone at home. This personal practical test serves to prove that the device satisfies *with ease*, every requirement of a perfect hearing device. Write for particulars at once, before the offer is withdrawn, for by this *personal test* plan the *final* selection of the one *completely satisfactory hearing aid* is made easy and inexpensive for every one.

This new invention, the Stolz Electrophone (U.S. Patent No 763,575) renders unnecessary such clumsy, unsightly and frequently harmful devices as trumpets, horns, tubes, ear drums, fans, etc. It is a tiny electric telephone that fits on the ear and which, the instant it is applied, *magnifies* the sound waves in such manner as to cause an *astonishing increase* in the *clearness* of *all sounds*. It overcomes the buzzing and roaring ear noises and, also, so constantly and electrically exercises the vital parts of the ear that, usually, the natural unaided hearing itself is gradually restored.

Mrs. C. Lideeka, 238 12th Ave., Maywood, Ill., wears an Electrophone
Less conspicuous than eyeglasses

What Three Business Men Say:

The Electrophone is very satisfactory. Being small in size and great in hearing qualities makes it preferable to any I have tried and I believe, I have tried all of them. M. W. Hoyt, Wholesale Grocer, Michigan Ave. and River St., Chicago.

The Stolz Electrophone Co., Chicago, Ill. Gentlemen:—I have used your Electrophone since July 1908. It enables me to hear speakers over 50 feet away. Without it I could not hear their voices. It has improved my natural hearing at least 50%, and has stopped the head noises which were so annoying. Refer to me at any time. Yours truly, E. P. Rogers, Suite 908-159 LaSalle St., Chicago, Ill.

I have now used your Electrophone over a year, and know that it is a first-class, scientific hearing device. Without it people have to shout directly in my ear to make me hear. With it, I can hear distinctly when spoken to in an ordinary tone. Best of all, it has stopped my head noises, which were a terrible aggravation. Lewis W. May, Cashier, 100 Washington St., Chicago.

Write to or call (call if you can) at our Chicago offices for particulars of our personal test offer and list of other prominent endorsers who will answer inquiries. Physicians cordially invited to investigate aurists' opinions.

Stolz Electrophone Co., 1854 Stewart Bldg., 7th floor, Chicago.
Branch Offices: Philadelphia, Cincinnati, Seattle, Los Angeles, Pittsburg, Louisville, Cleveland, Indianapolis, Des Moines, Toronto. Foreign Office: 82-85 Fleet St., London, Eng.

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Heighth 20 Inches.

—the latest globe on the market, lithographed in ten permanent oil colors. The stand which is made of oak, weathered finish, is more up-to-date and far superior to the old-style iron base. The ball, or globe proper, is finished with high-grade varnish and is, therefore, impervious to water. It can be kept bright by an occasional wiping with a damp cloth.

TIME DISC—By means of a time disc at the north pole, time at any point in the world may be instantly approximated by noting the time at the point where observation is made.

ISOTHERMAL LINES—The isothermal lines are represented by red and blue lines for January and July and at various intervals the mean temperature for three months is noted.

The ANALEMMA—Just west of Mexico is the Analemma representing a figure eight. This is divided into months and the months, in turn, into days, and shows just where the direct rays of the sun strike the earth for every day in the year.

NOTE. The globe weighs eight pounds when packed ready for shipment. The subscriber must pay the freight or express charges when delivery is made.

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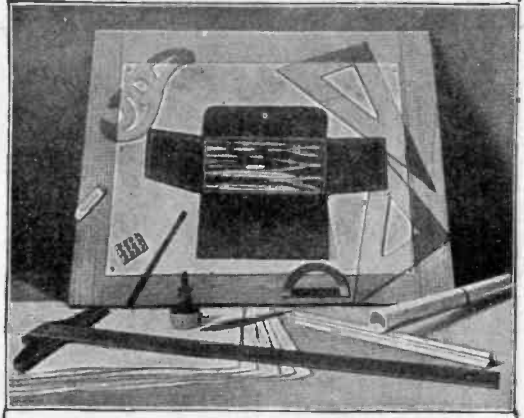

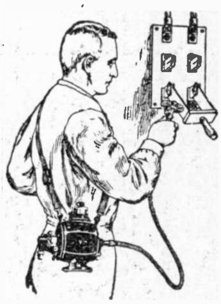

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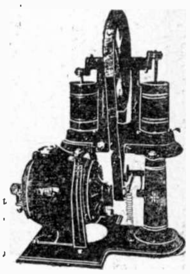
Consists of small motor with straps for swinging over operators shoulder and on the armature shaft of the motor a flix shaft is provided, at the end of which is a holder for rotary polishing discs, buffs, etc. Useful for polishing signs, railings and other brass work. Also in the garage central station, etc.

ELECTRICALLY OPERATED AIR COMPRESSORS



For Garages, Saloons, Central Stations, Air Brush work, etc. etc. Single and double cylinder types. Automatic pressure regulators.

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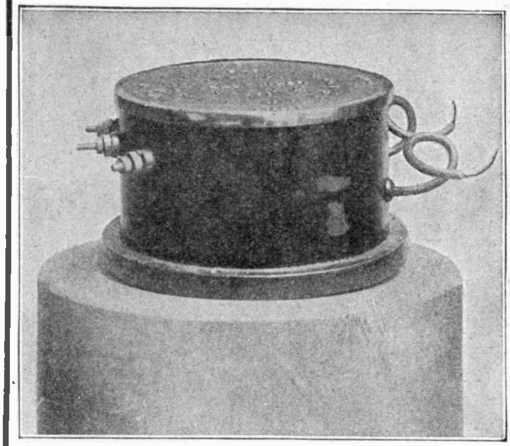

The Rollinson Bell Ringer

will operate buzzers, door bells, hotel calls, elevator calls, automatic gas lighters, etc., from an ordinary 110-volt lighting circuit, without the use of batteries.

The bell ringer is made in three sizes, all three taking 100 to 130 volts from the line and changing it to 6-13-19. and 8-16-24 volts respectively for supplying the bell circuit. Using alternating current, the device may be said to operate without cost for current.

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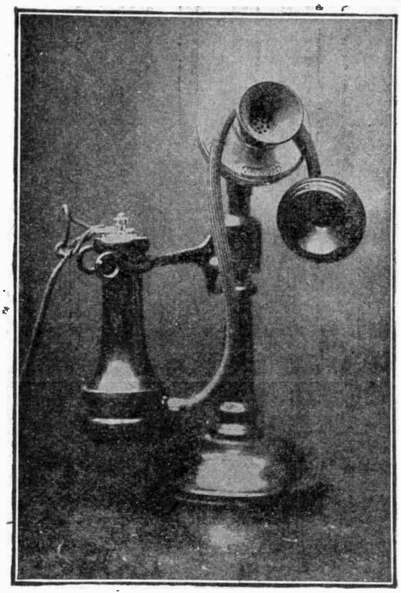

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How often do you have important conversations over your phone?

How often have you failed to hear distinctly?

The Help-a-Phone is just what you need where the noise of the typewriter, the buzz of conversation or the rattle of machinery interferes with the accurate and satisfactory hearing of messages.

Makes telephoning possible under any condition. Makes whispered conversations possible on local lines.

Offices, homes and shops where it has been in use report that it is invaluable. Money cheerfully refunded if you are not satisfied. State in ordering whether it is to fit a Bell or other instrument. Sent on receipt of price $3.50.

If you are not interested as a telephone user send to us for a few facts and figures on the Help-a-Phone as an agency proposition. We have men and women who are coining money.

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Our **Circuit Detector** will be a most valuable addition to your equipment. Just the instrument for testing your apparatus and connections. Detects all circuit and connection troubles.

Makes an Ideal and Reliable Wireless Operator's Head Receiver.

Complete—with high grade receiver—leather covered head band—battery and 5 foot green cord.

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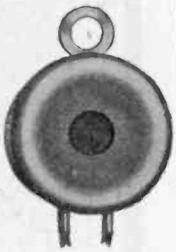
Three foot cords for same 20 cents.

We are the Manufacturers. Send Us Your Orders.

Wm. J. Murdock & Co., 40 Carter St., Chelsea, Mass.



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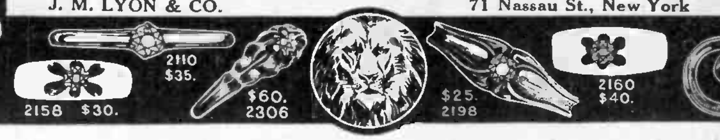
Why wait for your Diamond until you have saved the price? Pay for it by the Lyon Method. Lyon's prices are fully 20% lower than any others. Lyon's Diamonds are guaranteed perfect blue-white, imported in the rough, cut and polished here to save import duties and middlemen's profits. A written guarantee accompanies each Diamond. You have the option for exchange at any time at full purchase price. All goods sent prepaid for inspection. 10% discount for cash. Send now—today—for our catalogue No. 2, splendidly illustrated. *Established 1843.*

J. M. LYON & CO. **71 Nassau St., New York**



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You wouldn't do without an electric light anywhere because of its trifling cost. The General Electric fan costs no more to operate.

Summer heat is reduced at a cost less than that for lighting winter's darkness. Summer makes less demand for electric light. You should give yourself and office employees the benefit by enjoying the comfort given by General Electric fans.

Neglected Wastes Takes the Dividends

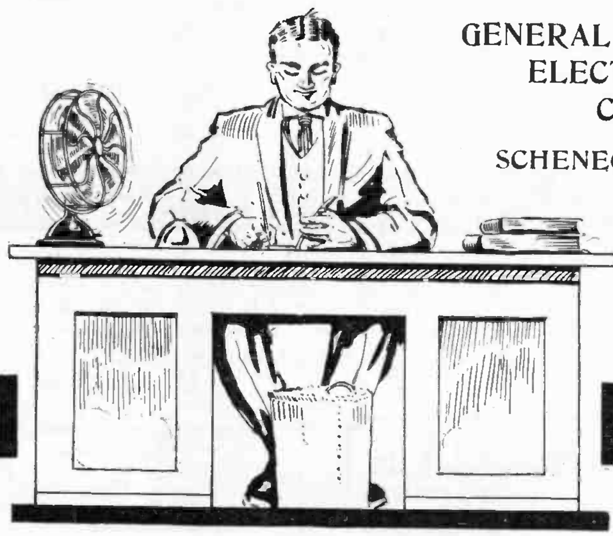
No man can keep alert to the vital elements of business details if he is oppressed by the heat or depressed by foul air. The General Electric fan will help him by dispelling both.

Mistakes are all Lost Motion

The one who makes mistakes is not so much to blame as the one who permits conditions that favor mistakes. The General Electric fan keeps the air fresh and cool and the worker keen and accurate.

The 1909 design of the General Electric fan merits your exclusive attention. Its many points of superiority are easily recognized—noiseless operation—even distribution of air over a large area—little space occupied—little current consumed—speed can be varied to produce a gale or zephyr at command—designs adapted to all ventilating and cooling purposes—and so, many points, too numerous to mention here, have been taken care of by the General Electric Company. You benefit more than you know when you buy a General Electric fan.

A beautiful Catalog No. 4632T illustrating these fans is available for those interested.



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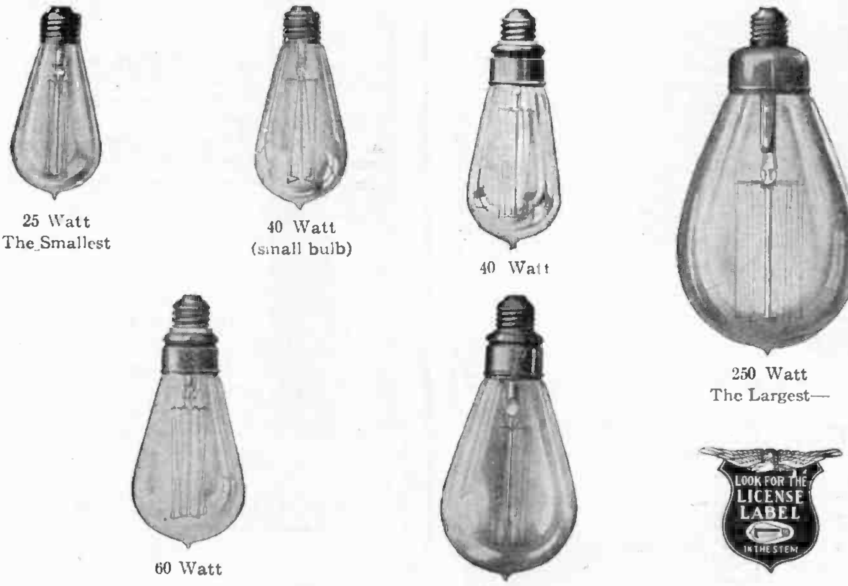

25 Watt
The Smallest

40 Watt
(small bulb)

40 Watt

250 Watt
The Largest—

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100 Watt

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G-I TUNGSTEN LAMPS

Write for Descriptive Bulletin No. 6D

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The demand for electric current can be greatly increased by advertising the advantages of electric power and light.

For years we have prepared and placed such advertising for the largest Central Electric Stations in the Country.

We will be glad to show you what we have done for them, and what we can do for you.

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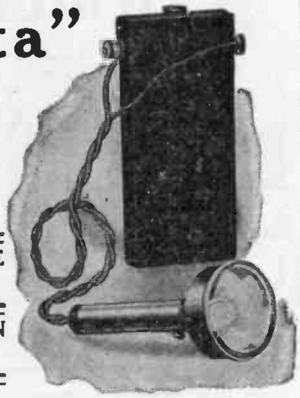
"Vesta" Pocket Electric Lantern

DRY STORAGE BATTERY

TUNGSTEN BULB



This is not a toy but is a practical portable lantern designed in response to an increasing demand for a safe powerful light where the use of gasoline oil or a candle is dangerous.

The battery is so made that it can be carried in the hip pocket without inconvenience and will give an exceptionally clear, white light from 12 to 15 hours on one charge.

Recharging can be done at small cost and the batteries will last for many months if properly cared for.

Write for further information.

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An Invention for the People

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For Burning Tungsten Lamps on Any Fixture

Only one difficulty has stood in the way of the universal adoption of the Tungsten lamp—it must be burned in a vertical position—and many fixtures and sockets are not installed with this in mind.

The Benjamin Tungsten Adapter disposes of this "vertical difficulty" in less than a minute's time. It is as inexpensive as it is simple.

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Let us tell you more about it.

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So You Can Understand It.

Are you limited in the knowledge of Electrical Testing?

Are you spending lots of time and money looking for troubles that you could locate and clear with the apparatus you now have at hand, or could make, if you only **knew how.**

It is wonderfully simple when you understand the **principle.**

We tell it to you so you can make even difficult tests the **first time.**

Our language and drawings simply make you see the theory and then you cannot make a mistake.

For 25 cents we can furnish you information on Electrical Testing subjects, written in a non-technical manner so that you can advance in this line of work to the rank of an expert. The information is worth many times the price and you cannot afford to be without the newest practical schemes. Money refunded if not satisfied.

Enclosed find 25 cents for which send me the following instructions.

1. How to locate telephone cable trouble with a voltmeter.
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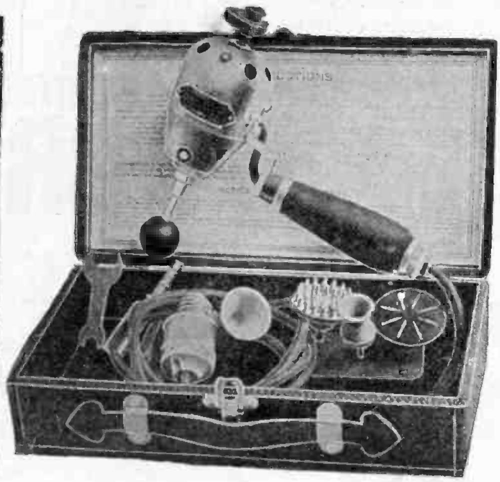

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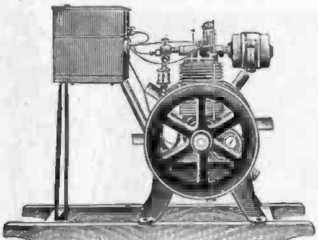

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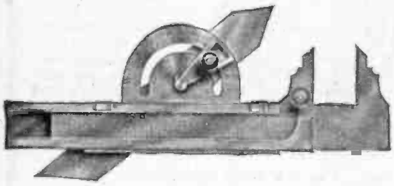
White Lily Mfg. Co., 1549 Rockingham Road, Davenport, Iowa.



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You can carry more than sixteen ACCURATE TOOLS in your vest pocket.

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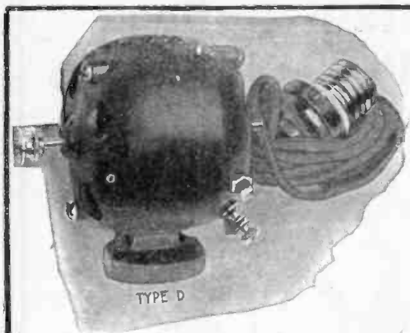

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Wizard Motors operate on Any Light Circuit; simply hook into the light socket; plug and cord with every order. We make all kinds of Toy Motors. Write for Circular 27.

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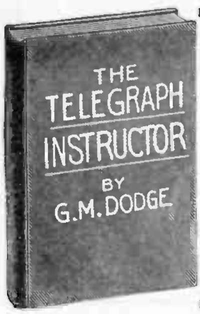

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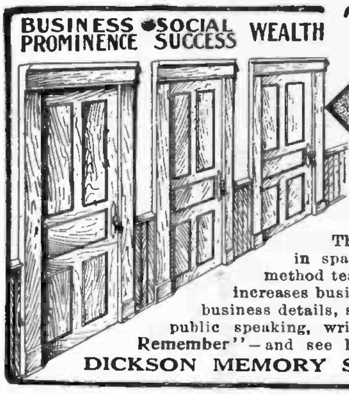

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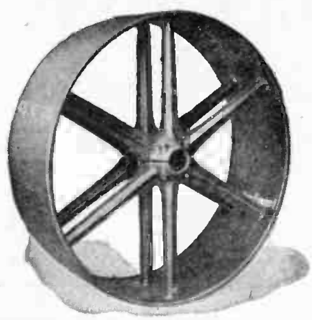

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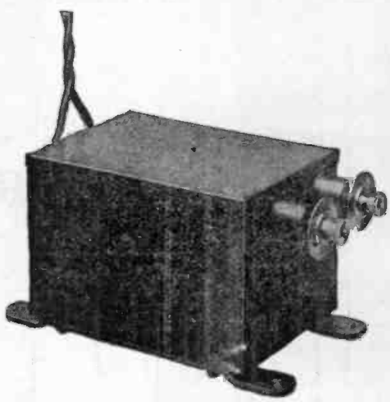

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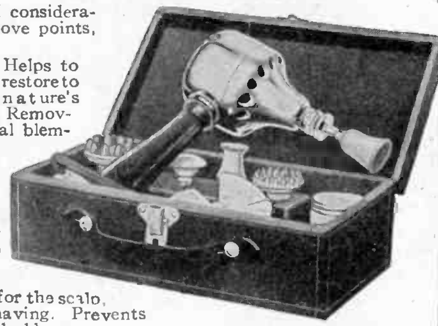

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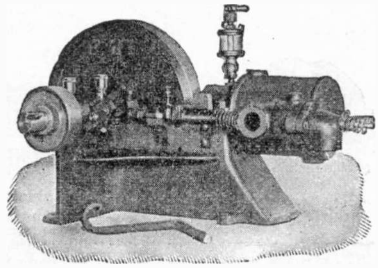

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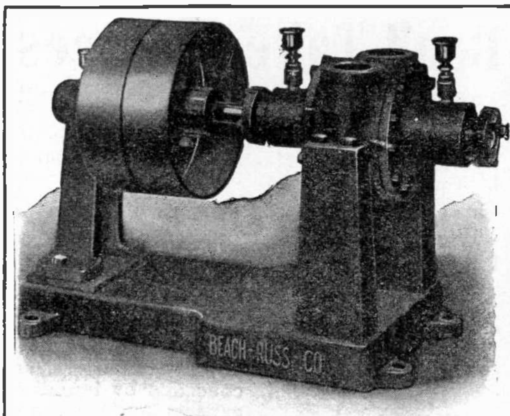

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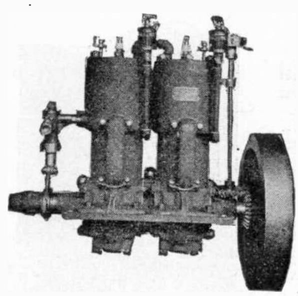

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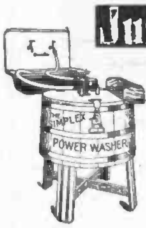

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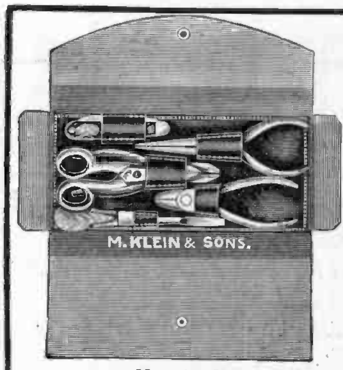

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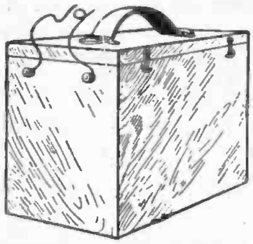

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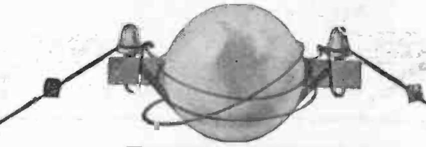

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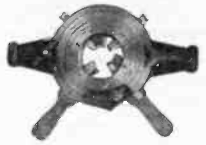

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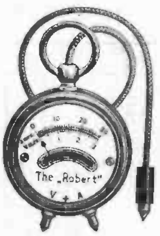

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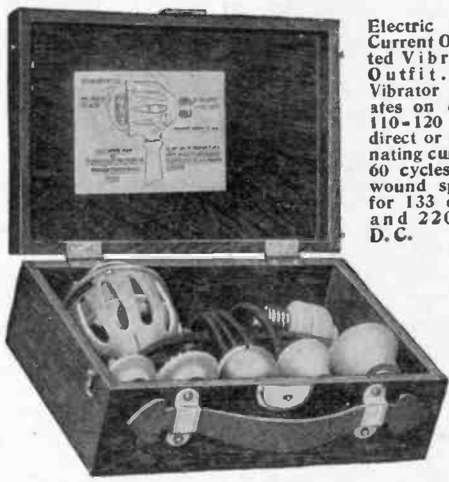
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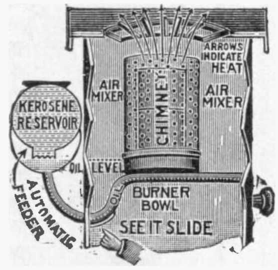

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