Practical Electrics

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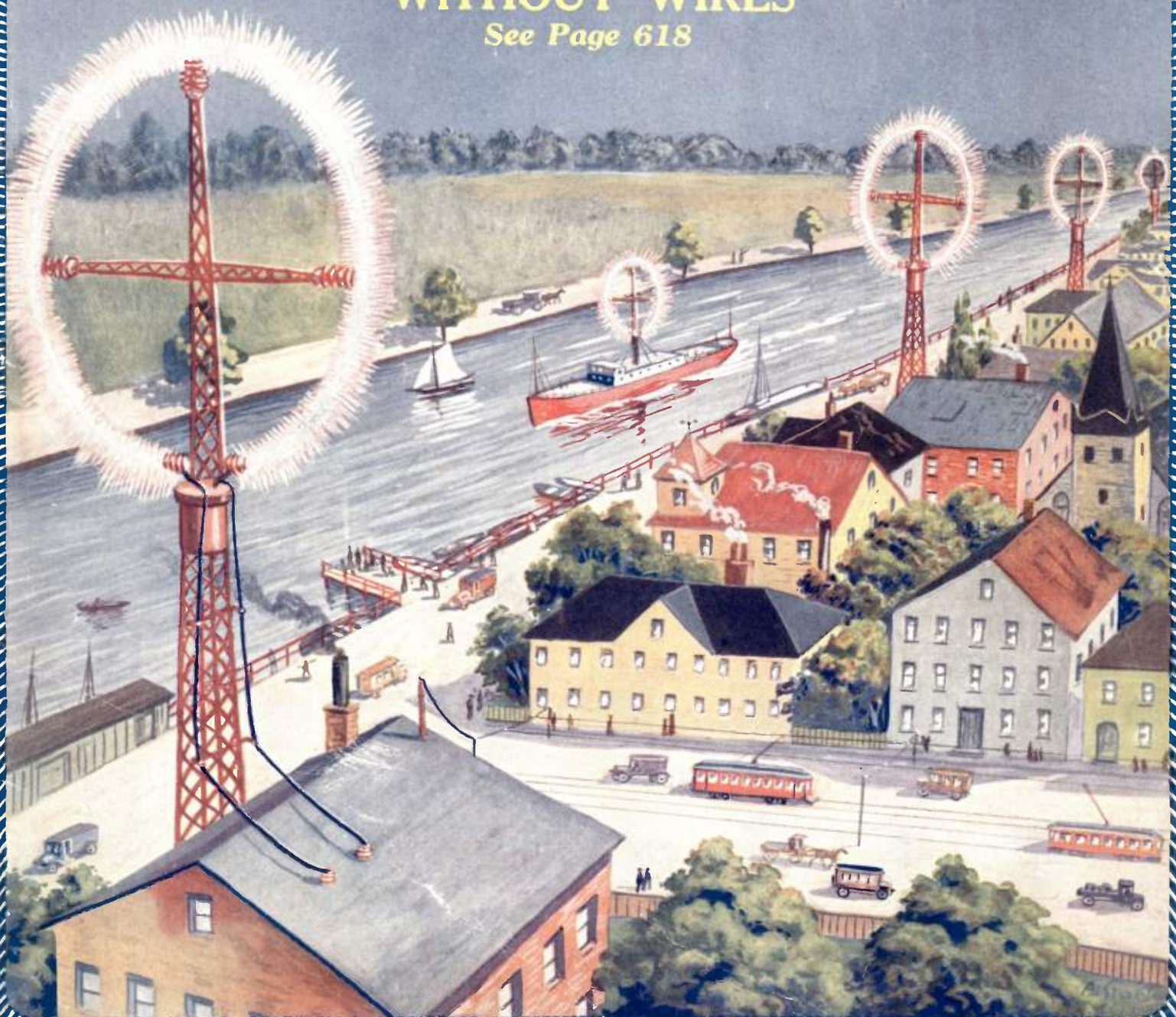
Sept. 1924

EDITED BY H. GERNSBACK

ELECTRIC POWER WITHOUT WIRES

See Page 618



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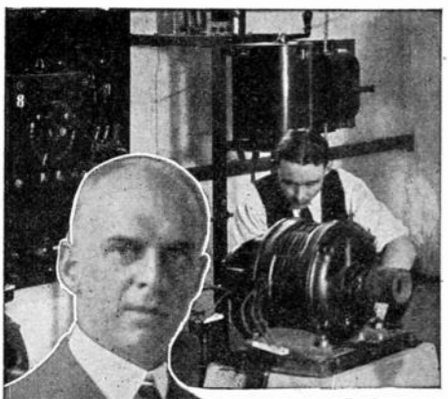
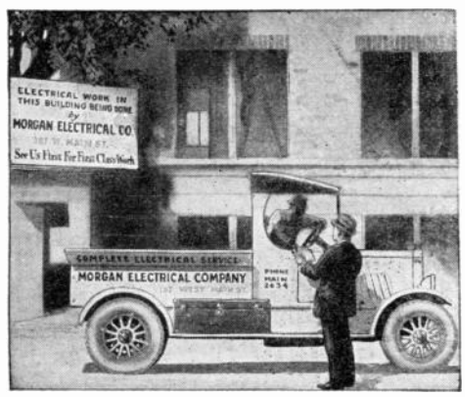


Herbert Dickerson, Warrenton, Va., makes $7,500 a year

Automotive Electricity pays W. E. Pence, Albany, Oregon, over $9,000 a year



J. R. Morgan, Columbus, Ohio, makes $30 to $50 a day in business for himself

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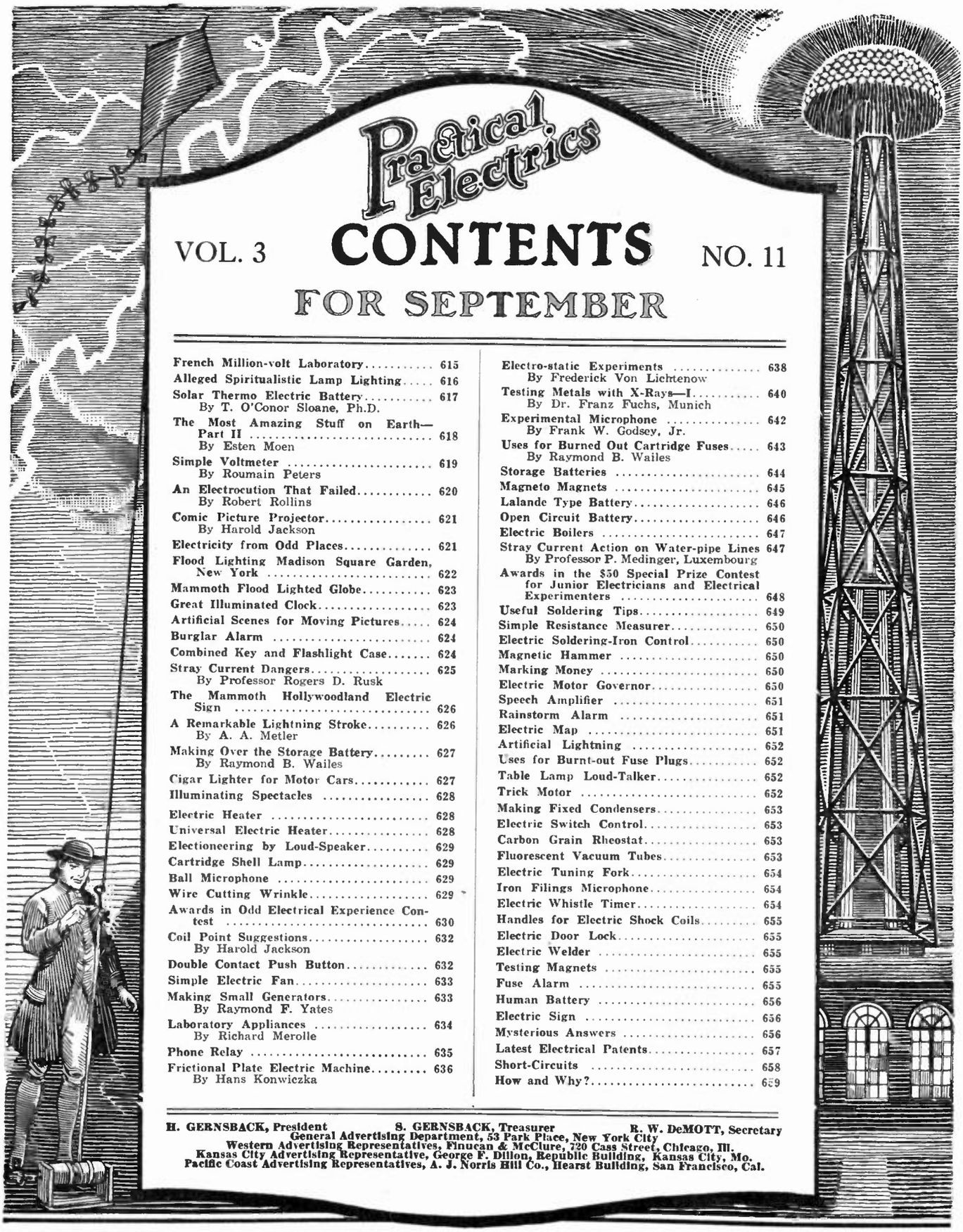

VOL. 3 **CONTENTS** NO. 11

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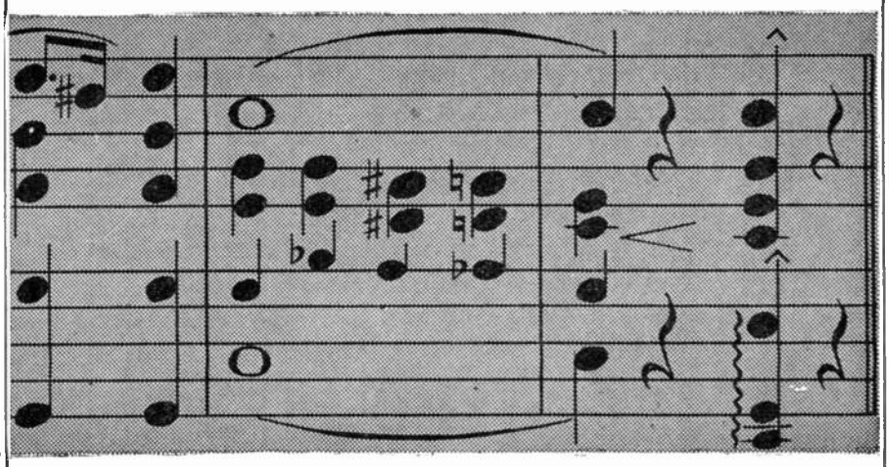

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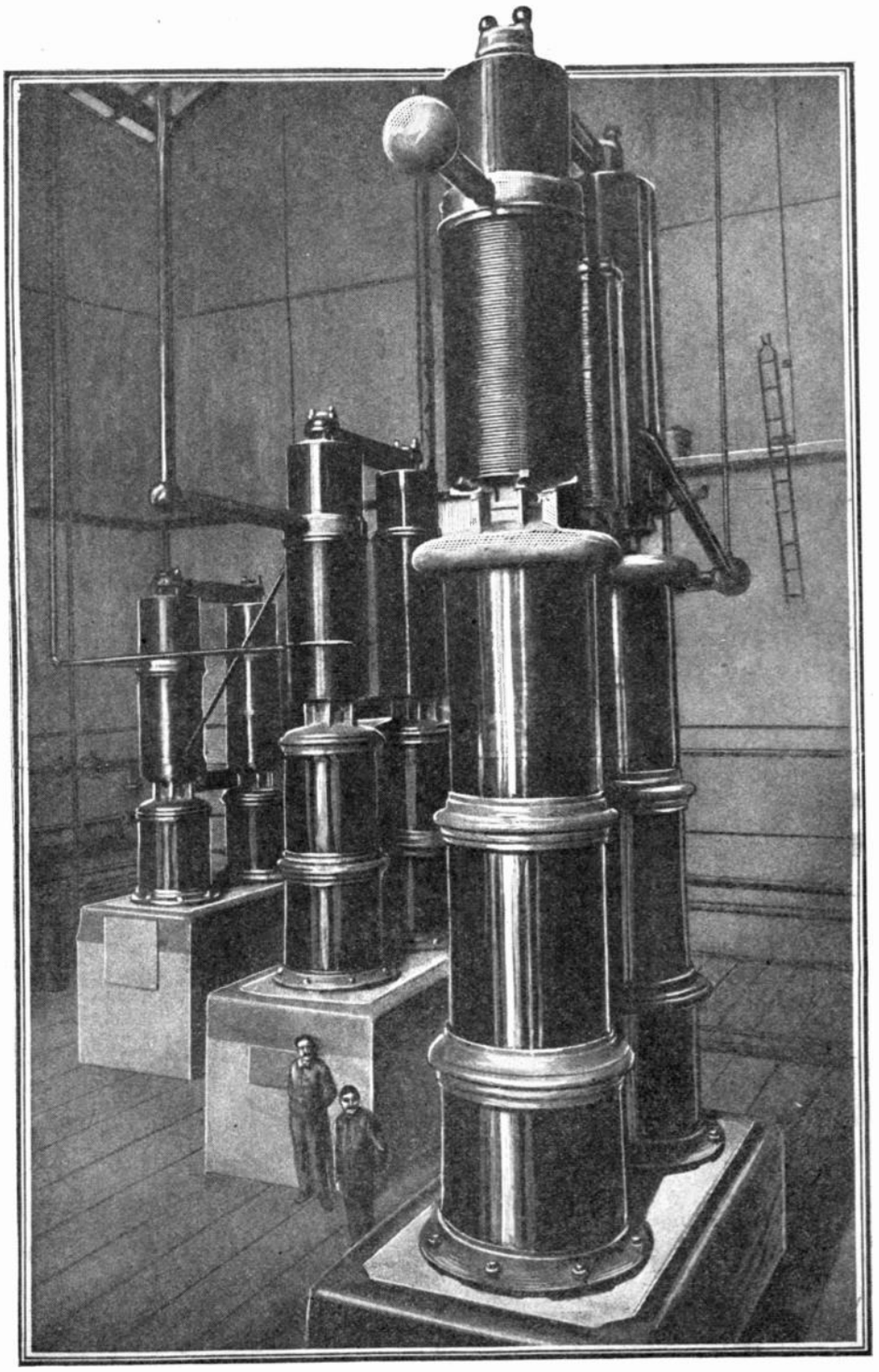
Volume 3
No. 11

Practical Electrics

September
1924

H. Gernsback, Editor and Publisher T. O'Conor Sloane, Ph.D., Associate Editor

French Million-Volt Laboratory



An impressive view of a million-volt installation for experimental uses, recently completed in France. There are three steps, as shown, that work up a five hundred-volt circuit to the desired million volts.

WE have illustrated and described in our columns million-volt experimental stations in Pittsfield and in Chicago. America led the way in instituting these laboratories, and at last we find Europe following in her footsteps.

Our contemporary, *Je sais tout*, a paper published in Paris, illustrates a million-volt installation which has been erected near Paris at Ivry by the Compagnie Generale d'Electro-Ceramique. We translate a few remarks describing some of the features. It is curious to observe the exaltation which the installation of such a laboratory in Europe for the first time occasioned.

"There is no need for us to go to the United States for information on artificial lighting, because we can soon go and see its manifestations at the very gates of Paris. It is in Ivry that the above named company has installed what is termed the Ampere Laboratory, where for the first time in Europe the potential of a million volts has been reached and even exceeded.

"It is in a great hall, entirely metallic in construction, that we find three transformers connected in cascade or one in series with the other, which receive current from a circuit at 500 volts potential and raise it to a million volts in the three steps."

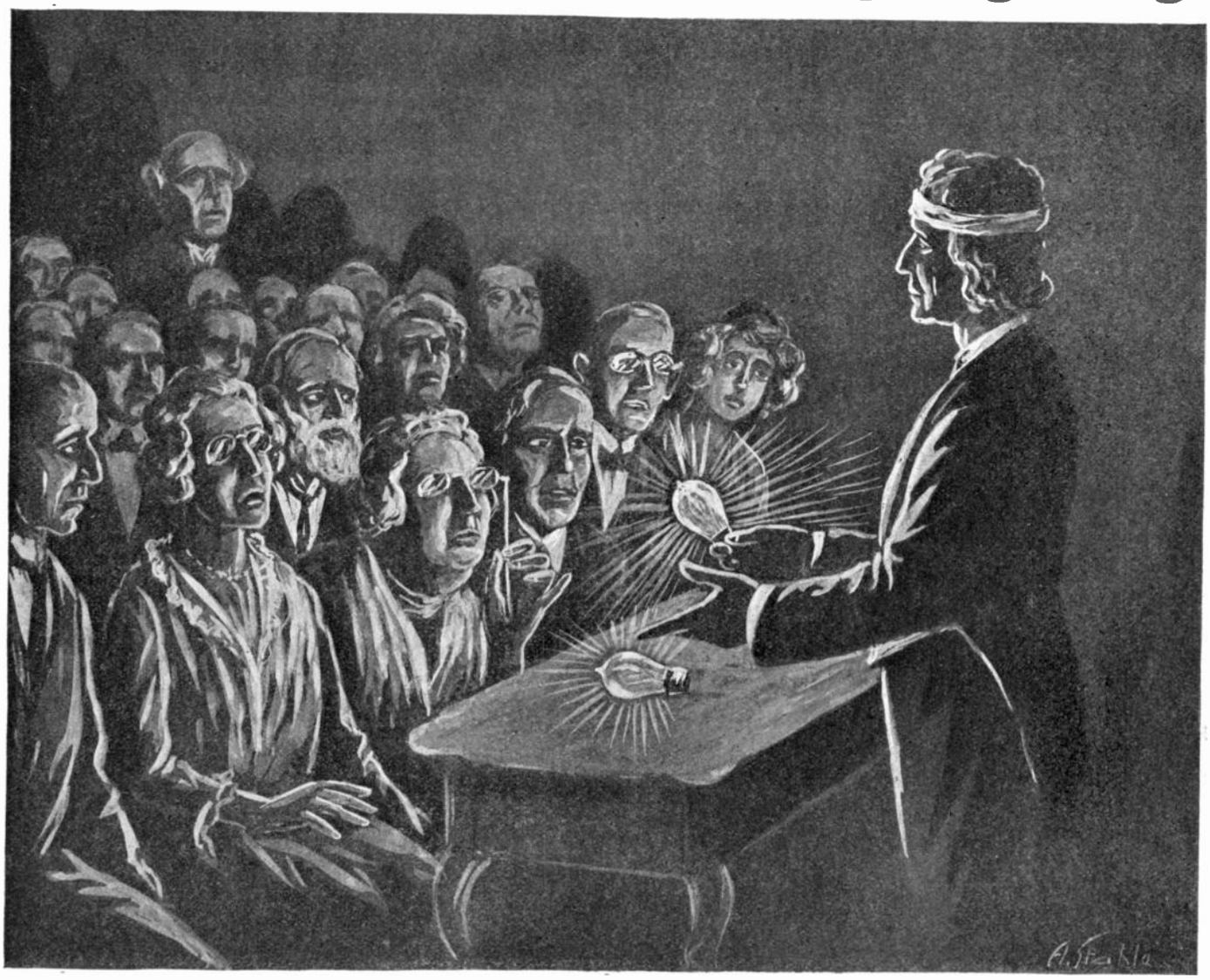
After leaving the last transformer an immense dazzling spark discharge is produced before the charge disappears into the earth. The name of the company which erected this great plant suggests one item of their business, for whose benefit we may consider that the laboratory was constructed. This item is porcelain insulators. There is a constant tendency to raise the potential between the earth and high power distributing lines in order to effect economy in copper. These high potentials require especially well constructed insulators, and these, in order to obtain any real data about them, have to be tested. The test, if of any value, must be at potentials far above those used on the line in order to give a good coefficient of safety.

Quoting again from our contemporary, we translate: "In three formidable leaps the current, previously inoffensive, discharges itself in the form of a great dazzling spark toward a copper sphere, before losing itself in the enormous reservoir constituted by the earth. The noise of the discharge is so deafening that it is termed artificial thunder. The laboratory is in charge of Professor d'Arsonval."

The compactment of the French installation is quite striking, so that without the figures of the workmen it would be hard to realize that it was so gigantic a plant. It seems less widely distributed than the American ones.

While the million-volt discharge assimilates lightning, the sharp deafening noise produced is quite another thing from the roll of distant thunder. The cause of the characteristic noise of the natural phenomena may fairly rank as unexplained.

Alleged Spiritualistic Lamp Lighting



A seance with a supposed exponent of spiritualism, who is said to have believed in his own entirely fictitious demonstration. It seems to have been a case of static electrification, which it is said the performer himself believed to be genuine psychic phenomenon.

A REPORT has been read before the Academy of Science in Paris by Professor Charles Richet, who has attained wide celebrity as an investigator of and as a writer on alleged psychic phenomena.

Our contemporary, the *Daily Science News Bulletin* of Washington, has given an account of these "spiritualistic" phenomena. The medium used an ordinary electric light bulb, which in itself should have made the audience suspicious. By rubbing it with his hands he produced glimmers which increased gradually from being very irregular to considerably greater strength. Once the light was produced it persisted between the frictional movements. After a lamp had been rubbed for several minutes the performer, holding it in his right hand, obtained intermittent illumination and sometimes a steady glow lasting two or three seconds.

Standing at a distance from the bulb which had just been rubbed the performer waved his hand, "concentrated his mind" and really got some flashes. Some failures were occasioned by uncertain atmospherical conditions and by dampness of the hand, which suggests, it would seem, condenser action. A variety of statements concerning it are embodied in the report and a simple explanation is given. The bulb as arranged acted condenser like; it was charged by rubbing and gave Geissler tube effects. An evacuated bulb containing practically no gas gave the most intense result, perhaps, but nitrogen-, argon- and neon-filled bulbs gave characteristic colored lights, the first a blue and the last a pink.

The investigators stated that the bulbs acted as condensers. Their discharges were recorded by an Einthoven galvanometer connected with them. The illuminations corresponded to the brief discharge in the rarefied atmosphere of the lamp of the electricity which accumulated, Leyden jar fashion, on its wall.

The "medium" undertook to have the lamp respond to his power, he being in an adjoining room. The experiment failed. It is said that the "medium" himself believed firmly in the psychical nature of the phenomena, and was very much disappointed at being shown that they were merely electrical.

The fact that the gentleman who exhibited the lamps believed in his own power and could not believe that he was deceiving himself, is a more curious comment on human credulity than is usually found in the transactions and exhibitions of every day fraudulent medium.

Solar Thermo Electric Battery

By T. O'Conor Sloane, Ph.D.

ONE cannot but feel that the thermo-electric couple as a means of generating a tangible working electric current is unjustly neglected.

In early days many attempts were made to apply it to laboratory purposes at least. The general idea is this: If two unlike conductors are in contact, one with the other, and a current of electricity is passed through the junction, a rise or fall of temperature will be produced, and whether it is rise or fall will be determined by the conductors used and by the direction of the current going through them. The amount of temperature change would depend upon the strength of the current.

Now if we reverse this, and heat the junction, a potential difference will be established; and if the free ends of the couple are connected by a wire a current will pass through it as long as the heat is maintained. Tables of data are given in all the electrical books touching on this subject.

Taking ordinary substances, not too rare for practical use, we find bismuth at one end of the series and antimony at the other end, omitting some impractical substances such as tellurium or selenium. If the latter were a first-class conductor and a cheap material it would be an admirable substance for one of the elements, as we may term the single conducting pieces.

Returning to our bismuth-antimony couple, we find that neither of these metals would stand a very high temperature. But when we find that a difference of temperature of one degree Centigrade, or 1.8 degrees Fahrenheit in the bismuth-antimony couple will maintain a potential difference of 103 micro-volts, we will see that at moderate temperatures it would be very easy to get up into the order of volts proper.

A micro-volt is one-millionth of a volt. One hundred micro-volts are one ten-thousandths of a volt. Now suppose our difference of temperature is but 100 degrees Centigrade, which is the difference between the temperature of melting ice and that of condensing steam, we will obtain about the hundredth of a volt, so that 100 of such couples would give us a volt. All this, of course, is in round numbers.

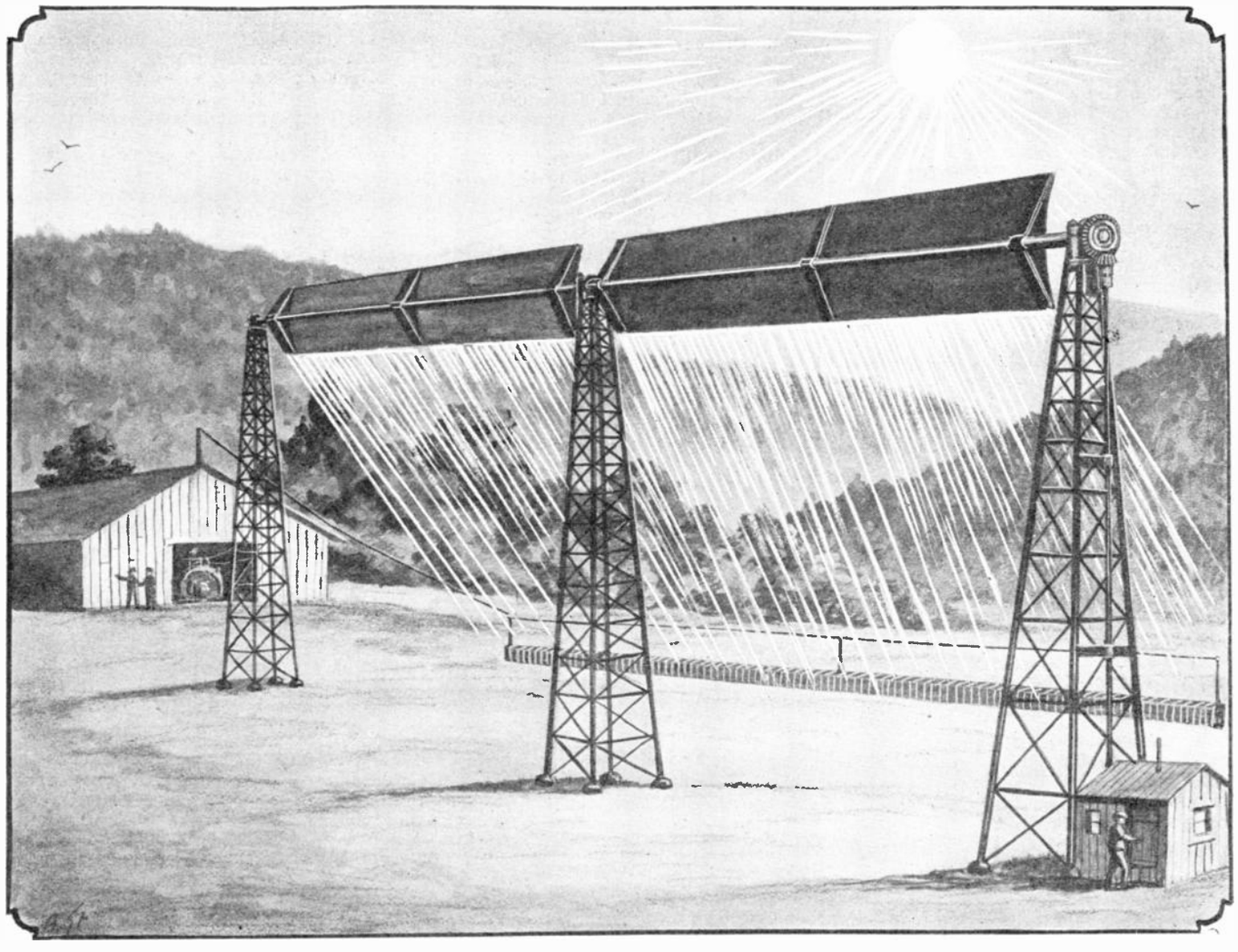
Therefore it is easy enough to get up to the order of volts with thermo-couples. Of course, by doubling, trebling or quadrupling the temperature our voltage would rise proportionately. The graphs of thermo-electric couples within ordinary limits are straight lines, therefore it is a simple matter to make calculations accordingly.

We hear a great deal these days about inefficiency and waste of heat. The sun radiates heat in all directions. If one will calculate the area of a sphere whose radius is the distance from the earth to the sun, and will divide that area by the cross-sectional area of the earth, it will appear that, as far as we are concerned, our sun is the greatest waster of heat that we know of.

Of the heat which does reach the earth a very large percentage is not utilized directly, and appealing to thermo-electric laws it is possible that a thermo-electric battery could be installed in sunlit desert regions, where the heat of the sun could be reflected and concentrated upon one set of junctions, while the other set would be buried at 25 or 30 feet depth in the earth. In this way there would be no difficulty of establishing a difference of potential between the buried and exposed junctions, running up into fairly good voltage, and which would be reinforced by the fact that by using large sections of metal in the thermo-electric battery its resistance could be kept so low that it would develop a good wattage.

It is this suggestion which we illustrate here. The battery elements are arranged as shown in a straight line, which may be of any length desired. Parallel with them at a proper elevation is a cylindrical mirror, or better, one of parabolic cross-section, which concentrates the rays of the sun upon the aerial junctions. There would be no trouble in keeping them at a temperature of several hundred degrees

(*Continued on page 662*)



The heat received by the earth from the sun is here supposed to be directly utilized. An extensive thermo-electric battery has its lower junctions buried to a depth where there is little change of temperature. The upper junctions are heated by the sun as shown. A storage battery is kept charged by the current thus produced.

The Most Amazing Stuff on Earth—Part II

By Esten Moen

THERE are a few wonderful stunts that can be pulled off if a fellow has a couple H. T. condensers, some pieces of heavy wire, spark coil, etc.

For instance, in the first photograph on page 618 you will see that power can be "extracted" from a short length of copper wire. Just a "black art" trick? Honestly, fellows, the demonstrator is not palming the wires from a dry cell. In spite of the truth that a heavy copper wire "shorts" the filament, the lamp does light up. Apparently you can't bluff H. F. currents by a short!

No doubt to old-time wireless "hams" this is merely a tedious duplication of *their illustrious* auto-transformer. To such scorners I say, "Do not steal my thunder." Look again in Fig. 2, where you will see the thrill in store for the magician who has enough patience to make the rig.

Now behold a wonderful stunt portrayed in illustration No. 3. We read of many machines that purpose to transmit electrical energy without wires, but can you find one to beat this for simplicity and efficiency? (Just a moment, ladies and gentlemen, the worthy demonstrator is my good friend Mr. Oliver G. Holt, to whom I am much indebted. I'm sure we will hear from him some day.) For this model is efficient—the spark coil drawing a minimum amount of juice from the batteries, while the lamp is brilliant.

I wish that you and I could discuss *why* this machine works. Suppose we contrast it with the Tesla machine, described in my former article. Note: The present machine uses *one* single turn of wire and a large condenser capacity to transmit power through the air. Contrarily, the Tesla machine requires only a slight capacity and a coil of many turns of wire to operate successfully. (Refer to the August issue of PRACTICAL ELECTRICS.) In simpler words, the Tesla machine operates "by volts," and the other "by amperes."

Let us take a step further in the direction of a theory. You remember when you studied physics in high school the instructor was fond of comparing the "flow" of electricity to the flow of water in pipes: the instructor presented the analogy to simplify the mystery of electricity. For example, electric voltage is analogous to hydraulic pressure. Resistance is analogous to the cross-section area of a pipe carrying water, the idea being this, that the bigger a pipe is the more water will flow through it.

Let us consider the analogy shown in Fig. 4. We may first accept the hypothesis that the "ether" is like unto air, and can be "fanned." Accordingly a transmitter is like unto a fan, and a receiver like unto a windmill. Literally speaking, the transmitter "fans" or "blows" the "draft" of "ai-the-r" over to the receiver, where a "com-motion," of a kind, occurs!

But even the admission of such an analogy to be plausible seems not to explain the mystery of the Tesla coil.

However, we must remember that the Tesla coil is just a modification of this single-turn-coil oscillator: differing in this, that it possesses a secondary. Accordingly we need only modify the air current set up by the fan to explain the action by analogy. Such a modification is indicated in Fig. 5. Let that be enough words on the "grand theory."

Now we come to the stunts portrayed in the last two photographs. They resemble the stunts with Tesla juice, as shown in my former article.

Apparently there seems to be no limit to the distance over which power can be sent—just place more "resonance units" at the correct places in between sender and receiver. Unfortunately these units require more copper than is needed for ordinary D. C. or A. C. power transmission. But perhaps a way can be found to overcome this difficulty. Above all, the goal which the inventor should strive for is simplicity of apparatus.

Here are some data concerning the apparatus seen and not seen in the photos; to help whoever desires to duplicate these experiments:

Spark Coil—Ford ¼ inch, operated by three dry cells.

Condensers—Six copper sheets, size 3 inch × 4 inch between seven 5 inch × 7 inch photo plates.

Spark Gap—One-thirty-second inch, approximately.

Lamp—Three-volt flashlight bulb.

Loop—One foot in diameter of "Copperweld" aerial wire.

Distance—Between sender and receiver only, 6 inches. For each additional "resonator," 3 to 4 inches extra.

Power Without Wires

By H. GERNSBACK,
Member American Physical Society

THE accompanying article by Mr. Esten Moen impresses us as of great interest because it suggests or even points the way to what can be done in the transfer of electric power without lines of wire. On our front cover we have illustrated the system as described in the article.

The idea is not at all fantastic, and does not exceed or overpass good engineering possibilities. While the reader may ask himself the question whether such a system would not be more expensive than poles with wires strung along them, the query does not really imply a difficulty in carrying out the principle.

In the first place, as everyone knows, there are corona losses over long distance power lines when a very high tension is used, the charge dissipating into the air.

In the system as shown on our cover, once the technical details are mastered the anticipated losses will be considerably less, because there is less wire for the corona to form on. Of course there are the losses between each two towers, but we believe that if the proper types of current and potential are used at the correct frequency, these losses would not be so very heavy. It would simply be a matter of tuning the two adjacent loops to the most efficient point.

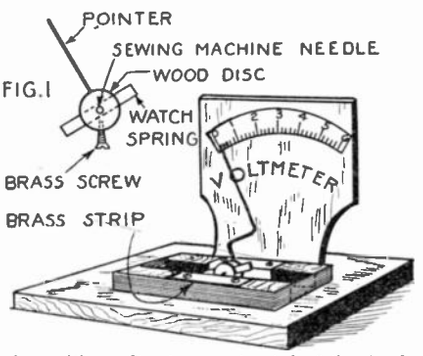
Aside from this, engineers will be compelled to resort to some such system in a short time, because when it comes to transmitting power with potentials above half a million volts, the corona loss will become so large that it will be uneconomical to carry the current on wires. The new system may solve the problem.

Simple Voltmeter

By ROUMAIN PETERS.

GET a baseboard about 5 × 3 inches and cut a slot ⅜ × 1½ inches long; on each side of this slot glue a block ½" high and ¼" wide. Using these as a support wind 260 feet of No. 32 magnet wire in a horizontal coil. Now get a piece of watch spring and soften the center by heat, and drill a hole in it. Put a sewing machine needle that has been filed sharp on both ends through this hole and place a little circular piece of wood on each side, then put a little glue to make everything solid. Stroke the piece of spring with a strong magnet and it will retain its magnetism.

Take a piece of broom straw and glue it perpendicular to the magnetic needle. Now take a small brass screw and screw it in one of the pieces of wood in such a way that the pointer, needle and counterweight will have the relation shown in Fig. 1. Take two pieces of thin brass about 1 inch long and ½ inch wide; in the middle and ¼ inch from the end put a little dent with a hammer and nail, being careful not to make a hole. Bend each strip at right angles at the center. Set



A sensitive voltmeter, constructed of the simplest materials, such as to be found in every house. The section of a spool will supply the small wooden disc.

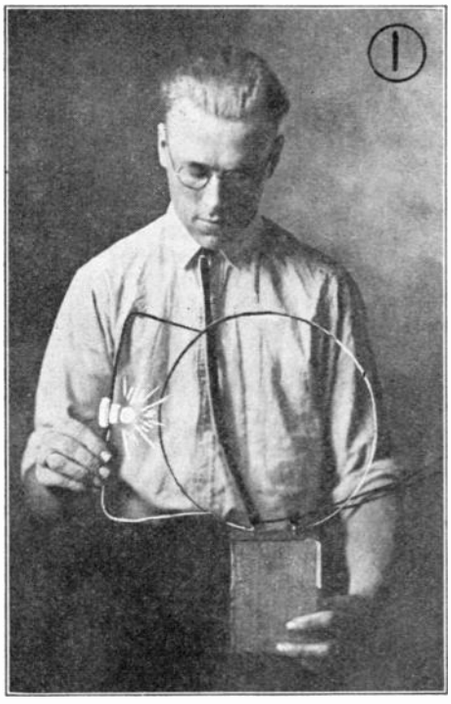
the shaft of the magnetic needle, with the counterweight down, in these two dents and adjust the angles of brass until the needle and pointer move freely and the counterweight brings the pointer to the position shown. At the back of the board mount a piece of thin wood with a scale on it located so that the needle passes in front of it but does not touch it.

All that remains is to mark the scale on the instrument. This can best be done by taking a 6-volt storage battery and adjusting the counterweight so that when this battery is connected to the instrument the pointer rests in the center of the scale; mark this six volts, then mark the far end twelve volts. Repeat using only two cells of the battery and mark this four volts, and the same distance on the other side of six mark four. Repeat, using but one cell and mark this point two volts and the same distance on the other side mark ten volts. If desired these two volt spaces may be bisected and the correct odd number placed there.

To use this instrument just connect it to the points where you desire to measure the voltage. This is a very handy and useful instrument, and can be made at a fraction of the cost of a new instrument, and will serve amateurs and experimenters equally well.

The Most Amazing Stuff on Earth—Part II.

By Esten Moen



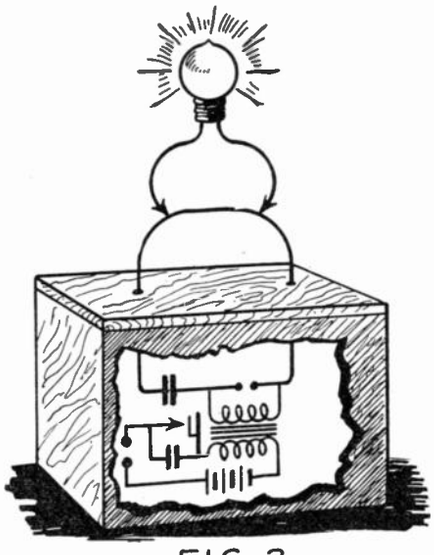
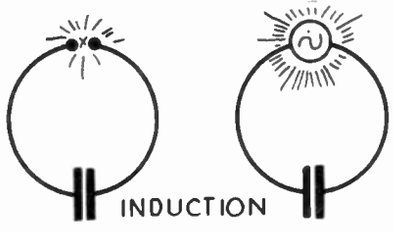


FIG. 2



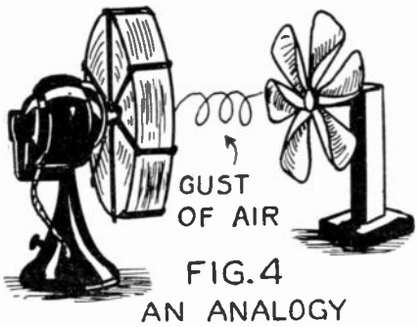
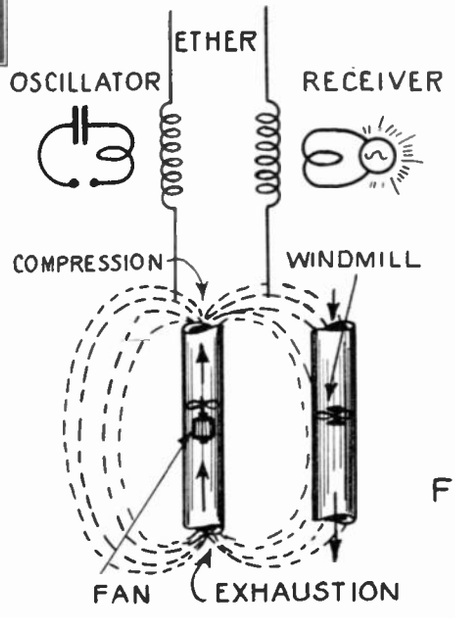


FIG. 4
AN ANALOGY



ANALOGY OF
TESLA POWER TRANSMISSION

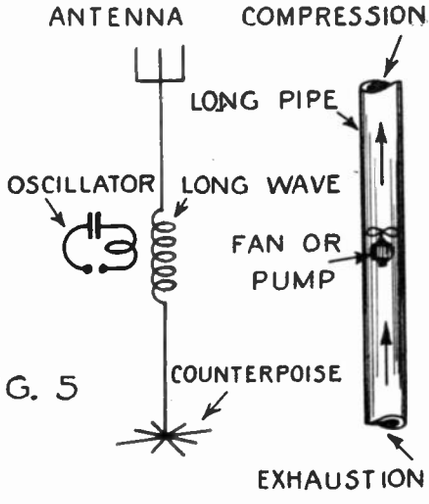
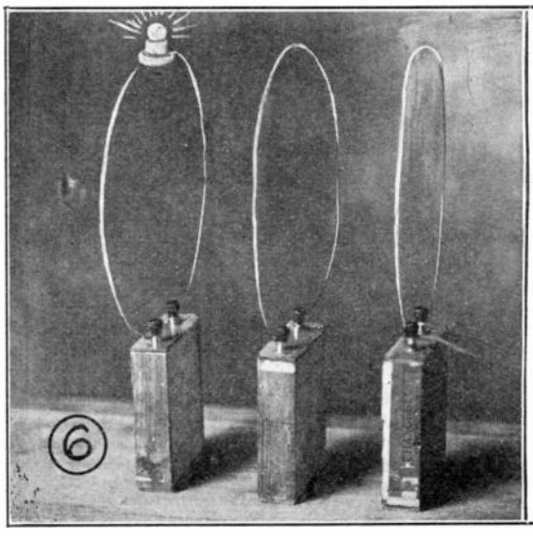


FIG. 5

ANALOGY OF TESLA COIL



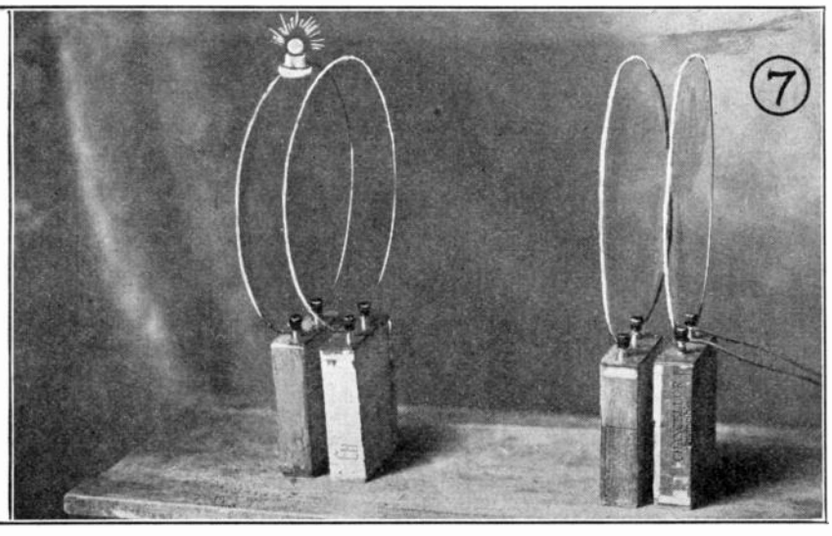


Fig. 1 shows the experimenter lighting a lamp which seems to be short-circuited. Fig. 2 shows the layout in detail. Fig. 3 is a variation in which a lamp is lighted, quite disconnected from the circuit. Figs. 4 and 5 are interesting analogies and illustrations of the Tesla experiments. Figs. 6 and 7 show the transmission of power through space without any conductor.

An Electrocution That Failed

By Robert Rollins

Quick! I slammed the switch—Volts, ohms, henries, amperes and phases came tumbling through the switch, and jumped into Fanny with bared fangs. She did a hand-spring, a triple dip and about two dozen original twists.

YES, it was sad, very sad, but it had to be done. We had to kill Fanny. She was not very old, only fourteen, but she wasn't as strong as a girl of seven. Her legs had been slightly crippled of late. Her eyes were none too good, and her hearing was poor. In fact, Fanny was a wreck, so she couldn't even walk. Yes, indeed, it was sad, but unavoidable. We cried, of course, Dick and I. We loved her. We had grown up and played together in the happiness of the past years. And now we were going to kill her.

The Problem Discussed

Then a fight began. That was natural. Dick and I are never faced by a problem that we don't argue with vim, vigor and violence. Physically we are well matched, so there is never a pronounced autocracy. But to get back to our subject—by what gate was Fanny to leave this "vale of tears"? We didn't know. Perhaps it is better to say that we both knew, but disagreed. You see, it's very difficult to kill one that enjoyed Fanny's position in our family. She wasn't really our sister. Indeed, if she were, the task would not have been so hard.

As everyone knows who reads the newspapers (Whom does that omit?) there are rules and "gentlemen's agreements" for the method of murdering other classes of people. For instance, if one man wants to kill another, only shooting is permissible. Poison in coffee is the regulation method of disengaging one's better half. And a revolver and then an axe and a trunk is what Hoyle prescribes for the extermination of bothersome husbands. Oh, that's all worked out, but about Fanny we could not agree.

You understand, of course, since I told you once, that we loved Fanny. We loved her with all our heart. (I say heart because I have never been convinced that Dick has one.) But we knew it was for the best. She must go. Then, too, it would be an experiment. (Dick and I have a corner in the cellar. We call it our laboratory, and we always spell Science with a capital "S." Now you know us.) As I said, Fanny must go. When love of Science clashes with love of women—well, sentiment's a transient thing. Fanny was doomed.

A Decision is Reached

It was at last decided—electrocution was the decision.

The Death Chair

The preparations were not elaborate. The "chair" was quite simple. Two pieces of wire were stripped about a foot at one end and tacked to each side of a twofoot board. This was the "chair" and we placed it on a table. On the floor, about six feet away, we laid a switch. It was a double pole one with a fuse bank. You see, Fanny had hay fever among her list of ailments, and we feared that in the excitement she would sneeze and "blow" a fuse. We took all precautions.

Our Current

We had ordered from the power-house one hundred and ten fresh volts of alternating, both positive and negative, all-wool-and-a-yard-wide electricity, sixty new cycles, and two strong phases. They had been thoroughly mixed and delivered, and were in the little black box of dials downstairs, "rarin" to go.

Catching the Victim

Fanny was seized. That was an easy task. She had been standing by us while we were preparing her door to Heaven. Poor, innocent thing, it was the old story of the trusting maid. We stood her in place. She was to be murdered. Her beautiful, languid eyes, dimmed slightly with a gray film, looked inquiringly at us, questioning, yet trusting us. It was hard. My brother winked his eyes repeatedly and his lashes glistened. I felt as if I had swallowed a basketball and had it lodge in my throat. Yes, we were not unmoved. But Science is Science, and Fanny was to die.

The Executioner Begins His Work

Dick wrapped a wire around one of her bare ankles. I twisted the other wire around her tail—she had one of the longest and most graceful tails that I have ever seen on a cat. No splendid princess could wave her fan with the fascinating grace with which Fanny undulated her terminal. It was exquisite. Well, she was ready, and

(*Continued on page 662*)

Comic Picture Projector

By Harold Jackson

THE comic picture projector shown in the accompanying illustrations is simple of construction and will furnish a great deal of entertainment, for everybody, whether young or old, likes "funny pictures." This projector works on the same principle as the well-known post card projector and can be made by any boy who likes to make things.

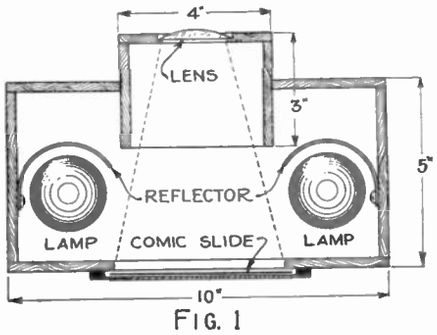


FIG. 1

Horizontal section of the projection machine, showing the two lamps whose rays directly impinge upon the picture, and are reflected, going thence through the lens and reproducing the design on the screen.

Fig. 1 shows the inside of the projector with the top removed. The part that carries the lens is made adjustable and can be moved in or out in order to focus the pictures on the screen. The lens should be about two inches in diameter and of the plano-convex type; that is, flat on one side and curved on the other as shown.

Two 50 watt lamps are turned into porcelain sockets at each side of the slide as shown. A bright tin reflector is placed back of each lamp to throw a powerful light on the slide. The slide is placed back of a square hole cut in the back of the projector as shown in Fig. 1. A tin guide is fastened to the edges of the opening to keep the slide in place. The tin guide is blocked out a little way so that the slide will have room to move easily.

Fig. 2 is a perspective view of the projector with the slide in place; one end is cut away to show the position of the lamp and reflector. Two small ventilators are placed on top just above the lamps so that air may circulate through the box. The inside of the projector is painted with a dull finish black paint. The outside is varnished or finished as desired. Fig. 3 shows the projector in use. It is placed on a small table about ten feet from the wall. The lamps are connected by a piece of flexible lamp cord to the nearest outlet. A white screen is stretched out on the wall so that the bright spot from the projector when the lamps are turned on will be in the center of the screen. An ordinary bed sheet makes a good screen.

The slide is made by cutting comic pictures from the comic section of the newspaper into separate pictures and pasting them to a strip of heavy brown paper a little wider than the pictures. The pictures must be pasted on upside down as shown in Fig. 3 or they will be upside down on the screen, for the images are reversed by passing through the lens. The

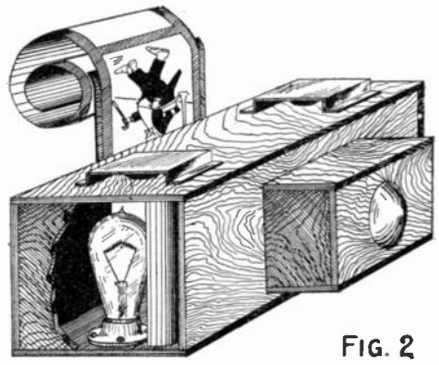
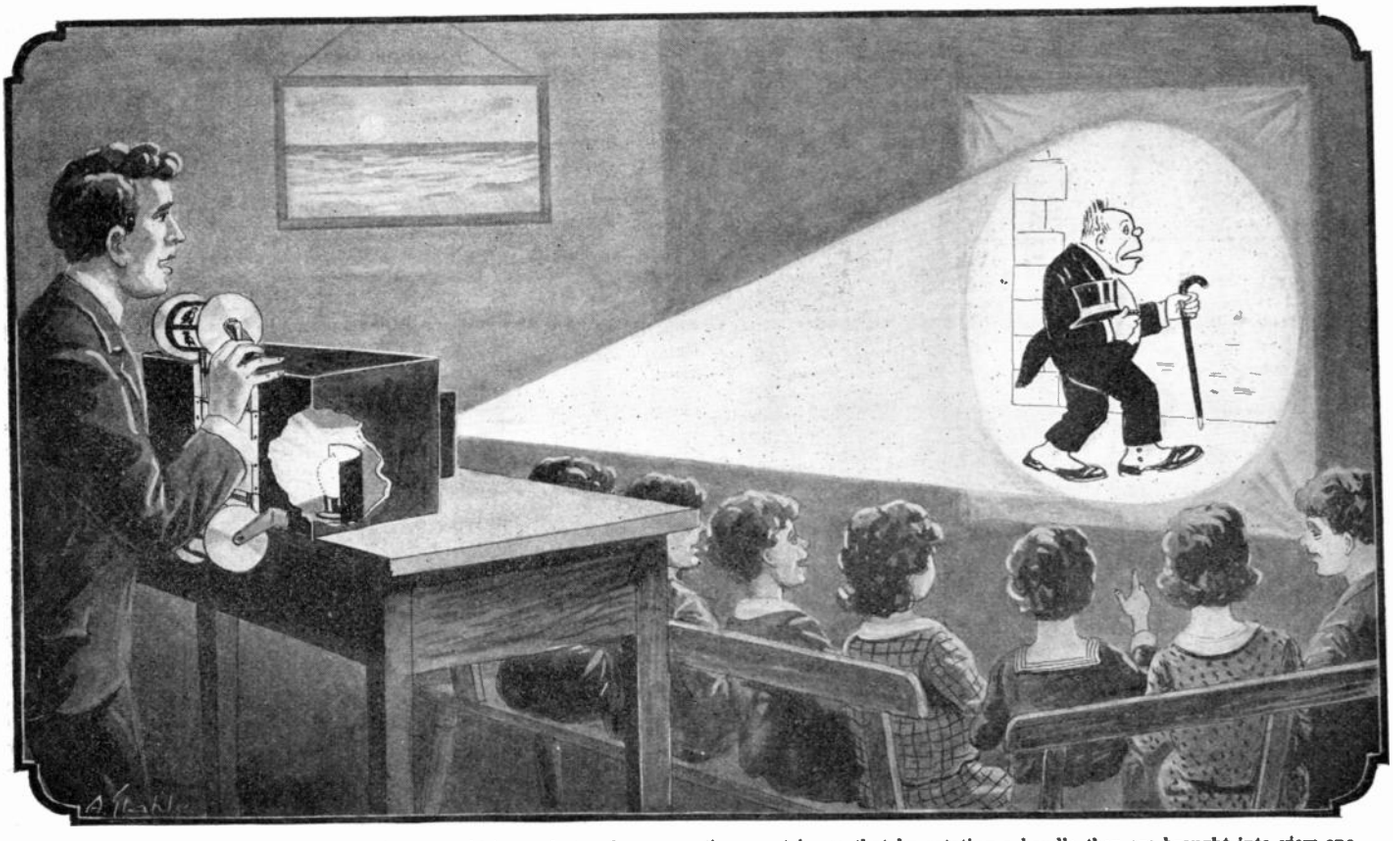


FIG. 2

General layout of the projection machine, showing the roll of paper carrying the design and the ventilating apertures at the top. One of the lamps can also be seen with its reflector.

room is darkened and the projector lighted. The slide is then run through the projector back of the tin guide so that the first picture of the series comes first.



A parlor projector for opaque pictures, which are fastened on a continuous strip, so that by rotating a handle they are brought into view one by one upon the screen.

Electricity from Odd Places

IN October PRACTICAL ELECTRICS I noticed a list of odd batteries contributed by Mr. Curry. I want to add to his list.

With a good radio head set one will run across various other places where minute currents of electricity can be formed.

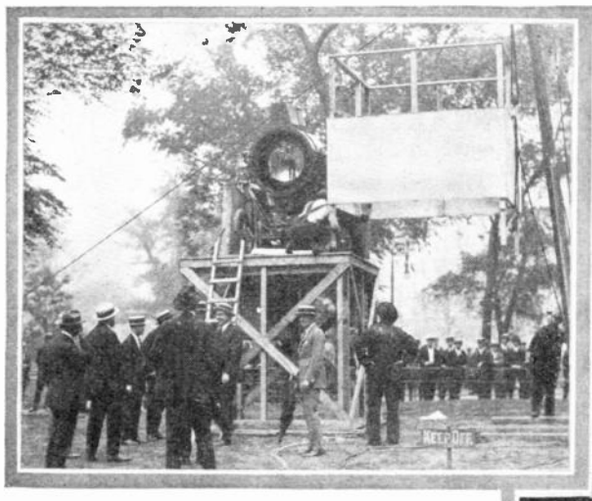
Moisten the tips of your first finger and thumb and take hold of one of the terminals of the receiver, then touch the other terminal to your tongue, and you will hear a noticeable click in the receiver, showing that some electricity has been produced.

Place one of the terminals in ordinary water (not distilled), then place the other terminal also in the same water and a click will be heard at the instant of immersion.

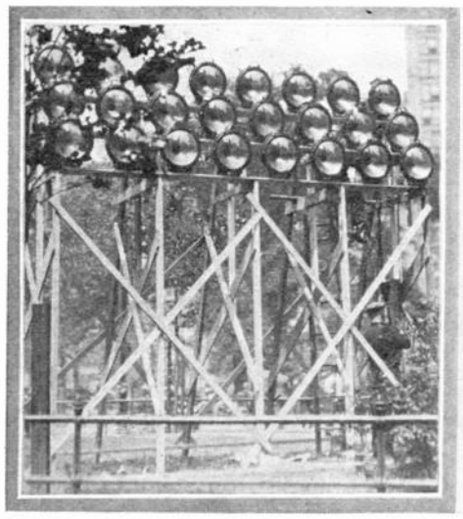
Another way is to take some acid fruit, for example an apple, push one terminal into the flesh of apple first, and then the other, and notice the click. The sensitiveness of the telephones is also demonstrated.

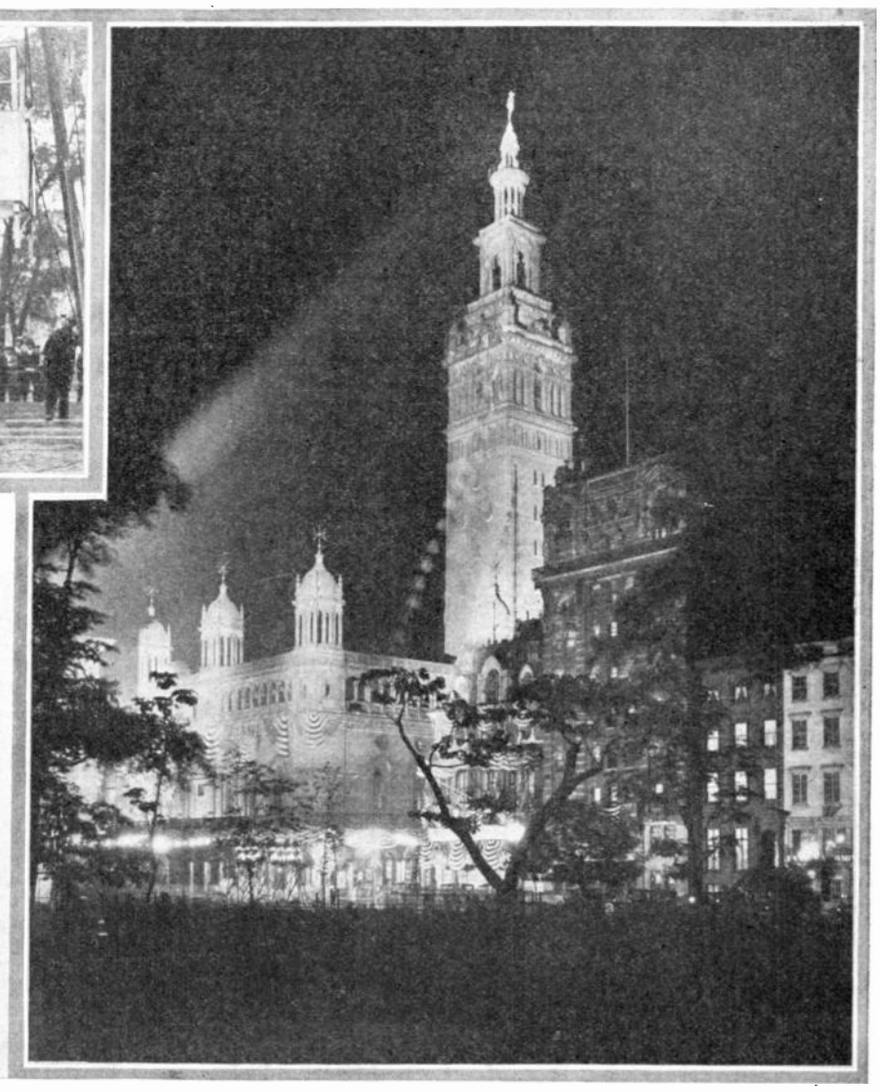
Contributed by HEINRICH POLSFUT.

Flood Lighting Madison Square Garden New York



The timber stand for holding the 18,000-watt Sperry searchlight. This light can penetrate 35 miles of space.





Left: A bank of flood lights mounted on a high frame. Right: The Garden and Stanford White's reproduction of the Seville tower flood lighted. Diana stands on the apex and can compare man's electric light with that of the moon of which she is the goddess.

DURING the Democratic National Convention in the city of New York a very remarkable electrical display was produced by the flood lighting carried out by the New York Edison Company.

The building, Madison Square Garden, and the vicinity were flood lighted by General Electric adjustable flood lighting projectors. There were seventy-five 500-watt lamps used in this set. Besides these twenty-six 1,000-watt lamps of commercial type were employed under the portico, filling the whole space with what is termed a "golden glow."

Paralleling the curb around the Garden there were two thousand 25-watt lamps suspended twenty feet above the sidewalk, in line with the curb. The lamps were blue, white and orange.

It is fair to say that flood lighting is the coming system of illuminating objects. The tower clock face lit from behind, and many other instances of the direct application of the lamp, as well as advertising signs outlined by incandescent lamps, all bid fair to be replaced to a great extent by flood lighting. It is interesting to note that the reproduction of the Seville tower, for such is the Garden tower, was illuminated in this way and not by strings of lamps.

In Madison Square, not far from the Garden, a heavy timbered platform was built, thoroughly braced, and roofed over to carry a one-ton Sperry searchlight. This projector used 150 amperes at a potential of 120 volts, and weighed approximately a ton. It was mounted on a Ford chassis, carried, of course, on rubber-tired wheels.

Approximately 100,000 candlepower are emitted at the crater of the carbon pencil, and the light was projected by a 36-inch lens. Taking the magnification constant at 5,000, it gives a total emission of 500,000,000 beam candlepower. At 40 degrees divergence the beam was spread out fan-shape to sufficiently illuminate the entire face of the building, so that practically an instantaneous photograph could be taken.

With a divergence of approximately 10 per cent, a range of 135 miles is assigned to this light, and its record is that it has spotted an aeroplane flying through the air at this distance.

What we speak of are the lights used in connection with illuminating the outside of the building which housed the convention. The searchlight represented 18 kilowatts of power, nearly 25 horsepower. The 72 flood lighting projectors consumed 36 kilowatts, or nearly 60 horsepower; at 26 and 50 kilowatts, respectively, 34 and 66 horsepower were expended by the two other systems as named. This gives a total of 100 kilowatts, close to 175 horsepower.

It may be interesting to describe the magnitude of preparation inside the Garden. Over 4,000 amperes at 120 volts were employed in a special manner in special illumination effects; flood lighting by 12 150-ampere sunray arcs for movies work; power for five 10-horsepower blowers; fans, etc. Data: 4,000 amperes at 120 volts aggregated 480,000 watts, approximately 616 horsepower.

The National Convention Committee appointed Mr. Arthur Williams, general commercial manager of the New York Edison Company, chairman of the Illuminations Committee, and Mr. Clarence L. Law, secretary of the same Committee. Mr. William G. Marthai, chief illuminating engineer of the New York Edison Company, under the direction of the above individuals, and Mr. Thomas Rochester, city engineer, under the direction of Mr. Grover Whalen, Commissioner of Plant and Structures, had entire charge of the above installation, as well as all other illuminations about the city and the Boardwalk at Coney Island. The S. E. Kimball Electric Company, 411 Fifth Avenue, made the actual installation of the work from the plans of the committee with the results shown.

Mammoth Flood Lighted Globe

ADVERTISERS who use electric light for display are beginning to realize the possibilities of flood lighting. Our illustration shows a very impressive example of what can be done therewith.

In Kansas City one of the great cold storage and warehouse companies has mounted a huge globe upon the summit of a tower of its building. The ball is made of structural steel and is 15 feet in diameter.

It was originally intended to cover the ball with four inches of concrete upon metal lath, and mirrors five inches square made from Florentine glass were to be set in the concrete. This developed trouble. The mirrors were too small and the correct position in the concrete could not be insured.

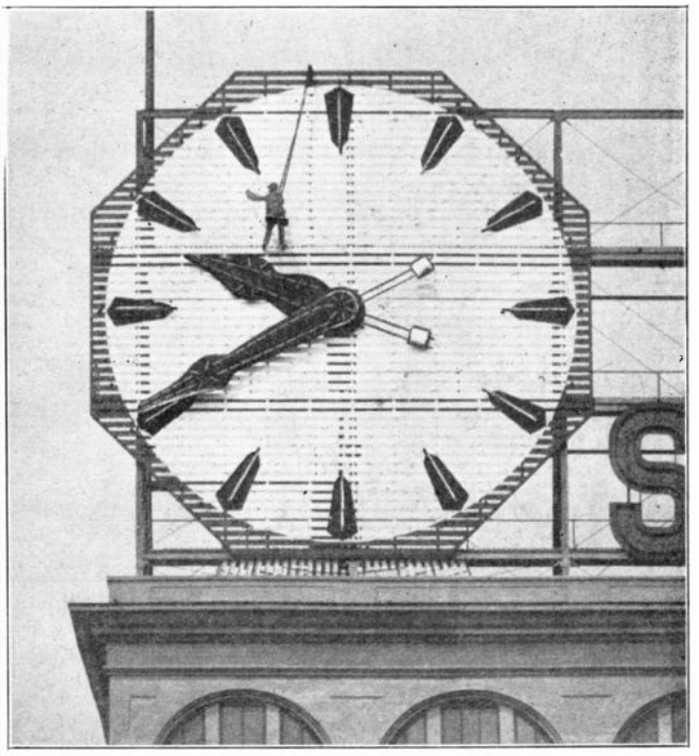
So the concrete was knocked off and sashes were made; they were in sections about 12 inches wide at the equator of the sphere and tapering to a point at the upper end so that their sides represented the meridians of the structure. To glaze the sashes ½-inch plate glass mirrors were set in them. The largest of these mirrors was about a foot square. Around the equator of the globe a frame was secured, carrying a quantity of red lights giving the words *Ice and Cold Storage*, which letters were about 30 inches high and stood quite a distance off from the surface.

The ball is carried entirely from its base, having no top support. It revolves on a shaft made of 4¼-inch round chrome steel, the weight being carried by eight sets of ball and roller bearings.

About one-eighth of the distance up from the bottom, a steel band surrounds the ball in the interior, and eight 6-inch roller bearings press against it so as to take up the wind thrust.

The weight of the structure is approximately six tons and it is rotated by a 5-horsepower motor, its speed of rotation being geared down to one revolution per minute.

The flood lighting is done by four lights above the ball and four upon the roof of the tower. The upper lights are carried by a standard rising from the top in line with the vertical axis. Each lamp is 1,000 watts power and the great tower itself is lighted by four more of the same lamps on the roof of the main building.



Left—An enormous flood lighted globe installed upon the top of a Cold Storage Plant in Kansas City. This impressive exponent of flood light is a most interesting example in the advertising field.

Above—View of the face of the great Colgate clock, the largest in the world. The white lines show the lines of lamps and the little figure of a man gives an idea of its size. The face is made of open board-work.

Great Illuminated Clock

TRAVELERS on the Hudson River between New York and Jersey City see upon the western shore on the top of a building what seems to be a fairly large clock. It is probable that very few realize how large an object they are looking at.

The dial, as will be seen from the illustration, is built up of boards; each board is 6 inches wide and they are spaced 6 inches apart to reduce the wind resistance. The clock face is 38 feet in diameter, the largest in the world. It appears as a solid dial when seen from the river. The clock seems to have the twelve numbers indicating the hours upon its huge dial; however, these are actually not numbers at all, but there is simply a dark mark for each numeral.

The hands are made of sheet copper stiffened by means of brass trussing and frame. They are painted black and sanded so that they will not reflect light. The hour hand is 15 feet long and 3 feet 10 inches at its greatest width. The minute hand is 20 feet long; the hands have counterpoises to balance them. The minute hand with its counterpoise weighs 640 pounds. The escapement operates to release the movement every half minute, so that the motion of the minute hand is a succession of jumps, 120 to the hour, each jump being 11½ inches long.

On reference to the illustration, a man will be seen standing on the face, and his figure gives a good conception of the size of the enormous structure.

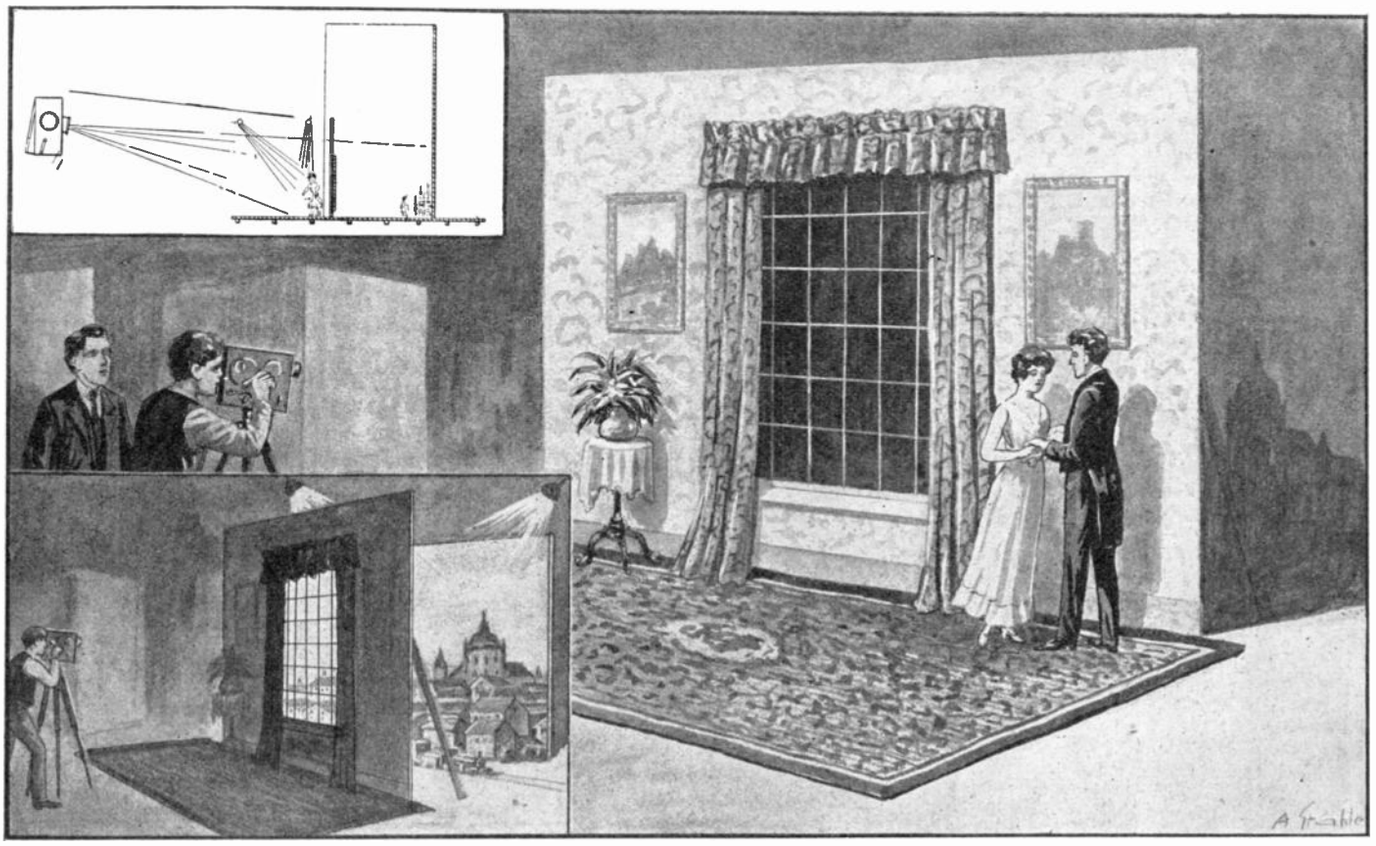
The hands and minute spaces are lighted by incandescent lamps. Red lamps mark the hours and there are 4-candlepower white lamps for the minutes. The minute space is 23 inches long. The hands also carry a series of electric lights. The position of the lamps is indicated by white lines on hour marks and hands.

A spot of light is carried across the base of the clock from right to left and back again, presumably to represent the swing of a pendulum.

The clock is driven by a weight at the end of a steel cable, the weight weighing 600 pounds. This movement has an 8-foot pendulum which weighs over 400 pounds, and while it keeps time, it acts upon the hands by a separate movement; they are moved by a special weight of more than half a ton, actuating a drum by a steel cable wound around it. The two movements together give the time with extreme accuracy.

An interesting item is that as the clock is to be taken away to one of the western factories of the Colgate firm in Jackson, Indiana, a new clock is to replace it and will exceed the present one in size. It will be 50 feet across the dial and the minute hand will be 27½ feet long. The winding will be done by two electric motors, one horsepower and one-sixth horsepower, respectively.

Artificial Scenes for Moving Pictures



An interesting method of taking moving pictures so as to be able to reproduce in the background scenes from different countries or of the past, while the actors and real objects are in the foreground, so as to give the relative sizes.

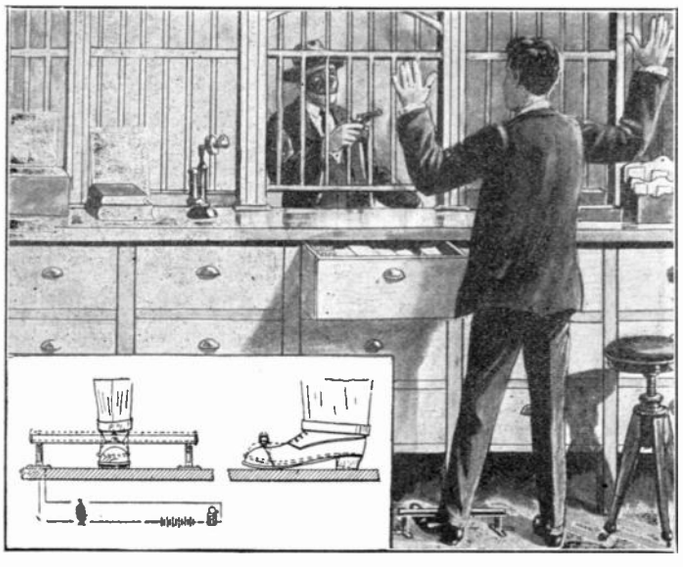
THE great expense incurred in taking motion pictures of ancient scenes, such as views in ancient Babylon, etc., have led many to improvise such scenery from miniature objects and photograph them in such a way that they will appear full size and real when projected on the screen. This method for reducing the cost of motion picture scenery was recently patented by a Mamaroneck, N. Y., inventor.

With such process it is possible to reduce the cost of scenery of photo-plays by placing natural sized objects and actors in the foreground and small models and dummies in the background and then operating the camera and the light effects and a curtain so that ultimately a negative will be formed in which the foreground and background will be properly blended.

The stage is divided by a partition having a window-opening which may be closed by a black curtain so as to be blank, or

(*Concluded on page 663*)

Burglar Alarm

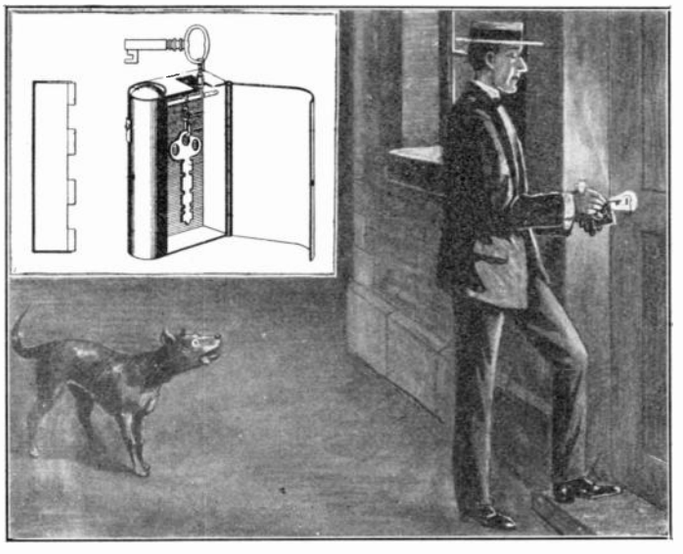


Alarm switch for use in a bank, which is operated by the clerk raising it with his foot. Thus there is no danger of pressure sounding the alarm.

THE daily papers have been so charged with reports of hold-ups and bank robberies of late that many experimenters have been working on burglar alarms for warning the police in cases of hold-up. Very few of these alarms have been foolproof. They usually consist of some sort of switch which may be closed by the foot without arousing suspicion in the robber. Often such switches have been closed accidentally, giving a false alarm and arousing the whole police force. These switches are used in banks and business houses,

(*Continued on page 663*)

Combined Key and Flashlight Case



A key case for the pocket, which embodies a flashlight so that the keyhole can be illuminated at night.

ALMOST everyone carries some sort of key case but few carry the small pocket flashlight. There are times when both come in handy; without the key case we are sometimes locked out until sunrise, and without the flashlight we

(*Continued on page 664*)

Stray Current Dangers

By Professor Rogers D. Rusk
Northwestern College, Illinois

STRAY electrical currents cost our large cities many thousands of dollars every year in damage done to water and gas mains and other underground metal work, besides endangering lives. An ordinary inch and a half iron gas or water pipe may be eaten up sometimes in six months' time, when it ought to last from fifteen to twenty-five years. This action is called in technical terms "stray current electrolysis."

This process of "electrical rusting" takes on startling proportions in the neighborhood of electrical distributing stations and street car lines or terminals. Such systems use the ground as the return conductor for the current, and the density of current in the earth's surface is particularly great near them. In such a neighborhood a large eight-inch cast iron main may be eaten up in a few months, leaving only the carbon from the iron in the shape of a soft frame which can be easily crushed in.

The accompanying photographs show in a marked way the effects of such stray currents. Fig. 1 shows a corrosion of 75 per cent on an eight-inch cast iron gas main. Near the pits the iron was eaten away, leaving a soft shell. Fig. 2 shows in a remarkable manner the holes formed in an inch and a quarter wrought iron service pipe which had been subject to heavy stray currents. Fig. 3 shows a six-inch cast iron main nearly eaten through in less than a year's time. Aside from the loss of piping, the escaping gas or water is likely to do great damage. Gas mains which should normally last for years may suddenly spring a leak and cause explosions, resulting in loss of life.

Everyone knows that if a metal spoon is hung in a silver solution and if a current is directed towards the spoon the spoon will soon be plated with silver. If the current is reversed, however, the silver will be driven away from the spoon and even the metal of the spoon may go into the solution and the spoon will be eaten up. It is this same action which eats up an iron pipe. Galvanizing the pipe protects it for a while from ordinary rust, but the electrical current attacks the galvanizing in the same way it attacks the iron. Hence it may be aptly called electrical rust.

Indeed, all chemical action is now considered to be electrical, because it is on account of electrical attraction that the atoms of matter are held together in a chemical compound. Ordinary rusting is a slow process, due to the interaction of

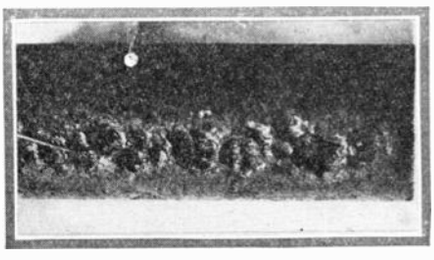


Fig. 2. Example of a small pipe, thickly corroded by escaping or stray currents.

electrical charges within the atoms. Electrolysis is a swift action in which great armies of atoms are swept away by an electrical current.

Nearly one hundred years ago Michael Faraday formulated the laws of electrolysis. According to these about three ten-thousandths of a gram of iron are liberated by electrolysis in one second by

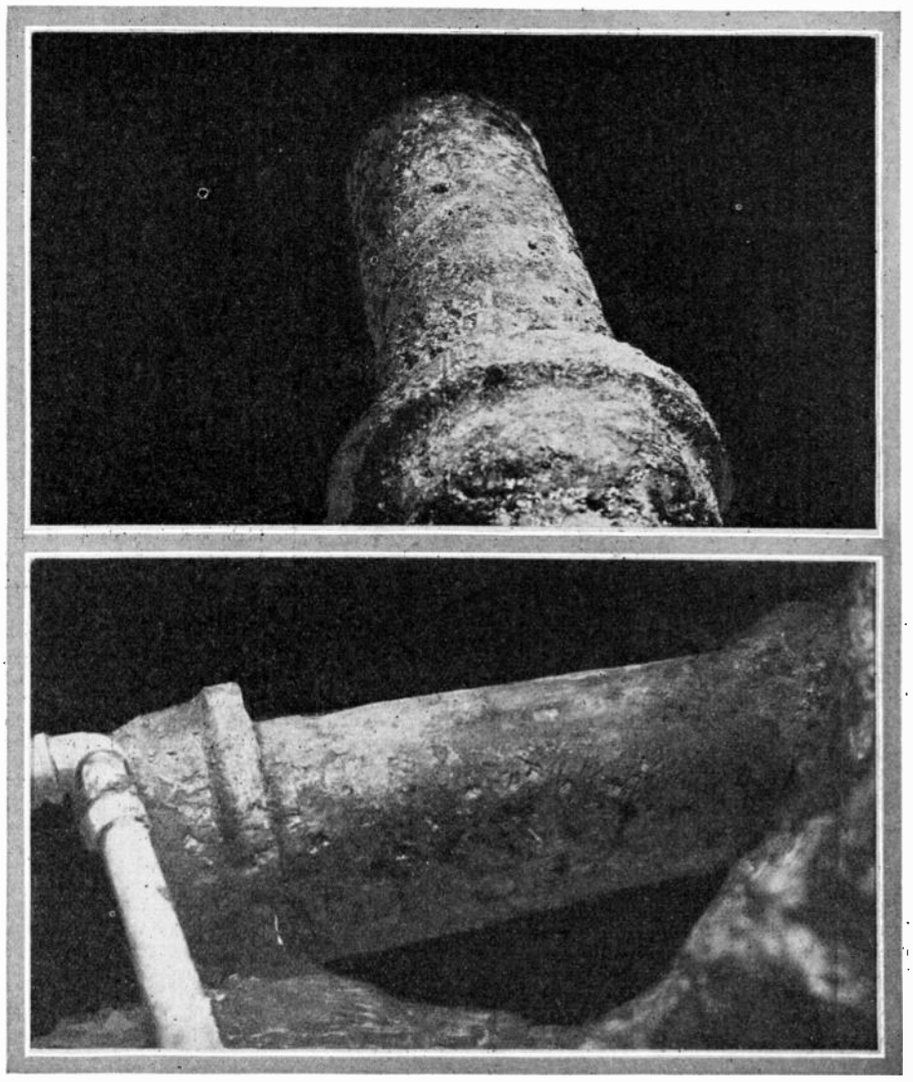


Fig. 1. Some interesting examples of corroded cast iron pipes. The corrosion is due to stray electric currents. In the absence of such currents, cast iron pipes last almost indefinitely underground. Stray currents of electric railways produce corrosion in a few months.

a current of one ampere. This is not a very large amount, but there are over thirty-one million seconds in a year, and that would mean nearly ten thousand grams of iron set free in a year for one ampere of current. The stray currents in a city water main may be ten or twenty amperes or more, so it is evident that a hole may be quickly eaten in an iron pipe by such stray currents. The same current would set free an even greater amount of zinc, so that galvanizing does not offer much protection.

Attempts have been made to reduce these losses by insulating the pipes. In one case a stove pipe filled with tar was put about the pipe, but the current was so great that it melted the tar. Attempts have also been made to insulate the sections of pipe from one another by cement rings for large pipes and fibre rings for small pipes. These attempts have been partially successful and seem to materially reduce the amount of stray current flowing on the pipes.

Fig. 4 shows how the current may jump from street car rails which do not make good contact, to gas or water mains. Near a distributing station, where the current is flowing in from all directions, the stray currents are very much greater, even though removed from the vicinity of any rails.

As electrical distribution and service increases, a remedy for this loss and the accompanying danger of broken gas and water mains must be found. This may be

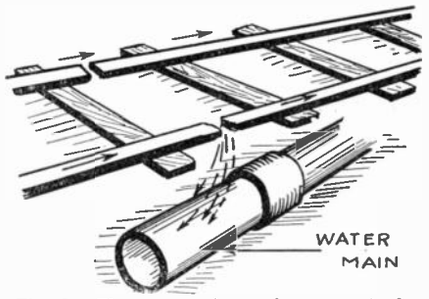
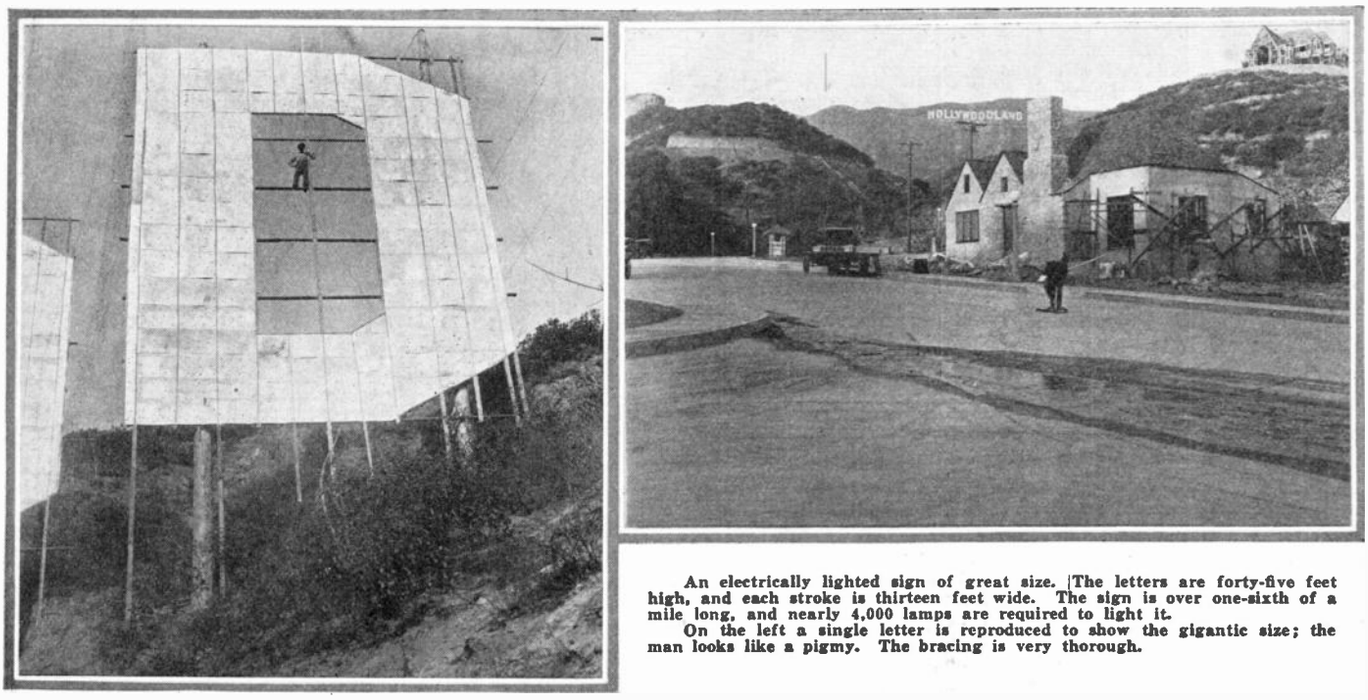


Fig. 3. The course of escaping currents from an electric railway to an iron pipe. This diagram explains the destruction.

done partly by better means of localizing and confining stray earth currents; such as, for instance, better contacts between street car rails, so that the return current will flow on them rather than through the ground surface; or better means of insulating the gas and water pipes.

The Mammoth Hollywoodland Electric Sign



An electrically lighted sign of great size. The letters are forty-five feet high, and each stroke is thirteen feet wide. The sign is over one-sixth of a mile long, and nearly 4,000 lamps are required to light it.
On the left a single letter is reproduced to show the gigantic size; the man looks like a pigmy. The bracing is very thorough.

HOLLYWOOD, California, is a familiar name to most of us, and the city hardly needs advertising. Yet they have seen fit to erect a gigantic sign high up, 1,000 feet above the city, bearing the name "Hollywoodland."

The great sign can be seen for a distance of twelve miles. When the sign was being built there were no roads for a mile beyond the location selected, but a caterpillar tractor overcame all difficulties.

The surface of the mountain is very irregular; the ground beneath the sign is rocky. The sign is supported by telephone poles 60 to 80 feet in height, several tons of dynamite being expended in making the holes for them.

The letters at one end are 15 feet higher than at the other, and it was even necessary, on account of the irregular surface, to put some letters 40 feet in advance of the proper line, and others as much back. At a distance in looking at the sign from the front these discrepancies are not noticeable.

Two by six inch timbers, placed 16 to 24 inches between centers, are the horizontal elements of the frame. To this the letters, made of galvanized iron, are nailed. Each stroke of a letter is 13 feet wide. To illuminate the 13 great letters 3,700 10-watt lamps are used, placed along the edge of each stroke. The effect of this is that there is a shadow or dark space between the sides of each stroke, which is found to give an advantage in legibility at night. There are 55 outlets to each circuit and the wiring is all open on the back of the structure. Everything centers in a junction box near the center of the sign. Here there is a pilot flasher and time switch.

The flasher switches on "HOLLY," then "WOOD," then "LAND," successively; then the whole sign is extinguished and the flasher repeats its work.

Taken on a straight line, the sign is 975 feet long and the letters are 45 feet high. Naturally there is a good deal of wind pressure exerted on the sign, but it is guyed by cable fastenings, and has already withstood one of the most violent windstorms that has visited Southern California in many years. It is claimed to be the largest sign in the United States and the only attention it has required during eight months of display has been a weekly winding of the time switch and oiling of the flasher twice a month.

A Remarkable Lightning Stroke

By A. E. Metler

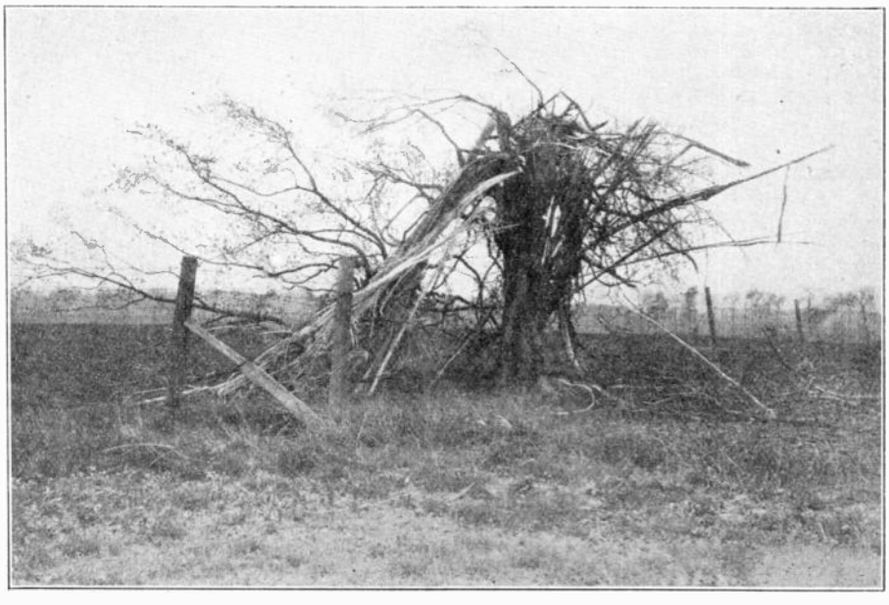
WE reproduce here a very remarkable photograph of a tree struck by lightning eight miles from Adrian, Mich. The details follow:

The tree stood in a field alone; there was no other obstruction within a radius of a quarter of a mile. The sap of the tree was probably heated and changed to steam by the current, causing the trunk to explode. Some of the debris was thrown over the field for twenty rods and had the appearance of straw. As there was no sign of the electricity entering the ground it is thought that the current followed the wire fences which intersected very near the tree.

Window panes were shattered in a house a quarter of a mile away by the concussion. Buildings were shaken in Adrian nearly eight miles away. The tree was an elm about fifty feet high and the trunk was about thirty inches in diameter.

The complete splintering of the wood is of interest; it suggests sudden evolution of gases, or an explosion of the same.

The photograph was taken by Velbert Metler at the request of Prof. George Tripp, of Adrian High School.

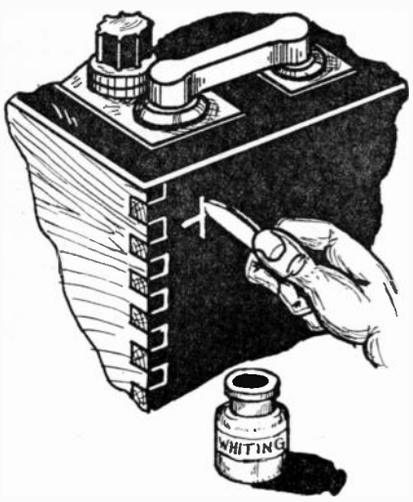


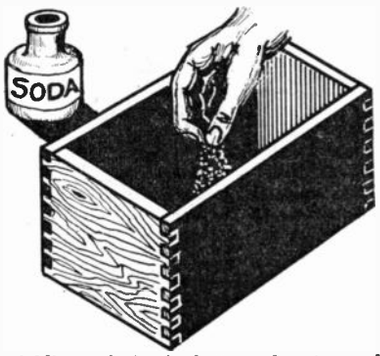
A wonderful lighting stroke, annihilated a tree; it was felt eight miles away from this point.

Motor Electrics

Making Over the Storage Battery

By Raymond B. Wailes





Sprinkling soda in the bottom of a storage battery box. This will protect the box from the action of the acid.

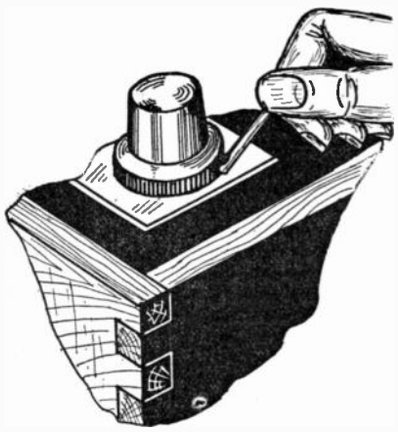
WHEN placing the storage battery in the new box sprinkle a bit of baking soda on the bottom. This will effectually neutralize any acid which may happen to leak from a cracked cell.

The polarity of the battery should be indicated by being cut into the sides of the box at the respective terminals. Whiting, or even plaster of Paris, smeared in the marks thus made will visualize the letters easily.

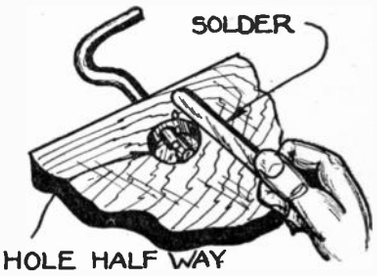
Handles are to be affixed as shown. Hot solder should be dropped into cavities made at the ends of the handles which have been thrust through the ends. On cooling, the solder holds the handles firmly in place by forming a slug around the little notches on the handle ends.

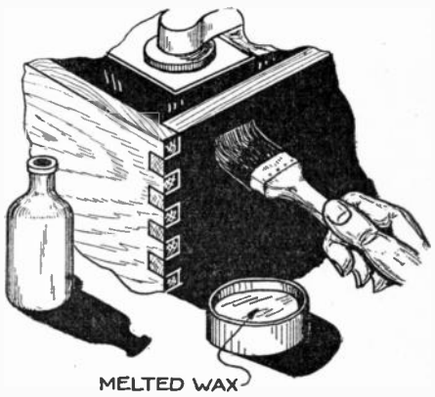
Vaseline smeared around the base of the terminals will prevent the acid electrolyte from creeping upward and causing corrosion of the wire leading to this terminal, and involving loss of and deterioration of the electrolyte.

A tar paint applied to a battery box will prevent the attack of acid if the paint is spread on heavily enough. Melted wax can also be used to impregnate the wood fibres. A solution of wax in carbon tetrachloride is another good acid proofing fluid.



Above—Marking the battery box outside to indicate the polarity. Below—Putting paraffin around a battery cap to prevent the acid escaping as the automobile is jolted.





Above—Fastening on the handles and hooks to the battery case, so that they shall be perfectly secure.

Below—Painting the box with melted wax and lampblack or other mixture, so as to protect it in every way.

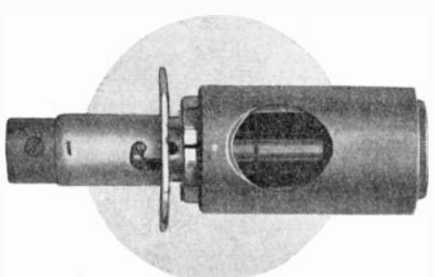
Cigar Lighter for Motor Cars

By C. G. Percival

AN electric cigar or cigarette lighter, adapted for tourists and campers because it has no attached wire, cord or reel, and can be handed about as freely as a match, is shown here.

The lighter has two carbons with thin points one-sixteenth inch apart, set within a composition shell. One is held firmly in the base and the other is attached to a spring-actuated push-button at the opposite end of the shell. Bringing the two carbon electrodes together by pressing the button on the end of the lighter for five or six seconds produces enough heat to enable several persons to light a cigar passing it about from one to the other before the heat dies down. The cigar or cigarette is applied to the red-hot points through an opening in one side of the shell.

The most attractive feature of the device is freedom from the restriction of



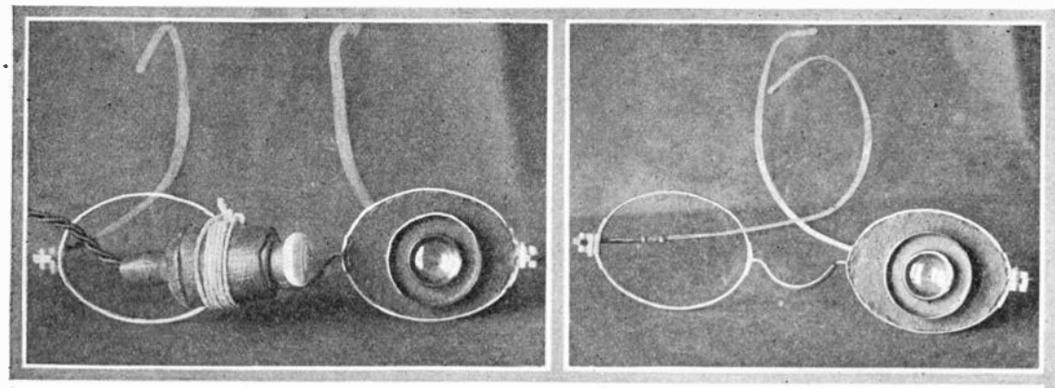
A very ingenious cigar lighter, which can be passed from one person to another and will light a number of cigars, when disconnected from the circuit.

wires. The lighter proper sits in a socket inserted in the dash. Before removing it the push-button is pressed for the few seconds and the carbon becomes hot, the lighter is turned in the socket, where it is held by a pair of pins, bayonet-joint fashion, and is removed. Thus it is available for use anywhere in the car.

If the dashboard of the motor car is of metal only one wire is needed, as it gets its own ground. If installed on a wooden dash a wire is required as a "ground." The lighter is fool-proof, there being but one part that moves in the whole operation. New carbons are easily inserted without tools and their life is put at three months, presumably varying with the number of cigars and cigarettes.

One of the old time competitions with trotting horses was the cigar race. To light a cigar then see how far he could drive before it would burn up. The point was that the motion through the air, for there were no windshields in those days, caused the cigar to burn at great rapidity obliging the driver to go at a happy mean. How would an automobilist fare?

Illuminating Spectacles



Above—Spectacles in one of whose openings there is a magnifying glass of comparatively high power. A little electric flash-light connected to the other side of the frame throws light on the object.

HIGH power magnifiers cannot be used with their full efficiency if held in the hand, as the unavoidable movement of the latter constantly alters the distance of the magnifiers from the object, throwing the image out of focus.

The best way out of the difficulty is to fit the magnifier into an empty spectacle frame, as shown on right. A piece of stout cardboard is cut to fit the frame opening, and the magnifier is mounted in a hole cut in the cardboard.

If desired a piece of brass or aluminum sheet can be used instead of the cardboard; but in any case both sides of the material used must be blackened to avoid unpleasant reflections.

The photo shows a thirty times magnifier; giving perfectly steady images when used in the frame, but is useless for accurate work when held in the hand. The other frame opening is left empty, so that ordinary vision is possible with the other eye, without having to take off the spectacle frame.

If the work is conducted in dim light or indoors additional illumination for the object is required, if the finest details are to be clearly seen. On left is such an arrangement; a small extension lamp-holder is provided with a small flashlight lamp which faces the object. A flexible cable of sufficient length leads to the flash-lamp casing with its switch and battery, a connector being screwed into the opening for the lamp.

The lamp-holder is attached to the empty frame opening and does not hinder work in the least. The under side of the lamp is blackened to avoid direct light reaching the eye, as it might cause eye-strain.

Owing to the close proximity of the lamp to the object, the latter is well lit up and the faintest details can be clearly seen with high magnification.

Such a device is of the greatest use when examining delicate screw threads, reading close divisions on micrometers, examining small insects, etc. When not needed the frame is pushed up to the forehead, when it is out of the way.

The battery case and switch are carried in the coat pocket, so that the outfit is self-contained, and can be carried around without trouble. The flexible cable from lamp-holder to battery case must be sufficiently long for this purpose.

Contributed by C. A. Oldroyd.

Electric Heater

Right—Electric heater. A cylindrical heating coil making a structure for heating, adapted to be placed in the guard frame of an electric fan.

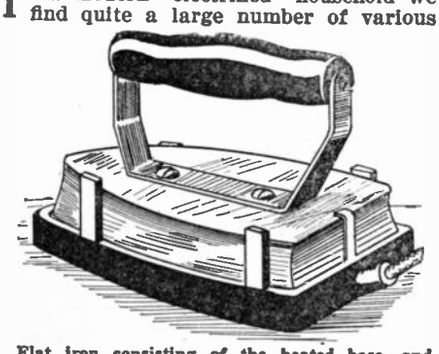
WE illustrate above a very simple electric heater which can be improvised by anyone possessing an electric fan. Across the front of the protecting screen of the fan there is mounted a heating coil. This may be an iron or nichrome resistance wire wound upon a porcelain cylinder, much as regulation heaters are wound. The connection is made from the heating coil directly to the supply wires of the fan, the motor being thrown out of the connection. In this way a very simple addition converts the every-day fan into an effective electric stove, as it may be termed. If it is possible to turn the fan screen into a horizontal position it may be arranged with cross wires to receive a vessel for heating.

It will be remembered that it is not simple straight winding that is used for this type of heater. The wire is first wound into a coil of about the diameter of a lead pencil, and this coil, which may contain many feet of wire, is in its turn wound around the insulating core.

Back of the heating element the guard may be closed by a reflector. It is well to remove the fan proper to give more room.

Universal Electric Heater

IN a modern "electrified" household we find quite a large number of various



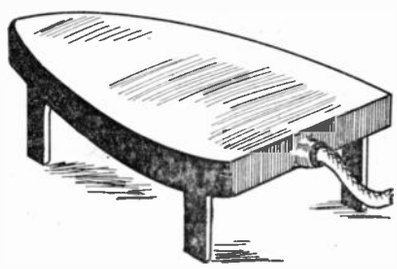
Flat iron consisting of the heated base, and upper base resting upon it with the handle attached thereto.

heating appliances for cooking, water heating, ironing, etc. It is possible, however, to materially reduce the number of devices by combining in one apparatus the functions of several others.

The accompanying illustrations show one such combination apparatus. It is intended primarily to work in connection with an ordinary sadiron and represents a hollow receptacle with resilient lugs or catches. An ordinary sad iron can be inserted in this receptacle, being held in place by these lugs. The bottom of the receptacle is provided with a heating element and an electric cord to be connected with a lamp socket. The receptacle with the sadiron can then be used as an electric iron.

The iron may be then removed when the ironing work is done, and the receptacle turned over (Fig. 2) to stand on its legs. In this form it may serve as a most convenient cooking device, for toasting bread, boiling water in a kettle, etc.

A simple regulating device may be added to control the desired degree of heat



The base of the iron is removed from it, turned up-side down and gives a convenient little heating stove.

for various purposes for which this device may be used.

Contributed by J. P. Nikonow.

Electioneering by Loud Speaker

A French politician giving a speech by loud speaker as he sits in comfort in his closed car.

THE metal speaking trumpet is an old institution. It is a reminiscence of the days of Nelson and of the old navy when it was always as distinctive a mark of the naval captain as the whistle was of the boatswain.

Coming down to old New York, such a silver-plated trumpet, or even a silver one, used to be carried by the foreman of volunteer fire department organizations. At a later period we began to hear of very large speaking trumpets being experimented with by Edison. Then the well-known pasteboard megaphone came in.

This is really a rather remarkable instrument in its combination of simplicity and efficacy, and is used extensively to the present day. The coxswains of racing shells and the coaches on athletic fields employ them. Even the managers of theatricals use them at rehearsals, and the distinctness of enunciation which they give and their carrying power is quite impressive.

But now the best of the megaphones yield to the loud speaker. Here electricity enters and surpasses the old-time more mechanical methods of producing loud enunciation. The talker speaking into the microphone has his voice stepped up, as it were, by the loud speaker. We read of the speeches of President Coolidge and others reaching enormous audiences directly as well as indirectly.

We illustrate here a very comfortable way of making an electioneering trip. Inside of the automobile there is installed a candidate in the French election, and he is delivering a campaign speech to an audience on the street. On the top of his automobile a broadcasting loud speaker is mounted and the winged words of eloquence which he utters are emitted with characteristic distinctness to the audience, however large it may be.

Cartridge Shell Lamp

A table lamp whose standard is a cartridge case giving good facilities for mounting the lamp socket and introducing the wires.

CLEAN the surface of a 3-inch or other metallic cartridge shell. It may be nickel-plated or it may be given a lacquer finish. Procure a screw-edge canopy so-called, and use it to give the top part of the shell a finished appearance. Sweat it in with solder, making the surface even all around.

Through the bottom drill two holes for a ¼-inch thread tap near the outer circle. The primer, which is in the center, is also drilled out to serve the purpose of passing in the cord.

Now take a slab of marble or a piece of bakelite or other attractive material and drill two holes, countersunk on the bottom, to correspond with those drilled near the circumference of the shell, and use these for fastening the shell to the base. The size of the base will depend on the size of the shell and on the material available.

A ¼-inch hole is drilled in the base for the outlet of the cord and it is bushed to give a finish. The cord passes up through the hole in the center of the base of the shell. A pull-chain socket, which may be nickeled or not, according to taste, is screwed into the canopy outlet on top.

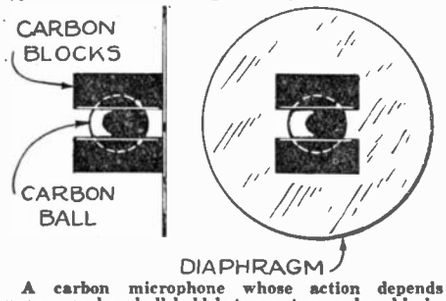
After all mechanical work is done the shell is finished up; namely is polished and lacquered or nickel plated. The constructor may also wish to try his hand at engraving it. This should also precede the finishing.

The shade for this particular lamp was made from Dennison's crepe paper and twisted paper yarn woven over a wire frame. The yarn can be twisted from strips of paper which are attached to the drive wheel on the back of a sewing machine. This twists them one by one very rapidly. A 75-watt bulb was used in the lamp shown.

Contributed by ELMER L. BERG.

Ball Microphone

THE diagram shows a microphone which has given excellent results. It is made of two pieces of carbon ¾ x ¾ x ⅜ inch, which are partially hollowed out so that a carbon ball ¾ inch in diameter will rest loosely in the recesses.



A carbon microphone whose action depends upon a carbon ball held between two carbon blocks and fitting into recesses in the same.

After the carbon ball is placed between the blocks they are then fastened to the diaphragm. If the diaphragm is made of metal it will be necessary to insulate one of the carbon blocks from the diaphragm. The two leads of the microphone are taken from the two carbon blocks. The microphone will work best when it is placed so that the two blocks are perpendicular.

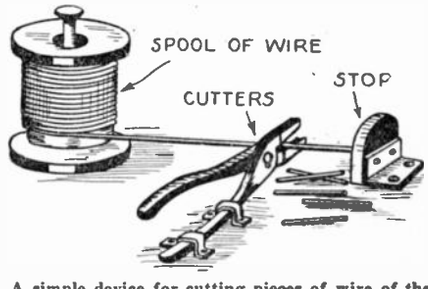
Contributed by NED GUFFEY.

Wire Cutting Wrinkle

MANY times it is desired to cut a number of wires the same length, generally for use in making armatures for magnets, induction coil cores, etc. But it is sometimes quite difficult to get all the wires of exactly the same length.

A very simple arrangement for doing this is shown in the accompanying illustration. A pair of wire-cutting pliers are fastened to a base as shown, with a small block placed at a distance from them, regulating the length the wires are to be cut.

All that is required is to pass the wire through the cutting part of the pliers until the end hits the block, and then cut it. This is quite a simple way of measuring each wire very quickly and cutting it at the same time.



A simple device for cutting pieces of wire of the same length for making up magnet cores and the like.

Contributed by EVERMONT FISEL.

Awards in Odd Electrical Experience Contest

First Prize, $20.	Second Prize, $10.	Third Prize, $5.	Fourth Prize, $2.50.
Robert B. Ellis, Gladstone, Oregon	R. Sorelle, C. P. O. Box 7, Tientsin, China	Durward Christman Mullins, S. C.	W. W. Ormond, Box 385, Rockingham, N. C.

First Prize

A Lame Man Cured

By Robert B. Ellis

I HAVE a cousin who served in the Canadian forces during the late war. One time, in jumping down into a trench, he dislocated his right hip. For some reason the injured hip could not be replaced and he limped considerably and found it necessary to use a cane.

After the war he settled down on a farm. He did very well at this occupation for one handicapped in such a way.

One day as he was walking from a neighboring farm back to his own, he noticed large, black, threatening clouds moving swiftly in his direction. He hurried but was not fast enough. The storm broke with all its fury just as he was about a mile from his home. It was a real old northern Wisconsin electrical storm. He had not gone much further, when a lightning bolt crashed less than four feet at his side!

An ex-service man with a dislocated hip was cured when lightning struck the ground within four feet of him.

When he regained consciousness the storm had passed on. He rose up and found to his happy surprise that his leg was all right and that he no longer needed the cane! He ran back to the house, glad that fate had at last turned to help him. Now, as to the sudden cure, I cannot account for that; either the lightning, frightening him, caused him to jump suddenly and replace the joints by his action, or the electricity cured his leg—I would vouch for the former reason.

Second Prize

A Tale from France

By R. Sorelle

SOME years ago I was a foreman in a town in France of about 15,000 inhabitants (Ecaussines d'Enghiene & Ecaussines Lalaing—the last famous for the Gouter-Monstré (swell lunch) they used to give once a year to the bachelors of the world).

The company I was working for had a power-house and managing offices some twenty miles from the place I had charge of, a three-phase power line, 6,000 volts, 40 cycles, the distribution at Ecaussines being made by transformers located in stations in the towns, the secondary voltage being 220.

In the beginning of the summer of the said year, having no other particular work to do and weather being fine, I decided to go on my bicycle on an inspection tour of the lines.

When I came to the end of the sector I was inspecting, about two miles from the transformer station, I met a friend of mine, a well-to-do farmer who was the last customer of the company connected to the sector. My friend told me that he had not got any electric light for a few days and that he had not taken the trouble to inform me at my office of the cut-off because of the little need of light for a farmer at this period of the year.

A rough inspection of the installation showed me that a line of two bare wires connecting the residence of my friend to some of his barns were in contact. The insulators supporting these lines were some twenty feet above the ground.

I asked for a ladder to separate the wires and started to beat and shake one of the wires to separate them.

I did it with my left hand, but the wires were so loose and so badly entangled that I got a little nervous on the top of my ladder. Then I changed my position and in doing so a part of my right hand, near the wrist, touched one of the wires I had just managed to separate. I was still keeping one of the wires in my left hand, the fingers of my right hand contracted, and now I was receiving the full 220 volts alternating potential through my body.

It is wonderful how a man can think quickly in a case of emergency. A few farmhands were watching my efforts on the top of the ladder, and I told those people (in a very unharmonious tone, to be exact) to go to the meter and cut the current off. Those chaps did not move an inch. They did not understand me, or maybe they enjoyed the spectacle without understanding how dangerous my position was. And during all this time I had the feeling of a man drowned in water, who begins to be asphyxiated. My heart was beating slower and slower and at the same time perspiration was pouring freely from my body. My hands were now burning and a dark smoke, such as that produced when a piece of fat meat falls into the stove, was now noticeable.

I told already that my mind was working quickly. I spoke mentally to myself. "You can't expect any help from anybody,

Presence of mind and quick thinking saved this engineer. His hands were paralyzed by the current so that he could not release the wires, but as he could move his arms, he brought the wires in contact one with the other and saved himself.

so, old chap, try to get yourself out of this mess." "What about jumping to the ground; never mind if you break some part of your anatomy at the end of the trip. Anything in that line is better than your present position." But just in the nick of time I remembered a trick which was told me during my blessed apprenticeship. I could not move my fingers, but I could move my arms. Then a balancing movement—one, two and three, hoop la, the wires were again together and I was free at last!

Immediately I descended my ladder and requested the farm hands to bring me at once some olive oil to put on my burns and some schnick (Belgian gin) to pour into my stomach; as the consequence of it all, I merely got a few abscesses on my hands for some weeks.

All the above seems to be "incroyable," but if you will take into consideration what I learned afterward by my experience that the bare wires were of phosphor bronze and were well covered by black oxidation, you will admit that the short circuit was imperfect and that the lead wires of the fuse boxes did not burn out. But my moist hands made for some time an excellent connection for my body. I remember it now.

$37.50 IN PRIZES

We take pleasure in offering a series of prizes for letters giving odd and unusual electrical experiences.

First Prize	$20.00
Second Prize	$10.00
Third Prize	$5.00
Fourth Prize	$2.50

Nearly every one of us has had an odd or unusual experience in electricity, sometimes humorous, sometimes pathetic, sometimes puzzling, and it would appear that our readers should let us have some of their personal experiences for the benefit of all.

The more unusual the experience, the more chance you have.

Illustrations are not necessary, but the letter should be either typewritten or written in ink. No penciled matter can be considered. Contest closes on the 15th of month of issue.

If two contestants should send in the same winning experience, both will receive the same prize. In the event of two or more persons sending in the same as best, second best, etc., each tying contestant will receive the prize tied for.

Prize winning letters will be judged as follows: The first prize will be awarded for the letter giving the oddest or most unusual experience. The second prize to the one considered next best, and so on.

Communications to this department should be addressed *Editor, Odd Electrical Experiences,* care Practical Electrics, 53 Park Place, New York City, N. Y.

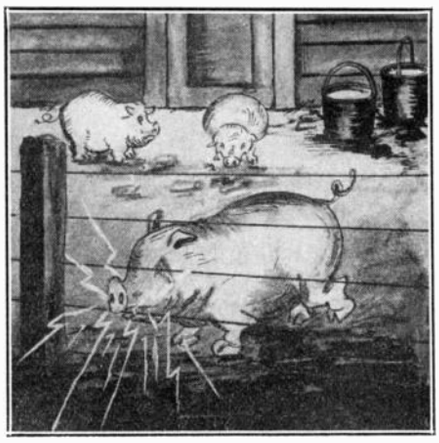
The "morality" of the above, dear Mr. Editor, is that before attempting to do any job in any electric circuit it is necessary to be perfectly sure that the multipolar switch is off and the fuses removed. Every little bit of it is summed up by your American motto, "Safety First."

Third Prize

The Electrical Fence Wire

By Durward Christman

WHEN a storm arrives in our rural community it always causes lots of excitement, for as a general thing we are



An investigating sow, or one desiring to escape, got the wire of a fence into her mouth when lightning struck the fence, and killed her.

famous for bad storms. The wind always sweeps the fields, the lightning tears something into pieces, and the rain pours in torrents.

But with all this, I don't think that one can find an odder experience than the one which follows:

One day the sky grew dark and it seemed as if a storm would sweep upon us at any minute. The lightning played freely about the lightning rods on our house. All too soon there came a flash of lightning and a clap of thunder which seemed to shake the very earth to its center. Quickly glancing across the yard I was alarmed to see a ball of fire appear in the hog pen. After the storm I rushed out of the house to the spot where I had seen the fire.

Lying there on the ground burnt to death was our prize Red Jersey sow, even every hair on her body had disappeared. I also noticed that she was still holding the wire fence in her mouth. After a careful study I decided that she was frightened and tried to escape by tearing the wire with her mouth. At the same instant that the lightning struck the rod on our home, it went to the wet ground, the steel post and wire conducted the electricity, the hog having hold of the wire the current passed through her body and electrocuted her.

Fourth Prize

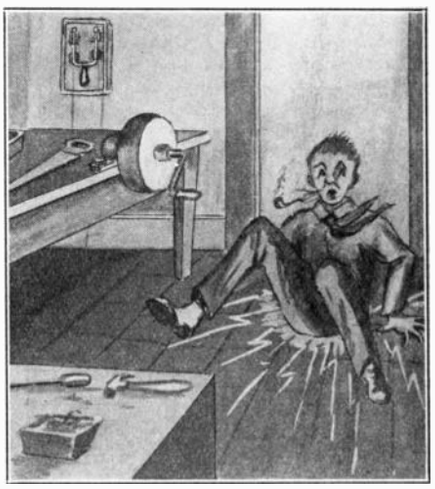
Hoist by His Own Petard

By W. W. Ormond

DURING my first experiments with electricity at the age of eighteen, I built a small shop in our back-yard. It contained a lathe, emery wheel, small circular saw, and a jig saw, all of which were of my own manufacture. They were belted to a line shaft secured to the ceiling, which shaft was driven by a ¼ H.P. 110-volt motor. I made file handles and baseball bats and many other things, besides experimenting.

On one side of my shop was a switchboard, with every kind of switch that was in service at that time controlling different experiments. In this shop I spent most of my time, although I was going to school. When summer came I was annoyed by all the small boys in the neighborhood asking more questions than an army of lawyers. These boys were barefooted—so I took some bare copper wire and tacked it all over the floor in lines two inches apart. Next to my work-bench I had a secret push button on the floor. I connected a 110-volt circuit to this. When the shop was full of boys I would step on the push button. Well, it was great fun watching them jump and all try to get out the door at the same time; then I was having my fun.

One night it was raining very hard and I went to my shop to smoke, as I was smoking on the sly. As soon as I stepped inside, my feet went out from under me, I could not stand up, and my head would not stay down and I was struggling to get



A young experimenter arranged to shock his friends who came to his laboratory, but eventually got badly shocked himself and removed the wires.

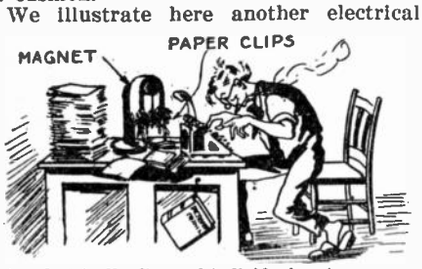
up like a dog scratching fleas. Finally I happened to put a foot where there were no wires. I turned the current off and took up all the wire before I went to bed. It was an awful shock—sometimes I feel it now.

I never told anybody about it, because the joke was sure on me; the boys never knew why the wires were taken up from the floor, and I hope they never will.

Magnetic Pin Cushion

MAGNETIC trouble lamps, magnetic hammers, and screw-drivers are paraphernalia familiar to all. As far as the hammer is concerned, it is rather a mystery to those of us who are educated in the belief that jarring injures a magnet how the hammer stands its repeated blows. It is probably because the tacks are driven into wood, which acts as a sort of cushion.

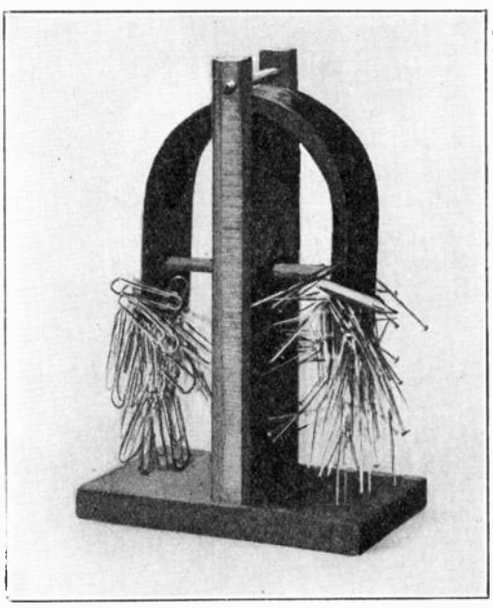
We illustrate here another electrical



An electrically disposed individual, using a magnet to hold paper clips, pins and pens.

appliance which we have termed the electric pin cushion. In old times pins were always made of brass, and the question of what became of all the pins was quite an unanswerable one, because brass does not corrode except slowly.

Of late years it has been discovered that steel is cheaper than brass, and many pins are now made of steel wire and then tinned. A magnet (the one shown was taken from an old magneto) is carried on a stand as shown. The two wooden rods, one passing transversely through the stand and the other locking the magnet down in position, hold it irremovably secure. In the instrument photographed the support was made of two pieces of fibre. Pins are on one side and clips on the other.



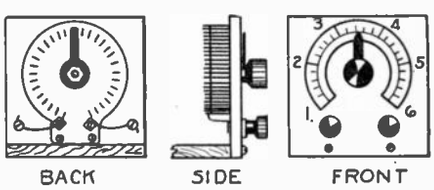
A reproduction of what we termed a "magnetic pin-cushion," carried on a simple support as shown, making a nice desk accessory for clips and the like.

Handy Laboratory Rheostat

By Raymond B. Wailes

A VERY serviceable and neat appearing rheostat can be constructed for the electrical laboratory from one of the radio panel mounting types.

The illustrations show how the instrument is mounted. The scale affixed to the panel of the instrument can be divided so that the approximate number of ohms which are in the circuit can read directly.



A rheostat utilizing the discs we are so familiar with on radio apparatus, making a very nice appearing instrument for the laboratory, and of delicate adjustment.

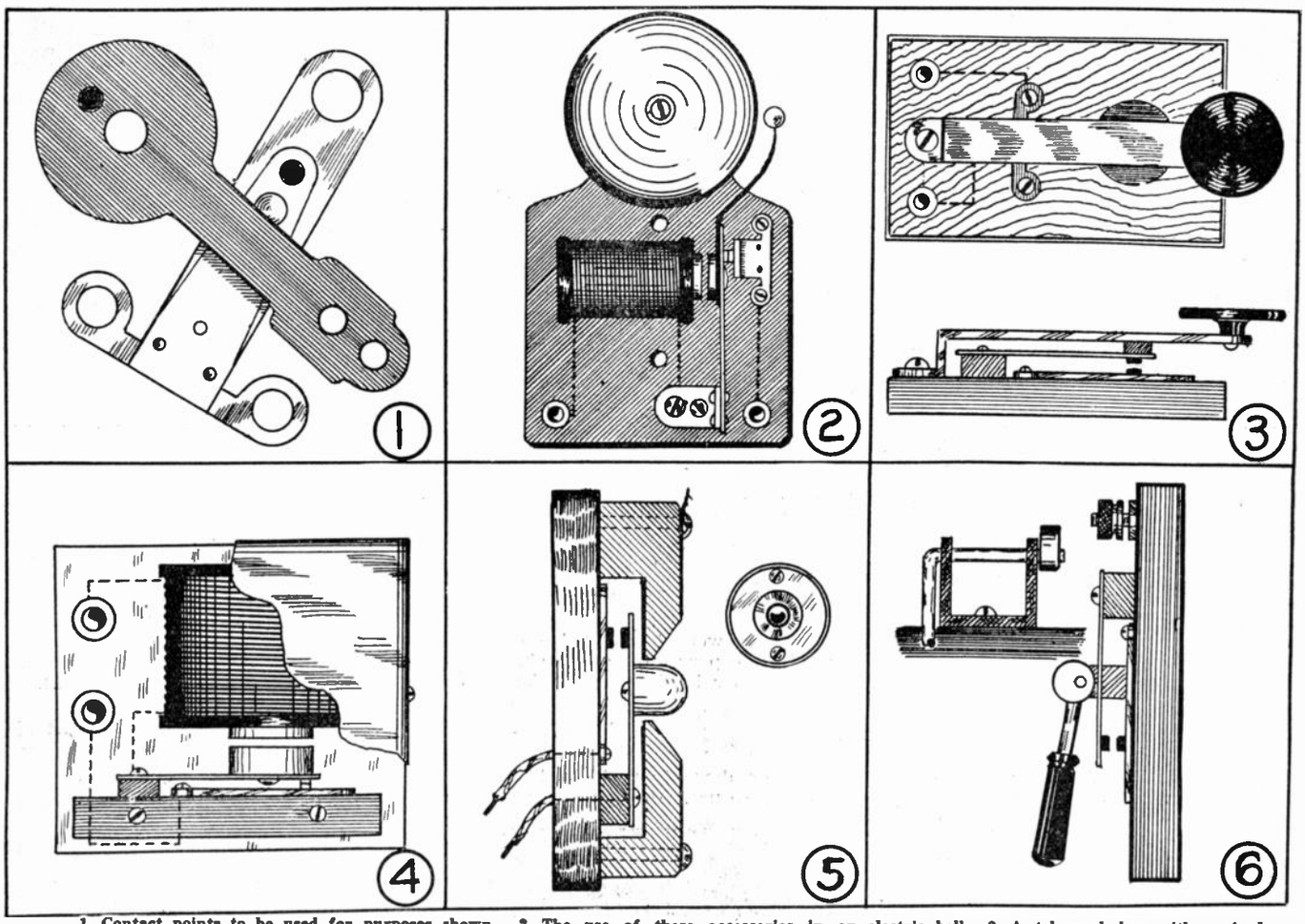
For instance, the usual radio rheostats are made in 6 ohm units. If the scale is divided into sixths, then one scale division as indicated by the pointer would be one ohm. Of course this is only approximate but is of value in many measurements.

If a 30 ohm rheostat is used and the scale is divided into sixths, then each division will be 5 ohms. By using a potentiometer of 400 ohms and using only two of the binding posts—that of the blade and one end of the resistance—the scale of the instrument can be divided so that 25, 50, and 100 ohms are indicated.

Experimental Electrics

Coil Point Suggestions

By Harold Jackson



1. Contact points to be used for purposes shown. 2. The use of these accessories in an electric bell. 3. A telegraph key with a single point beneath it. 4. Used for intermittent current through a magnet. 5. Improving the common push button with a contact point. 6. Acted on by an eccentric on switch axle to open and close circuit.

THERE are a number of ways in which coil points from a discarded Ford spark coil can be used by the experimenter in the construction of electrical apparatus. If no old coil is available a pair of these points can be purchased at any garage or ten-cent store for twenty cents a pair. Ten cents apiece in Woolworth's, N. Y.

In any piece of apparatus where the circuit is rapidly interrupted, such as in bells, buzzers and the like, it is essential that the part of the circuit where the make-and-break occurs shall be provided with platinum points as this is the best metal for this purpose. Platinum is also desirable for switch points.

Both the bridge and the vibrator of the Ford interrupter are used in these suggestions. The illustrations show clearly how these points are used and the caption tells the full story.

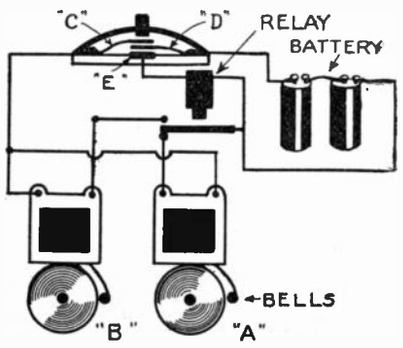
Double Contact Push Button

By Gerald Fitzgerald

A DOUBLE contact push-button with a relay connection is shown in the illustration.

When the button is pushed part way in, it brings the springs (C) and (D) together, closing the circuit, so that by direct battery action they ring the bell (A). There will be no difficulty in telling by the feel, if one has tried the button several times, when this connection is made.

Now, if the button is pushed in still further, the spring (D) comes in contact with the contact piece (E), which brings the relay magnet into the circuit. This attracts its armature and closes the circuit for the bell (B), which now rings.



Thus, those familiar with the button can ring either bell.

It will be seen that when the relay acts, it not only throws the bell (B) into the circuit but opens the circuit of the bell (A), so that only one bell rings at a time.

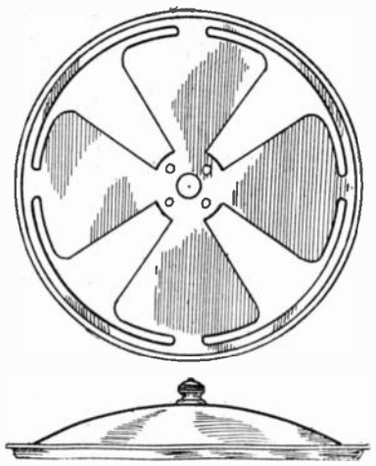
A double contact bell which will effect two different results by being pushed in more or less.

One thing more is to be noted. Unless the button is pushed in very quickly the bell (A) will ring, if only for a single pulsation or blow. Proper manipulation could keep both ringing.

Simple Electric Fan

By Harold Jackson

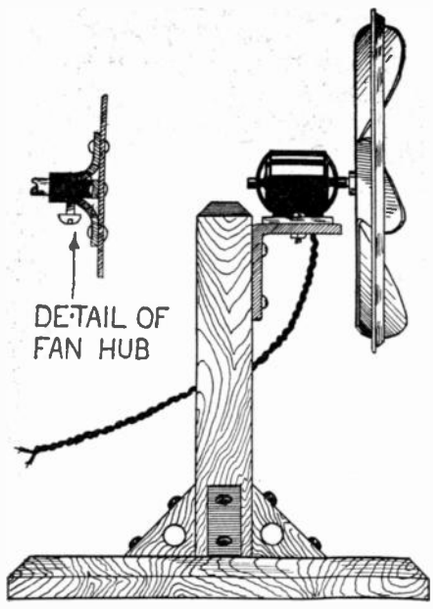
THE construction of an electric fan is a very simple matter. The electrical experimenter, or anyone in fact, can make this piece of apparatus in the home workshop at a considerable saving. If you have a small motor your fan will cost practically nothing save a little work.



Blades of a fan are made from the aluminum lid of a sauce pan cut out as shown and then bent into helical form.

The stand, which is mission style, is made of oak or other hard wood. The base is 8 inches square and 1 inch thick. The pedestal is 8 inches high and 2 inches square, braced at the bottom with triangular blocks as shown; round-head blued wood screws are used to fasten the blocks in place. Near the top of the pedestal is secured an angle iron bracket which supports the motor. The rotating part or blades of the fan are made of an aluminum kettle lid, portions being cut out between the blades of the fan. The blades are then twisted so as to cause the breeze to blow in an outward direction when the fan is in motion.

A simple flange made of a piece of pipe is used to secure the fan to the motor shaft. This flange, as shown, is provided with a set-screw which bears against the shaft, the aluminum fan being riveted to the four turned-out projections. The fan, being aluminum, is very light and requires but little power for its operation.



Details of mounting and driving the fan. Strictly a home made apparatus and constructed in pure mission style.

Making Small Generators

By Raymond F. Yates

OLD telephone magnetos form the basis of the dynamos that are to be described. Such magnetos can usually be obtained from junk dealers or a telephone exchange.

We first remove the fine wire which is wound upon the armature and replace it by winding the two poles full of No. 22 single cotton covered wire. Reference to Fig. 3 will show that the wire is wound in the same direction. This is a vital necessity for if the wire is not wound in the same direction our efforts are fruitless.

In Fig. 1, the constructional details of the disc commutator are shown. The copper segments are fastened to the fiber discs by means of small brass brads used as rivets. These brads must be filed perfectly flush with the surface of the segments after they are hammered into place. The hole in the center of the fiber disc should be a trifle smaller than the shaft so that a forced fit will be produced. The two leads from the winding of the armature are now brought through the shaft of the magneto, which is to be hollow, and are soldered to the segments, one to each segment.

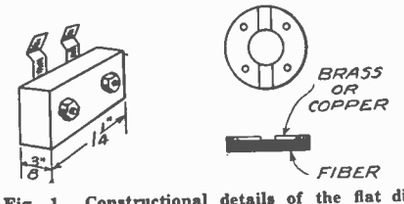


Fig. 1. Constructional details of the flat disc commutator and brushes used in the generator described.

Although the drawing shows only one magnet in use, two or three may be employed depending upon the power of the generator desired. However, two magnets will not double the power but will give it a substantial boost.

If the electrician desires a series wound machine the field coils should be wound with No. 24 single cotton covered wire. Approximately one-fourth pound will be needed. Tape or shellacked paper is first wound around the magnet to insulate it from the wire. It will not be necessary to wind the wire on a bobbin; if the experimenter is not fussy about appearances it is perfectly O. K. to place it on as shown in the photograph. As in the case of the armature, it will also be necessary to wind both field coils in exactly the same direction. They are then shellacked and given a covering of friction tape, leaving the leads protruding.

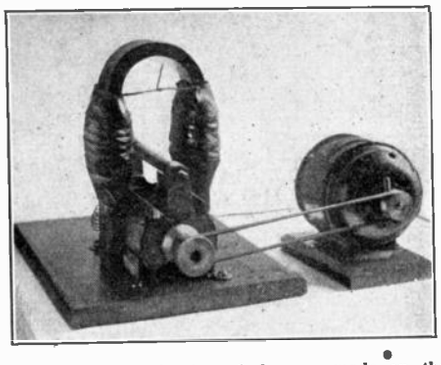


Fig. 4. Reproduction of dynamo made on the lines of construction just given.

The generator is now ready to be fitted with brushes. It makes no difference whether a shunt, a series or a compound wound generator is constructed, the brush system is the same. The brushes are cut from very thin sheet copper or phosphor-bronze and bent and attached to a small fiber or hard rubber block as illustrated.

After mounting the apparatus on a suitable base, the connections of the various parts are made as illustrated. It will be seen that the field winding is connected in series with the armature, which fact gives the dynamo its name. An empty thread spool is forced on the end of the shaft to serve as a driving pulley. The dynamo may be driven by a water motor, gas engine or other means. If the experimenter has alternating lighting current available, a small 110-volt motor may be used to drive the generator.

Fig. 2. Diagram of the relations of armature winding to the two piece commutator. In this case the winding is plain series, on the lines of the old-fashioned shuttle armature.

To build a shunt wound dynamo, it is necessary to use a different field winding. The field winding of a shunt wound dynamo should have a much higher resistance than the armature winding; it must have sufficient magnetizing power without drawing too much current. In this case, No. 30 single cotton covered copper wire should be used for the field coils. About one-half pound is the amount needed. It is wound on in the same way, the only difference being that it is connected in shunt to the armature instead of in series with it. The method of connecting a shunt wound dynamo is shown. This machine is ideal for charging storage batteries.

Compound wound dynamos are provided with two separate field windings. One winding, which is of fine wire, is connected in shunt across the brushes, while the other winding, which is of larger wire, is connected in series with the armature winding. The connections are plainly shown in the sketch. The fine wire should be wound on first and consists of three-eighths pound of No. 30 single cotton covered wire divided equally between the two poles. After being given a coat of shellac, a layer of paper is placed over the winding. The second winding, which

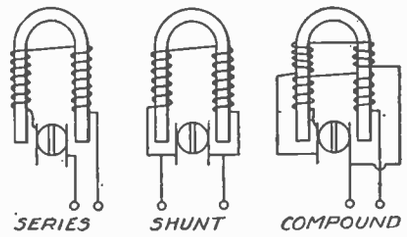
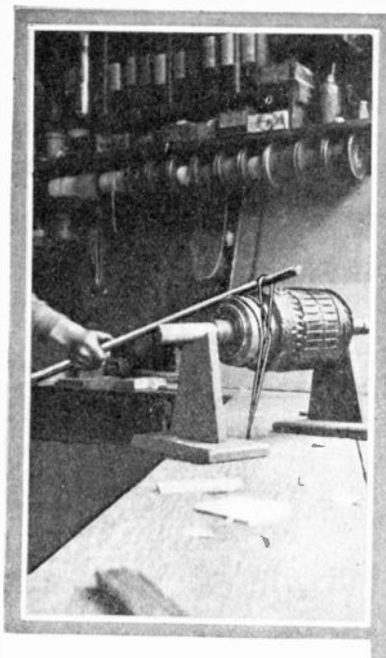


Fig. 3. Windings used for different types of dynamos; a very simple diagram applicable to the windings of machines in real practice.

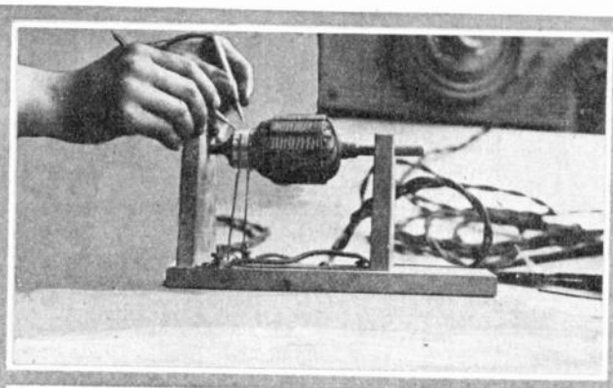
(*Continued on page 664*)

Laboratory Appliances

By Richard Merolle

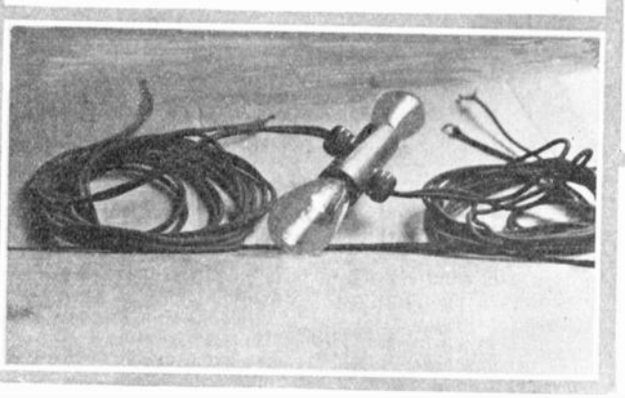


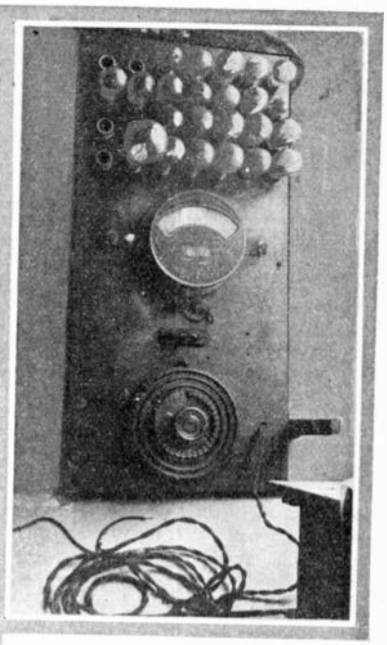
Commutator clamp. The commutator is carried on a pair of standards and a wire loop, one of whose ends is secured below the work bench, encircles the commutator. By using a steel pinch bar great pressure is brought to bear upon the commutator leaves, bringing them all home and ready for final clamping in position.



Above: Testing out an armature. It is held in adjustable supports; connecting wires supply current, and the coils are tested out by commutator leaves.

Below. A pair of lamps mounted in a tube to be used for testing purposes.

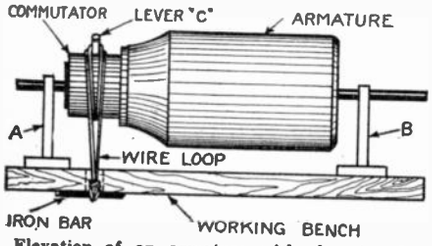




View of a switchboard with 28 lamps and a multiple switch directly below the voltmeter. This switchboard can give a great variety of potentials. The wiring is quite simple, practically all in parallel leads, and is fully described in the text.

Commutator Clamp

A VERY powerful clamp for assembling commutators is shown in the illustration. By twisting both ends of an iron wire around a bolt or a short iron bar a loop can be formed as shown.

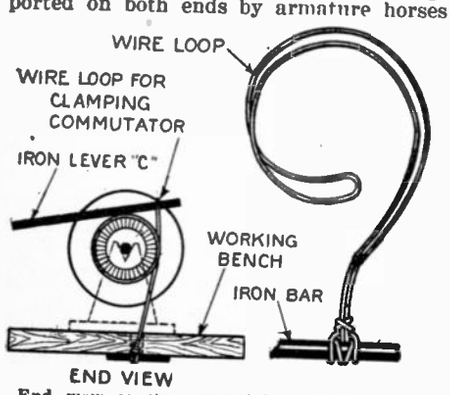


Elevation of an armature with clamping loop in place around the commutator.

A hole about one inch in diameter is drilled on the working bench for the loop to go through as shown in other views. The loop then is wound around the commutator in the manner indicated.

Thus, having the armature shaft supported on both ends by armature horses (A) and (B), it is evident that a slight pressure on the end of the iron lever (C) is sufficient to exert a powerful tightening pull around the commutator bars, leaving free access to the nut in front of the commutator, for locking same.

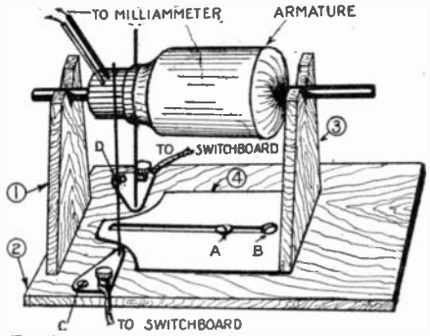
Of course, length and thickness of the wire depend on the size of the commutator to be worked at, but owing to the flexibility of the wire one loop can be used for several diameters of commutator by placing short blocks of wood under the bench, between it and the iron retaining bar, thus reducing the length of loop. This method has enabled me to do away with the usual series of clamping rings used for such purpose.



End view of the commutator, pinch bar and loop, and an enlarged view of the loop.

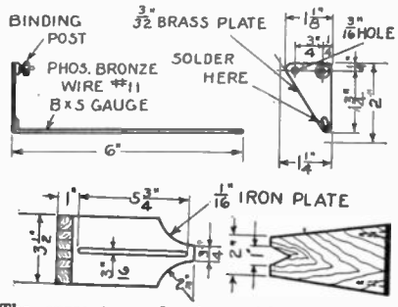
Adjustable Support for Testing Armatures

A VERY handy tool for testing small armatures is depicted here.



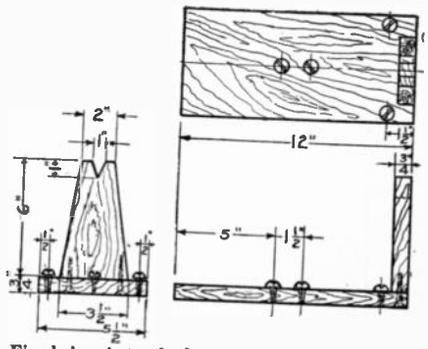
Testing an armature; the adjustable end bracket will be noted, and the two upright wires with their base plates, also to be attached to the footboard.

It consists of an adjustable support, constructed with a vertical piece of wood (1) fastened to baseboard (2) at right angle thereto, and (3) fastened to a slotted iron plate (4). This is held by screws (A) and (B), and is free to slide longitudinally on the base, thus permitting adjustment of outfit to different lengths of armatures.



The current supply-wires with their supports are here shown with dimensions, as well as the adjustable bracket with its slotted iron plate.

Two additional pieces of metal plates, provided with binding posts and spring wire risers, are mounted to turn around screws (C) and (D), thus bringing risers in contact on both sides of commutator. This offers adaptability of contact to those of various diameters.



Fixed bracket of the armature support, with baseboard, giving all dimensions.

It has always been more or less troublesome to take ammeter readings of small armatures, because of the difficulty of holding flexible leads from switchboards, which leads are often quite rigid, solidly tight on small commutators, as they are dragged down by their own weight and shifted, or touch more than one bar, and cause unequal deflection of the ammeter reading.

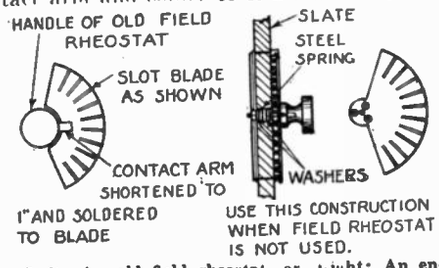
The above described outfit eliminates all of these inconveniences and insures invariability and steady contact.

Testing Board

THE illustration gives a wiring diagram and sketch of a board indispensable for electric shops and laboratories for testing purposes.

It is made of a piece of 1-inch slate 20 inches by 40 inches, which carries 28 standard wall sockets, one ammeter, one single-pole double-throw knife switch, an old field rheostat and several feet of double-coated solid copper wire. All is mounted on the slate panel as shown.

Before using the rheostat it is necessary to strip all resistances, shorten contact arm and solder to it a blade of phosphorus bronze one-thirty-second inch thick, cut and slotted as shown.

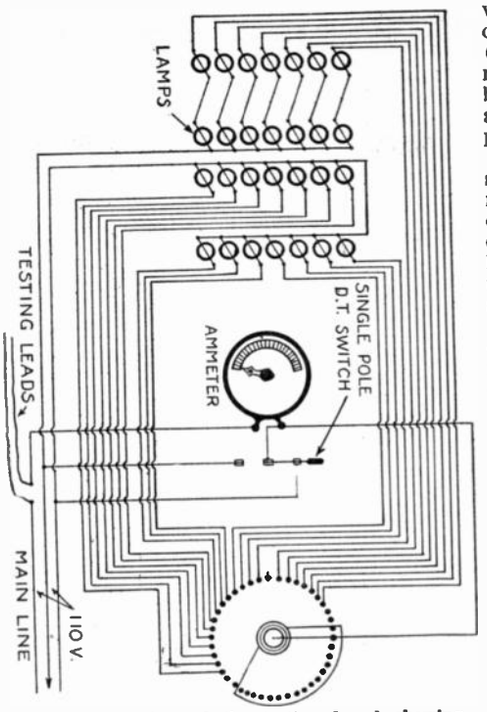


Left: An old field rheostat, or, right: An entirely new fixture used for the switch of the testing board.

When a separate rheostat is not available a contact arc or circle and a central handle can be built upon slate, as shown in construction No. 2. In either case, and for any number of lamps required in both circuits, the total number of contacts (T) should be at least equal to twice the number of studs (N) of one circuit, plus the smaller number (n) of other circuit, plus 1. Thus: $T = 2N + n + 1$.

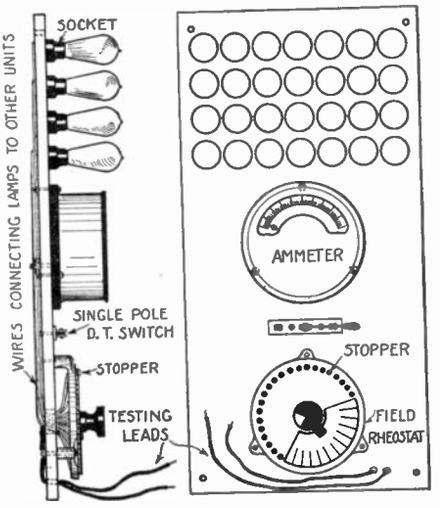
Example—22 lamps are wanted in a 220-volt circuit and 8 lamps in the 110-volt circuit. We know that for the 220-volt circuit we have 11 groups of 2 lamps in series, consequently 11 contacts are needed; hence the total contacts required is equal to $T = 2 \times 11 + 8 + 1 = 31$.

The 1 at the end of the formula represents a stud with no wire connection, and



Above: Wiring of the testing board showing how simple it is. The idle stud, acting as a stop, with no wire connection will be seen above the lower dial of the switch.

Below: Front and side elevation of the testing board.



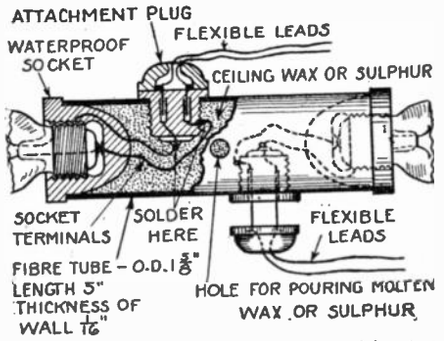
is made a little higher, to act as a stopper for the turning blade, whose angular width should cover not more than (N) contacts. Evidently this leaves another (N) contact where no wires are connected. This is the "off position" for the blade, and when using construction No. 2 a flat piece of fibre or metal can take the place of these lost contacts.

Obviously, a testing board thus constructed offers every facility to connect readily any number of lamps into either circuit; 110 and 220 volts are obtained directly from the service line by manipulating a small knife switch, and for all testings the same leads are used. These are to be made with flexible wires.

This simple and useful testing board ought to replace all cheap and poorly made boards used by 90 per cent of the electrical repair shops, where a row of several switches are mounted for controlling only a few lamps.

Testing Lamps

A HOLDER with connections for a pair of testing lamps can be made with a piece of fibre tube, two standard waterproof sockets and two standard attachment plugs.



Very complete testing apparatus comprising two lamps mounted in an insulating tube with a plug connection for each one.

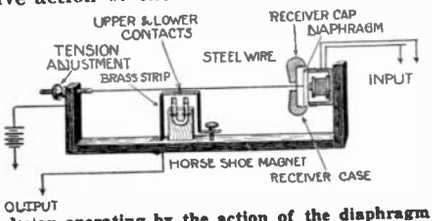
Cut two holes in the fibre tube each of the diameter of a plug as shown in the illustration; solder the terminals of the sockets to the plug as indicated; assemble all parts together, holding all together with clamps, and pour melted sealing wax or sulphur in the hole indicated.

A pair of lamps thus constructed besides having four leads, for using them either in series or in parallel, is a very solid and good-looking appliance, absolutely secure from shock and absolutely secure from short circuit when in use, because it has no metal parts exposed. It will be seen to be so constructed that new testing leads can be connected without impairing the appearance of set.

Phone Relay

By Jack Bront

THIS relay, which has been described in past numbers of *Radio News*, has been materially improved by the addition of two solenoid windings, which latter add greatly to the efficiency and the positive action of the device.

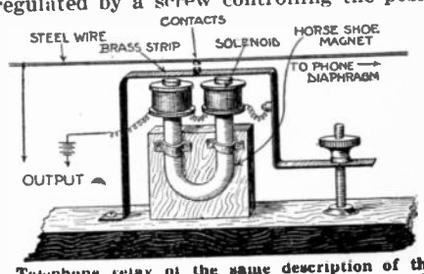


Relay operating by the action of the diaphragm of a telephone receiver upon a horizontal wire attached to its center.

As illustrated, the apparatus acts through the horizontal thrust of a phone diaphragm on a horizontal steel wire. A moment's thought and glance at the first illustration will show that the device not only "amplifies" electrically but also mechanically in regard to the phone action.

A very slight horizontal motion of the diaphragm will move against the axis of the steel wire. As the other end of the wire is fixed, it is seen that the wire must **"bulge" or bend at the middle in a long** arc. This "bulge" is several times greater along the axis of the wire. This entails the aforementioned mechanical "amplification" of the diaphragm movement, when actuated by pulsating or direct current through the phone windings.

To insure the downward "bulge" of the steel wire, when a horizontal thrust is applied, the horseshoe magnet maintains a magnetic attraction upon the wire, the direction of which is downward. Upon sufficient downward movement of the wire the upper and lower contacts are closed, and thus the "secondary" circuit is closed. Adjustment of the contact separation is regulated by a screw controlling the position of the brass strip upon which the lower contact is placed.



Telephone relay of the same description of the one just described, this time using two solenoid coils or electromagnets.

In the next figure an advance on the

(Continued on page 664)

Frictional Plate Electric Machine

By Hans Konwiczka

WHAT parts enter into the construction of the machine and how shall we procure them? The single parts are very few and can be made at home, with the exception of the glass plate.

1. Glass plate with shaft and bearings.
2. Baseboard.
3. Friction cushion.
4. Conductor with the collector.

As regards the procuring of these parts, usually the raw material will be right at hand. The glass plate must be completely

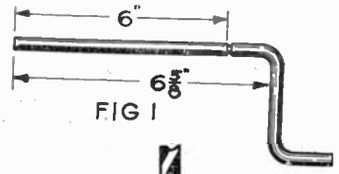


FIG 1

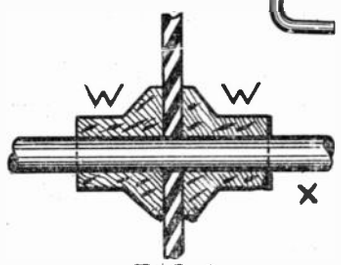


FIG 2

Fig. 1. Handle of the frictional electric machine, showing groove to prevent lateral shifting.
Fig. 2. The hubs for holding the plate upon the shaft.

free from bubbles and cut to a true circle. The wooden parts are made of dry hardwood, and to make the amalgam for the cushion some mercury from a broken barometer may be available. A few screws are required, and also a brass wire a foot long, and about one-quarter inch thick, a piece of a clock spring, a large spool, and a glass rod about ten inches long and one-half inch thick. A ball from a child's tenpin set, from 2½ to 4 inches diameter, may be found among some old discarded toys. If not, one can be purchased and work can be begun.

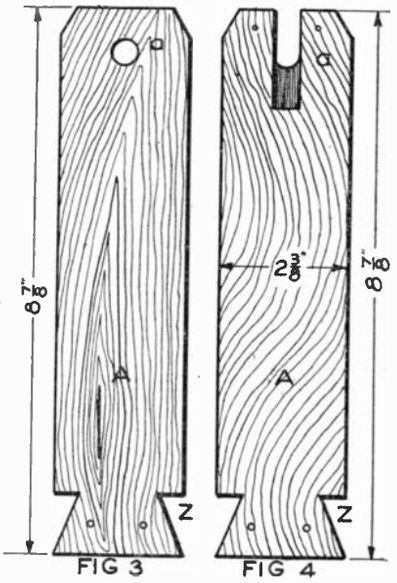


FIG 3 FIG 4

Two views of the standards, both of which are nearly identical except for the wedge in the open journal of the right hand one shown above.

1. Glass Disc with Shaft and Supports

We must get a plate-glass disc about .2 inch thick of 8 inches in diameter; this must be free of bubbles and its edges must be smoothly rounded. A hole about one-quarter inch in diameter must be drilled through the middle for the shaft.

To prepare the shaft for the glass disc, bend the three thirty-second inch brass wire as shown in Fig. 1. This provides the straight shaft part about seven inches


FIG 4a

How the wedge-shaped journal acts to prevent lateral action of the shaft and glass plate.

long, and the crank or handle. Six inches from the end of the straight part a groove, one twenty-fifth inch deep, is filed, whose object will be seen later. To fasten the glass disc to the shaft cut the spool into two parts (W W), Fig. 2; these turned around end to end are stuck upon the shaft (X), and fit it very tightly. If the glass disc is clamped between the two parts of the spool (WW) and cemented by means of a solution of shellac in alcohol, it will hold its position very well. The shaft is cemented to the halves of the spool (WW) by the same shellac. Before applying the shellac, these parts are to be warmed, the glass plate with greatest care, so as not to break it.

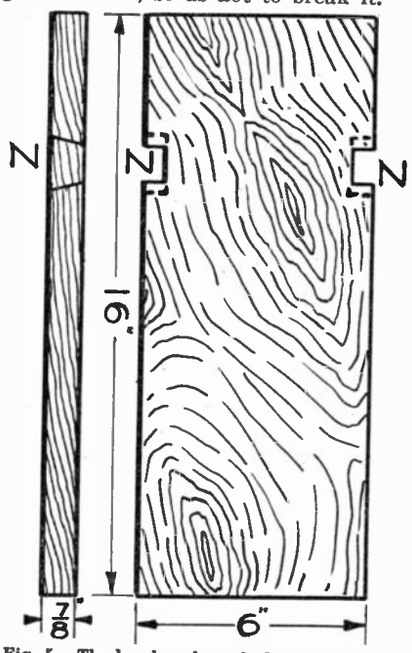


Fig. 5. The baseboard notched out for the dovetails of the two standards.

The shaft rests during its revolutions in the two bearings in Figs. 3 and 4, at the top of the standards (AA); these standards are made of hardwood about three-quarter inch thick. They are 9 inches high and 1½ inch wide. The dovetails (N) are for morticing into the baseboard. The mortices must be notched out to fit the dovetails. The standards are eventually glued to the baseboard, and are also secured by a couple of screws. The shaft can be thrust through the one bearing and is dropped into the other one. Fig. 4 shows how one of the bearings is a notch. The bottom of the open bearing is cut to form a wedge, Fig. 4a, which enters into the groove, made around the shaft, so that the shaft can shift neither to right nor to left.

2. The Baseboard

We now have to make a strong baseboard. Like all the other woodwork, this must be made of extremely dry wood, and for it we use a solid board about 16 inches long, 8 inches wide, and ⅞-inch thick, Fig. 5. About 3½ inches from one end we make the two notches (N, N) for receiving the dovetails of the two standards. These must fit the notches perfectly. The standards are at once to be glued fast and secured with screws.

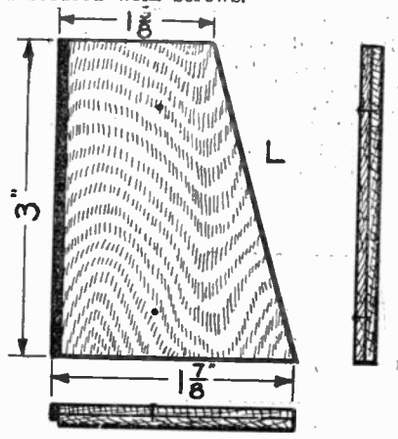


FIG 6

The cushions or rubbers. Two of these are provided, one for each side of the plate, and are pressed against it by a steel spring.

3. The Cushion

Cut four boards (L) of the form shown in Fig. 6 out of cigar box wood. They are about 3 inches long, 1⅞ inches wide at the bottom and 1⅜ inches wide at the top. Two of them are provided with very thin cloth which must project a little on one side. These two boards are fastened to a fork made of highly elastic brass strips or out of a piece of our clock spring (F), Figs. 7 and 8. A piece of the spring about 5½ inches long is perforated in the middle and at both ends with four holes, Fig. 7. It is bent into a U-shape, Fig. 8, which leaves each prong about 2½ inches long. The boards (L) and (L) are screwed tight to these prongs; two pins are driven through each of these boards so that they project about .1 inch from the same and are used for securing

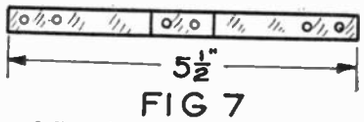


FIG 7

General dimensions of the steel spring to which the cushions are attached and which is bent up U-fashion, so as to press them against the glass.

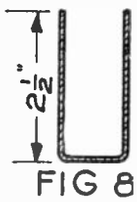


FIG 8

In Fig. 8 is shown one of the springs bent up into a U-shape; each arm is attached to a rubber and the plate rotates between the rubbers.


FIG 9

Fig. 9 shows a little ball with stem; its position in the machine is shown at (H), Figs. 10 and 11.

the other equally solid boards, so that these last may be real cushions. They are covered on the inner side with thin, soft felt. This spring is attached to a block of wood (B), Figs. 10 and 11, with screws; this block is one inch high, three-quarters inch wide and thick. It has on the side opposite to the spring a hole three-quarters inch deep (B) for receiving the glass rod (J), Figs. 10 and 11.

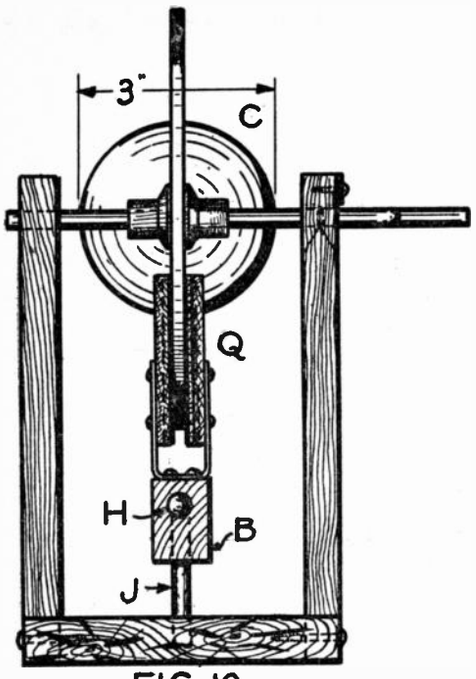


FIG 10

End view of machine, showing the rubbing cushions, the ball of the prime conductor, and the shaft secured from lateral motion by the groove and wedge-shaped bearing.

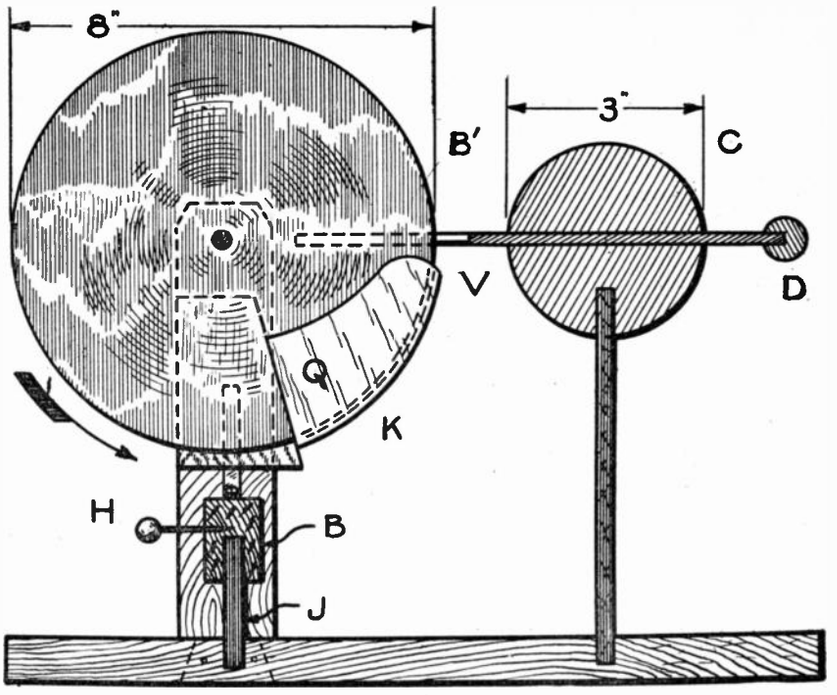


FIG 11

Side view of the frictional electric machine, showing the various parts; it will be seen that this is a simple machine to construct, comparatively speaking.

From a glass rod one-half inch thick we cut off a piece 2½ inches long and cement it with one end in the block (B), Figs. 10 and 11 of the rubbers. The other end is cemented in a hole directly under the shaft of the glass plate which lies in the center between the two uprights; the hole is three-quarters inch deep. A short pin, Fig. 9, which has a head at one end of it, is first driven into the block. This pin and the friction cushion to be amalgamated presently must be connected electrically one to the other by a strip of tinfoil. The frictional cushion is to be spread over with the so-called Kienmayer's amalgam. It consists of two parts of mercury, one part of zinc and one part of tin. The amalgam is rubbed on with the fingertips until a thick gray coating is produced. If the amalgam does not stick well a little lard is added to it. The friction cushions are now so strongly pressed against the corresponding boards which are attached to the spring, that the pins are forced into the uncoated side of the cushion boards. The cushions by the action of the springs and the outer boards are so firmly pressed against the glass plate that the amalgamated side rubs strongly against its surface.

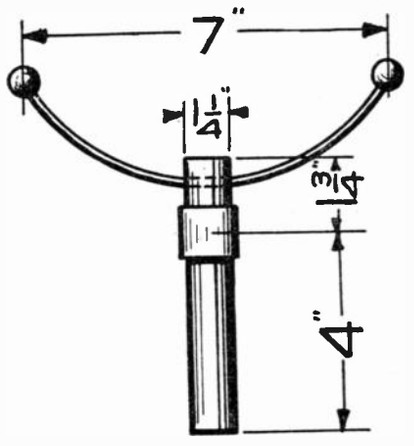


FIG 12

Simple discharger for use with Leyden jars which may be employed on this machine or on the influence machine shortly to be described.

4. The Prime Conductor

Consists of a hollow brass ball, 3 to 4 inches in diameter. As we could not easily spin up such a ball, we will make our prime conductor of wood and cover it with tinfoil, as shown in (C), Figs. 10 and 11. The ball is bored completely through, exactly following its diameter in any desired direction. Through this hole we thrust a brass wire (V), Fig. 11, about one-eighth inch thick, to which a fork (B) is soldered at one end. The wire is six inches long and the fork, made out of the same wire as (V), is three inches long. The space between the prongs of the fork is nearly one-half inch. It is provided with teeth as shown in Figs. 12 and 13, made out of thin brass pins and soldered so as to be exactly opposite each other on

(*Continued on page 665*)

Below. Plan view of the electric machine, the rubbers being omitted to avoid complication in the drawing.

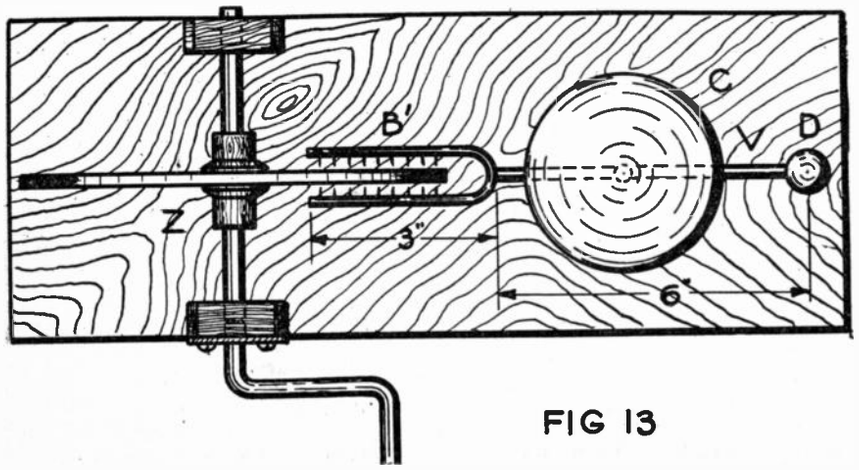


FIG 13

Right. Ball of the prime conductor with two pieces of tinfoil attached, and, below it, one of the cloth wings to be attached to the rubber.

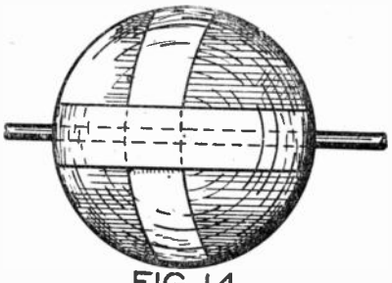


FIG 14

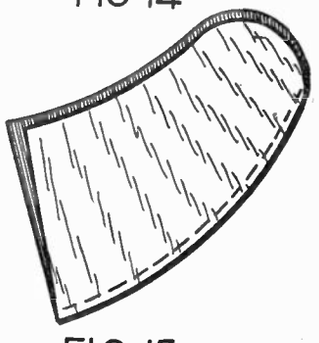


FIG 15

Electro-Static Experiments

By Frederick Von Lichtenow

THE attractive and repulsive forces peculiar to static electricity enable the person experimenting in this field to do things which would be impossible with any other kind of electricity. However insignificant these may appear to the uninitiated, for the true experimenter they carry a deep meaning.

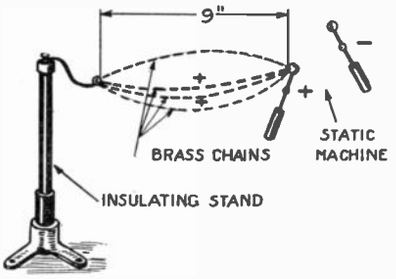


Fig. 1. Repulsion between two chains charged with the electricity of the same sign.

Experimenting in static electricity is playing with the electricity of the earth in microform. This fact alone throws a vast amount of fascination into this odd and yet so natural a branch of electrical science.

Static electricity shows itself in probably more ways and certainly requires less apparatus for its production and experimental conduction than any other form of experimental electricity. A rod of glass and a piece of silk or a sheet of hard rubber and a piece of fur, together with some bits of tissue paper, are sufficient apparatus for the practical study of its elementary principles.

A small static machine, however, such as the Wimshurst influence machine, is required for the successful reproduction of the following experiments, which will aid the novice in grasping the principles underlying them:

The opposing or repelling chains give a simple and yet quite impressive way of showing the repulsive effect of like-charged bodies. Two very light and equally long brass chains, such as are usually found around static instruments for connection purposes, are suspended horizontally side by side by their respective ends as shown in Fig. 1. They must hang well off the table and under just enough tension to form only a slight down-

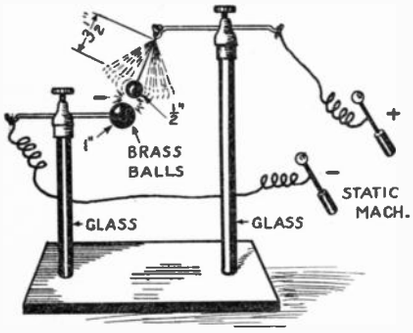


Fig. 2. Static ball pendulum. The suspended ball keeps in vibration as long as excited.

ward curve. The electrodes of the machine are then set beyond sparking distance, when with a few turns of the crank handle the chains will be caused to press sideways, each strongly repelling the other, in which position they will remain for some time after the machine has been stopped, gradually and slowly falling back into normal position with the leaking away of the static charge.

If the discharge balls are brought within sparking distance, so that sparks may pass at certain intervals, the chains will set up a rhythmic motion — separating upon being discharged, meeting again upon neutralization—as long as the plates are rotated.

Fig. 2 shows the apparatus required for the static ball pendulum, which clearly illustrates the principle of alternate attraction and neutralization, helped along by the weight of the ball in gathering momentum, which in the end effects the pendulum motion. This latter will continue as long as the machine is working. Both balls consist of solid brass and should be kept in a well polished condition. The smaller, swinging ball, one-half inch in diameter, is suspended by a piece of very thin copper wire, 3½ or 4 inches long, having a loop on its upper end to insure the necessary free movement. The larger one, measuring one inch in diameter, is stationary, while the whole is supported upon insulating stands. No sparks must pass across the static machine gap.

Working under the same principle as that involved in experiment No. 2, the static vibrator, as I will call it, forms another highly interesting piece of apparatus. The smaller ball is here replaced by a short

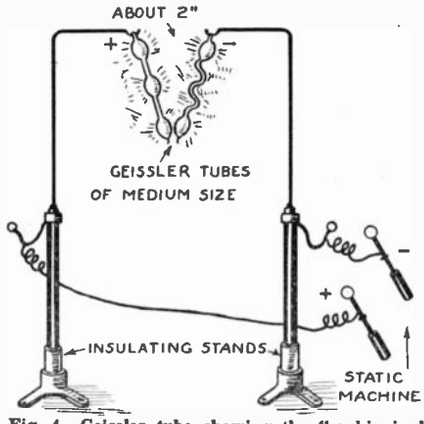


Fig. 4. Geissler tube showing the "cushioning" effect of the static spark.

piece of very fine, perfectly straight copper wire, about 2½ inches long, held rigid in a clip as indicated in Fig. 3. The free end of this horizontally placed wire must reach nearly across the entire width of the brass ball, without however touching it, and must center upon it. Both should be separated by a gap of from one-quarter to one-half inch, this depending entirely on the size and condition of the static machine employed. With the discharge rods set far apart and machine put to work, the wire will immediately be attracted to the ball, since both are oppositely charged, as quickly released under the neutralizing spark, attracted again under the new charge and so on, which, assisted by the spring element existing in it, will cause it to vibrate at an incredible speed.

The "cushioning" effect of the spark can be shown in our experiment, which at once affords a spectacular way of lighting Geissler tubes causing them to swing at the same time, and gives an opportunity for the study of the "cushioning" effect of the static spark.

Two medium sized Geissler tubes of equal length (of the rarefied gas and not the heavy liquid type) are suspended a couple of inches or so apart from insulating stands connected to the respective poles of the static machine (Fig. 4).

With the passage of the electric charge they will at once approach each other, being attracted as a consequence of their opposite polarity, when upon meeting by their lower bulbs the spark discharge will take place through their entire lengths, strongly lighting them up for the moment. Being released under the effect of the neutralizing spark, they fall back into their former positions, only to be attracted to one another again with the approach of

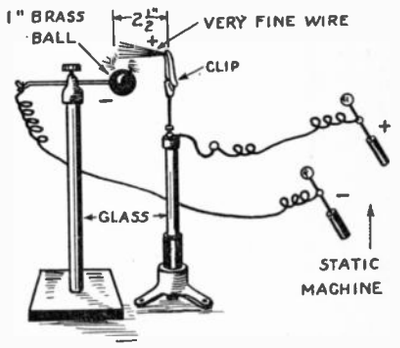


Fig. 3. The static vibrator; a fine wire kept in active motion by static excitation.

the new charge (Fig. 5). This in repetition causes a sort of swinging motion on the part of the tubes, which in the end—one would think at least—must lead to their striking hard together; but they never do. Each time they meet, the resulting spark acts as if it were a cushion placed between them; in fact they sometimes seem to cling together for the instant, while the discharge is taking place, which on the other hand forces them always to a fresh start, in this way limiting the momentum gained by the tubes on each trip. They will perform in this manner as long as the machine is in action, the terminals of which are to be separated beyond their spark limit.

In working out these static "stunts" I had in mind not only the beginner, but the less capitalized experimenter who, unable to buy the more expensive auxiliary apparatus, may not be satisfied with the average run of experiments belonging in the tissue paper-tinfoil pithball class.

The next experiments are described by Percival G. Bull. The "bronze" or "metal" paper needed in the experiment seems, as I faintly remember, to be an uncertain article on the local market. There is something entirely wrong with it. Either the demand for it is so brisk that stocks are early exhausted, or there is no call for it at all, and, consequently, nobody

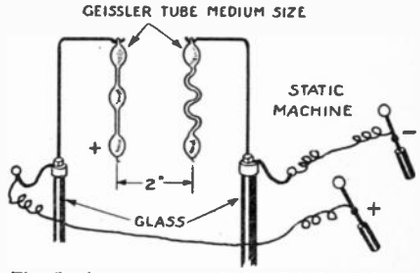


Fig. 5. Arrangement of the Geissler tubes on their insulated supports for the experiment described in the text.

bothers with it. I was for a time inclined to think the latter was the case, until finally, after a prolonged and fruitless search among the various stationery stores, I was shown at some small place what looked to be the remnant of a once glorious pile. Whether I purchased the real, honest-to-goodness "metal" paper or not has been an open question with me to this day, since it was not sold to me under that somewhat mysterious sounding name. At any rate, it works.

The following illustrations and short descriptions give the results of my tests with three kinds of the metal-coated paper (Fig. 6).

One characteristic of this paper is that the sparks always show a strong tendency

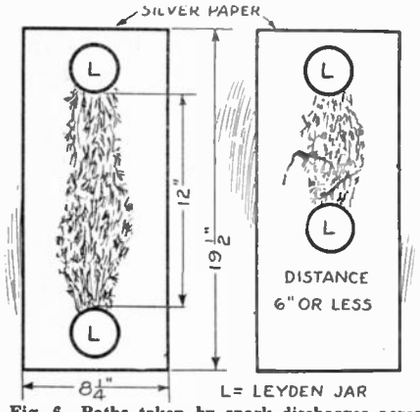


Fig. 6. Paths taken by spark discharges across silver-coated paper.

toward branching out over its surface, whether the distance between the jars be a few inches or a foot, or even more. Their color is a beautiful bluish-white. With the jars separated a few inches, up

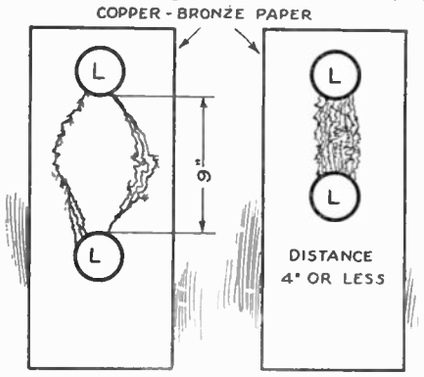


Fig. 7. Examples of discharges across copper bronze paper.

to six inches or so, the discharge manifests itself in thousands of bright little stars hanging together by shiny threads. These very striking effects are due to the relatively high conducting quality of the metal particles covering this paper.

The paper illustrated in Fig. 7, offering a somewhat higher resistance to the condenser discharge than the former, limits the distance between the jars to nine inches. At or near that distance the sparks are very pronounced and appear concentrated in the form of miniature lightning bolts of a clear white color. They hit around in curves and are accompanied by a loud report. If the jars are approached to within four inches or less, as indicated, the sparks will dart in spray fashion across the intervening space, lighting up in a vivid emerald green.

This paper is the worst conductor of the three, and, consequently, permits only a separation of a few inches between the Leyden jars. Set at that distance, the spark effect is very similar to the one last noticed on the "copper-bronze" paper, however, it is not quite so distinct. The color shade of the sparks runs more into a dull yellowish green, not unlike that of oxidized brass.

The above spark-and-color effects are those as observed in an artificially (moderately) lighted room. The papers may be placed in triple or quadruple layers, thus insuring a better insulation for the Leyden jars, in addition to which an oil-cloth covering on the table may be advisable. Care must be taken that the discharge balls of the machine are first to be separated beyond sparking distance while charging the jars and not set "a few inches apart" as prescribed by the text book, which may be misunderstood, since the small Wimshurst machine I used in these tests delivers a three-inch spark when in a healthy condition, not to speak of the many larger static machines with their correspondingly much greater spark lengths. After thus charging the jars for a short while the electrodes are gradually and slowly brought toward each other, when upon reaching the stress limit the resulting spark will be accompanied by the condenser discharge across the paper.

Following the above tests I was led to another experiment, terminating in the following discovery—if I may call it such—which I will give here for what it is worth:

In order to ascertain the conducting value of these metal papers as a circuit link, I had introduced a separate gap (spark gap) into the former set-up. With the conductors of the machine placed wide apart I was testing the spark across this new gap under various adjustments, when,

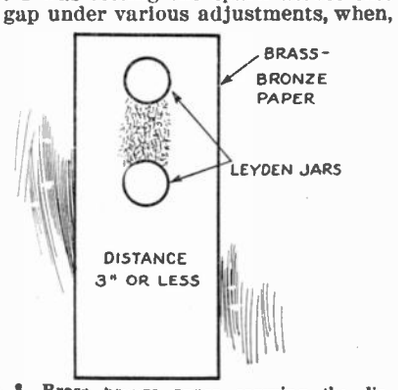


Fig. 8. Brass bronze paper carrying the discharge of Leyden jars.

happening to glance around while turning the crank, I noticed my gold leaf electroscope standing some distance away near the further end of the table, under the influence of a strong discharge. I discharged it and tried again with the same result, then looked at the gap, where only a silent discharge was taking place, caused by being set at the spark limit.

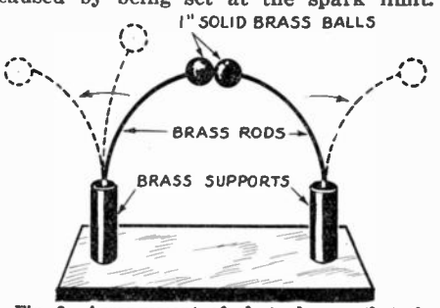


Fig. 9. Arrangement of electrodes, so that the distance between them can be readily varied.

Without disturbing anything, I studied their respective positions and found the knob of the electroscope to be at exactly

(*Continued on page 665*)

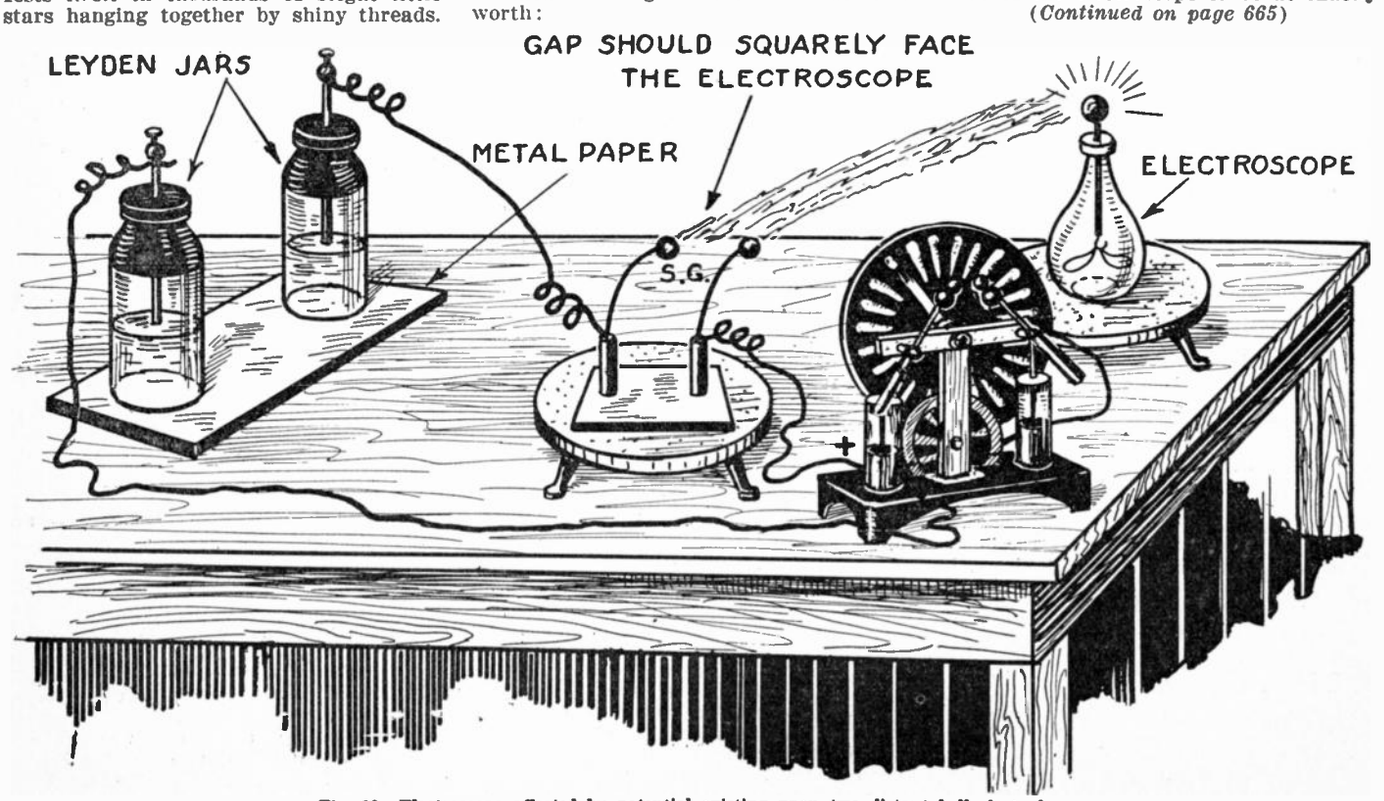


Fig. 10. Electroscope affected by potential existing upon two distant ball electrodes.

Testing Metals with X-Rays—I

By Dr. Franz Fuchs, Munich

ROENTGEN rays or X-rays have found a field of usefulness in the realm of health. The original radiographs of the skeleton hand which were full of promise, pointed to a goal which today is not only attained but has been passed by. In the last years the applicability of X-rays has been expanded over a whole quantity of technical requirements, among which the examination of the interior of substances, especially of metals, to determine their reliability, is certainly the most important.

Roentgen in his very first publication had suggested the possibility of this use for the X-ray. Fig. 1 shows his photograph of the breech mechanism of a double-barreled shot gun with two cartridges therein. One sees in the radiograph the objects made of different metals, reproduced with all their peculiarities and even the flaws in the metal clearly and sharply to be recognized.

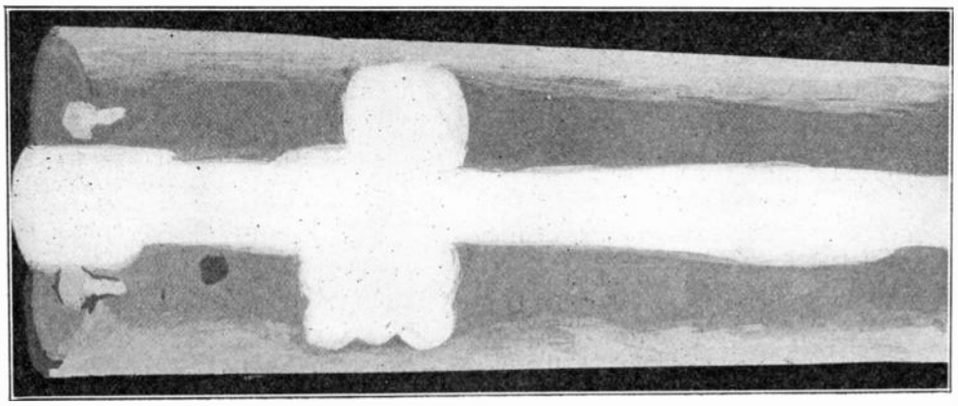


Fig. 1. One of Roentgen's first radiographs. It is the lock of a rifle, and shows many of the parts.

This important suggestion of Roentgen bore fruit a few years ago when, especially by experience, the capacity of the X-ray in technical work has been considerably increased. In more recent times a number of the larger firms here and abroad have had great success in the investigation of castings, to detect gas bubbles and similar failings in their interior. The experiments often give an astonishing insight into the inner structure of cast metal, of drawn wires, of forgings and the like. X-ray investigation of metals

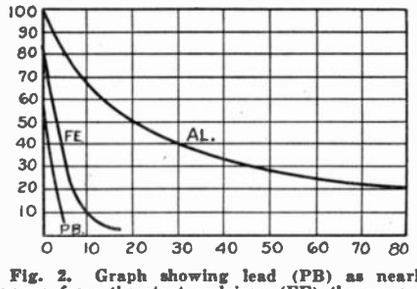


Fig. 2. Graph showing lead (PB) as nearly opaque from the start and iron (FE) the same.

in many ways shows itself superior to the mechanical and optical tests of material of construction. The ray makes possible above all a quick investigation of castings over their whole extent, and without injury to the pieces. In mechanical tests they can only be examined by drilling, so that one has no assurance that a defect in material does not exist in some other places not investigated. Moreover, the X-rays have the capacity of transmission through metals in thicknesses of several inches, so that the investigation costs but a trifle. But if one has regard to the economy due to the finding of a flaw before the piece goes on the machine, it can be seen that the purchase of an X-ray apparatus always will pay for itself.

Certainly such tests are emphatically to be recommended for expensive construction, such as tanks and cylinders of airplanes and automobiles, surgical instruments and the like.

1. *The Physical Bases of Metal Radiographs*

A great difficulty in the way of radiographing metals compared to the human body lies in the fact that metals only allow a small percentage of the Roentgen rays to pass through them.

The transparency of a body for Roentgen rays in general is less as it is thicker and also as its atomic weight is greater. Water, wood and aluminum, for instance, are comparatively transparent to them. Heavy metals, iron, copper, lead, on the other hand, for ordinary Roentgen tubes, are impervious if but a small fraction of an inch thick.

The great variations in transparency of bodies for X-rays makes it possible to photograph an impervious body enclosed in another non-transparent body as a darker or lighter shadow, according to whether the body is thicker or thinner than its surroundings.

In each body absorption increases with the thickness of the layer penetrated, and equal resistance to the X-ray can be obtained by a thin sheet of lead or a proportionately thicker sheet of a lighter metal, as of copper or aluminum.

The relations of the absorption of X-rays by the metals, aluminum iron and lead, is shown in the curves of Fig. 2. The ordinates or perpendicular lines give the thickness of the layers in tenths of millimeters, and the horizontal lines or abscissas give the strength of the rays which pass through. Thus, if we take the intensity of the impinging rays at 100, we see in the aluminum curve that one millimeter of it cuts it down to 70 per cent; two millimeters of aluminum absorb half the rays. But after this the curve flattens out so that even ten millimeters of aluminum only absorb 80 per cent of the rays.

But if metals of higher specific gravity are under investigation, a much greater absorption power is shown with increasing thickness. Taking the curve for iron (Fe) we see that in the first millimeter only 15 per cent of the rays get through, and that at two millimeters thickness only 3 per cent pass through the iron. At the very best the relations for lead are much more unfavorable with its much higher specific gravity. The lead curve soon becomes nearly vertical and a thickness of half a millimeter absorbs all but a small percentage of the rays.

The high absorption power of lead is useful in Roentgen technique. In order to restrict the rays from going where they are not to be used and are not desired, wooden partitions may be painted with white lead, lead glass may be used, and

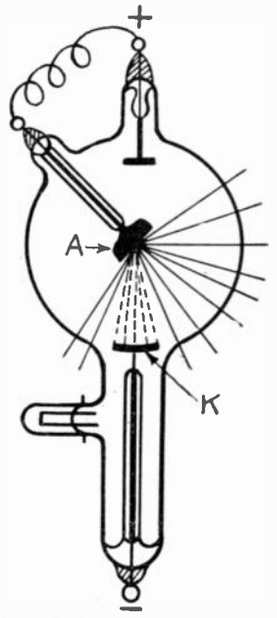


Fig. 3. General idea of an X-ray tube. (K) is the cathode; the rays originate at (A).

India rubber containing lead carbonate or other compound of lead can be used.

Flaws in castings are generally due to air bubbles or a fragment of carbon. The variation in thickness in the neighborhood of the same is therefore very large and this is a favorable circumstance. In order to bring out the positions of such imperfections on the photographic plate, enough rays must not pass through the object to darken the whole photographic plate, as the flaws in a total thickness of material generally make up only a small percentage. The rays have to penetrate everywhere through nearly the whole thickness of the metal.

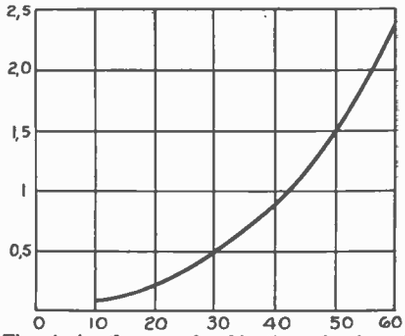


Fig. 4. Another graph, this time showing the relation between X-rays and tube current.

To penetrate metals in the ordinary thicknesses of a inch or two the following requirements are to be observed.

1. Increasing the intensity and hardness of the rays.
2. Holding back the secondary rays.
3. Increasing the action of the X-rays on the photographic plate.

To understand these requirements we must put down two things about the production and peculiarities of the Roentgen rays. The Roentgen rays are based on

the emission from the cathode of radiating cathode rays to the so-called anti-cathode, Fig. 3. The cathode rays consist of electrons, that according to the potential applied, move with a velocity of 18,000 to 90,000 miles per second, that is, with one-tenth to one-half the velocity of light. When they issue from the anti-cathode the great velocity of the electrons is suddenly diminished and there are emitted

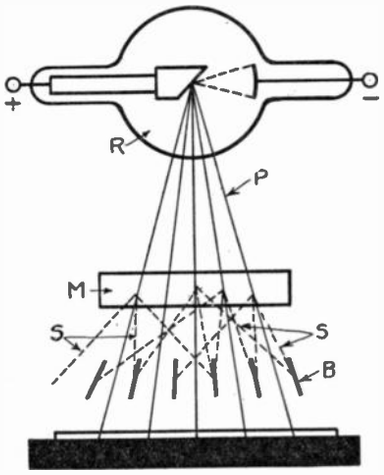


Fig. 5. Screening out the secondary rays by a sort of grating, of honey-comb type.

from the same in all directions the short ether wave which we call Roentgen rays.

The intensity or the quantity per unit of time of X-rays emitted, depends on the number of electrons passing in one second between cathode and anti-cathode, that is to say, on the strength of the current passing through the tube. As measurer of the mean intensity of emission, the measured strength of the X-ray current can be determined by a milliammeter. This strength for practical medium and intense loading of the tube comes between two and three milliamperes. With increasing intensity of the Roentgen rays the intensity of the ray penetrating a material and thereby action on the photographic plate increases, but the penetrating power of the Roentgen rays does not depend alone on their intensity but in very considerable proportion on the hardness of the rays.

Roentgen determined that the penetrating power of X-rays is so much the greater the higher the vacuum in the producing tube is, and the higher tension one has to use, in order to obtain a discharge. The penetrating rays are termed, hard, the rays which have slight penetrating power are termed, soft. For determining the hardness of rays Roentgen used platinum plates of varying thickness which were set into holes across openings in a lead plate behind a fluoroscope screen. The harder the rays were the more platinum plates would be penetrated. An indirect method of determining the hardness of the rays is given by the potential applied to the tube, which can be measured by a spark gap connected in parallel with the same tube. The higher the potential producing the rays is, the greater is the velocity of the cathode ray, and the harder the Roentgen rays resulting. If a very hard X-ray is to be produced, one must use high potential difference.

We see from this that in order to get a successful representation of metallic pieces, the operation of the secondary ray must be suppressed as much as possible. The secondary rays in the environment of the body under investigation emitted from the plate holder, from the plate itself, and from the air, bring about a "light striking" of the plate from the side and from beneath, so that every single part of the edge of the object is lost by over-exposure. This influence is the more injurious the thicker the body to be penetrated by the Roentgen rays is. To avoid this source of trouble the margins of the plate holder are masked with lead or the proof piece is surrounded with a margin of lead plate 1¼ to 2 inches wide. The "glass rays" from the Roentgen tube are disposed of by a protecting case lined with lead, permitting only a small beam to pass through a little opening, so that its emission will cover only the area of the body to be radiographed and no more.

As regards the secondary rays emitted from the metal itself they can for the greater part be made innocuous by a honeycomb grating between the piece to be radiographed and the photographic plate. The grating as shown in Fig. 5, consists of a great number of pieces placed side by side which have the form of truncated pyramids. The axes of these pyramids all radiate from a common center which lies on the diagonal face of the anti-cathode. The grating therefore only lets the direct rays pass through, while the secondary rays, emanating in all directions, are absorbed by the walls of the cells. The grating is pictured upon the plate as a network of dark lines. Nevertheless the image is much richer in its detail.

2. The Apparatus.

The bases so far described for the penetration of metals bring with them the requirements which have to be embodied in the apparatus, namely, the highest endurance for the production of very hard and intense rays. These requirements are best expressed by the large instruments used in Roentgen therapy and whose present arrangements we shall treat of briefly.

For actuating a Roentgen tube, a high potential of 100,000 to 200,000 volts are required, which have a length of spark of 1½ to 2 inches. As the tube must always pass the current in the same direction, there can only be used for Roentgen rays apparatus that gives a direct potential, namely, (1) induction coils with circuit breakers. (2) Alternating current transformer with high potential rectifier. In large induction coils the insulation of the secondary coils must be very carefully carried out, and regard must be had to

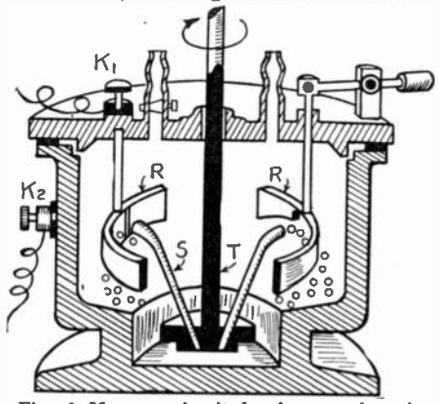


Fig. 6. Mercury circuit breaker, an ingenious apparatus operating on the principle of intermittently completing a circuit by a jet of mercury.

the fact that with higher currents the insulation has to withstand an elevation of temperature.

For breaking the circuit for a large induction coil, the rotary mercury circuit breaker or the electrolytic circuit breaker are employed. As an example of the many types of modern circuit breakers, the much employed gas circuit breaker of the last construction is here shown in Fig. 6. On the base of a cast iron vessel there is a layer of quicksilver, which by a small rapidly rotating turbine (S) is drawn up so that it impinges in periodic drops against a metal ring provided with slots. The mercury stream which strikes the ring gives a contact, but if it meets a slot the circuit is broken. In order to prevent the mercury from being impaired by the spark produced at the openings, the rotary mass of mercury is immersed in petroleum or illuminating gas.

The gas circuit can handle the strongest currents without injury and works also very evenly under heavy load. For the employment of higher alternating poten-

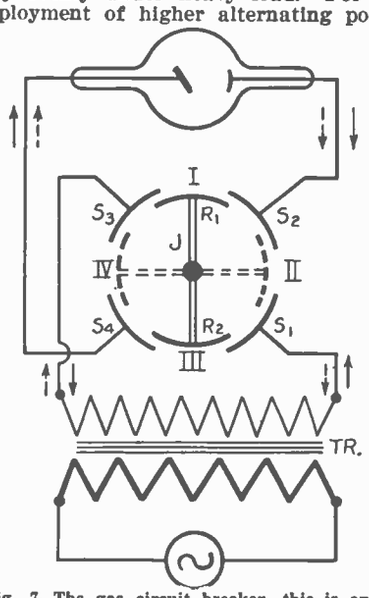


Fig. 7. The gas circuit breaker, this is an instrument of good power, even under heavy loads.

tials in Roentgen ray work, apparatus must be used to rectify the said potentials. The greatest difficulties in the practical production of this apparatus, the high potential rectifier, today can be regarded as overcome, so that these apparatus are used in very many places.

The basic idea of the high potential rectifier is shown in Fig. 7. The alternating current at low potential, 100 to 220 volts, which can be taken right off the street circuit, is by a transformer (Tr) brought up to a potential of 15,000 to 120,000 volts. The secondary coil is connected to the two cylindrical segments (S_1 and S_2) of the commutator, while the segments (S_3 and S_4) are connected with the Roentgen tube. In the circle defined by these four stationary segments an arm (J) of insulating material rotates in synchronism with the period of the alternating current. The arm is provided with two metallic segments (R_1 and R_2) at its ends, which as they rotate pass very close to the stationary segments, and by the spark springing across constantly maintain the connection so that the current impact of the Roentgen tube always has the same direction. This saves the tube a great deal and gives very sharp and contrasting images.

For the examination of metals, gas-filled or ion tubes as well as high vacuum or electron tubes can be employed. In the ion tubes, Fig. 3, the air is pumped out to about 0.001 mm. of mercury (.000,004 inch). Of the remaining neutral molecules of gas, just as in the atmosphere, some are already split up into positive and negative molecules, so-called ions. Under the influence of an induction coil of 12 to 16-inch spark gap the positive ions are attracted to the cathode, the negative to the anode. The ions impinging upon the cathode so shake up their atoms that they set free electrons. These electrons take a straight course into space perpendicular to the surface of emission.

In the ion tubes the cathode is bent into a cylindrical shape so that the rays unite at the middle point of a sphere and form the so-called focal point. At this focal point of the cathode rays the anti-cathode of platinum, of iridium alloy or of tungsten is placed. The Roentgen rays radiate from this focus in all directions.

(*Continued in October Issue*)

Experimental Microphone

By Frank W. Godsey, Jr.

IN the January, 1924, number of PRACTICAL ELECTRICS an article entitled "An Aneroid Microphone" was published. Since that time a few improvements have been made and a type of transmitter designed which is easily accessible to the average electrical experimenter.

The older type of telephone consisted of an air chamber, one end of which was covered by a diaphragm, with a tube leading from it to an especially constructed microphone. This unit was composed of two carbon rods sealed in a glass tube, one end of which was connected to the outlet of the air chamber. Between these rods a drop of mercury or a similar liquid conductor was suspended, closing the air passage through the tube. The ends of the carbon rods projecting from the tube were connected to the battery and telephone. When the diaphragm of the air chamber was spoken against, the pressure in the chamber and tube was changed, altering the position of the globule of mercury in synchronism with the vibrations in the air due to the voice. Thus the resistance of the carbon rods was changed in exact proportion to the undulations of the voice, developing a speaking current through the battery.

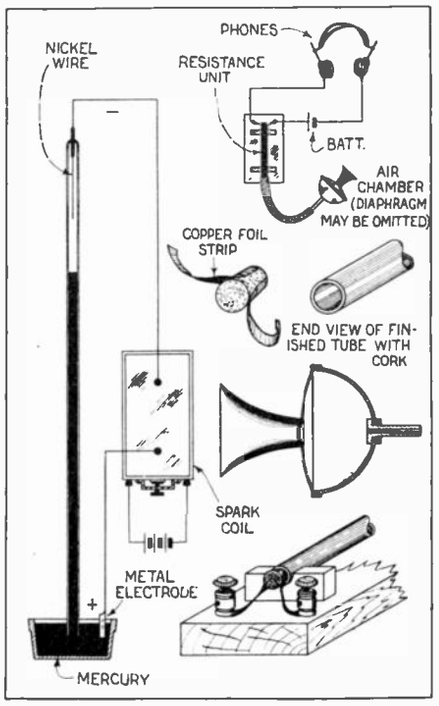
A microphone of this type, while very simple in operation, is rather difficult to construct because of the difficulty of properly working the glass and carbon to obtain a suitable resistance unit. It is at once apparent that if the walls of the glass tube were plated with a substance having a high electrical resistance and this plating were divided into two strips without electrical contact with each other, and their extremities were connected to two binding posts for outside connection, they would be much more efficient than the carbon rods.

A glass or quartz tube is obtained which has an inside diameter of one-eighth to three-sixteenths inch. This tube may be of any convenient length over three inches. However, it will eliminate a good deal of necessary work later on if the tube is about four feet long. One end is heated in a gas flame and is drawn out until a short length of the tube is obtained small enough to slip into the other end of the tube. About one-half of this is cut off and laid aside for further use. Next a short length of nickel wire long enough to extend two or three inches into the large open end of the tube is obtained. This wire may be of almost any size small enough to pass easily through the short section of small or drawn out tube. No. 22 or 24 is the most convenient to handle.

The short piece of tube is slipped over the wire and about one-half inch of wire is allowed to project out at one end. It is then held in a flame until the glass seals around the metal wire. This short section of wire with the glass sealed around it is then straightened as much as possible and is suspended inside the larger glass tube with the center of the seal even with the top of the tube. The tube is then heated at the end until it contracts around the glass seal on the wire, sealing the end of the tube with a nickel wire extending down its center. It is now allowed to cool, then thoroughly washed out with strong ammonia and allowed to dry.

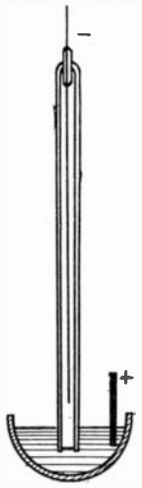
In case a short tube was used, another tube of any convenient composition, though preferably of metal, is fastened to it by means of a short length of rubber hose, giving a total length over 960 mm., about four feet long. The end of the elongated tube is turned up and it is filled with mercury. Place the thumb over the open end of the tube, which is inverted in a dish of mercury and clamped in that position. The mercury in the tube falls to about 30 inches according to the barometric pressure, leaving an almost perfect vacuum in the top of the tube. The unusual length of the tube is necessary to overcome the air pressure on the surface of the mercury in the dish. (Figure 1.)

The nickel wire will now be found to extend down the center of the glass tube for two or three inches, and the short piece projecting out of the top of the tube is now connected to the negative terminal



Various parts of the mercury globule microphone, using the changes of resistance due to shortening and lengthening a circuit.

of an induction coil having a spark capacity of about one or two inches. The wire from the positive terminal is then dipped in the mercury in the dish and the current is allowed to flow through the primary of the coil. The nickel wire will



Coating the interior of the tube. A prolonged electric discharge plates the interior of the tube.

begin to spark and glow, and after the coil has discharged for about an hour and a half or two hours, a thin coating of nickel will be found to be deposited on the walls of the tube. A strip of tin foil placed around the glass tube and connected to the positive pole of the induction coil will hasten the operation.

The apparatus is then disconnected and the tip end of the tube holding the nickel wire in place is cut or broken off, leaving a straight piece of glass tubing, open at both ends, two or three inches in length. The coating of nickel in the tube is continuous, and must be divided into two strips, one on each side of the tube.

A small amount of steel or brass wire, as long as the inside diameter of the tube and about as fine as the bristles in a shaving brush, is secured. It is soldered on the end of a stiff wire with the ends of the wires projecting out from the stiff wire handle. (Figure 4.)

The glass tube is then clamped in position and the brush is pushed in one end, care being taken that neither the tube nor the brush turns. The brush is then pushed back and forth in the tube until the ends of the wires cut away two narrow strips of nickel. This leaves the glass tube with two strips of nickel extending its entire length.

The remainder of the work on the microphone is very easy. A base of wood or bakelite is made according to the general outline in Figures 2 and 3, and the glass tube is fastened to the two brackets. A small cork large enough to fit snugly in the end of the glass tube is obtained and two narrow strips of brass or copper foil are fastened on it with glue, one to each side. The cork is then forced into the tube in such a position that the strips of foil make contact, each with one of the strips of nickel on the inside of the tube. The cork is then sealed in with shellac or wax. The ends of the metal foil strips are fastened under the bases of the binding posts on the end of the mounting block.

A drop of mercury is allowed to fall into the open end of the tube and is shaken down until it reaches the middle of the strips on the walls of the tubes when the tube is in a horizontal position. The open end of the tube is then connected with a rubber tube, which is in turn connected to the bell of a thistle tube. This bell is only an air chamber and may be made of any hollow object a few inches in diameter with a tube leading from it. Over the open face of the bell is stretched a rubber membrane fastened by means of a rubber band or a piece of twine behind the flange on the edge of the bell.

The binding posts are connected to a phone and battery and the diaphragm is spoken against. The voice should be reproduced in the telephone with exceptional strength and clarity. Diaphragms of different metal may be experimented with. Doubtless, a steel or aluminum diaphragm will operate best.

In the preceding case, a metal was used which would not alloy with mercury in the construction of a resistance unit. The use of silver instead of nickel as a metal for the resistance unit greatly simplifies matters, although the sensitivity of the microphone is affected a little. The silver coating may be obtained by chemical deposition.

It may be well to say here, that although nickel and silver are both excellent conductors of electricity, the resistance is gained through the very small cross sectional area of the strips. Consequently, a short reduction in length will make a large difference in the resistance.

The silvering solution is prepared as follows: To one-half pint of water add one gram of silver nitrate and one gram

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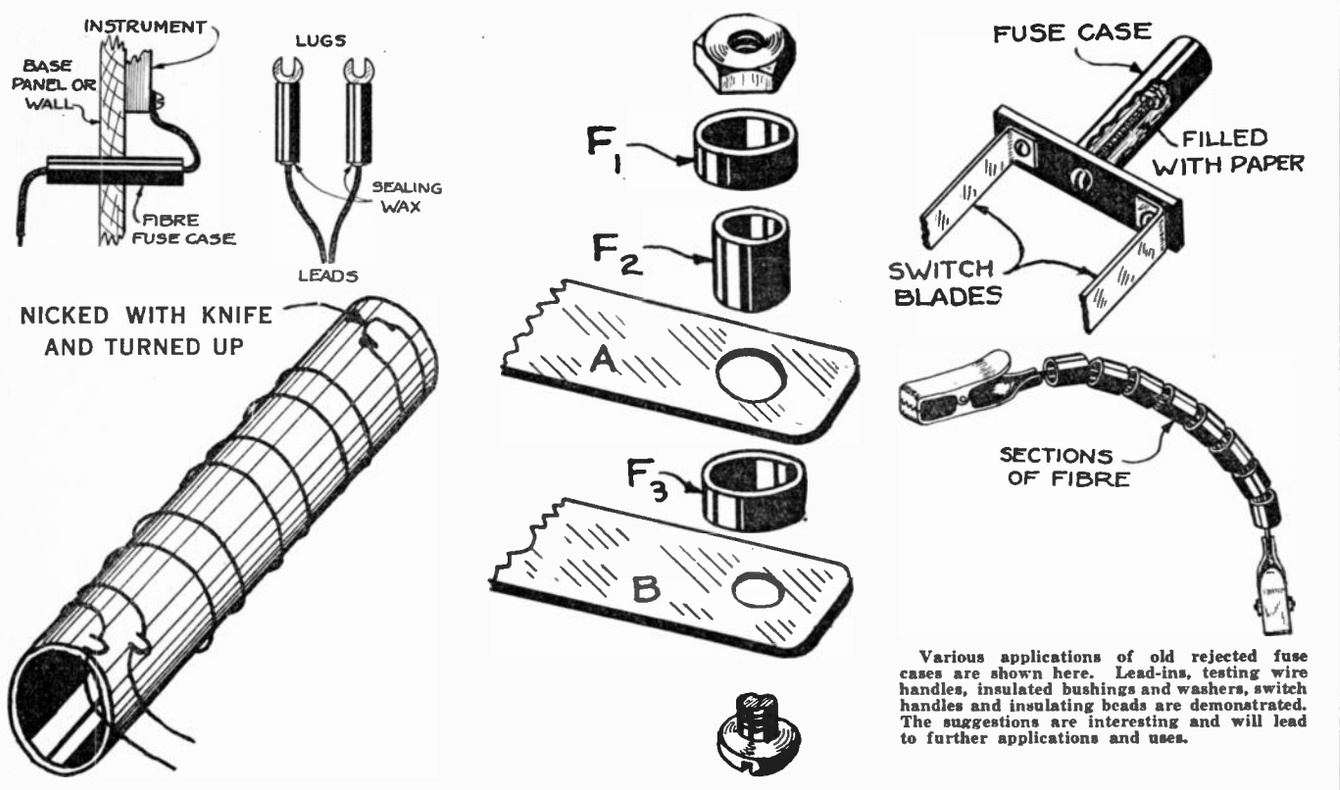
Uses for Burned Out Cartridge Fuses

By Raymond B. Wailes



Various applications of old rejected fuse cases are shown here. Lead-ins, testing wire handles, insulated bushings and washers, switch handles and insulating beads are demonstrated. The suggestions are interesting and will lead to further applications and uses.

CARTRIDGE fuses are enclosed in short fibre tubes. Below are suggestions for their utilization when the fuse is burned out.

The fibre case can be used as a lead-in insulator, for running wires behind panels, through table tops, etc.

A fibre tube from an old fuse makes a convenient handle for testing wires. Lugs soldered to the wires and the fuse case slipped over the joint and fastened with shellac or sealing wax make admirable handles for such appliances.

Different sized fuse cases can be sawed into sections and made into insulated bushings and washers. In Fig. 3, if strip (A) is to be insulated from (B) but to be fastened to it by the one machine bolt, two large sections of fibre should be used, (F1) and (F3), and an inner smaller one (F2).

By winding a bit of resistance wire around one of the fibre cartridges a compact resistance unit can be made. A nick in the side of the tube will hold the wire tight.

Break the handle of one of your switches? Use an old cartridge type of fuse to make a new one.

Sections sawed from the fibre tube and slipped over wire makes a serviceable battery charging lead, being flexible yet insulated.

Experimental Microphone

(*Concluded from page 642*)

of Rochelle salts. Boil this solution for ten minutes and then allow to cool and filter.

In another container, mix 1.5 grams of silver nitrate with a small amount of water and add a few drops of ammonia with constant stirring until the solution is clear. Add water until a half pint of solution is obtained and dissolve in it 1.25 grams of silver nitrate. Filter the solution, stirring constantly with a glass rod, and set aside in a separate bottle.

The first solution is now mixed with the last, using small equal amounts of each as it will be needed for the plating.

The glass tube should now be washed in hot water and later in ammonia and allowed to dry, after wiping out with a wet chamois, to prevent the presence of any ammonia. The evenness of the precipitation of silver depends upon the cleaning of the glass.

The short length of glass tube is then corked at one end and filled with a mixture of the silvering solutions. The open end is corked and laid on its side and left until the solution precipitates. The old solution is then washed out and a fresh one poured in and allowed to precipitate. This is continued until a good deposit of silver is obtained on the inside.

This process may take some time to complete, but it is very much easier than nickel plating the tube.

After the desired deposit is secured, the tube is treated in the same way as the nickel-plated tube, splitting the deposit up into two strips and mounting on the same kind of base. The silver plate will handle a slightly heavier current than the nickel because of the mercury which alloys upon the surface of the silver.

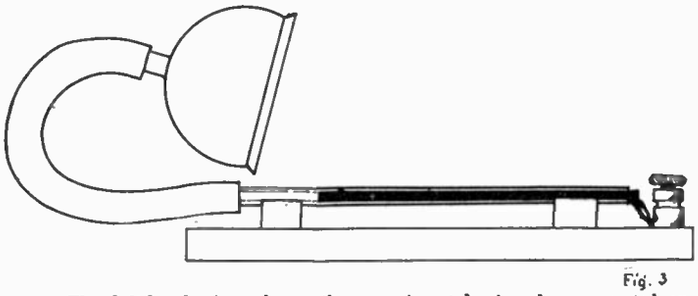
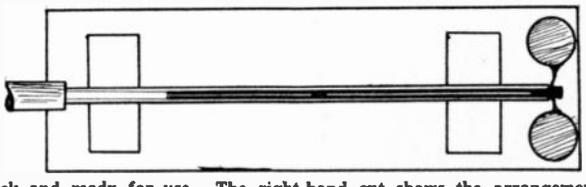


Fig. 3

Fig. 4



The left-hand view shows the experimental microphone mounted on a block and ready for use. The right-hand cut shows the arrangement of tube and binding posts. Above is shown a small brush used to separate the metallic coating of the tube into two parts.

Storage Batteries

By Hans Konwiczka

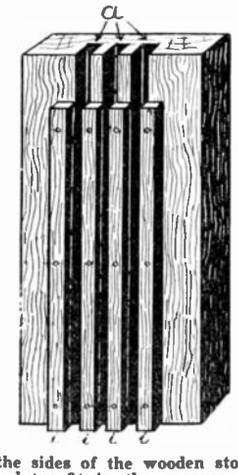
THE term storage battery is not altogether correct, for no electricity is stored in the battery. The currents of electricity which pass through it in the charging only serve to bring about a chemical change, so that it will in its turn give an electric current. The products due to the electro-chemical decomposition and newly formed thereby are on their side adapted for a certain time to develop electric potential and an electric current. It may interest our readers to understand the action of the storage battery better before we give the practical details of how to build one.

If we connect two small pieces of sheet platinum of perhaps a square inch area each with the terminals of a galvanic battery and immerse them in a glass vessel filled with water to which a little sulphuric acid has been added, the plates being separated from each other so that they are not touching, an electric current passed through this combination will cause an evolution of gas, oxygen from one plate and hydrogen from the other.

The anode which is connected to the positive pole of the battery becomes covered with little bubbles of oxygen, while the cathode connected to the negative pole of the battery is covered with bubbles of hydrogen. The presence of these bubbles interferes perceptibly with further decomposition, for the glass no longer contains two simple plates of identical material, but has electrodes of widely differing material, namely, one of oxygen and one of hydrogen, one at the anode and one at the cathode.

The plates thus covered develop an electric potential and can produce a current opposed in direction to the original one from the other battery. This goes to weaken the charging current by opposed E. M. F. This opposing property is termed "polarization," and depolarizers are used in the batteries we have already described to prevent it. In storage batteries this very polarization, injurious in primary batteries, is what is used and desired, and is what gives them their value as a sort of reservoir of electric energy.

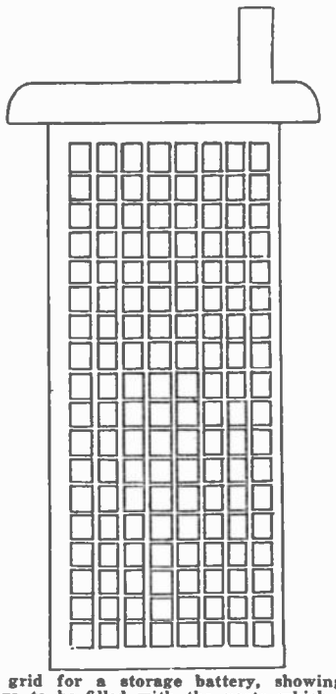
Electrodes used in storage batteries consist of easily oxidizable lead. The ma-



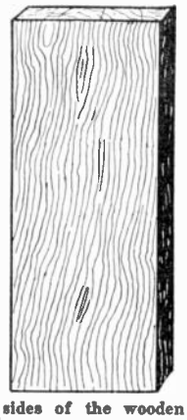
One of the sides of the wooden storage battery cell. The plates fit in the grooves and between the wooden strips.

terial of the electrodes reciprocally decomposes, giving the potential.

The general principle of a storage battery is represented by two plates of lead placed as near as possible without touching and immersed in dilute sulphuric acid. Its one plate is connected to the positive and the other to the negative pole of a source of current. The water is decomposed into the hydrogen and oxygen, the oxygen converts the one plate as regards its surface into dark lead super-oxide, PbO_2, while the hydrogen of the other plate escapes in small bubbles and adheres



The grid for a storage battery, showing the openings to be filled with the paste which eventually hardens and sets firmly in place.



One of the sides of the wooden container of the storage cell.

in part without changing the metallic lead.

We now have lead super-oxide and hydrogen as our two electrodes. If they are connected by wire, the other current terminals being disconnected, a current in the reverse direction will flow from one place to the other and will continue until the plates have got back to their former state or until the lead super-oxide has been reduced to lead. In practice a number of lead plates are used in each cell, put in alternately, positive and negative, all the negatives and all positives being connected. In present practice the plates are arranged so that they can be affected to their entire thickness instead of merely on the surface.

The first thing is to get the lead plates. These can be bought much more cheaply than they can be made. For a single cell we will procure three lead gratings or grids (Fig. 1), which may be 4 inches long, 1½ inches wide, ⅛ inch thick. Of course any desired size can be used. Size affects the amperage, but not the voltage.

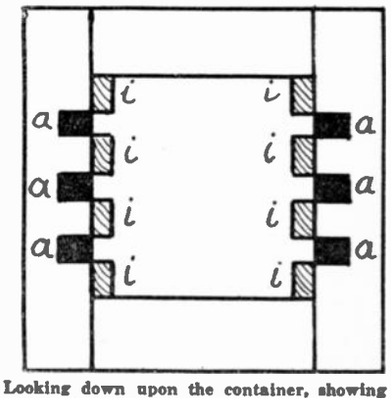
Pasting the Grids

The empty grid, of which we are supposed to be using three for a single cell, are first purified by immersion in hot caustic soda solution, followed by warm water and then by cold water. We now have to paste them. The paste for the negative plates, of which there will be two, consist of chemically pure litharge, lead oxide, which is mixed to the consistency of butter, with 24° B. chemically pure sulphuric acid. This is then well kneaded with a wooden spatula and the apertures of the grid are plastered full of it. If the paste hardens too much for easy working, we add a little more dilute sulphuric acid.

The single positive plate we treat in the same manner with a mixture of red lead and dilute sulphuric acid, which we allow to dry and harden as the first did. The plates are now wrapped each by itself in linen cloth which has been dipped in dilute sulphuric acid, and are placed one on top of the other and allowed to stand 24 hours, the cloth being constantly moistened if it tends to dry. While the plates are thus hardening, if we have no glass cell we must make a wooden one. For our plates we need a square receptacle 6 inches high and 1½ by 1¼ inches, approximately, inside cross section. Half-inch wood will do for two of the side pieces (Fig. 2), and for the other two we use wood a little over ¼ inch thick (Fig. 3). For the bottom the piece must be 2¼ by 1¾ inches in area.

The sides are 4½ inches high and 1¾ inches wide. In one pair of them there are three grooves (A, Figs. 2 and 5), ½ inch deep and ⅛ inch wide. Four strips are fastened on each side of the grooves so as to deepen them. The plates are pushed down into these grooves. Fig. 5 shows the cross-section of the container seen from above. The edges of the plate (Fig. 1) fit into the grooves. The grooves (A) are not carried the complete length of the side pieces, so that the plates will not reach too near the bottom. The other two smaller side pieces are 1⅜ inches wide and the same height as the others. Fig. 6 shows a longitudinal section of the container, (G) is the base, (SS) are the smaller side pieces (i,i,i) are the strips of wood.

After this the case, thoroughly dried



Looking down upon the container, showing the cross section, with its grooves (a, a) and the separating slips (i, i).

and warmed in an oven, is poured full of melted paraffin, which is at once poured out again, leaving it water and acid proof.

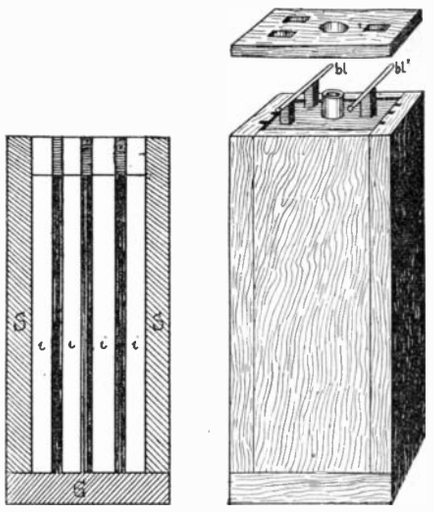
Forming the Plates

In putting it together the positive plate is put in the middle grooves and a negative plate on each side thereof. The plates must, of course, be perfectly insulated from each other. This is done by

the strips of wood (i,i,i), and in glass receptacles it may be done by projections moulded when the vessels are made.

A cover (Fig. 7) made out of paraffined cigar box wood, or even of heavy pasteboard, is provided. It is pierced with rather tightly fitting apertures for the lugs of the positive and negative plates. The round hole in the middle is for the introduction of the electrolyte, and in this a glass tube is thrust, fitting it tightly. The two negative plates are connected by a piece of lead soldered to them (bl, bl') and another piece is soldered to the positive plate. Melted paraffin is then poured over the top to a depth of 1/16 inch, great care being taken that none goes into the interior. It is to be noted that even if more plates are used there is always just one more negative plate than positive ones. All the plates of the same polarity are connected by a lead wire or strip soldered to them.

The container is now filled with dilute sulphuric acid poured through the glass tube. The charging circuit must be at a higher potential than that to be given by the storage battery. To charge this cell we will need two Bunsen elements, giving



Figs. 6, 7, 8. These show cross section and outside view of the storage battery and its cover. The cover is put on before connections are soldered, and the terminals of the plates project through it, and are connected as shown.

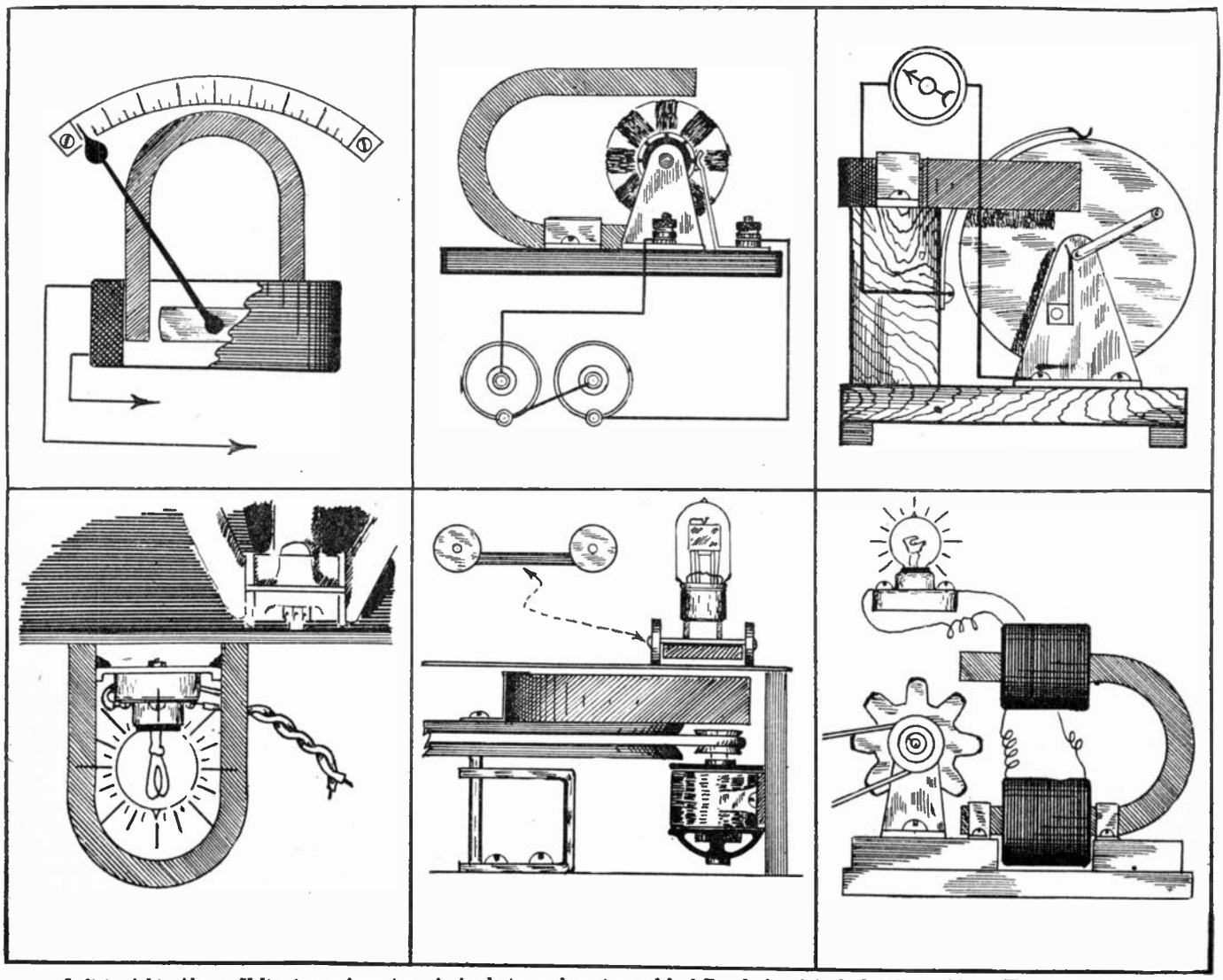
from 3.6 to 3.8 volts. To form it we connect the negative pole of the Bunsen battery, which corresponds to the zinc pole, with the negative pole of the storage cell, and the positive pole is connected to the other pole of the battery.

We must have a voltmeter. As soon as the storage battery shows about 2.4 volts it is disconnected from the charging battery and discharged through some resistance, a toy motor, a coil or an incandescent lamp. It will take three or four chargings and dischargings to bring the battery up to its proper rating. The voltage must not be allowed to go under 1.8 volts. When it reaches this it must be immediately recharged.

If we use a house lighting circuit, proper resistance must be put in to prevent too high a charging current. A single cell gives about two volts, so that eight cells are needed for a 16-volt lamp. The cells can be arranged in series, in parallel or any desired arrangement. It is even possible, putting them in parallel, to charge them at a connection giving a low voltage and then connect them in series so as to discharge at a high voltage, and vice versa.

Uses for Magneto Magnets

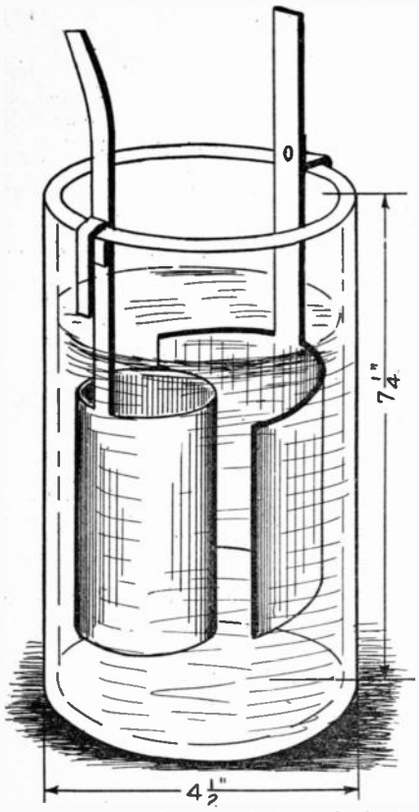
By Harold Jackson



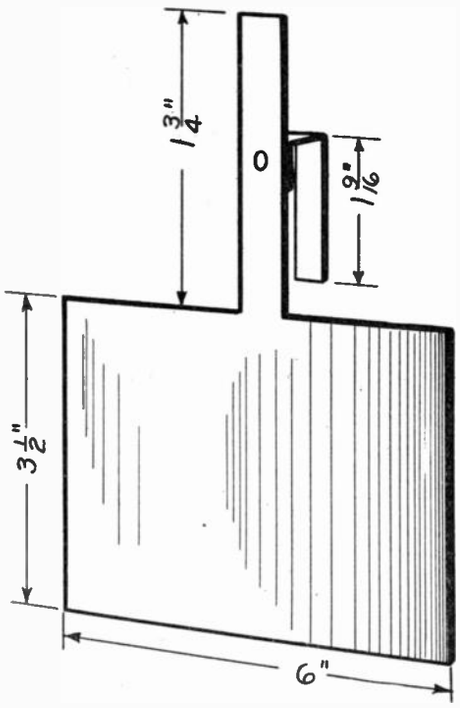
Left to right—Above—Voltmeter or Ammeter.—A simple two pole motor-model of Faraday's original electric machine. Three interesting examples of what can be done with magneto magnets. Below—A trouble lamp for the automobile—A traveling car for a window advertisement—induction alternater. Three more suggestions for the experimenter.

The illustrations given above embody a few suggestions of what we can do with the permanent magnets from a discarded magneto. Elsewhere will be seen how one can be used to hold paper clips, pins and small steel objects on a desk, and many other ways of employing these "waste products" of the garage will be found in back numbers of PRACTICAL ELECTRICS.

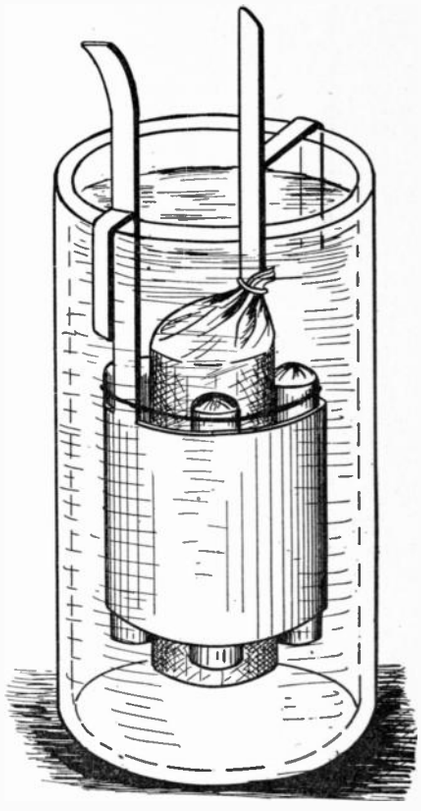
Lalande Type Battery



An interesting battery of the Lalande type using oxide of copper as the depolarizer.



The zinc plate of this battery as first cut out. This is curved into a half circle as shown in the left-hand view.



A modification of the battery just shown. The zinc is bent into a cylinder, enclosing the iron electrode and contents, and wooden or other separators are used to keep the plates apart.

ONE of the great inconveniences of radio apparatus using audion bulbs is the excessive cost of the storage batteries used for igniting the filament, so that many a wireless amateur avoids the use of bulbs not knowing any substitute for the storage batteries.

We have therefore thought it well to make known this battery, of slight cost, which can replace advantageously the ordinary storage battery.

The battery described is neither more nor less than the well known Lalande or oxide of copper battery, whose most notable properties are: Not consuming its zinc and depolarizer except in proportion to the work which it does; long duration; and large electric capacity.

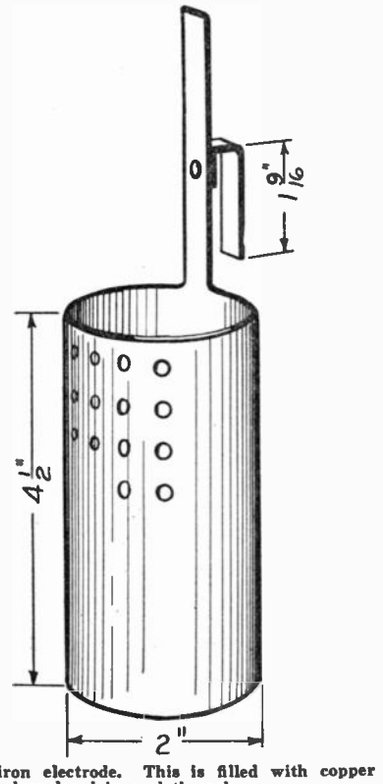
One of these elements which we are going to describe, can supply a one-bulb apparatus for a period of approximately 100 to 110 hours. Fig. 1 shows the small model whose approximate data are the following:

Capacity, 60 to 70 ampere-hours.

Internal resistance, 25/100 to 35/100 ohms.

Normal constant current, one ampere, which may be increased temporarily to 2 or 3 amperes.

The anode of the cell of this battery consists of a cylindrical box of sheet iron, which for the upper 2 inches of its 4½ inches of height, is perforated with holes; the interior is filled with black copper oxide; the whole then wrapped with porous cloth, introducing only inappreciable resistance.



The iron electrode. This is filled with copper oxide and enclosed in a cloth sack.

The cathode is a zinc plate 5¼ inches wide, 3½ inches high, and about three-eighths-inch thick. Anode and cathode are hung from the edge of the jar, which may be made of glass. The large model shown in Fig. 2 gives the following characteristics:

Capacity 250 to 275 ampere-hours.

Interior resistance .05 to .09 ohms.

Normal current 2½ to 4 amperes.

Temporary current 7 to 9 amperes.

The construction of this model differs from the one just described only in the cathode, which is now a cylinder surrounding the anode and held concentric therewith by glass or porcelain separators. The dimensions are: Anode, 2¾ inches high by 11¼ inches wide. Cathode 4½ inches high by 8½ inches wide, and 1/25-inch thickness.

The solution is made with caustic potash dissolved in distilled water. The solution after cooling is poured in until the electrodes are covered by one-half inch or one inch of the fluid.

By the figures our readers will see the most convenient form to select for the electrodes. A battery of four such elements each one of an electromotive force of .8 to .9 volts, can supply the filament of a French bulb for 110 hours.

Radio Revista.

Open Circuit Battery

FROM France we have received a brief description of the M. L. Neu alkaline open circuit battery. The positive pole consists of a plate or bar of zinc. It is immersed in a strong solution of caustic potash. The negative electrode consists of a plate of sheet iron. This is embedded in grains of retort carbon contained in a sack of asbestos. This sack rises above the level of the liquid, so that the depolarizing substance can "breathe" the atmosphere. The electromotive force is about one volt.

The battery on open circuit does not expend itself. It has low internal resistance. The concentrated solution of caustic potash operates in order to maintain a constant level of the liquid. The humidity in the air compensates for all evaporation.

To regenerate the battery the sack is washed out with hydrochloric acid and is filled with fresh grains of retort carbon.

A cell 8 inches high and 4¾ inches in diameter, giving out 50 milliamperes, ran for 300 days, giving 330 ampere hours.

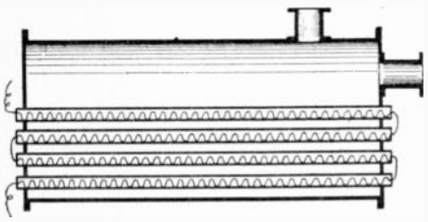
Open circuit batteries are now receiving much attention in France.

Electric Boilers

By Dr. Ing. E. Zeulmann (Abstract)

THE advantage of electrically heated boilers is largely due to the simple, convenient and clean operation thereof. No expensive storage room is required for the coal or for storing or disposing of the ashes. There are no chimneys or smoke and the surroundings are therefore free from contamination by smoke, chimney gases or fine disseminated ashes from the chimneys.

To heat one kilogram of water from 0° C. (32 degrees F.) up to the boiling point, 100 heat units (kilogram calories) are required. Then to convert this water into steam 537 additional calories are required, making a total of 637 units.

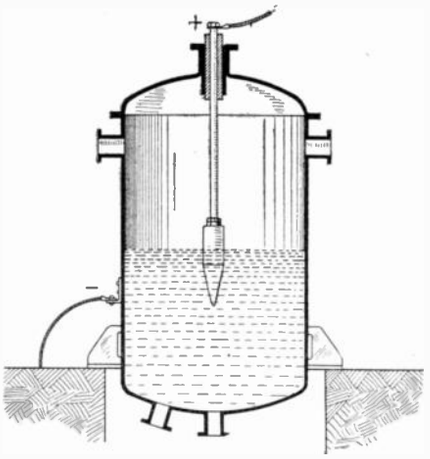


A boiler of the tubular type, heated by insulated heating coils within the tubes. This can be used with direct current; the other cannot.

A kilowatt hour of electricity develops 845 heat units per hour. Allowing for waste, one kilowatt hour will produce 2.3 kilograms of steam, about 2½ pounds.

A boiler can be heated by induction, by the electric arc, or by passing the current through a resistance. Only the latter method has hitherto been successfully used. The first illustration shows a boiler of tubular construction, within whose tubes, and insulated therefrom, are coils of heating wire. These wires really represent in a sense, the hot products of combustion, which would flow through them were it a coal-heated generator. This system is adapted for direct current, as the heating elements are not in contact with the water, so there is no danger of decomposition of the water and the production of combustible hydrogen gas, or worse still of an explosive mixture of oxygen and hydrogen.

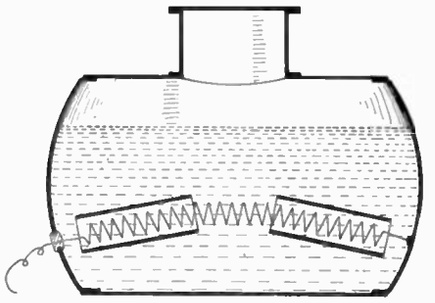
But if we use the alternating current this can be employed for any kind of boiler as it cannot decompose water. Up to 750 volts, the method shown in Figure 1 can be employed, just as for direct current, or the same coils can be carried directly through the water. In the latter case the current goes partly through the wire and partly through the water. But as the temperature rises the hot wire increases the resistance as well as in power of heat production, while the boiler water decreases, so that the sum of the two, namely of the heat produced by the wire and the heat produced by the water are almost the same.



A system of heating a boiler by causing a current to pass through the water. As the level of the water sinks, the immersion of the electrode diminishes so as to cut off the current, giving an element of regulation.

The wire in these cases is made of chrome nickel steel.

We will now come to a third method shown in the last illustration. Here a heavy electrode, usually of metal, is immersed in the water and the water itself forms the resistance, conducting enough current to become heated. The current flows between the electrode and the plating of the boiler, the opposite leads from the battery being connected to these places; the central electrode is insulated where it passes through the shell. Provision may be made for varying the depth of immersion of the electrode so as to change according to requirements the amount of heat developed. In these electrode-boilers connections can be made directly to high potential circuits, there being no need of step-down transformers. Scale does not form in such boilers, because the shell of the boiler is nowhere heated sufficiently to solidify it, so that deposits collect as a slime in the bottom and can be easily washed out.



Another system of operating an electric boiler. Here the wire is insulated from the shell of the boiler, but not otherwise.

In the electrode system it is impossible to burn the boiler and an explosion is well nigh impossible, because as the level falls, which is one of the great causes of explosion, the resistance increases and the heat absorbed diminishes.

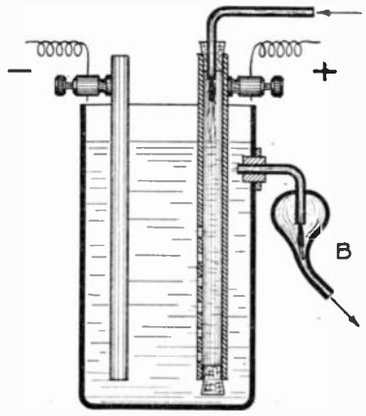
Stray Current Action on Water-Pipe Lines

By Professor Pierre Medinger, Luxembourg

THE question whether rapid destruction of city water pipes was due to self-corrosion caused by the agency of the soil, or to the action of stray currents, has in hundreds of cases been the object of costly law suits. Electric railway companies have often been unjustly accused and sued.

It is well known today, for example that clay soils with a sulphate (gypsum) can produce absolutely the same effects on cast iron pipes which stray currents are known to do. The use of millivoltmeters, telephones, etc., in such cases has frequently led to false conclusions. It should therefore be of great interest to find some indicator which will enable us to prove with certainty the action of stray currents. Such an indicator was found some years ago by the author and its description is published for the first time here.

Having been entrusted by the Luxembourg authorities with the study of an extraordinarily rapid corrosion and destruction of a cast iron water-pipe line, he found soon, that the damage was produced by an injured electric cable, which crossed and touched the pipe line. In pure scientific aim he made a complete analysis of the rust covering the perforations of the pipes, through which the water had been escaping for weeks. The analysis showed an astonishingly high amount of chlorine in the rust, 23 per cent! As the surrounding soil contained no chlorine at all, this chlorine must have come from the water flowing out of the pipe. As this water had only 0,0004 per cent of chlorine it must have accumulated in the rust in the form of an insoluble compound, which was found to be ferroxychlorid (Fe_2OCl_4). This explanation was proved to be true by the following experiment:



A very interesting and illuminating experiment on the corrosion of pipes by electrolysis, as carried out by Professor Medinger of Luxembourg.

Into a high glass cylinder filled with soil were plunged an iron rod and an iron pipe as electrodes. The pipe was closed at its lower end by means of a cork and had several lateral perforations through which a slow current of water was kept flowing out into the soil. The rapidity of this water current was controlled by means of a glass bulb (Fig. 1) inserted in the overflow tube. An electric current one of 0.1 ampere at 8 volts was kept flowing from the tube as positive electrode to the rod. After four weeks the pipe was deeply corroded and the rust adhering to the perforations contained over 10 per cent of ferroxychlorid. The water employed had only 4 mgr. chlorine per liter (0,0004 per cent).

The explanation of the phenomenon is simple: by the electric current the anion chlorine is directed towards the positive pipe electrode together with the oxyhydrogen ion (OH). So we have around the pipe: chlorine ions, oxyhydrogen ions and alkaline reaction; all the conditions required for the formation of ferroxychlorid are given! So we have in this composition a chemical indicator of the action of stray currents, which in many cases may be of great value.

Awards in the $50 Special Prize Contest
For Junior Electricians and Electrical Experimenters

First Prize, $25.
E. Davis,
604 Madisonville St., Princeton, Ky.

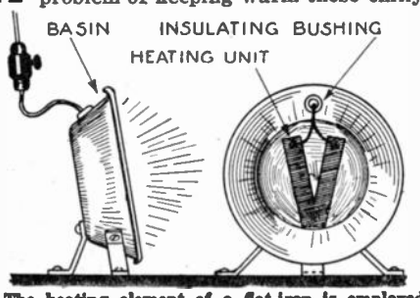
Second Prize, $15.
Paul A. Simpson,
10703 Parkhurst Dr., Cleveland, Ohio

Third Prize, $10.
Francis Paulowski
2849 N. Springfield Ave., Chicago, Ill.

First Honorable Mention—Roscoe Betts, Box 4, Arcadia, Neb.
Second Honorable Mention—Phillippe A. Judd, 1525 Tenth St., Portsmouth, Ohio.
Third Honorable Mention—Roscoe Betts, Box 4, Arcadia, Neb.

First Prize
A Simple Electric Heater
By E. Davis

HERE is a simple heater to solve the problem of keeping warm these chilly

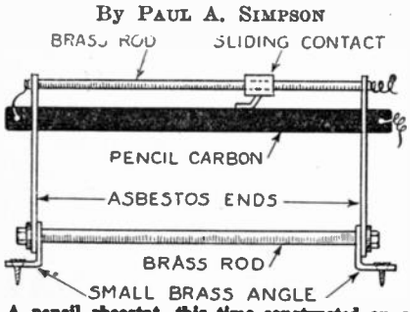


The heating element of a flat-iron is employed for an electric reflecting heater. A ten-cent wash basin is used for the reflector.

spring and summer nights. All the material required for this heater is an old flatiron element, a 10-cent wash-basin (tin), a length of heater cord, screw insulating washers, etc.

You can procure an old element for a very small sum and in most cases for nothing. Now for the actual construction. First punch or drill three holes for the element, two at the two ends and one where the two legs join. Now place the element in position and secure it with three machine bolts, placing it between mica or asbestos washers. Now make a single hole above the terminal ends of the element. In this hole is placed an insulating bushing and the length of heater cord is run through it and connected to the element. The legs (A) and (BB) are made of strip brass or iron or any suitable material. They are fastened to the sides and to the leg in the back. Fasten an attachment plug on the other end of the cord and the heater is ready for use. It heats one corner of a room very nicely and has been in use at my radio station for some time, giving perfect service the entire time.

Second Prize
Pencil Rheostat
By Paul A. Simpson



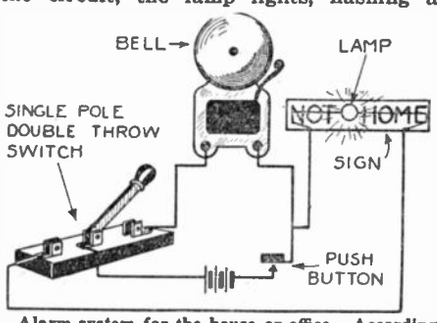
A pencil rheostat, this time constructed on advanced lines, having a permanent stand and a sliding contact.

I ENCLOSE a very good method for making a rheostat out of a carpenter's pencil. The diagram is enough to explain it. This rheostat can be used to start a motor. I used it on a one-quarter horsepower motor and it worked fine. It can be used on radio tubes, electro-plating, electric furnaces, etc. One must be very careful when exposing the lead of the pencil.

Third Prize
Home Alarm System
By Francis Paulowski

I AM submitting for your Electrical Wrinkle Contest an alarm system which I have installed in my own house and which proves convenient in all ways.

This is to be installed in connection with the usual doorbell alarm system. When the occupants are at home the knife switch is in position (AB), connected to the bell. When the family leaves the house or flat the switch is put in position (BC), disconnecting the bell and connecting a small electric lamp encased behind a glass pane just above the push-button. The pane is of frosted surface upon which "Not Home" is printed with black paint. When the caller presses the button, completing the circuit, the lamp lights, flashing a "Not Home" signal, informing him that nobody is at home, if such is the case. Otherwise the bell rings.



Alarm system for the house or office. According to the way in which the switch inside the house is thrown, pressing the push-button at the door will ring a bell or display a "Not home" sign.

$50 IN PRIZES

A special prize contest for Junior Electricians and Electrical Experimenters will be held each month. There will be three monthly prizes as follows:

First Prize	**$25.00 in gold**
Second Prize	**$15.00 in gold**
Third Prize	**$10.00 in gold**
Total	**$50.00 in gold**

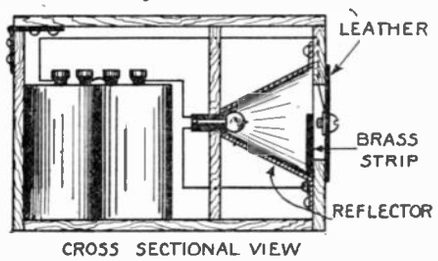
This department desires particularly to publish new and original ideas on how to make things electrical, new electrical wrinkles and ideas that are of benefit to the user of electricity, be he a householder, business man, or in a factory.

There are dozens of valuable little stunts and ideas that we young men run across every month, and we mean to publish these for the benefit of all electrical experimenters.

This prize contest is open to everyone. All prizes will be paid upon publication. If two contestants submit the same idea, both will receive the same prize.

Address all manuscripts, photos, models, etc., to *Editor, Electrical Wrinkle Contest*, in care of this publication.

1st Honorable Mention
Automatic Egg Candler
By Roscoe Betts



An apparatus for inspecting eggs. In front is a leather curtain with holes for the eggs and a slight pressure closes a switch back of the leather and lights the lamp. It may be used in horizontal or vertical position.

THE egg candler illustrated has many advantages since two eggs can be candled at one time, it is compact, and the cost of operation is low.

Cut two holes in a strip of leather, each hole just large enough to accommodate about one-fourth of an egg. Tack the strip over a hole made in one side of a box.

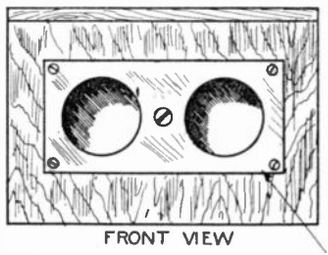
A small bolt, held by a nut, is fastened between the holes in the leather, and serves as a contact. A small brass strip fastened on the inside of the box serves as the other contact.

A partition in the box provides for the holding of the miniature light bulb and socket and the reflector, the latter being made from tin with a somewhat polished surface.

The dry cells, the light and the contact points are connected as shown.

It will be noticed that when two eggs to be candled are placed in the holes, a slight pressure on the eggs closes the circuit and the lamp becomes lighted.

After the eggs are taken away it is evident that the circuit will be broken, due to the elasticity of the leather, and the lamp will become dark, showing that the light and battery are actually used only when the candling is being done.



Front view of the apparatus for candling eggs.

2d Honorable Mention
A Plaster of Paris Spook
By Phillippe A. Judd

HAVE you any old plaster casts, such as art students are generally encumbered with, lying around? I have, and had intended throwing them into that

limbo provided for such useless things—the attic—but instead have electrified mine, and in so doing have secured some very eerie and mysterious effects from it.

The *piece de resistance* of the bunch is a rather incongruously modeled head, life-

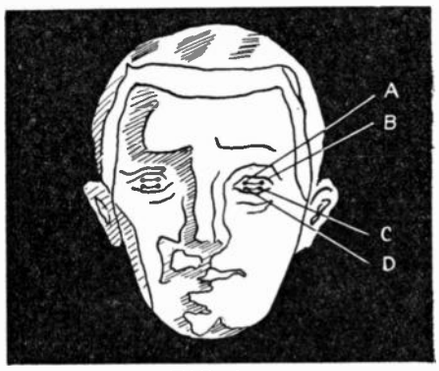


FIG. 1

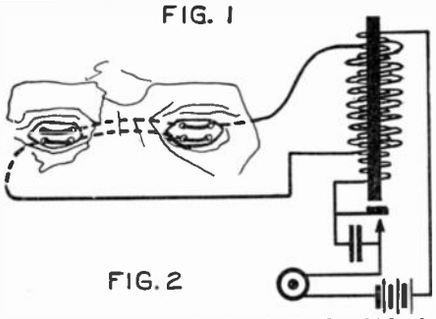


FIG. 2

Fig. 1 shows the classic (?) head, which the author describes, and Fig. 2 shows connections for making the eyes sparkle by an induction coil spark.

size, supposedly representing the classic physiognomy.

I was about to consign it to the junk pile when its horribly lifeless eyes encountered mine. Seemingly, they pleaded with me for that cause and requisite of all life—electricity. Compassionately, I acquiesced, and with the assistance of a quarter-inch spark coil, a few dry cells, some copper wire, the thing was soon grinning its thanks at me, its eyes sparkling with a diabolic gratitude.

The operation in electrified optics was performed thus-wise:

Four very small holes were drilled through each eyeball, *i.e.*, (A, B, C, D, Fig. 1). Two small copper wires were

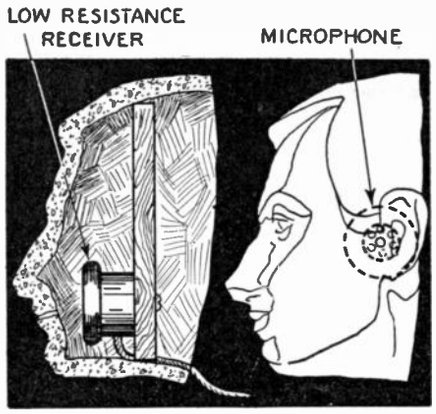


FIG. 3 FIG. 4

Section and side view of the head, this time with a microphone to give it hearing and a receiver to make it vocal.

strung through these holes as shown in Fig. 2. One end of each wire was then soldered to a well-insulated high-tension conductor running to the secondary terminals of the coil. These leads were concealed under the wall covering on which the cast was hung. (A black velvet drapery is best for this purpose, as it adds to the general spookiness of the atmosphere.)

Now, having given my ghostly offspring the sense of sight, I am considering the addition of further virtues. Why shouldn't he speak and hear, as well as see?

The proposed vocal and aural operations will be performed somewhat as shown in Figs. 3 and 4.

He is a bodyless spook, his torso having never existed, to my knowledge, although I am in possession of one each of his several hands and feet. I have not as yet determined how to use them, but that they shall ultimately be electrified I am certain.

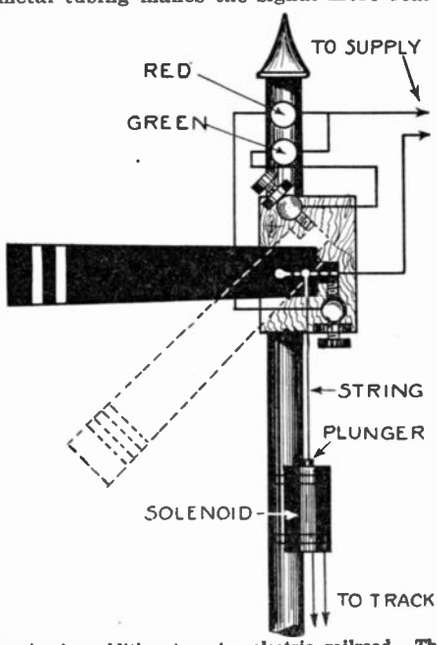
3d Honorable Mention

Lighted Block Signal for Toy Trains

By Roscoe Betts

TOY electric trains are often equipped with electric headlights, hence they must be supposed to be operated in the dark (?). Signaling apparatus must then be equipped for night service, and the semaphore signal illustrated herewith is so arranged and constructed that when the red arm is in a horizontal position the red light is lighted, meaning "stop," but when the arm drops below the horizontal the green light is lighted, meaning "proceed," just the same as on real railroads.

The pole may be made of wood, but metal tubing makes the signal more real-



A nice addition to a toy electric railroad. The youthful engineer can connect this to be operated automatically with a switch, or in any way he deems advanced practice.

istic. Near the upper end of this pole two miniature light bulbs are placed, the upper one stained red and the lower one green, with dips.

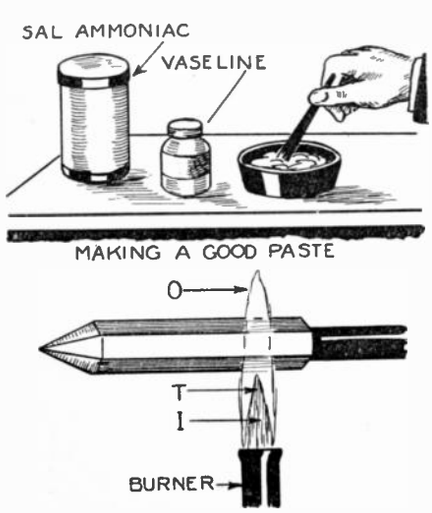
Directly below these is fastened a small wooden block carrying two adjustable contact posts and the pivot on which the semaphore arm swings, the latter being made from light sheet metal and painted red with two white stripes.

The contact posts, lights and arm are arranged and wired as clearly shown by the drawing.

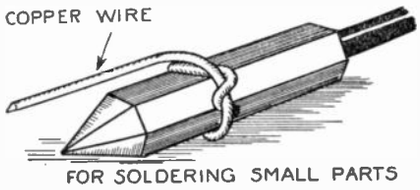
The arm is operated by the plunger in the solenoid when the latter is excited due to the closed circuit in the track or elsewhere.

Useful Soldering Tips

By Raymond B. Wailes



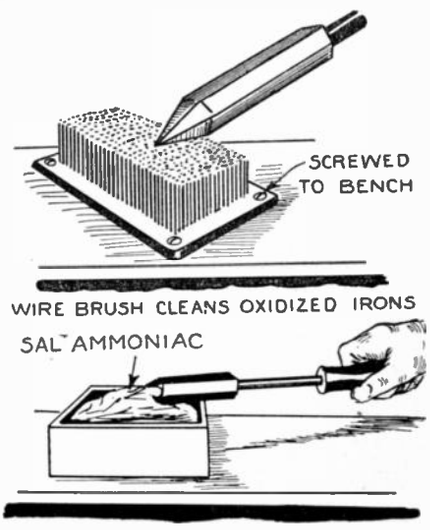
SOLDERING pastes offer the practical electrician an easy means of making non-corroding joints. You can make a soldering paste by rubbing up equal parts of vaseline and sal ammoniac.



Mixing soldering paste, an iron prepared for soldering in difficultly accessible places and the use of a steel brush for cleaning the iron are shown in the three upper illustrations. Below is shown the proper way of heating the iron in a Bunsen burner and the use of a lump of sal-ammoniac for cleaning the iron.

For soldering small parts a small iron is usually used. But small irons do not retain their heat long. By affixing a piece of copper wire to the bit of the iron as shown, the soldering of small parts is easily accomplished. The heat contained in the larger bit is rapidly carried along the smaller soldering bit (the wire) because of the high thermal conductivity of copper. The wire is simply twisted on the bit.

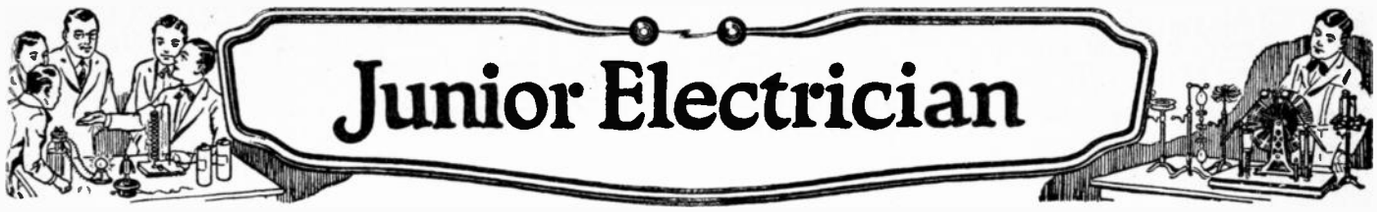
A stiff wire bristle brush screwed to the bench where soldering is performed makes



an ideal scraper for removing the lead and copper oxides which form on the soldering iron.

You should use the correct flame for

(*Continued on page 669*)



Simple Resistance Measurer

THIS is an instrument much needed by the experimenter and electrical student. No laboratory is complete without it.

Three circular 10-ohm rheostats, a bakelite panel, eight inches high by twelve inches long, four binding posts and a galvanometer comprise the material needed.

The rheostats are calibrated as in Fig. 1 by drawing an arc around each one and marking off into ten divisions of one ohm each, with subdivisions indicating one-tenth ohm each.

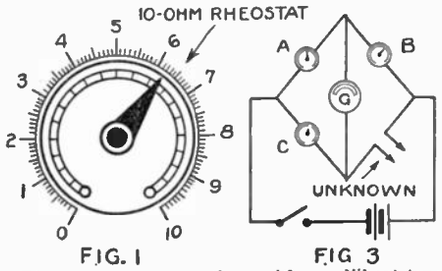


FIG. 1 FIG 3

Rheostats in connection with a Wheatstone bridge connection give a simple method of measuring resistance.

The panel layout is shown in Fig. 2.

The galvanometer is connected into the circuit as shown in Fig. 3, binding posts being provided for the battery and unknown resistance.

In use connect a battery of two or three cells, in series with a switch, to the battery binding posts; the resistance to be measured is connected to the "unknown posts." Turn on the current, and, due to the fact that the circuit is not balanced, current will flow through the galvanometer, which will register the flow one way or the other.

Now change the various resistances until the galvanometer needle shows no current when the switch is closed. The proper sequence of resistance is really quite complicated, but a little practice soon enables the user to get the right values quickly.

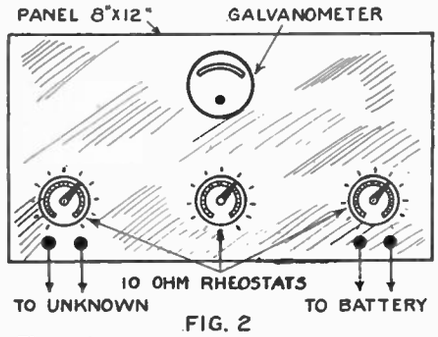


FIG. 2

The resistance panel showing the three rheostats and the galvanometer. It will be found to work very expeditiously.

The apparatus is a Wheatstone bridge and is calculated as such.

Contributed by ROBERT ACKER.

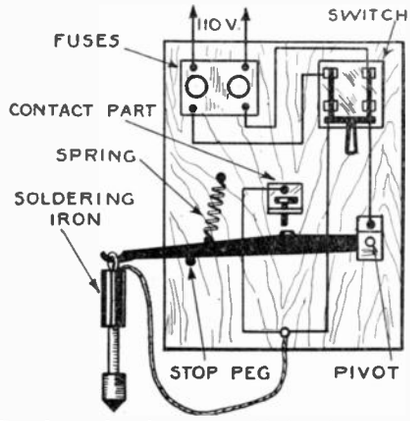
Electric Soldering-Iron Control

WHEN using an electric soldering iron, it is inconvenient to turn the current on and off; this results in a loss of time, and a very simple switch may be made that will automatically control the current.

The first part to procure is the base, which is of wood or other insulating material. This has a fuse block and hook switch arranged as shown. A lever arm of brass is made and attached by means of a simple pivot. The end of this arm has a hook for holding the soldering-iron, a small peg being arranged as a stop. A contact part is made and placed as shown. This is simply a piece of brass bent in the form of a right angle, a small bolt, etc., passing through a hole in the upright part. This bolt may be replaced by a contact part taken from a spark coil if desired. Another piece taken from a spark coil is arranged on the arm also.

A spring is arranged to pull the contact studs together, when the iron is removed from the hook. The weight of the iron keeps the lever against the peg, and the circuit is open, but when removed, the lever is pulled upward by the spring thus closing the contacts. This control should save much time, especially for the builder of radio sets, etc., where quite a lot of soldering is done, for as soon as the iron is taken from the hook the current is turned on, and is turned off as soon as the iron is replaced.

Contributed by EVERMONT FISEL.



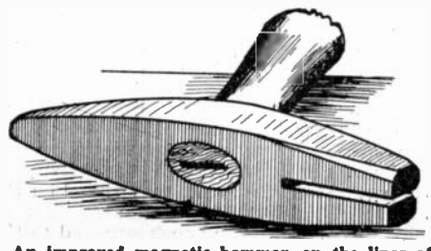
By always hanging your soldering iron on a hookswitch with connections as shown you avoid waste of electric power.

Magnetic Hammer

AN ordinary tack hammer of mild steel can be permanently magnetized in an improved fashion by cutting a slot in the head. The deeper this slot is the better the hammer will retain its magnetism; in this condition it is really a horseshoe magnet, and as such should retain its magnetic force almost indefinitely.

Set the hammer head in a vise and with a sharp hacksaw cut two slots, each parallel and only about one-thirty-second inch apart, to within one-half inch of the hole for the handle. Smooth off the rough edges with a file.

The method of magnetizing steel is well known and need not be given here.



An improved magnetic hammer, on the lines of a horseshoe or double pole magnet.

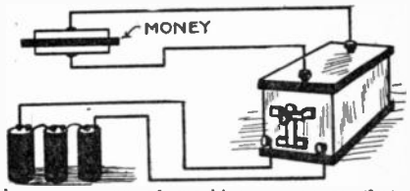
A magnetized hammer is a useful article when laying carpet, as the tacks can be picked up and driven home with one hand while the other hand holds the carpet straight, or smooths out an obstinate wrinkle.

Contributed by DALE R. VAN HORN.

Marking Money

PROCURE two blocks of wood 2 × 4 × ½ inch, cover each with a thin copper plate, or heavy tinfoil.

A wire is run from each plate to a spark coil clamp, the bills to be marked for identification in between the plates, turn on the current, and the money will be perforated with tiny holes, which, can only be seen on very close examination. This is an efficient method of marking money for identification and protection against criminals.



[illegible] way of marking money so that it will be recognized if stolen. The purloiner will never see the marks.

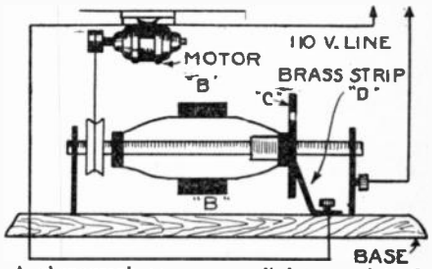
Electric Motor Governor

MATERIAL for constructing this instrument can be easily procured or may be found in the experimenter's laboratory.

A governor from an old phonograph, a hardwood base, five by five by one inch, and a pulley to fit the governor shaft are needed. Other minor requirements are: two bolts, one and one-quarter inches long; two binding posts, one to be two inches and the other three-quarters of an inch long; a brass strip, two and one-half inches long and one-quarter of an inch wide, with a hole drilled to fit a binding post in one end.

To assemble, first put the pulley on the governor shaft. Next bore two holes in the base for putting the governor shaft through. After it is securely on the base, bend the brass strip as in the diagram, bore holes in the base for fastening it down, letting the strip touch the disc (c) lightly. Then hook the motor up to it as illustrated in diagram.

When the motor starts, the governor balls (b) are carried around, the speed making them spread, pulling the disc (c) away from the contact (d). To increase speed move contact closer to disc and vice versa.



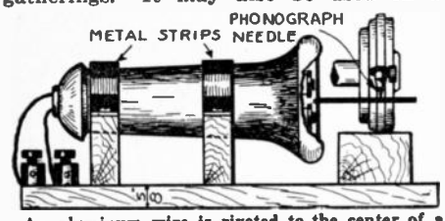
A phonograph governor applied to regulate the speed of an electric motor. The speed can be varied by adjusting the governor.

Contributed by OSBAND TURNER.

Speech Amplifier

By O. A. Buell

THIS device may be used in any of a number of ways. First, on an ordinary telephone line, by connecting it in place of the receiver usually employed. Then it may be used in series with battery and a transmitter, as an amplifier, such as is used in speaking to large gatherings. It may also be used on a

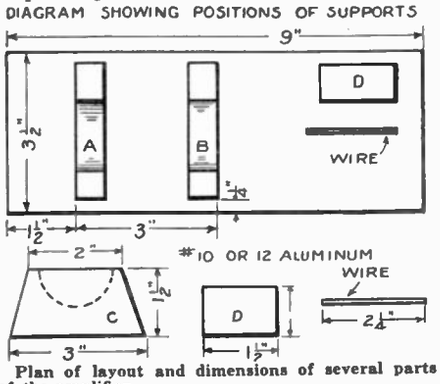


An aluminum wire is riveted to the center of a telephone receiver diaphragm and the outer end of the same wire receives in a little indentation the end of a phonograph needle so that the sound box and horn give out an amplified reproduction.

radio set, but if it is used in this manner the set must be one employing at least two stages of audio frequency amplification.

The apparatus consists of a receiver mounted as shown in the illustration, with an aluminum wire riveted to the center of the diaphragm. When in use, the end of the reproducing needle of a phonograph rests in a small cavity in the end of the wire. A rubber band is used to hold the wire firmly against the needle.

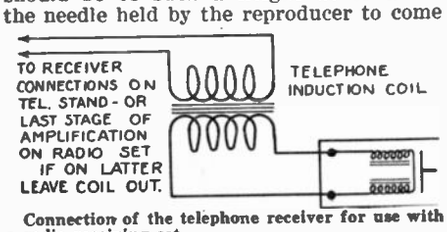
When the diaphragm, acted upon by the magnets of the receiver, is responding to a speaking current, the vibrations set up



Plan of layout and dimensions of several parts of the amplifier.

are transmitted to the diaphragm of the reproducer by the aluminum wire which sends them out in the form of sound waves through the sound box of the phonograph.

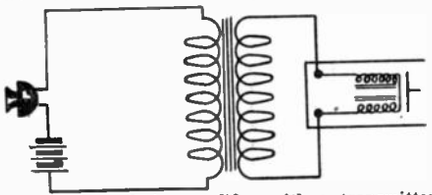
The supports (A and B) are made according to the dimensions as shown. The portion to be cut away, shown by the dotted line, corresponds to the diameter of the receiver at the points where the same rests on the supports. The block (D) should be of such a height as to allow the needle held by the reproducer to come



Connection of the telephone receiver for use with a radio receiving set.

in contact with the aluminum wire and yet not spring it in any direction, because if it does it will buckle or strain the diaphragm and the instrument will not work.

The aluminum wire is a piece of No. 10 or No. 12 gauge, two and one-quarter inches long. If for any reason aluminum wire cannot be procured, then a substitute may be made by cutting a piece of one-eighth inch sheet aluminum the desired length and about one-eighth inch wide. This may be filed down or rolled into wire. On one end of the wire a shoulder should be filed. Then a small hole is drilled in the diaphragm of the receiver and the small end of the wire is inserted and peened over. The wire should be as near the center of the diaphragm of the receiver as possible, and before it is inserted in the hole in the diaphragm a small dent must be made, with a prick-punch or some other sharp object, about one-half inch from the outer end of the wire. This hole is to receive the end of the needle of the phonograph in.



Connection of the amplifier with a transmitter and battery circuit by an induction coil.

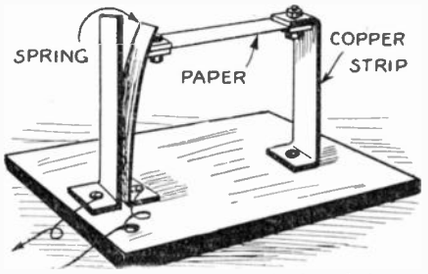
Rainstorm Alarm

A RAINSTORM alarm, as it is usually termed, but which is a water alarm, as any water which gets at it will give the signal, is based on the action of water on thin, bibulous paper.

Paper, such as tissue paper or very thin unsized paper of any kind, may have considerable strength when dry, but will be greatly weakened by being wet. The least amount of water will suffice to greatly reduce the tensile power of a strip of such paper. If such a strip is arranged so that it is strained pretty well up to its breaking point a single drop of water will cause it to part. It is easy to arrange an electric circuit in which a breakage of the paper strip will close a contact and thereby set off an alarm.

The uses of such an arrangement are obvious. It may be needed to give warning of a rainstorm, so that the windows shall be shut. It may be arranged to give notice of a rise in a body of water. Thus it could tell when a tank was full, so that measures could be taken to prevent an overflow.

A suggestion for the connections is shown which is self-explanatory. The electric contact is held open against the force of a spring by the strip of paper as indicated in the illustration. Now let the



A rainstorm alarm based on the fact that paper loses its strength when wet. This piece of paper holds the circuit open and if it breaks the circuit will close and ring a bell.

paper be moistened in any way and it will break under the stress of the spring, the spring will fly to the left, closing the circuit, the electric bell will ring or any other action will ensue according to the appliances operated on by the current in the circuit thus closed.

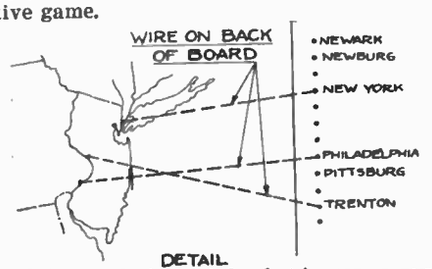
There is one objection attaching to the use of paper in this role; it has to be replaced after each operation. But the apparatus was primarily designed to notify householders of rain, and it would presumably be in an accessible place so that the insertion of a slip of paper between the clamps would be a simple and easy matter. There should be also a switch in the circuit so as to open the circuit once the alarm was heard and acted on.

Contributed by P. Stroppa.

Electric Map

By Gene Deachem

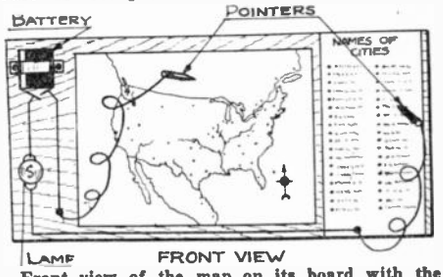
THE electric map is a simple device by which instruction in geography may be converted into an amusing and instructive game.



Wiring on the back of the electric map—a very interesting toy which will teach geography and can readily be adapted to other branches.

An outline map with no geographic names on it is pasted in the center of a thin board. On one side is a list of cities in alphabetic order indicated on the map, and on the other side an electric bulb. When the student touches a pointer to a contact opposite the name of a city on the list, say, St. Louis, and touches the other pointer to the place where he thinks the city is located, the electric bulb will automatically show whether he is right or not by lighting or failing to do so.

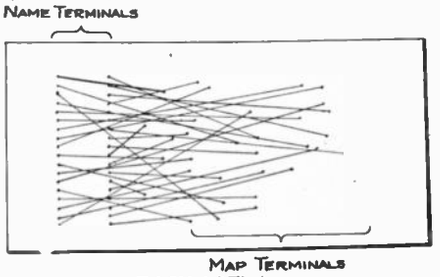
The illustration shows the wiring of the electric map. The pointers which the student uses are connected with a battery and miniature lamp, so that when the circuit is completed between the pointers



Front view of the map on its board with the list of cities on the right and the battery and little lamp on the left.

the bulb will light. A small nail is driven through the board opposite the name of each city and for each name on the list a corresponding nail is driven through the map at the location of that city; on the back of the board the two nails are connected with insulated wire.

When the two pointers are brought into contact with the two ends of the hidden wire the circuit is completed and the bulb lights: if a mistake is made the circuit



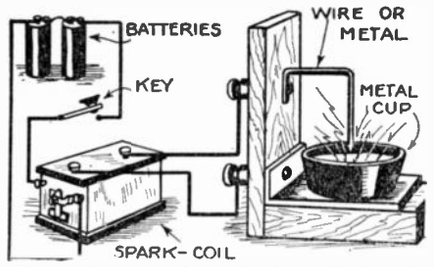
How the wires may run over the back of the board each starting from the list of cities; as this is a back view the city list is on the left and each wire will run to its own city as designated.

will not be completed and the bulb will not light.

The device may be adapted to any use where a question requires a specific answer. The questions may be listed on one side of the board and the answers on the other and the two wired as above.

Artificial Lightning

A VERY simple experiment that may be performed with the spark coil is shown in the accompanying illustration. This method of producing artificial lightning may even be used with success in small plays that call for lightning effects.



Very curious experiment in the production of a bright flash by an induction coil discharge through kerosene oil.

All that is required is a spark coil (a Ford coil will work nicely), key, batteries and the few parts to make the lightning. A piece of wood is mounted upright to another which forms the base. On the base is fastened a metal cup which has a wide mouth; this cup is connected to one of the binding posts on the upright piece of wood.

A piece of wire is bent as shown, this being connected to the other binding post. A piece of metal may be used in place of the wire by cutting the part that extends toward the cup in a point. The cup in question is filled about one-third to a half full of kerosene (coal oil) and the binding posts are connected to the secondaries of the spark coil.

The bent wire or metal should be close to the oil in the cup so that the arc will form through the oil. When the key is pressed there will be a violent flash, but as soon as the key is raised the oil ceases to burn.

Contributed by EVERMONT FISEL.

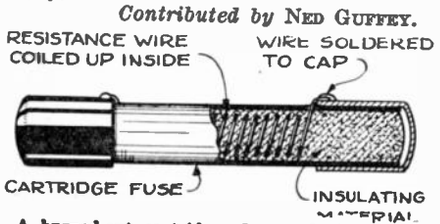
Uses for Burnt-Out Fuse Plugs

OLD burnt-out fuse plugs can be used to hold resistances of different values, having a different resistance in each one.

The covering can be taken off and the pieces of the fuse wire removed. Then one can measure the length of wire necessary for a certain resistance and coil it up so as to go inside the fuse.

The two ends of the resistance are soldered to the two terminals and some insulating material is melted and poured around the wire to keep it in place. Resistances of different values can be made this way and they can easily be placed in a circuit by inserting a fuse block so that they may be put in or removed from easily.

Contributed by NED GUFFEY.



A burned-out cartridge plug made into a convenient little resistance coil; the idea is that a number of these should be made and kept on hand for experimental uses.

Table Lamp Loud Talker

By D. D. WELLS

IN the accompanying photographs and diagram there is shown a loud talker made from an old telephone receiver and the following material, which is usually around the workshop. If not, all can be purchased for a sum not to exceed two dollars:

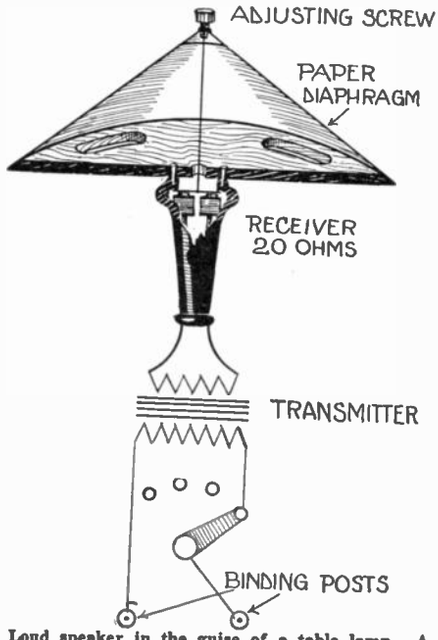
One Ford coil, two binding posts, one switch lever and knob, four switch points, eight wood screws, 1½ inches long, round head; four wood screws, 1½ inches long, flat head; 24 × 24-inch cardboard, two yards of fringe, one violin string, steel, E; one adjusting nut, 6/32-inch; one piece of threaded rod, 6/32 inch by 1½ inches long; 2 pieces of tin, two inches in diameter; two small brass machine screws.

First dismantle the receiver and take off about two-thirds of the wire winding from the 75-ohm magnets, which will leave between 20 and 25 ohms resistance; now connect back the leads.

Drill two small holes in the cap, to receive the brass machine screws which hold the cap to the sounding board. Countersink the screw heads. Punch a small hole in the center of the diaphragm for a violin string and solder the end fast, using very little solder.

Now cut out an 18-inch circle of ½-inch pine, drill a ½-inch hole in the center, also two small holes to match the ones in the receiver. Cut out four openings, as in photograph, and assemble.

The paper diaphragm is made from



Loud speaker in the guise of a table lamp. A telephone receiver acts as the standard; an adjusting screw at the apex of the conical shade enables the best results to be obtained.

heavy drawing paper. It is cut into a circle 20 inches across. Cut out a piece from the outside, 11 inches, coming together at the center. Bring both sides together and sew on taping, one-quarter inch wide. Cut two pieces of tin two inches in diameter and cone-shaped to fit inside and out of the apex of the paper cone. Pull their radial sides together and solder, leaving a hole large enough to let the 6/32-inch adjusting screw pass through the top of the cone, and shellac the surface under the tin.

Take the primary and secondary from the Ford coil and take off four taps from the fine wire which goes to the switch points. On the large wire connect the telephone receiver, leaving the iron core in, but take the rest all off, as you will not need the vibrator or the condenser.

The base is 6 × 7 × 1 inches, the two side pieces of the stand are each 4 × 10 × ½ and the two end pieces are 3 × 10 × ½, which takes the average receiver, which is 3 inches by 6 inches. It also allows for the transformer in the bottom.

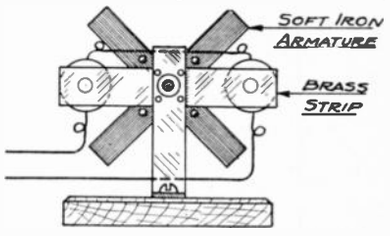
The builder can use his own way of putting on the fringe and staining; the easiest way is to use upholstering tacks for the fringe.

Connect up as in the diagram, shellac the paper cone to the sounding board and shellac up and down the seams.

Trick Motor

HERE is a motor whose construction is simplicity itself and which will give surprising results in more ways than one.

In the first place, if the speed of the motor when running varies more than one



An alternating current motor of extreme simplicity of construction, which is supposed to run with almost mathematically exact speed of rotation.

or even one revolution per minute it will stop.

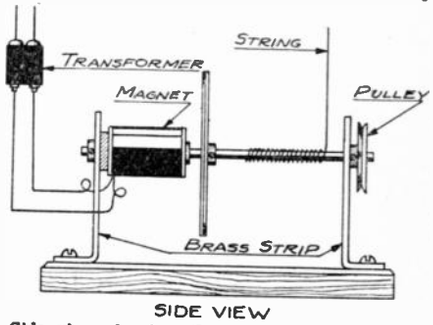
Secondly, it will stand a big load for its size without varying in speed one revolution per minute, the power depending on the size of the magnets and amount of current used. The author has one that will run 1,800 r.p.m. at 3 volts A. C., with about one-half ampere of current, with no load.

Third, it has no commutator or brushes or anything resembling them. Neither has it any armature coils.

It must be run on alternating current, and preferably 60 cycles. A rheostat or transformer must be used to cut down the voltage so as not to burn up the magnets or fuses.

The construction of the machine is clearly shown in the diagram and requires no further explanation.

The operation is quite unusual. In order to start it the motor must be brought up to the proper speed by some means, such as a string wound around the shaft and pulled. The proper speed for four armature poles shown and on 60-cycle current is 1,800 r.p.m. If an electric light bulb is placed behind the armature shadows will be seen spinning around in the armature when the motor is nearly at the correct speed. If the motor is running too fast they will spin one way and when it slows down to correct speed they will stop spinning, and when it slows down below the correct speed they will start spinning the other way. When the shadows just stop spinning the current should be turned on (and not before), and the motor should keep on running at that speed. It may be hard to see the shadows at first, but after a little watching and practice you will be able to start it every



Side view showing the mounting of the little motor and the starting string; it has to be started by hand like an old-fashioned automobile engine.

time with one trial. The motor runs by keeping in step with the alternating current.

It can be used to run small devices, and if fan blades are fastened on the end of the shaft it makes a very effective and efficient fan.

Contributed by GORDON L. REED.

Making Fixed Condensers

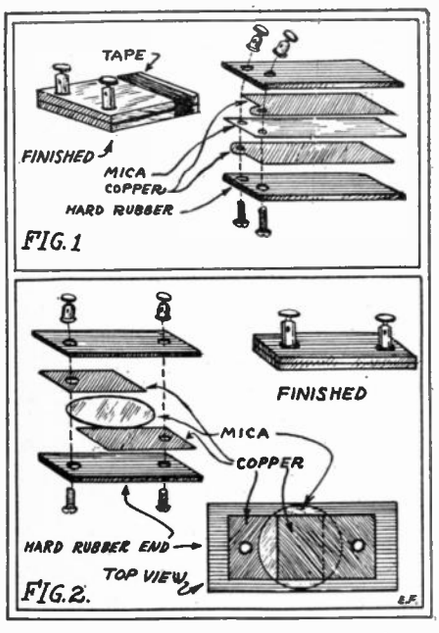
FIXED condensers are often needed in telephone work, in radio sets, and in other electrical work, but at times they cannot be obtained just when needed. For those who will take the time, quite efficient condensers may be made from parts found around the shop.

In making the condensers as shown in Fig. 1, two wood or hard rubber end pieces are required. These should be perfectly flat, and thick enough so that they will not warp out of shape and change the capacity of the condenser. Holes are drilled in these pieces as shown.

The metal plates are next procured. These may be thin sheet copper or even tin foil, and are cut as shown, with holes for the binding posts to which they make connection. For the condenser a piece of mica or waxed paper will insulate the two plates. The assembly of the condenser is clearly shown, two binding posts passing through the two holes which serve to make connection to the plates and also to hold them together. If desired, more plates may be added, in the manner shown, each metal plate being insulated from the next with mica or waxed paper.

In Fig. 2 is shown another efficient type, more easily constructed than the first. It consists of the end plates of hard rubber, bakelite, etc., the metal (tin foil or copper) plates and the mica insulation. In this type holes are drilled in each end of the end plates instead of both in one end, thus giving more pressure on the plates. The mica may be taken from an ordinary fuse plug, and is split with a knife into a number of thinner pieces. The condenser is built up similarly to the one shown in Fig. 1, any number of plates being used, according to the capacity desired.

Contributed by EVERMONT FISEL.



Two systems of construction of fixed condensers made from parts to be found around the ordinary electrical experimenter's shop, such as mica, copper plates, odd binding posts and the like.

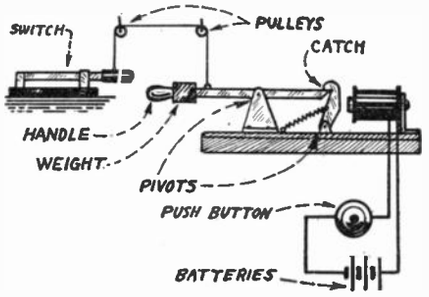
Electric Switch Control

A VERY simple device may be easily constructed to control any desired switch. A push button or time switch may be used to control the apparatus, and the instant the contact is made, the switch to which the control apparatus is connected will be opened.

A base is procured and an electromagnet mounted on it. In front of this there is an armature which is made as shown. This is on a pivot or hinge, and a catch is formed on the top. A small spring catch is also fastened on the armature. Another lever is arranged on a hinge, one end being placed so as to remain under the catch on the armature. On the other end is placed a weight and handle for resetting the lever. On this end is attached a cord which is run through two pulleys and connects to the handle of the switch which it is to control.

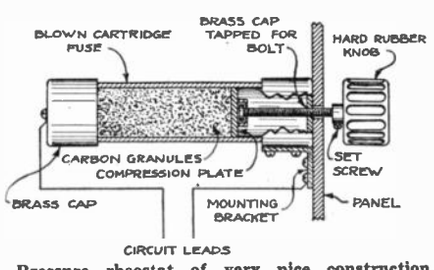
When contact is made in the battery circuit leading to the magnet, the armature will be pulled to it, thus releasing the end of the lever, the weight causing one end to lower, thus throwing out the switch it is fastened to. This device will no doubt save many steps and much time.

Contributed by EVERMONT FISEL.



Very simple switch operated by the attraction of an armature releasing a catch, and causing the switch arm to be very rapidly jerked out of the contact leaves.

Carbon Grain Rheostat



Pressure rheostat of very nice construction, using carbon granules at varying pressure to produce different resistances.

THE illustration shows the construction of a compact rheostat made strictly from odds and ends, mostly ends. The shell is a blown cartridge fuse or it may be even a shell from a large gauge shot gun. It is fitted with a piston and mounted with brackets against a panel, and a screw is provided to screw in and out of it like a piston rod, the inside end of the screw having a plunger fitting the tube fairly closely.

The carbon granules may be made by powdering battery carbons and winnowing out the dust. When packed with such granules and placed in a circuit with a source of current, the resistance of the rheostat will modify the current according to whether the screw is turned in or out, pressure decreasing the resistance, and release of pressure increasing it.

As shown in the illustration, there are caps at each end, but it is evident that the construction can be modified in all such respects.

Contributed by RALPH SWEET.

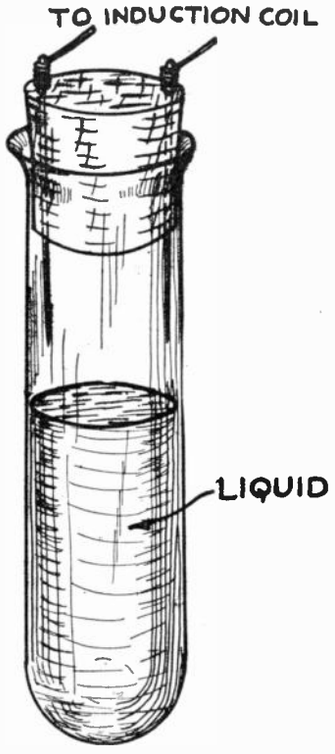
Fluorescent Vacuum Tubes

AS is well known, the electric discharge in vacuo gives rise to ultraviolet rays. The vacuum tubes described below are designed to show the fluorescent effects produced by these rays. For their construction, several large test tubes with rubber stoppers to fit will be needed.

With a pair of pliers two large needles are forced through each stopper so that the points extend an inch or more beyond the smaller end of the stoppers. The electrodes thus formed should be spaced as far apart as the width of the stopper permits.

A small quantity of some fluorescent liquid is now poured into each tube. Suggested solutions are those of fluorescein, uranine, and quinine. Ordinary red ink (aesculin) diluted with water will display a rich, blood-red glow. The tubes are exhausted to a pressure of about 3 mm. by boiling the liquid and corking the tube tightly immediately after removal from the flame.

I used a transformer giving 1000 volts to excite the tubes, and pretty effects were obtained in the dark. If an induction coil is used, a small spark gap should be inserted in series with the secondary.



Fluorescent effects are produced in a test tube partly filled with different liquids, the effect depending entirely on the solution used.

Electric Tuning Fork

THE tuning fork illustrated is mounted on a baseboard by means of a rigid standard which raises the fork some small distance from the baseboard.

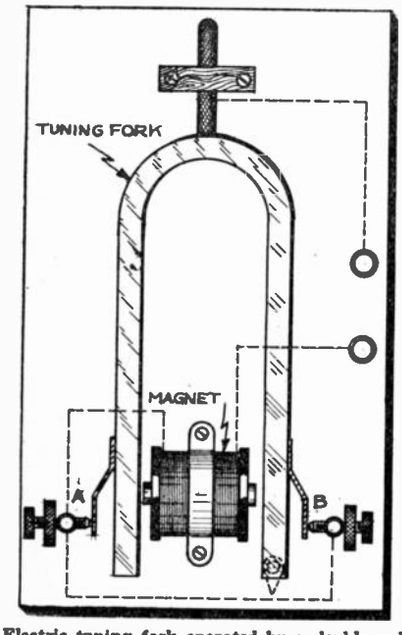
Near the end of the prongs is mounted an electro-magnet in such a position that the ends of the core are a short distance from the respective prongs. The magnet is wound to suit the conditions of the builder; *i. e.*, if the instrument is to be used with dry cells, the magnet should be of low resistance; but if the D. C. power supply is to be used, a high resistance coil should be wound.

The prongs are equipped with contact strips, making contact with the adjustable points at (A) and (B).

It will be noticed from the wiring that the prongs are set in motion in exactly the same manner as is the armature of an electric bell or buzzer, and if the prongs are equipped with pointers the action may be recorded on a revolving cylinder.

Although the above and the illustration are for the employment of D. C. only, the instrument will respond equally well on A. C. by connecting the coil directly in series with the A. C., the pulsations or alternations of the current causing the prongs to vibrate.

Contributed by ROSCOE BETTS.



Electric tuning fork operated by a double-ended electromagnet, attracting first one limb and then the other.

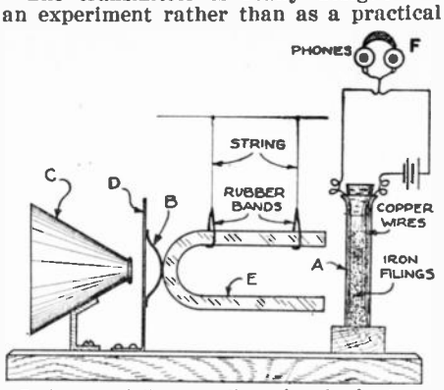
Iron Filings Microphone

THE ordinary microphone transmitter used for telephoning utilizes the vibration produced by the voice on a diaphragm to change the resistance of a small quantity of carbon granules in a case behind the diaphragm.

In the present transmitter the speaker stands in front of the mouthpiece (C) and his voice waves impinge upon the diaphragm (D). The bend of a horseshoe magnet (E) rests lightly upon a spring (B) attached to the diaphragm. It is suspended by strings attached to rubber bands so as to be very sensitive to motion.

In front of the poles of the magnet is a test tube (A) containing iron filings; terminals from a circuit, including battery and phones, enter the tube and are imbedded in the filings. When this microphone is spoken to the slight vibrations of the magnet change the density of the lines of force passing through the iron filings, thereby changing the resistance of the filings, so that the telephones are supposed to repeat the voice.

The transmitter is really designed as an experiment rather than as a practical



Curious variation on the microphonic transmitter, using the variation in resistance of iron filings due to changing of the magnetic field for producing the speaking current.

telephone, and it may lead to very interesting laboratory work.

Contributed by SCOTT WILLIAMSON.

Electric Whistle Timer

By GEORGE G. MCVICKER

IN commercial establishments where it is customary to blow a whistle at the morning, noon and evening work hours, the accompanying automatic electric timer will be of good service. The device may be constructed from parts found about most shops and none of the mechanism is so accurate but that any one knowing how to use tools can make and assemble the parts.

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EDITOR.

In the illustration the can (A) of about five gallon size is set on a shelf and connected to an outlet waste pipe at the bottom. Another can of about three gallon capacity somewhat smaller in diameter than the former is provided with a flap valve in its bottom and this can is attached to the whistle cord. A peg six inches long is set in the center of the bottom of the large can so that when the smaller can descends the flap valve will be pushed up and opened.

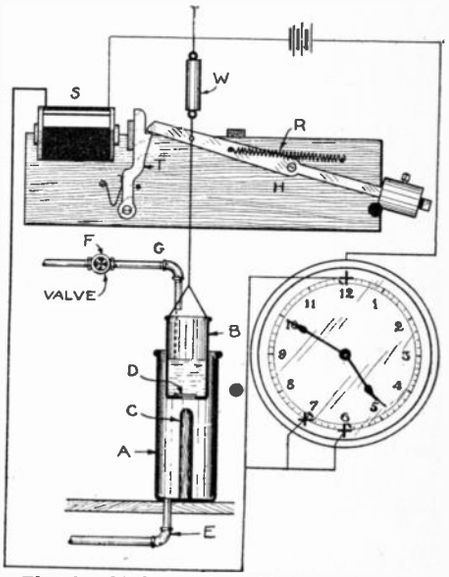
A feed pipe through which water trickles fast enough to fill the three gallon can in six hours' time is arranged to feed to the smaller can, a valve at (F) being provided to regulate the flow. The flow may be more than suggested as the excess will simply overflow into the larger can and pass to the waste pipe. On the panel is fulcrumed the arm at (H) with one end attached to the whistle cord and on the other end a weight sufficiently heavy to overbalance the weight of the empty three gallon pail. The end of this arm rests upon the latch (T) and is held there until the action of the solenoid coil (S) pulling on the soft iron core, releases it.

The action then is as follows: An electric circuit being closed at the desired time a current passes through the coil, attracts the core and releases the arm. The three gallon pail now being full of water, descends, stretching the spring (R) and lifting the weight on the end of the arm (H). This pulls the whistle cord and allows the whistle to blow.

As the valve in the bottom of the three gallon pail is opened by the peg in the bottom of the other can, the water is allowed to flow out. This will take some time, the size of the valve determining the time during which the whistle is to be blown. As the water becomes nearly discharged from the small can the weight gradually lifts the empty can but not sufficiently to allow the whistle valve to close. But as the can moves up the action of the spring (R) becomes greater and when the center of this action is passed, that is, when the spring can act in a straight line, it pulls the arm and can up quickly. This shuts the whistle off without the dreaded lowering moaning sound caused by a slow closing whistle valve.

So far what has been explained would blow the whistle at each hour for which the clock contacts were set, but while a whistle is to be blown at seven in the morning it is not usually to be blown at seven in the evening and while it will have to be blown at six in the evening it will not do to blow it at six in the morning. The same applies to the noon and midnight twelve o'clock periods.

To accomplish the selective blowing a four-pronged brass spider is set at each of the hours at which the whistle is to



Electric whistle sounder; this keeps the whistle blowing for a regulated time and shuts the whistle off suddenly. It is operated by a clock and can be blown at various intervals, not necessarily twelve hours apart.

be blown. On the face of two opposite prongs of the spider is attached a plate of fiber. The spider is set so that it may rotate on a pin at its center but all parts of it are insulated from the metal parts of the clock. On the end of the hour hand (the small hand) a brass spring is attached to its end and in a position as shown a fiber dog is attached to the clock face so that when the spring on the clock hand reaches it the spring will be caught by the pin at the hour mark. But as the hand passes on, the end of the spring will pass over the pin, and as it does so the dog will be thrown out and the spider will turn one fourth revolution.

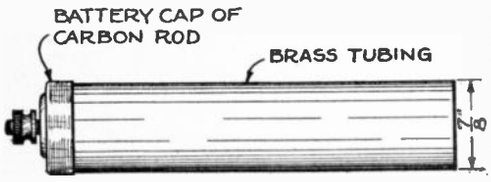
The action of the spring on the prong gives this motion for turning and at the same time makes a contact for the electric circuit providing there is not a fiber plate on the prong it meets. Thus the circuit is closed at each alternate time the hour hand passes the hour mark. The other end of the electric circuit is attached to the clock works and passes through a set of dry cells sufficient to operate the coil (S).

Handles for Electric Shock Coils

WHILE trying to find something in the way of handles for a medical coil, I found that the cap off an old dry battery carbon would fit over a piece of seven-eighths inch brass pipe or casing.

After soldering a couple of tubes and caps together and giving them a polish they make a very good pair of handles.

Contributed by H. McCULLOUGH.



A battery cap from a round carbon makes a very elegant terminal for a piece of brass tubing, to constitute a handle for an electric shocking machine.

Electric Door Lock

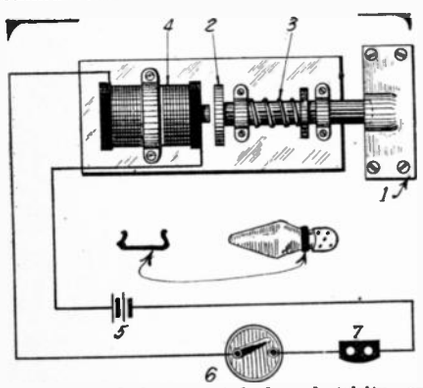
THE characteristic of this door lock is that the electric contact requisite for opening it is made by means of a strip of copper crossing the sole of the shoe.

The hasp (1) is attached to the door jamb; the rest comprises essentially a spring (3), an armature (2), and an electromagnet (4). The wiring is clearly shown in the illustration.

The shoe has sprung upon it a cross piece of copper just forward of the heel, When this is brought in contact with the two terminals at (7), assuming that the switch (6) is closed, it completes the circuit, the magnet is excited and draws the bolt from the hasp.

It will be understood that all the locking mechanism is placed inside the door so as to be out of sight. The switch (6) and battery (5) can be placed anywhere desired. When the foot is taken off the contact the spring forces the bolt into the hasp again.

The contacts at (7) may be two inconspicuous tacks; the push-button or switch may be in full sight. Closing the circuit there will have no effect, however, unless the two tacks are brought into electric communication with each other.



Ingenious lock, operated by electricity and made to open by a secret contact operated by a plate on the sole of the shoe.

The opening of the door is made more of a mystery if a conspicuous push-button or switch meets the eye. Of course such switch or push-button must be near the two tacks, so that one person can put the shoe upon the tacks and close the switch or push-button from one position.

Contributed by H. MANUEL.

Electric Welder

THIS welding device is excellent for light work such as welding wires, and at the same time is an interesting appliance to work with.

An iron pipe one by fifteen inches is insulated with mica and a coil of heavy iron wire wrapped around it. This should be mounted on a slate base. A carbon block and a carbon pencil, with some kind of a holder such as an old screwdriver, will also be required.

The carbon block can be made out of the carbons from old dry cells. The carbons should be cut so that the sides are square. Eight of these may be bolted together in the form of a square and tied. This will give a very good block.

The carbon pencil can be made from the carbon out of a flash-light cell. It should be pointed on one end and clamped to the handle on the other.

The object to be welded is to be placed on the carbon block, then the pencil is touched to the carbon block and quickly drawn away about a quarter inch. This strikes an arc. Next push the carbon pencil toward the object to be welded, but do not touch the metal. The intense heat set up by the arc will in a very short time melt the object near it, and the metal will run together.

Interesting Articles to Appear in October Practical Electrics

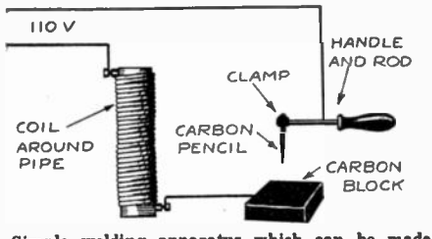
Phenomena of Magneto-Striction
By Edward Shaw, A.M.A.I.E.E.

Talking Transformers and Dynamos
By Eugene J. Dwyer

Induction Motors
By Harold Jackson

Applications of Photo Electric Cells
By H. Vigneron

Testing Metals with X-Rays—II
By Dr. Franz Fuchs, Munich



Simple welding apparatus which can be made very readily and which will do for welding or soldering, especially of small objects.

Very good work can be done with this device after a little practice. Smoked or colored glasses should be worn when using the apparatus, as the extremely bright light of the arc is injurious to the eyes.

Contributed by JACK PARRISH.

Testing Magnets

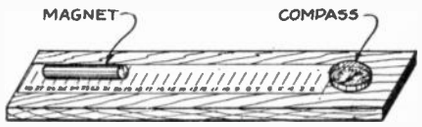
THIS instrument is very easily constructed. In making it the following materials are required:

A pocket compass, two bar magnets, and a board.

Take a board about three feet in length by four inches in width and one-half inch thick. At the end of the board, about one inch from the edge, bore a hole so that the compass will fit tightly therein. The compass must at least penetrate the board so that the glass disk will be a little above the board and the needle of the compass will be about on the level of the surface of the board.

Now begin from the compass and measure one inch spaces to about thirty in number and mark the lines beginning from the compass needle one, two, three, four, and so on.

When this has been done, place the board on a table. The compass needle will then come to rest pointing to the magnetic north and south. Turn the board so that the needle will be at right angles to the longitudinal axis of the board. The compass needle must be right over the north and south poles thereof, and the north point of the needle must point to 0.



A simple apparatus for testing the polarity of a magnet and its intensity of magnetization. The distance of a magnet pole from a compass tells the story, when the deflection of the compass is considered.

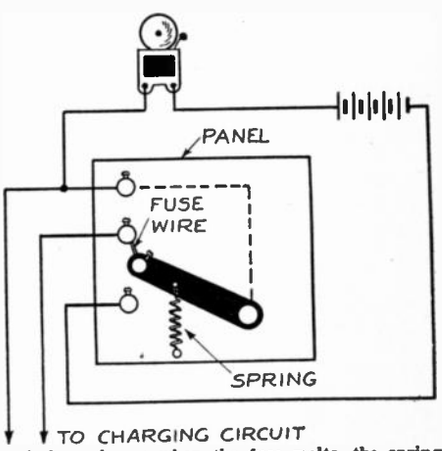
The instrument is now ready for use. Take one of the magnet bars and place it on the board, so that either one of its poles points to the compass needle. Now move the bar magnet toward the compass needle until the needle shows deflection. This may be as much as ten degrees on the compass dial with a distance of twenty-five inches for the pole of the magnet under trial. Remove this magnet, and place the other magnet at the same distance. The magnetic needle may be deflected twenty degrees at the same distance of twenty-five inches. This shows that the bar magnet tested last was stronger than the first one, or ten degrees stronger, taken arbitrarily.

An electromagnet can also be tested in the same manner. This instrument can be used to test any of two bar magnets so as to determine which of them is the stronger.

Contributed by PASQUALE STROPPA.

Fuse Alarm

THE illustration shows a fuse alarm which can be used to advantage on a battery charging circuit or on any circuit which might cause trouble if opened for any length of time.



A fuse alarm; when the fuse melts, the spring pulls down the switch arm and closes an alarm circuit to disclose the trouble.

The instant the current becomes too great and the fuse is blown the spring pulls the metal arm down to another terminal post, which closes a battery circuit through an alarm bell.

This device can be used to great advantage when there are quite a number of different circuits with fuses in different locations, by running the alarm circuits through annunciator drops at some central location so as to determine the exact location of the blown fuse when the alarm sounds.

Contributed by J. G. KYPER.

IN this department are published various tricks that can be performed by means of the electrical current. Such tricks may be used for entertaining, for window displays, or for any other purpose. This department will pay monthly a first prize of $3.00 for the best electrical trick, and the Editor invites manuscripts from contributors.

To win the first prize, the trick must necessarily be new and original. All other Elec-Tricks published are paid for at regular space rates.

Human Battery

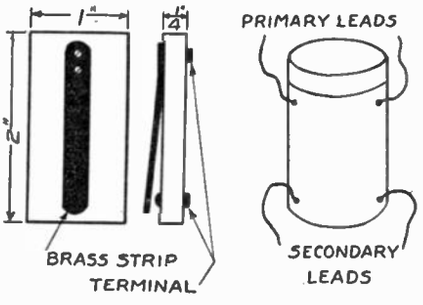


FIG. 1

FIG. 3

FIG. 2

Details of the armor of the human battery who gives shocks to those who venture to shake hands with him, a human representative of the electric flashes.

A FELLOW walks up to a friend and grasps both his hands as he greets him. The friend receives a shock and begins investigating to find out what it was that he came in contact with.

The secret revealed. The materials necessary for producing the shock are: Four vest pocket flashlight batteries; a small induction coil (about three inches long and 1¼ inches in diameter; this can be made at home). Some flexible cord. A round wooden pill box (about 3½ by 1½ inches inside). Some strips of brass. The coil may be constructed on the lines of the medical coil in the March edition of PRACTICAL ELECTRICS, except that the end pieces should be round instead of square, so that it will fit tightly into the wooden box; the top carries the vibrator; the finished coil should appear as Fig. 3.

A small switch should be constructed as shown in Fig. 1. Next make a very light wooden box just large enough to carry the batteries as shown in Fig. 4.

Next cut out two pieces of brass or tin as shown in Fig. 2, and cover them with mica or even a few thicknesses of paper; the insulation should be one-sixteenth inch larger all around than the brass clips; these clips are to fit the second finger of the left and right hand.

The coil is then put in the right-hand pocket, the battery is carried in the hip pocket and connected with the switch, which is carried under the coat, and in such a position that when the arm is pushed against it it closes the circuit and starts the vibrator on the coil; the secondary is connected to the metal tips on the fingers, through the sleeves by insulated wires; these should be concealed as much as possible; the instruments are connected as shown in Fig. 4.

All conductors should be well insulated except the electrodes or clips which are bare on the outside. It is important that the coil should be carried inside the box as it protects the vibrator. Care should be taken to insulate the insides of the electrodes or the joke will be on oneself.

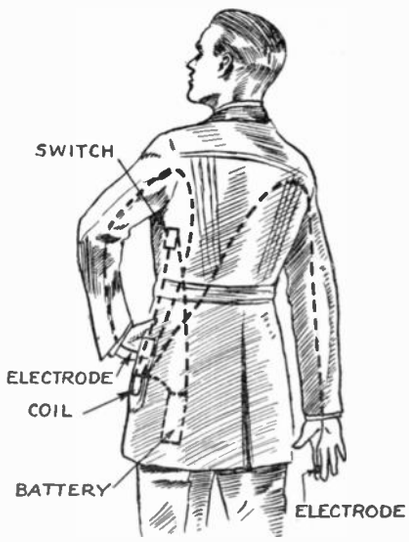


FIG. 4

A view of the complete armor and of the battery and appliances in place upon the figure. It will be seen that all is concealed by the outer garments.

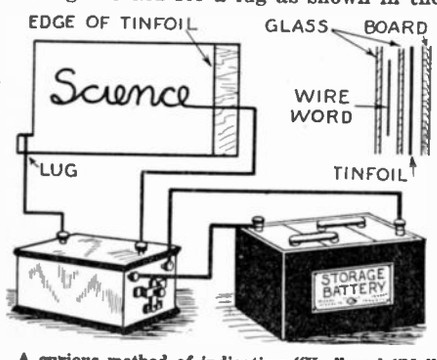
Contributed by OLLIS ALLEN.

Electric Sign

By WILBUR LEMON

THIS electric sign is made of a board about 18 by 16 inches, two pieces of window glass same size (not too thick), a piece of tinfoil same size, and a word made of bent wire.

The tinfoil is placed on the board after cutting one end for a lug as shown in the illustration. Over the tinfoil are placed the two pieces of glass, with the wire word sandwiched between them. The connections are made from the tinfoil and the wire word.



A curious method of indicating "Yes" and "No" spark coil discharge. The inscription of wire between two sheets of tin-foil produces the effect.

Connect the terminals to the secondary of an induction coil. The result is that the word will have an illuminated appearance caused by the electric discharge. The best results are obtained at night.

Mysterious Answers

By CLAUDE OWEN

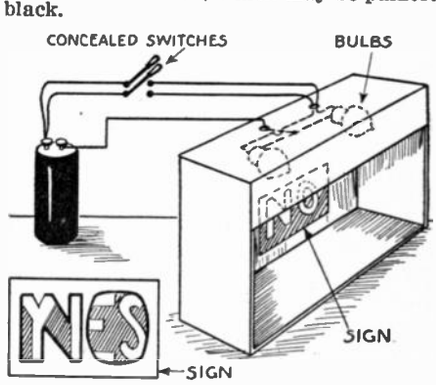
THE following experiment depends upon the action of complementary colors. Two electric lamps are required, one of which must be light green and the other red.

The idea is this: If a green opaque screen is placed in front of the red light, it will appear practically black, the lamp being concealed from the observer, and if an orange screen is placed in front of the same lamp it will show hardly at all. If the green lamp is replaced by a red one, both screens will appear rather gray. Some experimentation will be required to get the proper effect.

We now come to the apparatus. A portion of the lid of a cigar box is cut off so that when closed it affords a screen for a red and a green lamp which are to be placed behind it. These lamps can be covered by regular dips sold for the purpose or with transparent aniline colors which may be dissolved in alcohol or in water.

The general arrangement is shown in one of the illustrations. The lamps appear in dotted lines behind the screen afforded by the cut-off top of the box and part of a sign is seen below, which is supposed to be illuminated by one of the lamps.

A sign which will give both "no" and "yes" comes next, and the sign is shown in the other illustration. The shaded portions are orange paint, and the unshaded portions are green paint. This is pasted to the back of the box, which may be painted black.



A curious method of indicatig "Yes" and "No" electrically on a screen so as to produce answers to questions for exhibition purposes.

The operation is simple. When the red light is turned on, the green, which is represented by the unshaded portions, will appear black, thus giving the word "yes." The green is turned on and the red off, and both orange and green appear as a sort of gray, and the word "no" will be discernible.

Latest Electrical Patents

Display Device

To display all sides of a piece of apparatus mirrors are used. In this case a suction sweeper in operation is placed on a glass plate and the under side of it is reflected by the mirrors, thus showing the action.

Patent 1,492,324, issued to Howard E. Hoover.

Dry Cell Indicator

To determine the condition of a dry cell an ammeter or voltmeter is usually used. The simple method shown in the illustration does away with a measuring instrument. The current from the cell passes through moistened paper saturated with phenolphthalein which changes color, the depth of color depending upon the strength of the current and therefore indicating the condition of the cell.

Patent 1,497,388, issued to Edward M. Sterling.

Display Apparatus

In the attractive display device shown in the illustration oranges or other fruit are carried up into the tree on a belt driven by an electric motor and then roll down the spiral track to the base.

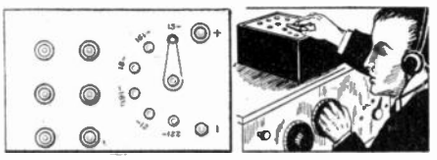
Patent 1,492,105, issued to William F. Reynolds and William A. Cathey.

Figure Toy

The toy dog shown is for children. Jerking the strap causes the dog's tail to wag and his mouth to open. Pressing the push button causes him to bark, which is accomplished by means of an electric horn.

Patent 1,490,185, issued to Walter Ross.

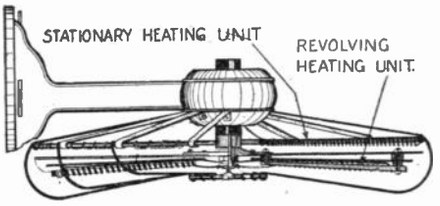
Battery



Instead of using binding posts connected to different portions of a battery this method makes use of a switch lever and contact points. Special arrangement is provided for rigidly attaching the contact points to the frail cardboard casing which holds the cells.

Patent 1,492,297, issued to Harry T. Hipwell.

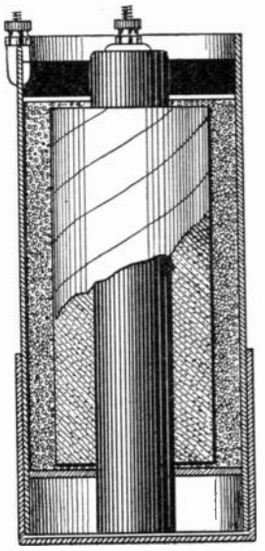
Electric Fan and Heater



Greater efficiency is claimed for this heater by combining it with an electric fan. A heating unit is carried by the fan blades, which blades also act as a heat reflector. Another unit is mounted directly behind the blades. The air is heated as it passes over the units.

Patent 1,479,494, issued to Michael Beck.

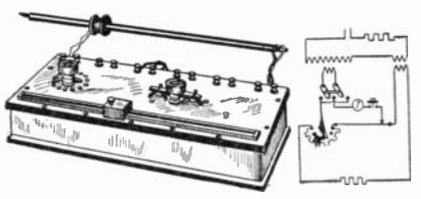
Dry Cell



A water-renovated reserve cell comprising a container holding a material capable of rapidly absorbing the water is shown in the illustration. A cup adapted to serve as a measure of the liquid also acts as a bottom closure for the cell.

Patent 1,501,091, issued to R. C. Benner and H. H. Thompson.

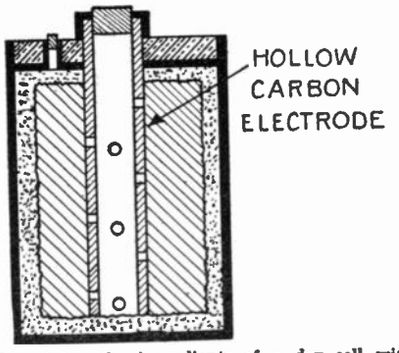
Alternating Current Potentiometer



When manufacturing a number of coils in quantity production a quick and accurate test of the number of turns is desired. With this method the coils under test are quickly compared with a standard by a bridge method and an alternating current indicating instrument gives the result.

Patent 1,487,615, issued to Byron W. St. Clair.

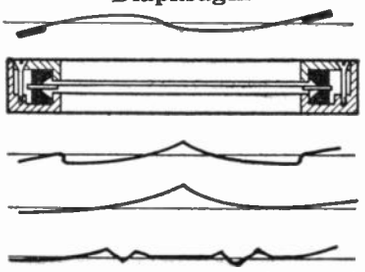
Dry Cell



By mixing the ingredients of a dry cell with alcohol instead of water and then forming the pasted solution in the cell, on evaporation of the alcohol the ingredients are thoroughly mixed and the mould is porous and easily absorbs water. The water may be added at any time after manufacture of the cell through the hollow carbon electrode.

Patent 1,484,780 issued to G. W. Heise and C. W. Brokate.

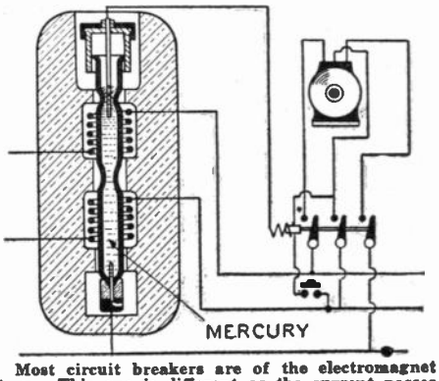
Diaphragm



Special construction of this diaphragm not only stiffens it but stretches it radially when clamped in place. It is made of thin sheets of absorbent material saturated with bakelite varnishes and baked. Especially recommended for telephone receivers and the like.

Patent 1,484,821, issued to Harry L. Duncan.

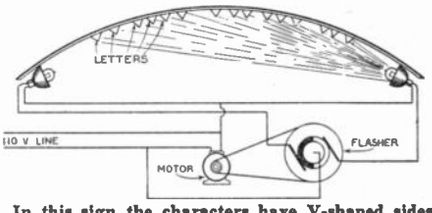
Circuit Breaker



Most circuit breakers are of the electromagnet type. This one is different as the current passes through a column of mercury in a glass tube. An overload produces mercury vapor which collects in the narrow portion of the tube and forms bubbles, which opens the circuit.

Patent 1,488,939, issued to Frederick L. Re Qua.

Illuminated Sign



In this sign the characters have V-shaped sides and the sides are illuminated alternately by two electric lamps. The lamps are flashed first on one side and then on the other by a mechanical switch whereby an apparent oscillating motion is given to the characters of the sign.

Patent 1,501,102, issued to L. Duncan and C. P. Upton.

Short-Circuits

THE idea of this department is to present to the layman the dangers of the electrical current in a manner that can be understood by everyone, and that will be instructive, too. We have given monthly prizes of $3.00 for the best idea on "short-circuits." Look at the illustrations and send us your own "Short-Circuit." It is understood that the idea must be possible or probable. If it shows something that occurs as a regular thing, such an idea will have a good chance to win the prize. It is not necessary to make an elaborate sketch, or to write the verses. We will attend to that. Now let's see what you can do!

Here rests in peace
Poor Jonathan McCrane.
His streaming spray
Crossed a lighting main.
—GEORGE G. MCVICKER.

In this new grave
Lies Mary Lomb.
On a register she stood
With an electric comb.
—JOHN WATERS.

Beneath this sod
Lies Joseph McStein.
His tobacco can
Touched the feeder line.
—PHILLIPPE A. JUDD.

Deep in this ground
Lies Patrick Le Donne.
He stood in the wet
And used the 'phone.
—JAMES P. RICH.

Lady Put Socket In Her Mouth— Revived Later

By The Associated Press.

New Orleans, May 29.—Mrs. Maggie Menendez, 30, disconnected her electric curling iron last night and preparatory to take the cord from a droplight, placed the socket in her mouth. She was revived by physicians who arrived aboard an ambulance. Her condition is not serious.

Man Sustains Severe Shock When He Steps on Broken Wire in His Yard.

John Harris of 393 West street sustained slight injuries yesterday afternoon shortly before 3 o'clock when he stepped on a 2300-volt electric wire which had broken and fallen to the ground in front of his home.

He was thrown to the ground by the force of the shock, but it is believed he sustained no internal injuries.

The broken wire set fire to the grass in front of the Harris home and it was while attempting to put out the blaze that Mr. Harris stepped on the wire.

Dr. F. H. Everett, who was called to attend Mr. Harris said last night the only injuries sustained by his patient were two small burns on one arm. The effect of the shock will confine the man to his home for a few days in the opinion of the physician.

The grass fire was put out with brooms and water by members of the fire department, and the broken wire was repaired last night by workmen of the Rutland Railway, Light & Power company.

This grave is made
For Nathan Fritch.
Whose careless drill
Struck a motor's switch.
—WALTER WINTER.

THIS department is conducted for the benefit of everyone interested in electricity in all its phases. We are glad to answer questions for the benefit of all, but necessarily can only publish such matter as interests the majority of readers.

1. Not more than three questions can be answered for each correspondent.
2. Write on only one side of the paper; all matter should be typewritten, or else written in ink. No attention can be paid to penciled letters.
3. Sketches, diagrams, etc., must always be on separate sheets.
4. This department does not answer questions by mail free of charge. The editor will, however, be glad to answer special questions at the rate of 25 cents for each. On questions entailing research work, intricate calculations, patent research work, etc., a special charge will be made. Correspondents will be informed as to such charge.

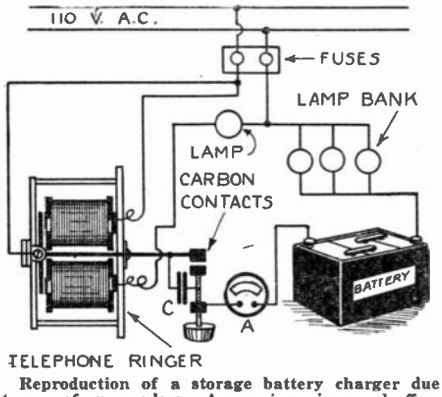
Kindly oblige us by making your letter as short as possible.

Simple Battery Charger

(460)—Dr. R. H. Kirk, Pittsburgh, Pa., writes:

Q. 1.—I have been informed that it is possible to construct a rectifier for charging storage batteries from the 110-volt A. C. line by using a telephone bell-ringer and a few lamps for resistances. I am inclosing a diagram and would like to know if it is feasible.

A. 1.—We are reproducing the diagram for the benefit of other readers, as the scheme is feasible and makes a very simple battery charger. The ringer magnets are connected in series with a 25-watt lamp. The ringer is of the polarized type and vibrates in synchronism with the frequency of the alternating current. A carbon contact is placed on the vibrator and this makes contact with another carbon contact mounted on an adjusting



Reproduction of a storage battery charger due to one of our readers. A very ingenious and effectual connection.

screw. It may be advisable to place a one-microfarad condenser (C) across the contacts to prevent excessive sparking. The battery is charged in series with a lamp bank resistance which may consist of three 100-watt lamps or the equivalent. A direct current ammeter (A) should be used to determine the charging rate of the battery and also for use as a polarity indicator to show that the battery is being charged and not discharged.

Q. 2.—Does this rectifier rectify one side of the cycle or both sides?

A. 2.—This rectifier only rectifies one half of the cycle. In order to rectify both sides extra contacts would have to be carried by the vibrator, and on account of the extra weight it probably would be difficult to make the rectifier work properly.

Choke Coil

(461)—R. F. Merril, Toronto, Canada, asks:

Q. 1.—Kindly tell me the formula used in calculating the resistance of a choke coil when used as a rheostat.

A. 1.—The D. C. resistance of a choke coil is merely the resistance of the wire used in its winding. This, of course, is easily obtained by calculating or measuring the length of the wire and its diameter and looking up the resistance in wire tables in electrical handbooks. But a choke coil is usually used for impeding the flow of alternating current and the resistance it offers to alternating current is much greater than the resistance it offers to direct current. This is due to the inductance in the winding increased in effect by the iron core. Although the inductance can be calculated it is much simpler to measure it, as the inductance depends upon the size and shape of the coil, the amount of iron in the core, if iron is used, and the shape of the core, and the frequency of the current. There is no general formulae that will apply to all coils. After the inductance is found, the impedance must be calculated, but this varies, which is the result of inductance and resistance acting together with the frequency; that is, the impedance of the coil is much higher at a frequency of 1,000 cycles than it is at 100 cycles. The simplest way to measure the impedance of a choke coil is to connect it to the alternating current line on which the coil is to be operated and measure the current and voltage and calculate the apparent resistance in ohms by Ohm's law. The result will be the impedance, approximately.

Condenser Queries

(462)—Arthur Avery, Bow Island, Alberta, asks:

Q. 1.—Would you advise using a variable condenser in a medical coil to take the place of the variable primary coil?

A. 1.—We know of no way in which a variable condenser could be used in a medical coil.

Q. 2.—Could a variable resistance be used in connection with a fixed condenser to make a variable condenser?

A. 2.—No. A resistance has no effect on the electrostatic capacity of a condenser.

Q. 3.—Can condensers be repaired, and how?

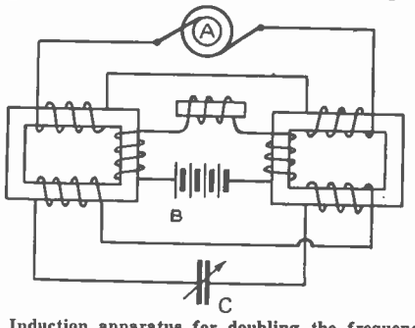
A. 3.—A condenser consists of two conducting plates generally of metal, insulated from each other and placed close together, parallel and not touching. There are many types of condensers. Some consist of metal plates placed close together and insulated by the air space between them. Should the plates touch each other the condenser will not work and it can be repaired by separating the plates. Other condensers consist of sheets of tinfoil insulated and separated from each other by sheets of paraffin paper. Occasionally a high voltage across the condenser sheets will puncture the paper and the tinfoil sheets will touch each other. This can be repaired by taking the condenser apart and patching the hole in the paper insulation. A one-microfarad condenser, as often constructed, has two strips of tinfoil about 15 feet long and 4 inches wide separated by strips of paraffin paper, the whole being wound up in a tight roll. Sometimes glass or other non-conductor separates the metal plates or foil. The intervening non-conductor is called the dielectric. The constants of the coil vary with different dielectrics.

Frequency Doubler

(463)—Lewis Alexander, San Marcos, Texas, writes:

Q. 1.—In the November, 1923, issue there was an article explaining how to triple the frequency of an alternating current. The article stated that similar methods were used for doubling the frequency. Please show how this is accomplished.

A. 1.—Two transformers, each having three windings, are used, as shown in the illustration. The alternator (A) sends current through the two primaries, which are wound oppositely relative to each other. A direct current source (B) sends current through the two auxiliary coils, which also are wound oppositely relative to each other. The secondaries are wound in the same direction and connected to the variable condenser. By choosing the right values the iron cores will be oper-



Induction apparatus for doubling the frequency of the potential received from an alternating circuit. The solution of a very interesting A. C. problem.

ated on the upper bend of their magnetizing curves and a powerful second harmonic will be set up in the secondary winding. By tuning the secondary circuit by means of the variable condenser to the frequency of the second harmonic, the efficiency in improved and powerful currents of double frequency will flow in the secondary circuit. It will be noted that an iron core choke coil is included in the direct current circuit to prevent alternating currents from flowing in this circuit.

Charging the Body

(464)—K. A. Fernando, New York City, asks:

Q. 1.—Will you please tell me how to charge one's body with electricity so that shocks can be given to others and oil torches can be lighted when brought in contact with the body?

A. 1.—This is easily accomplished by using a frictional static machine. Otto von Guericke in the seventeenth century produced static electricity by rubbing a globe of sulphur with the hand. This was no doubt the first real static machine. The ball of sulphur was belted to a large wheel whereby it could be spun rapidly. The person whose body was to be charged stood on a stool on glass insulators and held his hands on the spinning globe of sulphur. In this way his

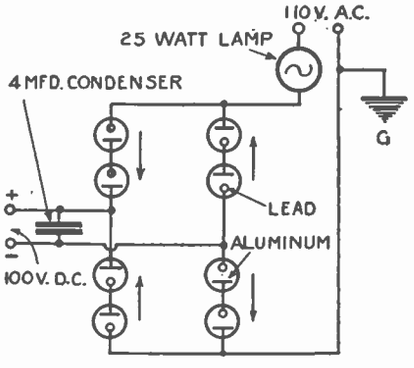
body was charged to a very high potential and sparks could be drawn from it by a person standing on the ground or floor. Static machines are now constructed that are much more efficient and compact than the one used by Guericke. The only precaution to take while trying this experiment is to be sure that the person being charged is standing on good insulators, such as plate glass thoroughly dry, or a glass-legged stool. The experiment can be performed with greatest success in dry weather.

High Voltage Rectifier

(465)—Olenius Olsen, Winfield, Ill., asks:

Q. 1.—What solution is used in rectifier jars, and how can I use 110 volts A. C. on the plate circuit of my receiving set?

A. 1.—The solution used in rectifier jars is generally sodium phosphate. This can be obtained from any drug store as a dry salt. A 10 per cent solution should be made by mixing with hot water and the solution allowed to cool before using. The rectifier is made of 1 inch × 6 inches test tubes, of which eight are required, connected as shown in the diagram. Strips of lead and aluminum are used for electrodes. In the illustration the circles represent the lead strips and the dashes the aluminum. A lamp is used in series with the line so that an accidental short will not blow the fuses. A four-microfarad paper condenser is used to filter the resulting pulsations and make the D. C. voltage constant. As one side of the



Very clear diagram of the layout of a high voltage rectifier. A 25-watt lamp in series and a condenser in parallel insure quiet working and prevent heating.

line is grounded, as indicated at (G), care should be taken not to ground the filaments of the tubes in the set.

Staccatone Queries

(466)—Edmond Cormier, New Bedford, Mass., inquires:

Q. 1.—I have built the staccatone as described in the March, 1924, issue, but have to add the honeycomb coils to complete it. Can I wind these by hand, and if so, will they have to be wound honeycomb fashion?

A. 1.—It is not necessary to wind the coils honeycomb fashion. They may be wound haphazardly on suitable wooden forms by hand. It is advisable to wind them in six sections so that the proper taps can be taken off for tuning the instrument.

Q. 2.—Please give me a diagram of a staccatone on which chords can be played.

A. 2.—A staccatone on which chords can be played is quite complicated, as the diagram shows. However, if a little patience is taken in building the set, a very amusing musical instrument will be the result. As the diagram shows, one tube is required for each note. Each tube also requires one set of coils and one condenser. Of course the sizes of the coils vary. The tube that gives the lowest note would require six honeycomb coils, while the tube that gives the highest note would only require one. The condensers should be variable so that the instrument can be tuned. Mica insulated compression type condensers are recommended. It will be noted that the keys are in the filament circuits of the tubes. With this arrangement only the tubes that are in use will be lit. As many tubes as desired may be employed, depending upon the range of the instrument. The diagram shows 18 tubes.

Copper Wire Table

(467)—Santiago Wright, Acambaro, Gto., Mexico, asks:

Q. 1.—What is the equivalent of 25 mills diameter in the American copper wire gauge (B. and S.) and what is the mill?

A. 1.—Number 22 B and S gauge wire is 25.35 mills in diameter. This is nearest to the size you wanted. A mill is 1/1000 of an inch. If a wire is 25 mills in diameter it is 25/1000 or 1/40 of an inch in diameter. The area in circular mills is the diameter in mills squared. Thus the 25 mill wire would have an area of 25 × 25 or 625 circular mills. It is well to remember that No. 10 wire has a diameter of 101.9 mills and is therefore approximately 1/10 of an inch in diameter. A wire three sizes larger has twice the cross-sectional area and carries double the current; a wire three sizes smaller has the cross-sectional area and carries half the current.

Q. 2.—I want to get rid of batteries in my radio set, so I am using a little direct current dynamo, but I cannot overcome the commutator noise. How can I prevent it?

A. 2.—If you are using the dynamo to light the filaments of the tubes it will be necessary to connect choke coils in the two leads. These coils should be as large as possible and not have enough resistance to materially reduce the voltage. Each coil should contain an open iron core, such as a bundle of iron wires either straight or if curved it should have an air gap. If the dynamo is used to furnish plate current, paper condensers of about four microfarads capacity should be connected across the dynamo terminals. These condensers will filter out the commutator ripple. Choke coils having many turns of fine wire will also help.

Transformer Losses

(468)—Carl Fischer, Chico, Calif., asks:

Q. 1.—Please explain what causes heat in the transformation of electricity as in a transformer. Define more fully than just resistance.

A. 1.—There are several causes of heat in a transformer. Heat is generated in the windings due to resistance. It is generated in the iron core due to eddy currents set up in the core laminations. These currents meeting resistance in the iron generate heat. The thinner the iron laminations the less heat generated. Heat is also caused by hysteresis in the iron core. The rapidly changing magnetic flux in the iron core reverses the positions of the molecules, which offer resistance and produce heat. Resistance in electrical apparatus is analagous to friction in mechanical apparatus.

Q. 2.—How can the horsepower of a 12-volt horn motor be calculated?

A. 2.—This can be roughly calculated by taking the potential at 12 volts, multiplying by the amperes to get the watts. If the current was one ampere the watts would be 12. There are 746 watts to a horsepower; therefore one watt should be .00134 H.P. and 12 watts would be .01608 H.P. This is the input to the motor. If the losses in the motor are 10 per cent we would have to deduct 10 per cent to obtain the actual horsepower of the motor.

Battery Charger

(469)—L. O. Pettyjaha, Heagland, Ind., inquires:

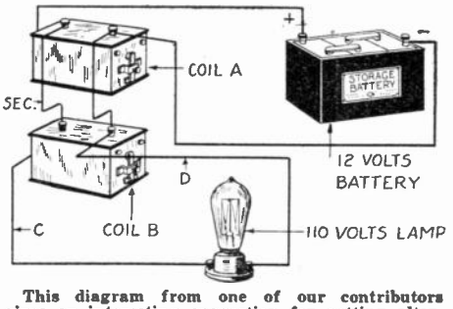
Q. 1.—I made the two-bulb tungar rectifier as described in the November, 1923, issue, page 28, and it worked satisfactorily for a while. Recently I connected the battery in the reverse position and the ammeter registered 20 amperes. Now one bulb lights brighter than the other and the output of the rectifier is very low. Are the bulbs worn out?

A. 1.—We would suggest that you try charging the battery first with one bulb and then with the other, and try each in both sockets. You will probably find that the bulb that now lights dimly is worn out and is not working. If one of the bulbs is good the battery can be charged with it on one half of the alternating current cycle and the ammeter should indicate a charging current. Sometimes new bulbs lose their electronic emission after being in use a few hours, and probably the heavy current of 20 amperes that passed through the bulbs when you reversed the battery connections impaired the action of the gas in the bulbs.

Q. 2.—Can I use this same transformer for a one-bulb rectifier?

A. 2.—You can reconstruct the transformer so as to adapt it for a one-bulb charger by following the directions given in the March, 1922, issue.

A. C. from Storage Battery



This diagram from one of our contributors gives an interesting suggestion for getting alternating current from a storage battery by using two induction coils.

(470)—W. L. Holbert, Memphis, Tenn., inquires:

Q. 1.—Is it possible to obtain alternating current from a storage battery by first stepping up the voltage from the battery with a Ford coil and then stepping it down again as shown in the illustration? In this diagram, the second coil B acts as a transformer only, and its vibrator is screwed down tightly.

A. 1.—There is no reason why this cannot be done, but the efficiency will be very low. You might try the experiment and test the output with a lamp or other device that may be operated from alternating current.

Ball Lightning

RETURNING to Brixham, Devon, on November 10th, the skipper of the fishing smack *Flowerlet* reported that while trawling about thirty miles south of Devon the vessel was struck by two balls of fire which tore away the upper planks in the bow from their bolts and knocked a piece off the rail. The smack appeared to be lifted out of the water and the crew experienced what felt like a severe electric shock. The first flash passed between the masts, and the second made a hole in the jib. The mastlight was extinguished.—*London, Eng., Daily Mail.*

An Electrocution That Failed

By Robert Rollins

(Continued from page 620)

the crisis was at hand. Dick suggested that we get a piece of the butcher's liver to keep her quiet and make her last moment a happy one. That's Dick. It was too late then. Delays were dangerous. We might weaken any moment. A momentous question that men had asked ever since Noah's two cats ate the two currants on board, was to be solved. Would the house current be sufficient to close the door of life on all nine lives? We were to answer that.

Who Is to Throw the Switch?

Naturally, the next thing was an argument—we were faced with a problem. Who was going to throw the switch?

Dick said: "You do it."

Of course I would have done it, but Dick was nearer (by all of four inches) to the switch than I. So I said: "Do it yourself."

"Watcher fraidov?"

"Nothing. Why don't you do it?"

"Well, I would, but——"

The Switch Is Thrown

You know how it is. Goodness knows how long it would have lasted, but Fanny was weary of the proceedings, and was going to jump from the table. Quick! I slammed the switch——

Volts, ohms, henries, amperes, and phases came tumbling through the switch and jumped into Fanny with bared fangs. She did a hand-spring, a triple-flip and about two dozen original twists—she always was a clever cat—while her melodious voice oscillated between mezzo-soprano and a frequency so high that Dick swears it turned into blue light. Every hair spit fire at every other hair. Her four legs and tail (one of the latter, of course, Fanny's unusualness was not physical) formed knots and patterns that would have delighted an old ladies' knitting society to see. I think she even disappeared into the Fourth Dimension once for a tenth of a second. Then the wires became loose; and Fanny, charged like a Leyden jar with crackling sparks, hit the ceiling, and flew through the open door, leaving behind her a string of white-hot curses and an odor of brimstone that took a stiff breeze a half-hour to blow away.

Silence Ensued

I looked at Dick, and Dick looked at me. Silence.

A New Fanny

Fanny came back two days later—but such a Fanny! She is not the weak, suffering cat that left us. Her fur is no longer worn and shabby, nor is her step shaky and nervous. Instead of the quivering meekness of her mew, her voice now has a vibrant ring of power and energy. Her step is light and springy. Her eyes sparkle with renewed vitality. Her coat is sleek and glossy. Once more "Toms" render light operatic selections on the back fence for her ears at night. The Flapper has met and vanquished the Black Oxen! Packed with one hundred and ten of the company's best volts, Fanny is young again! recharged as it were!

But deep behind her curving lashes there burns a green, malicious, glittering flame—and neither Dick nor I can look her in the eyes.

Solar Thermo Electric Battery

By T. O'Conor Sloane

(Continued from page 617)

Centigrade; the buried ends would change but little. The mirror is pivoted and its

axis may be taken as at right angles to the meridian. A special mechanism operated by a time clock moves it on its shaft so as to cause it to reflect the rays of the sun upon the straight line of junctions whatever the altitude of the luminary may be. By making the mirror somewhat longer than the series to be heated it will take care of the east and west motion of the sun as long as there is any object in utilizing it; that is to say, as long as the sun has sufficient heat to be of value.

As a part of the plant there would be a great storage battery, and the thermo-battery would charge this as long as the sun shone. An automatic cut-out would prevent the storage battery from discharging through the thermo-elements if the voltage fell low enough to permit it to do so.

The question would be to arrive at a just medium between the highly efficient structure and the structure of low first cost.

Artificial Scenes for Moving Pictures

(*Continued from page 624*)

which may be opened so that a view can be had from the camera to the rear of the partition. The foreground is illuminated by the front electric lights and the background by the rear ones. The dummies may be attached to strings so they can be given motion and a realistic effect. The actors act on one side of the window only and not in front of it.

Assuming that the moving pictures to be produced should show actors before the window with a background beyond the window composed of a city, a forest and clouds, etc., and perhaps some moving dummies, a boat on a lake or what not, the procedure is as follows:

The curtain over the window is first lowered, the rear lights are extinguished, the front lights are lighted, and the actors perform their parts before the camera in the usual way. When their act is complete, the front lights are extinguished and the rear lights lighted. The camera is reversed until the film is at its initial starting point and the curtain is removed from the window. The film is again run through the camera and the background is photographed through the window.

When the negative is developed it will be a composite photo, the foreground and background will properly blend and positives may be taken from this negative in the usual way; from these positives the moving pictures can be displayed.

Burglar Alarm

(*Continued from page 624*)

where daylight robberies and hold-ups are apt to occur. They sound a distant alarm to warn police officials or others that a robbery is taking place. As these switches are operated by a downward pressure of the foot they are often operated unintentionally. Sometimes dogs have been known to lie down on the alarm pedal and spring the alarm.

To overcome this unintentional closing of the alarm circuit the switch shown in the illustration, recently patented by two Minneapolis inventors, has been designed. Instead of being closed by the downward pressure of the foot, this switch is closed by an upward lifting. It consists of a horizontal bar within easy reach of the teller or clerk, and placed high enough above the floor so that his foot can be placed under it. A slight upward move-

ment of the toe will close the circuit and sound the alarm. It is so constructed that resting the foot on the bar or a downward pressure or a blow will have no effect whatever on the closing mechanism.

Combined Key and Flashlight Case

(Continued from page 624)

may be locked out a few hours' searching for the keyhole. Although some doors are equipped with a small electric lamp for illuminating the keyhole, which lamp lights when we push a button, this arrangement is unsatisfactory at times and requires a lamp and battery on each door.

The illustration shows a combined key and flashlight case. The construction is very simple, the whole being formed from one piece of sheet metal. The device is designed so that it may be readily held in a manner to direct the rays from the flashlight to a lock, while in the act of inserting the key into the keyhole.

The flashlight is of the conventional design and may be used for other purposes as well. The key compartment holds several keys as shown, each being securely fastened by means of a small chain. This device was recently patented by a Brooklyn inventor. It is so shaped that it is easily carried in the pocket.

Making Small Generators

By RAYMOND F. YATES

(Continued from page 633)

consists of three-eighths pound of No. 18 single cotton covered wire, is then wound over the first. After being shellacked, it is covered with friction tape and the machine is assembled.

A very good universal generator can be made by winding each one of the three magnets furnished with the magneto. One can be wound for a series dynamo, one for shunt and one for compound. The experimenter will then have a machine of any type by using the corresponding magnet over the armature. It is not necessary to arrange any mechanical contrivance to hold the different magnets in place as they generally fit tightly over the sheet iron frame that covers the armature. It will be necessary, of course, to use the proper connections for each different magnet.

These small generators, if properly constructed, should deliver from 10 to 15 watts of energy. This will depend largely upon the strength of the magnets.

Phone Relay

By JACK BRONT

(Continued from page 635)

original design is shown wherein solenoid windings are attached to the horseshoe magnet. When the secondary contacts are closed, the secondary battery current traverses the solenoid windings and thus brings greater attraction to bear upon the steel wire, drawing the wire down very firmly, and assuring a most positive contact of the electrodes, and a positive action of the device. When the thrust is withdrawn from the wire (steel), the wire moves upward to its original position, separating the contacts and thus breaking the "secondary" circuit.

Care must be exercised in regulating the magnetic strength of the solenoid attraction, otherwise the relay may "stick."

Excellent relay work with telegraphic

signals and time broadcasts has been done with a carefully constructed device of this type.

It is obvious that any mica or metal diaphragm phone or many loud speaker units may be untilized in the construction of the apparatus.

Different working materials at hand will suggest new departures from the rather crude type illustrated.

Frictional Plate Electric Machine

By Hans Konwiczka

(Continued from page 637)

the two sides. These teeth or points are so long that they do not touch the glass plate which turns between them, Fig. 13 (Z), yet they must be as near as possible thereto. The other end of the straight wire projecting from the prime conductor has a small brass ball (D), Figs. 11, 12 and 13 upon it.

We now have to drill a hole in the prime conductor at right angles to the original one, to receive the glass rod which has to carry the whole affair. The glass rod must be so long that the fork will be supported at the level of the shaft of the disc, Fig. 11. It follows that if we insert it five-eighths of an inch in the prime conductor and the same depth in the baseboard it would have to be seven inches long. We now cement around the wooden balls crosswise two strips of tinfoil a little over one-half inch wide, Fig. 14, and cover the whole surface with aluminum bronze. It will be better to cover the whole surface with tinfoil, but as this is quite difficult the simpler method will generally be pursued. The surface of the ball must be perfectly smooth. Finally, we glue to both the outside boards of the cushion two wings of stiff silk of the form shown in Fig. 11. They are stitched together along the edge; *i. e.*, the glass disc, Fig. 11, turns between these two pieces; these wings must reach from the friction-cushion almost all the way to the points of the conductor. The machine must always be turned in the direction from rubbing friction cushion to the points of the conductor in the direction of the arrow, Fig. 11.

Cracked phonograph plates made of vulcanized rubber or ebonite can be used instead of the glass plate. Such plates can sometimes be procured for little or nothing. In this case, instead of the amalgamated felt cushions, cat skin with the hair on must be used.

And finally the baseboard must not stand flat upon the table but must be provided with four short feet glued to it. All the wood parts are gone over with a good varnish. For exciting the machine there is hung to the ball (C) or (D), Fig. 11, a brass chain such as we find in Swiss clocks, which is connected to a gas or water pipe.

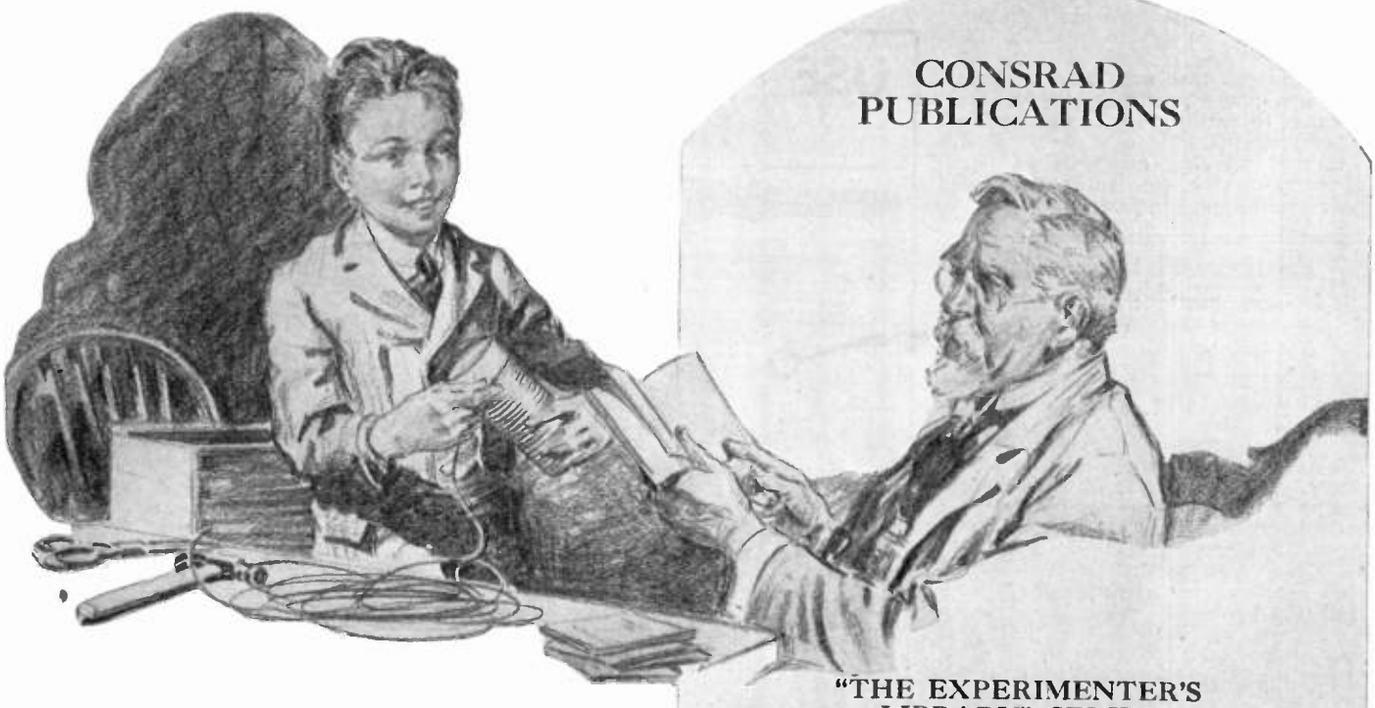
Electro-Static Experiments

By Frederick Von Lichtenow

(Continued from page 639)

the same elevation as the busy end of the gap, with the latter squarely facing the former. Therein rested the secret, evidently. The oscillatory waves set up by the spark were in this way forced upon and recorded by the very sensitive instrument, which latter fact proves that a strong, unipolar factor predominated in the charge (Fig. 10).

The discharge rods of the spark gap, being in a vertical position, are curved in order to be capable of a wide range of adjustments. The rods consist of heavy, polished brass wire and carry at their terminals one-inch solid brass balls, well



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polished, as all the terminals on static instruments should be. All in all, the spark gap is a "concoction" of my own, brought about by the dire need for just such a gap (Fig. 9). No sparks will occur between the Leyden jars in this connection.

Lead Storage Cells

(*Continued from August Issue*)

Further, a statement is made respecting the voltage of an open circuit. This means that the voltage is taken when the cell is not discharging any appreciable current. It is impossible, of course, to take such theoretically, because one must close the circuit through the voltmeter, which, in common with all galvanometers, must have a current through it to actuate it. But if it is a good voltmeter it will have a high internal resistance, and will take so small a current to actuate it that the resultant voltage measured may be taken as equivalent to the open circuit voltage. The closed circuit voltage is that taken from a cell when it is discharging an appreciable current, approximating in value the maximum current of which it is capable. Such voltage must be taken across the terminals of the cell with the voltmeter in shunt to the main circuit, that is, in parallel to it. Never on any account put a voltmeter in series with an active circuit in order to measure the closed circuit voltage, because the resistance of the main circuit put in series with that of the voltmeter will so reduce the current that the voltage indicated will have no value respecting the state of the cell or battery. There are three useful voltage values to be got from a lead battery. The first is the closed circuit charging voltage taken in shunt across the terminals of the cell or battery while the charge is on. This is generally the highest recorded. The next is the open circuit voltage with the charge switched off. In taking this it will be found to have several values, due to the fact that if taken immediately after cutting off the charge it is much higher than if the cell is allowed to stand a little time. It is better to take the open circuit voltage at least ten or fifteen minutes after cutting off the charge. Finally, the closed circuit discharging voltage, which, as a matter of course, is the lowest recorded, and is, as a general thing, the most useful to know to get a good idea of the capabilities of a cell.

Further back the writer mentioned that lead sulphate was formed superficially inside and out, and as the plate may appear solid this seems absurd. The fact is that the capacity of the plates of a battery is proportionate to the actual area of the lead or peroxide upon which the electrolyte (the acid and water) can react. We may neglect for the moment the negative plates, because there are usually two to each positive, but, taking the positive plate, if the only surface on which the action could take place was the outside, one would have to use a very large plate in a large containing vessel to get only a moderate capacity in ampere hours. For this reason both the positive and negative plates are made cellular in the active material, as will be described, so that the acid and water go right into them, and react upon all the inside surfaces of the tiny channels or pores. This adds by far a greater proportion of surface to the plate than does just the outside, and makes quite a small plate very effective, and especially if it is proportionately thick.

Returning now to the case of the charged cell, and assuming that it has been discharged at its normal current rate, and has been superficially sulphated

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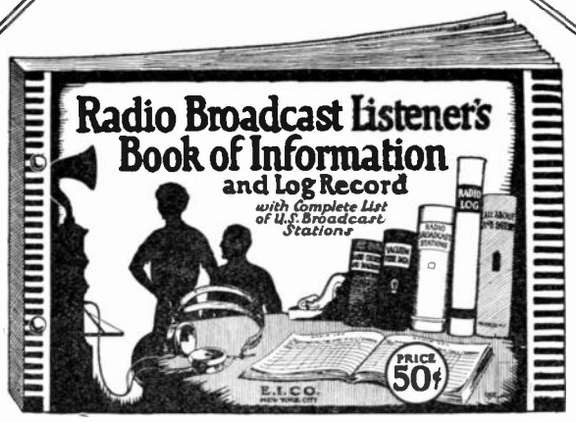

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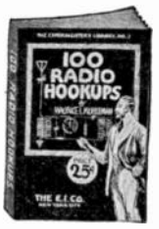

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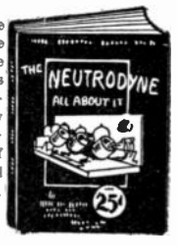

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both inside and out by the discharge, as soon as the sulphating is complete, particularly in the positive, the closed circuit voltage drops, and that fairly rapidly. This indicates that the cell is discharged, and although the open circuit voltage may still be as much as 1.8 the cell is no longer any use to maintain anything like a constant current. What has taken place is that the acid of the electrolyte has been reacting with the lead and lead peroxide, and has formed their surfaces, both inside and out, into an extremely thin coating of lead sulphate, which has the effect of slightly darkening the lead or negative plate, and has considerably lightened in color the chocolate of the positive plate. Imagine for a moment the appearance of a new cake of plain chocolate taken by the shopman from its air-tight packing-case. It has a fine even dark color and a more or less polished-looking surface. Let him put this cake into a badly-sealed window fitment, where the air, moisture and sun can get at it, and very shortly it will lose its fresh surface and dark color and become dull-looking, patchy and have cocoa-colored patches on it. These two appearances closely resemble those of a charged and discharged positive plate of a lead cell, and it is the formation of the sulphate that effects the change in this case.

Recharging a Cell

Upon applying a voltage of about 2.5 or 2.6, the positive of the charging medium being attached to the external positive or peroxide plate of the cell, and the negative to the lead cell of the exhausted battery, the cell will then be on charge. That is to say, the peroxide plate will become the inside positive, and the operation will be that the water of the electrolyte will be split up into its constituents of hydrogen and oxygen, the former going on to the lead plate and reacting with the sulphate, forming again sulphuric acid and leaving lead, while the oxygen will replace with the lead similarly set free at the positive plate, forming peroxide again and free sulphuric acid. As soon as all the sulphate is reduced the battery is again in a charged state, the positive being an even dark and glistening chocolate color, and the lead plate lighter gray in color. The above is not quite the exact cycle of reactions, because the sulphuric acid comes into it also, but the net result, it will be seen, is that, on discharge, the sulphuric acid is used up, and therefore the specific gravity of the electrolyte goes down, and on charge it is again reformed, and water is reduced; therefore, its specific gravity goes up again. Figures are difficult things to uphold, but in a properly constituted cell the discharged Sp.G. (specific gravity) should be about 1.17 or 1.18, and the charged Sp.G. about 1.21 to 1.23 or thereabouts. These quantities, however, differ for different makes of cell, but as experimental quantities will not prove far out.

(To be continued)

Useful Soldering Tips

By RAYMOND B. WAILES

(Continued from page 649)

heating your iron. The tip of the inner flame is the hottest. Place the *rear* and *not the tip* of the iron above this inner cone and let the outer flame cone (O) play above it. Inside of the inner cone is unburned *cool* gas, therefore do not support the iron in this flame. The heat at the base will be conducted to the tip without trouble, don't fear.

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