Practical Electrics

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June 1924
VOL 3 N 8

EDITED BY H. GERNSBACK

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See Page 438

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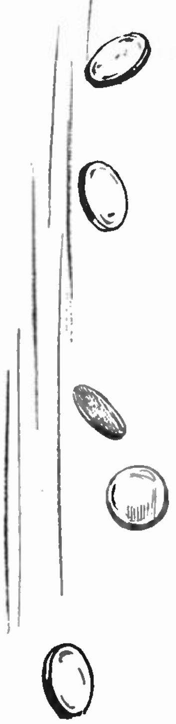

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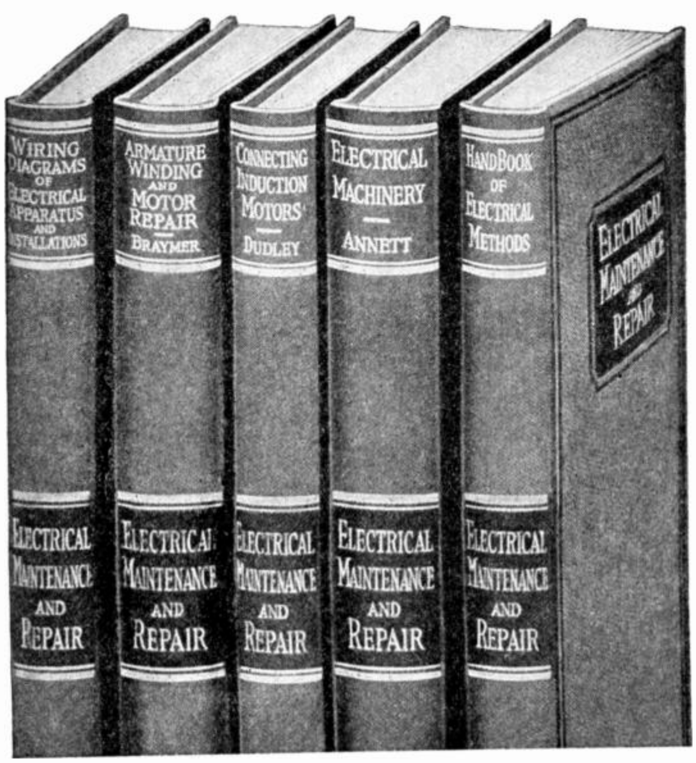

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Practical Electrics

VOL. 3 CONTENTS NO. 8

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Volume 3
No. 8

Practical Electrics

June
1924

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

The Large and Small in Armatures

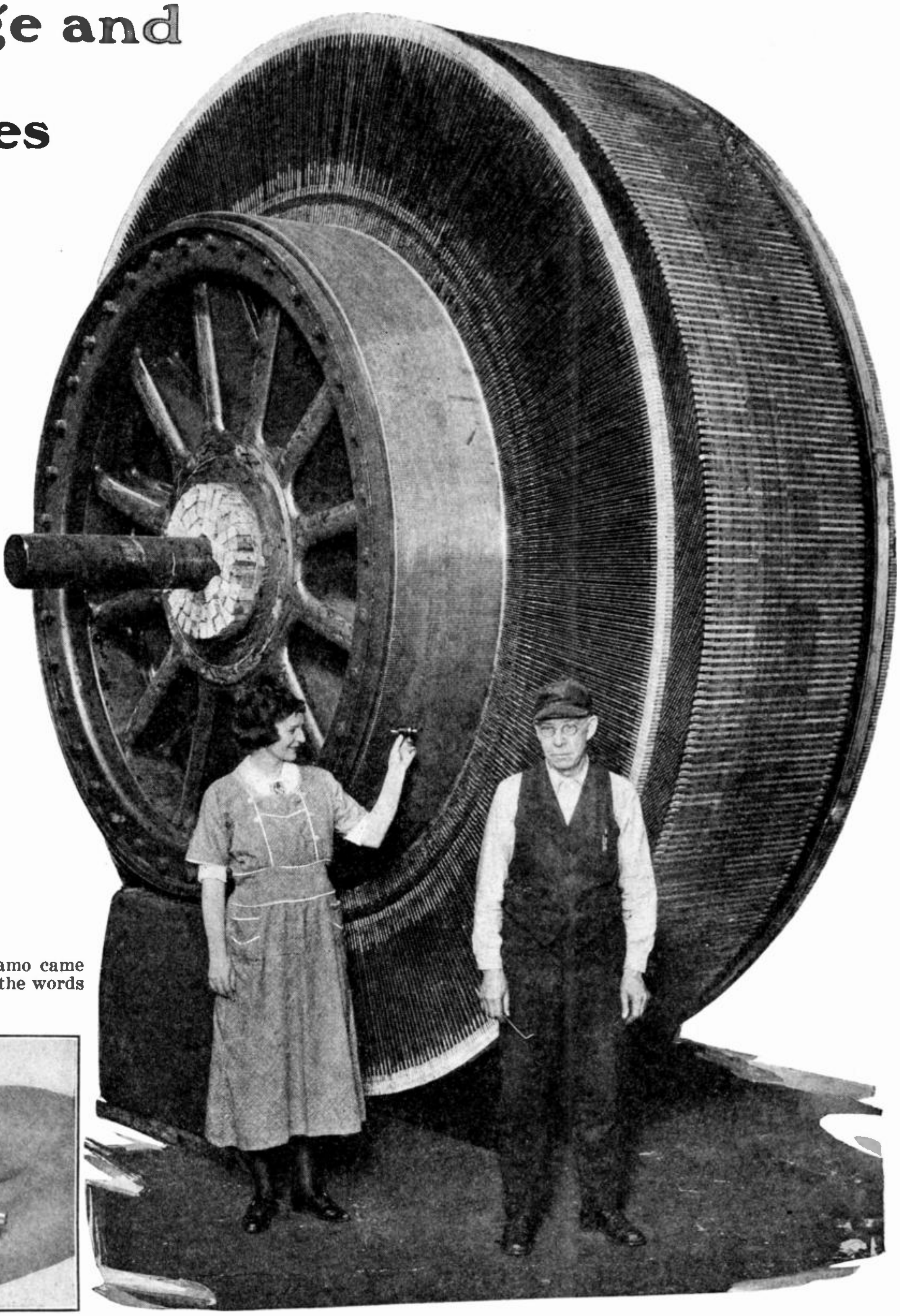
A STUDY in armature contrasts is offered in the illustrations which show one armature weighing 96,000 pounds, and a second one, equally complete, weighing six and one-quarter ounces. Both armatures were assembled in the same building of the Schenectady Works of the General Electric Company.

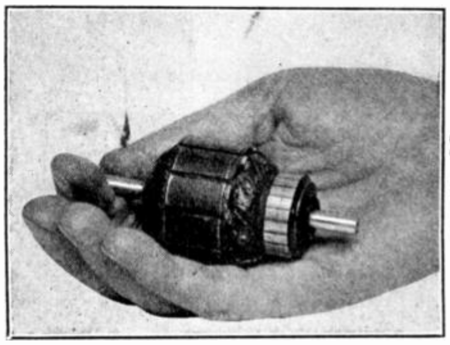
The huge piece of apparatus is for a motor which is being constructed for use in a steel mill of one of the Ford plants. The motor, of which it will be a part, will develop 4,500 horsepower, and the armature will revolve 67 times per minute.

The tiny winding which Miss Edith Bartlett holds in her hand was rewound by the service department for use in a small blower in the G-E hospital. The diameter of the large winding is thirteen feet four inches; of the other, one and one-half inches.

We believe it was the great German writer and poet, Goethe, who said that electricity concerned itself with the minor productions or appliances of life. This was true in the days when frictional machines were the principal producers of electricity.

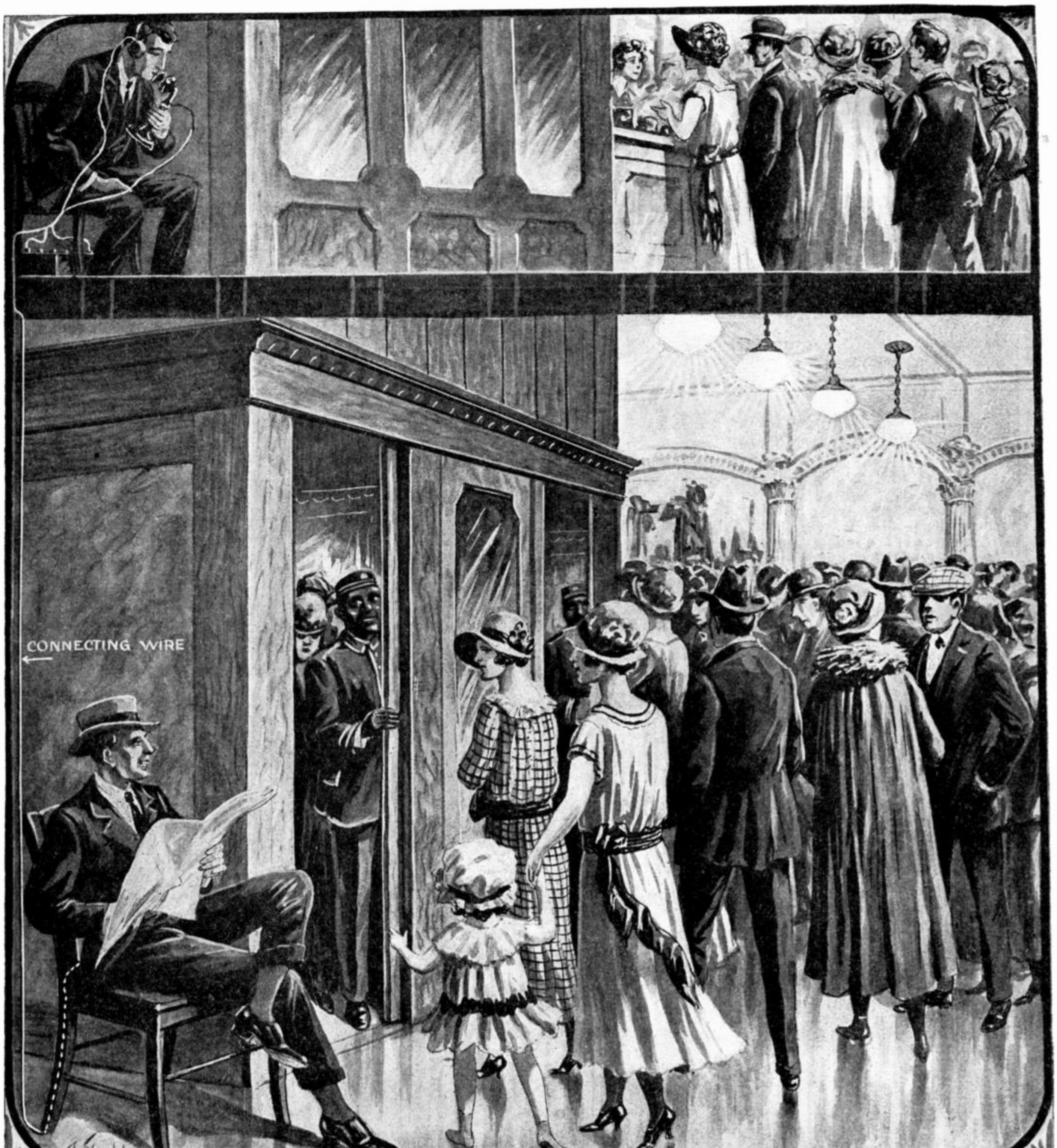
When we come to the early days of the last century, we find Sir Humphry Davy striving for high electric power with the miserable primary battery of those days. The dynamo came in some half a century later and the words of Goethe were no longer true.





The lady in the picture is holding the small armature in a position to contrast with the enormous one directly back of her and the workman. The impressive difference in size is thus shown. On the left the little armature appears lying in the lady's hand to give a true idea of its minute dimensions. It is an absolutely operative commercial armature.

Talking Figures



Information bureau. The gentleman reading the paper is a figure of composition, not a real person, and is fitted with an ultra-sensitive microphone for receiving inquiries from and a loud speaker for giving information to visitors. The operator in the upper story gives the information as asked for.

IN former times in this vicinity cigar stores were indicated by a "Wooden Indian" standing at their entrance. It was quite characteristic of old New York, but they have disappeared so completely, that efforts are actually being made by some museums to get a sample for exhibition and preservation as a relic.

We show here a modern version of the wooden Indian; this time it is a Caucasian seated comfortably in a chair and prepared to answer questions, to tell inquiring visitors in a department store where they can get special articles, on what floor they will find neckties, where they can purchase shoestrings, and if the resources of the store permit, which is not always the case, where they can procure needles.

The figure which we illustrate is in itself quite a find and is jocosely termed "Sunny Jim" by its owners, who are using it to demonstrate a super-sensitive microphone and loud speaker.

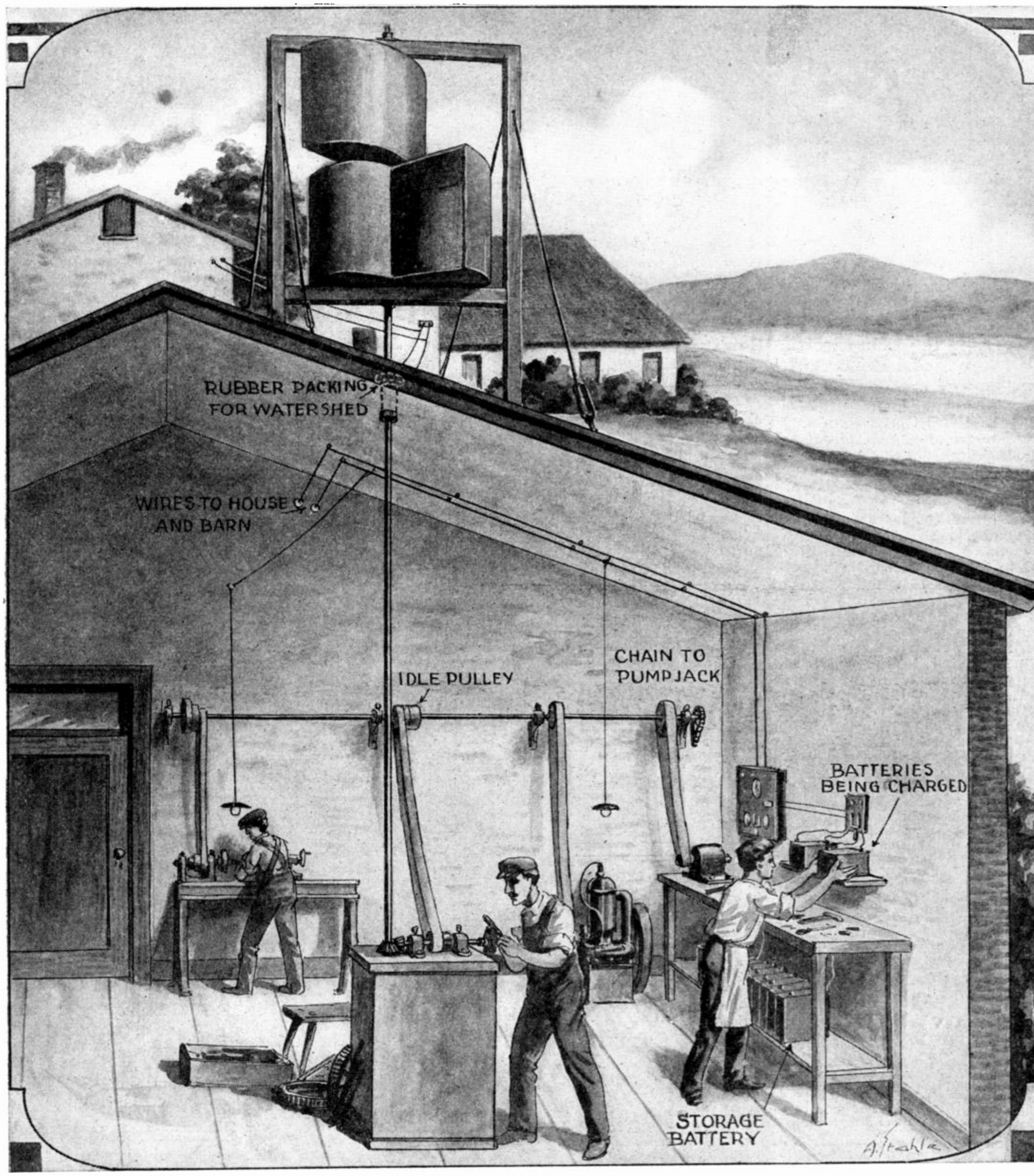
You can ask it any question in a colloquial voice, standing off at a distance. The voice is transmitted to a telephone receiver in a more or less distant part where an operator is established. He receives the message and telephones back his answer. This is received by a loud speaker inside the figure and the information required is enunciated with great distinctness and in a clear conversational voice.

The installation is extremely simple and it is obvious that there are endless applications in the advertising field. The

(Concluded on page 471)

Novel Wind Power Plant

By J. T. Garver



A workshop operated by a wind motor; the shaft goes through the roof, where a rubber washer prevents water entering, and it operates an electric system for various purposes, as well as for charging a storage battery.

THE up to date experimenter is linking wind and radio together in more ways than one, and since a well charged storage battery means just the difference between good and bad reception, many a farm home now glows with electric lights.

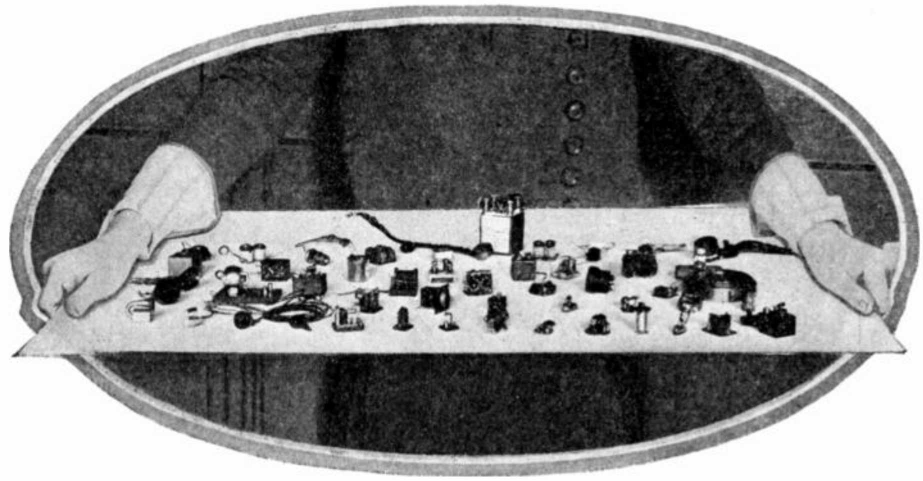
How one enthusiast worked out a power plant is shown herewith. The vanes of the turbine-like wheel are always in the wind and are mounted around a perpendicular shaft.

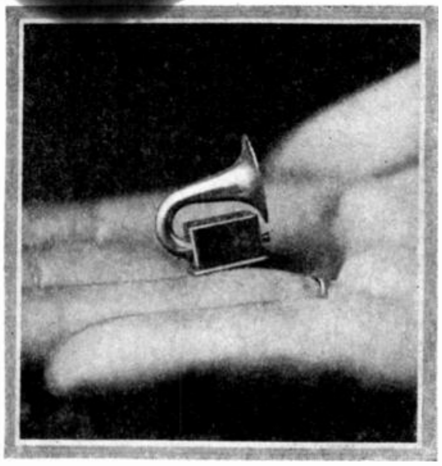
The two open S-shaped chambers, placed at right angles to each other, allow the free passage of air through the motor, thus counter-balancing the back pressure on the returning side.

The wheel is built by assembling semi-circular board discs which are separated according to the size and power desired. Beaver board (heavy tin will do) is nailed to the disc peripheries. The edges are then bound with galvanized iron strips and the whole given three coats of paint.

The space between the discs and width of the beaver board is twenty-four inches. The eight wood segments are laid out on a twenty inch radius.

The power is applied through suitable gear and pulley reduction to generator, lathe, emery stone and any appliance as needed. This outfit paid for itself the first year. The engine is so seldom called on to take up the burden that it could be dispensed with altogether, the air motor keeping the battery charged perfectly.





Our Miniature Model Contest

Awards in the $200 Electric Miniature Model Prize Contest

SELDOM have we conducted a competition as interesting as our miniature model prize contest. This contest had more aspirants than any of our previous ones. It was to our minds of such importance that we felt impelled to call in various newspaper correspondents, and newspapers the country over have given considerable space to this unique event, the like of which was probably never staged before in this country.

As will be remembered, the rules of the contest specified the following conditions:

1. That the electric model must not measure more than ¾ inch in any dimension. Also that the model must actually work in an electrical sense, for instance, if it is a motor, it must run, if an electric heater it must heat,—just as their big brothers are called upon to do.

The judges were truly amazed at the quality and quantity of the material received. There were over 100 entries, nearly all of which were sent by registered mail. Nearly all of these models would gladden the heart of any electrical man or model maker. They can only be expressed as works of art.

For instance, the first prize winner was a reproduction of the well known Dictaphone grand opera loud speaker *and was made entirely of gold*, that is at least, the outside casing. Small as it was, we could actually get sounds from the instrument.

$200 IN PRIZES

First Prize	$75 in gold
Second Prize	50 in gold
Third Prize	20 in gold
Fourth Prize	20 in gold
Fifth Prize	10 in gold
Sixth Prize	10 in gold
Seventh Prize	5 in gold
Eighth Prize	5 in gold
Ninth Prize	5 in gold

Fig. 1. On the left is to be seen a small tray on which a great quantity of the miniature models are placed, telling in an impressive manner the wonderful story of the competition.

Fig. 2. The prize winner, an exquisitely constructed little loud speaker, gold plated and perfect in all respects, actually operative.

Then there were a number of electrical motors and generators, all of which worked to perfection. Small telephone receivers, less than ½ inch in diameter reproduced sounds exceedingly well. Midget telegraph sounders worked as well as their big brothers. Electric flatirons heated up and then naturally there was the complete radio outfit, inductance coil, detector, switch case and all, contained

First Prize, $75.00,
Ivan T. Nedland,
Hillsboro, N. D.,
Loud Speaker.

Second Prize, $50.00,
W. H. Spence,
82 Helena Ave.,
Toronto, Can.,
Motor.

Third Prize, $20.00,
Julius F. Braselman,
Highland Park,
Del. Co., Pa.,
Telegraph Sounder.

Fourth Prize, $20.00,
D. L. Roberts,
Corydon, Iowa,
Variocoupler and
Crystal Detector.

Fifth Prize, $10.00,
P. F. Webb,
378 So. Main St.,
Columbiana, Ohio,
Motor

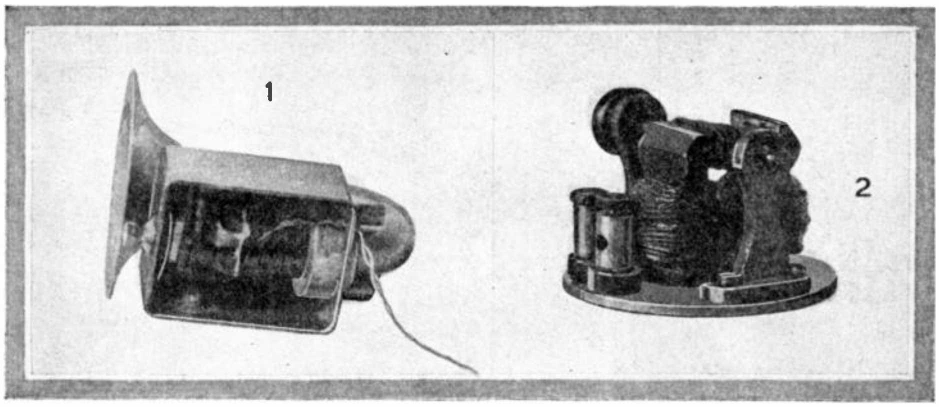


Fig. 3. The first and second prize winners in greatly enlarged reproduction; the first is the loud speaker, this time turned on one side, with the case open, to show that it is a bona fide structure and it did talk.

Next to it is the second prize, a very good bi-polar motor whose construction seems eminently practical, and which has a three-penny bit for a base.

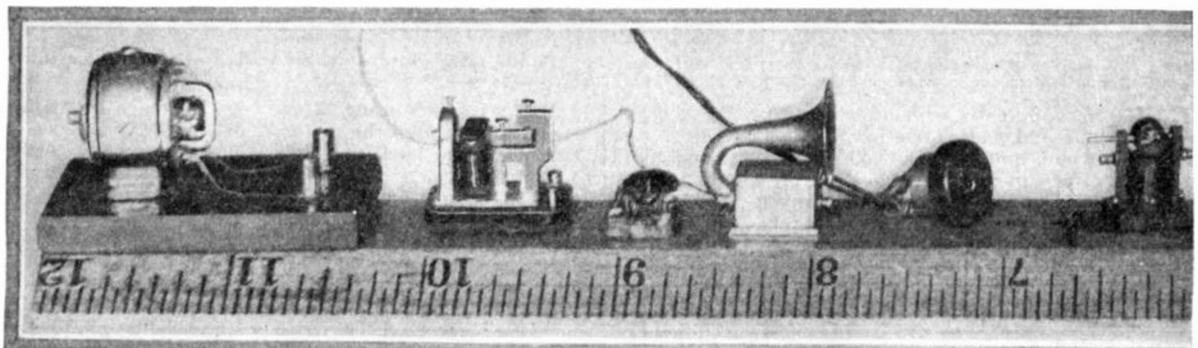


Fig. 4. One-half of a foot rule. In the neighborhood of Fig. 11 is a drum armature motor, at Fig. 10 a very perfect sounder, at Fig. 8 we see our first prize winner, and in the neighborhood of Fig. 7 a telephone receiver which is really operative.

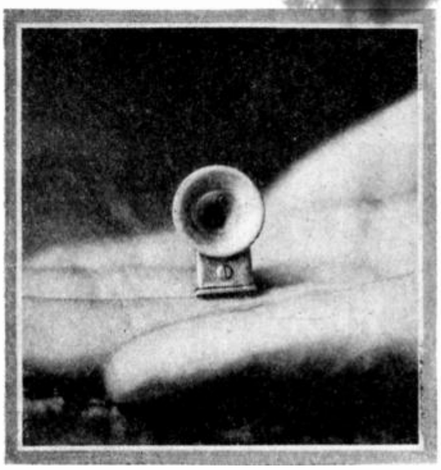


Fig. 5. This is another view of the first prize winner, in a slightly different position, held upon the hand, giving an impressive idea of its minute dimensions.

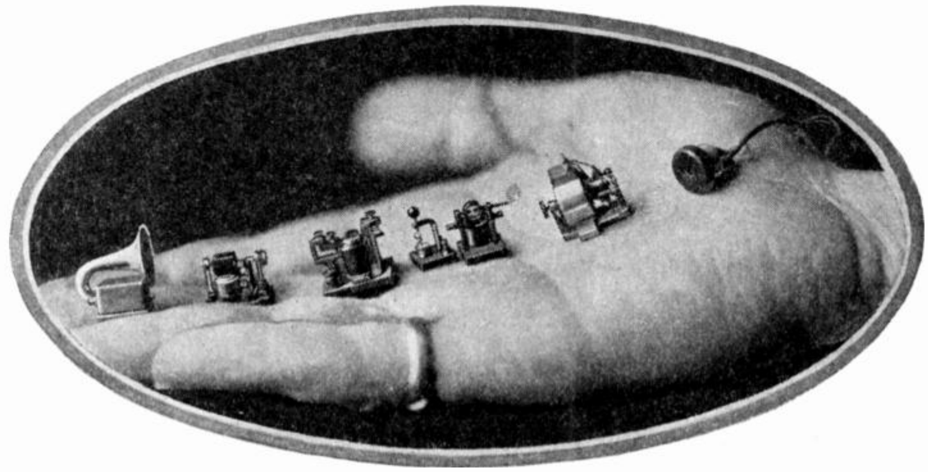


Fig. 6. A selection of electrical machinery and appliances in its various departments, all held upon an outstretched hand.

in a space exactly ¾ inch cube and of course it worked! We actually received signals over it.

The ingenuity displayed by the contestants in some of the entries was nothing short of marvelous, and the amount of time necessary to assemble the models must certainly have been considerable.

All in all we are happy to state that we never held a contest possessing more interest than did the miniature model competition, and we doubt if we shall ever again hold a contest as interesting as this one. We wish to compliment our contestants on the interest taken in the competition and hope that our readers will be pleased with the results.

Sixth Prize, $10.00,
E. Dickey,
Dayton, Ohio,
Telephone Receiver.

Seventh Prize, $5.00,
Walter M. Garrard,
1430 N. 12th Court,
Birmingham, Ala.,
Electric Bell.

Eighth Prize, $3.00,
R. Lindsay,
1111 S. Adams St.,
Glendale, Calif.,
Crystal Radio Set.

Ninth Prize, $5.00,
Harold Jackson,
R. 4, Box 141,
Kankakee, Ill.,
Electric Flatiron.

Some of our illustrations show the instruments of their exact size, while other illustrations, in order to show up the exquisite work, have been enlarged in order to give the reader an idea of the actual construction.

First Prize

Loud Speaker

By Ivan T. Nedland

THIS is a very elegantly constructed loud speaker. Our competition, as will be seen from the further descriptions, is based not only on ingenuity, but on mechanical construction, and the minute loud speaker to which we award the first prize, not only gives a sound, for we have tried it, but is so beautifully constructed that it really would serve as a watch guard charm. We take great pleasure in feeling that it has secured the first prize. To give an idea of its dimensions, we may state that the base measures exactly ½ inch, and the length of the horn itself is about ¾ inch. It is interesting to mote that this little loud speaker is equipped with a set screw for adjusting the length of the air gap between the magnet and the diaphragm, just as the larger ones are constructed.

This model is shown in Figs. 2, 3 and 4, on page 426, and Figs. 5 and 6, page 427, and on Figs. 9 and 10, page 428.

Second Prize

Motor

By W. H. Spence

WE now come to the second prize, a very wonderful little motor. To emphasize its minute dimensions, the builder has selected a coin to which the apparatus is secured. The coin is 11/16 inch in diameter and looks suspiciously like a gold coin, but has a tell-tale figure 3 upon it which indicates that it is a three-penny bit, which the ingenious constructor of the motor has gold plated. And the motor actually runs. 1½ volts potential drives

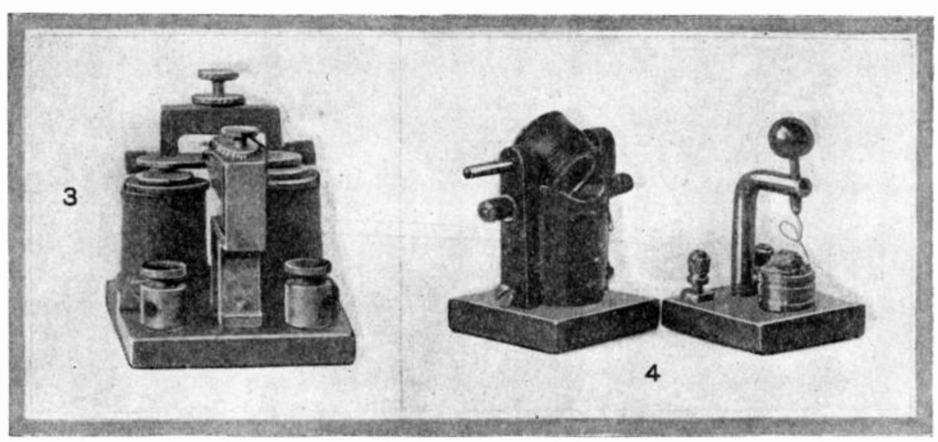


Fig. 7. The third and fourth prize winner, the first a perfect sounder, and the next a crystal receiver and varicoupler reproduced on an enlarged scale. The telegraph and radio operator are here represented in two wonderfully perfect miniature models.

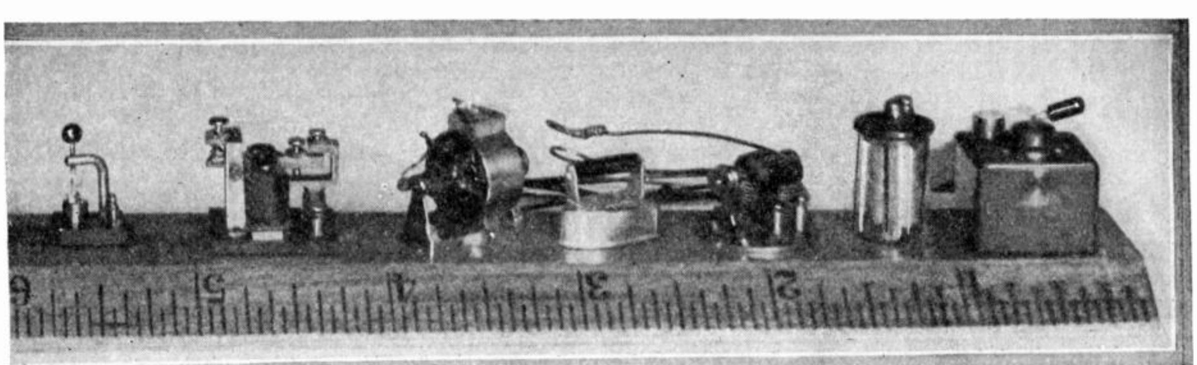


Fig. 8. The other half of our foot rule; here we have another accumulation of models. In the neighborhood of Fig. 5, the third and fourth prize winners are represented, and not to neglect the fair sex, a flatiron is shown at Fig. 3. Note all models on the foot rule are shown in full size.

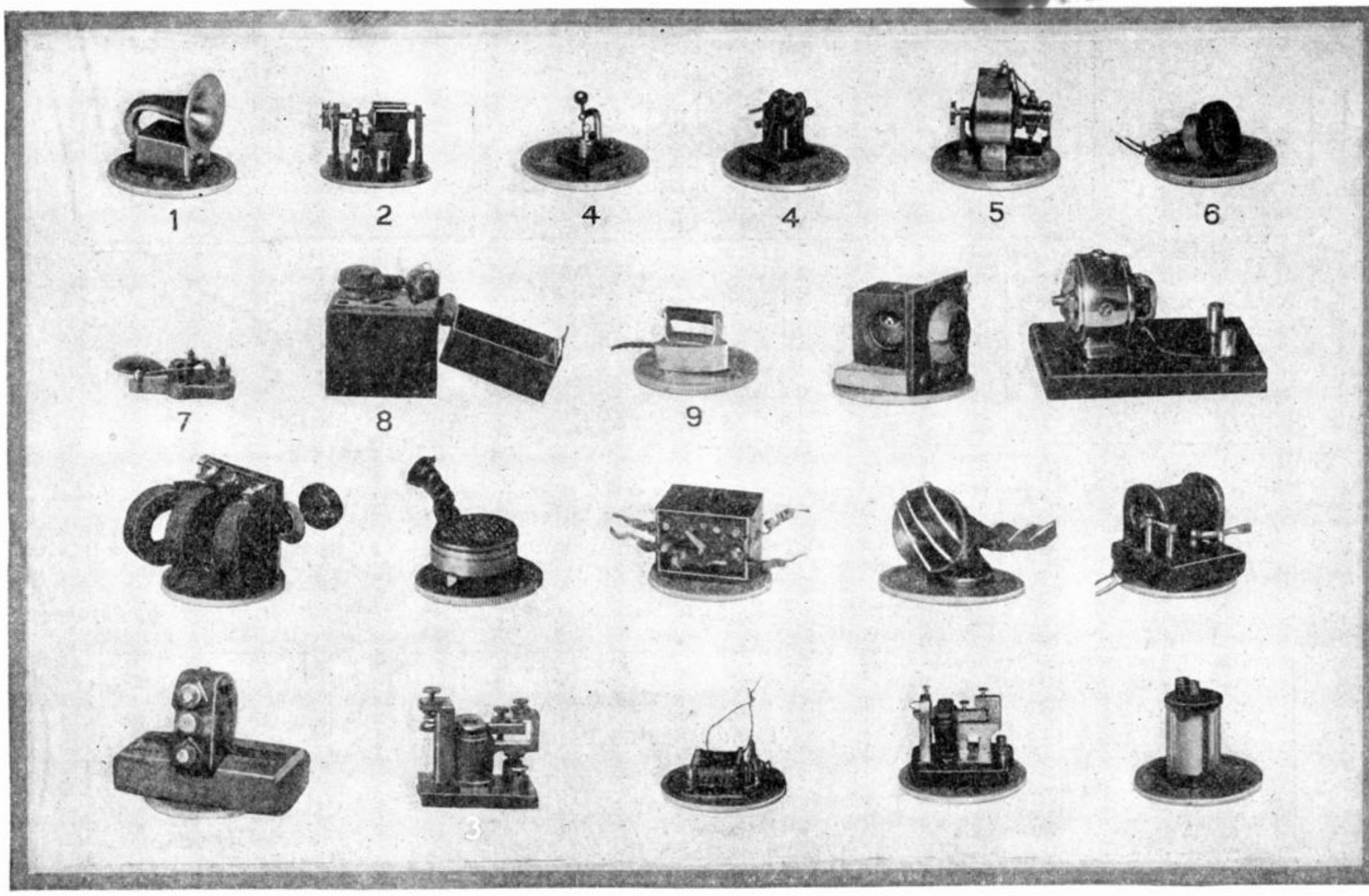


Fig. 9. Above are shown some of the most important models, separated so as to be more distinctly seen than when they were posed upon the foot rule.

On the upper line of models, numbers 4 combined indicate the fourth prize winner. Below, on the bottom line, the model, number 3, is the third prize winner. The other numbers shown give the remaining prize winners in their order.

Fig. 10. Below are seen six of the prize winners, again on a greatly enlarged scale, and the copy of "Practical Electrics" at the very bottom of the page, with the winning nine stretched in order across it.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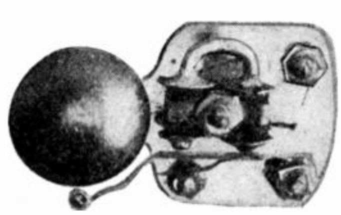
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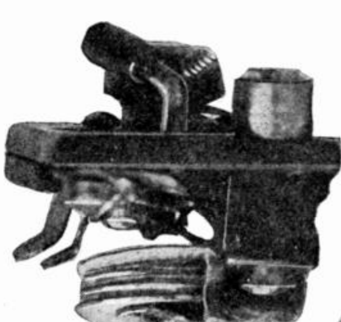
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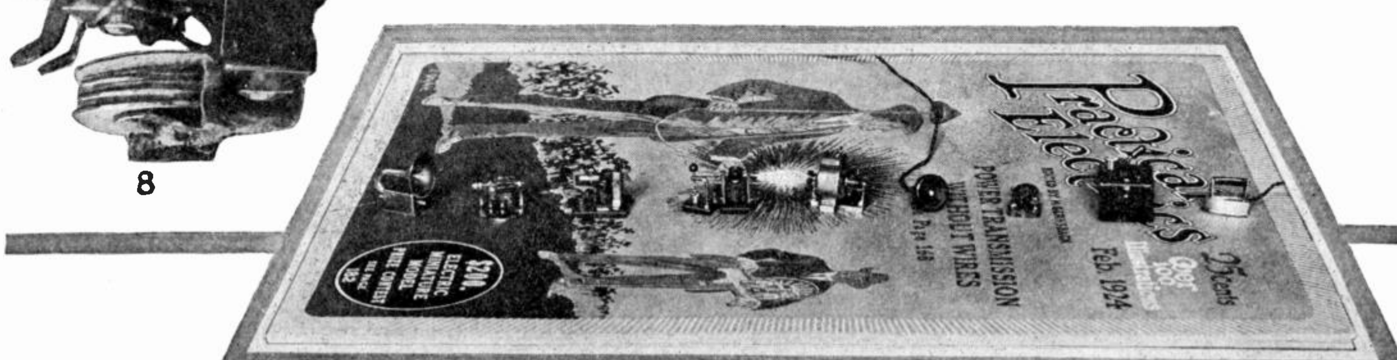


it nicely. The make-and-break is quite ingenious; there is a double cam on the shaft which for each rotation produces two contacts by pressing a spring arm against an adjustable fixed arm. The motor runs at a very high speed and produces a high pitched sound when in operation.

The little motor will be seen in Fig. 3, page 426; Figs. 6 and 8, page 427, and Figs. 9 and 10, page 428.

Third Prize

Telegraph Sounder

By Julius F. Braselman

In this rather wonderfully built model, the ½ inch dimension again prevails. In a shade over an area of ½ inch square, we have an absolutely perfect Morse sounder, with adjusting screws for the down and back stroke, so we have no doubt that a knight of the wire more competent in telegraphy than the editors of this paper, could take a cable message on it. It is thoroughly operative. The details are perfect, even to the knurling of the adjusting screws.

This sounder can be seen standing on the foot rule in Fig. 3, page 426; Fig. 6, page 427, and on an enlarged scale in Fig. 7, page 427, and in Fig. 10, page 428.

Fourth Prize

Variocoupler and Crystal Detector

By D. L. Roberts

It has been our pleasant fortune to have a number of miniature radio sets submitted in this competition, and here we have two of the essentials of a radio set, a variocoupler within the limits of a ⅜ inch base and a crystal detector mounted on a still smaller base. Both of these essentials of the radio set are nothing less than perfect in construction and might work very well with some of the ultra short wave lengths now employed by some broadcasting stations. The little models are real; like the rest, there is no imitation about them. The rotor of the variocoupler is mounted on a shaft, allowing it to be turned.

The two pieces making up this prize are shown in Figs. 6 and 7, page 427, and in Fig. 9 in the upper line marked 4 on page 428, and in Fig. 10, page 428.

Fifth Prize

Motor

By P. F. Webb

This is a two-pole motor with a ring mounting for the poles and a six-part commutator. It is less decorative, perhaps, than some of the other models but has an inspiring appearance of practicability. It is quite interesting to have two motors as prize winners, this one representing the regulation D.C. armature and the other the two-pole one. It is less than ¾ inch long and about ½ inch in extreme width. In operation this machine sounds like the buzzing of a mosquito, and runs very fast on 1½ or 3 volts.

This little motor is shown in Figs. 6 and 8, page 427, and in Figs. 9 and 10, page 428.

Sixth Prize

Telephone Receiver

By E. Dickey

A prize is awarded for what we may term really a perfect telephone receiver whose diameter is 7/16 inch. Its depth is 5/16 inch. Yet within this small volume everything is included; unscrewing the cap we find the little diaphragm held firmly in position by the magnet, and on trial it really produces sound. It might work very well with some of the ultra-audible sounds which we read about, supposed to be produced by insects. In connection with this very finely constructed receiver, we have to remark that in the entire collection of interesting models there was no microphone transmitter submitted. It would have certainly been very nice if the constructor of this ingenious receiver had favored us with a carbon grain microphone. The receiver shell is of steel, permanently magnetized. The electromagnet, through which the telephonic currents pass, is located in the center of the shell.

The receiver lies upon the foot rule in Fig. 4, page 426, and is shown in Fig. 6, page 427, and in Figs. 9 and 10, page 428.

Seventh Prize

Electric Bell

By Walter M. Garrard

Now we come to a very minute bell. Its length is ¾ inch and its width 5/16 inch. Like the other models, we may say that it is "all there," for the clapper does strike the gong, although the noise which it produces is far from alarming. An interesting feature is the base; the model is mounted on a little slab of glass, or some similar substance, which gives a very pretty effect, and as in the Galilean myth, the bell does move when connected. The gong is made from the head of a tack.

The bell can be seen in Figs. 9 and 10, page 428.

Eighth Prize

Crystal Radio Set

By R. Lindsay

Here, again, radio has inspired one of its devotees to produce a miniature set. But not content with giving detached pieces, the constructor has enclosed the set in a very neat little box, whose volume does not greatly exceed ½ of a cubic inch. It is about as large as a mammoth die, with which devotees to chance are addicted to tempting the fickle goddess, Fortune. The little box is quite an accurate piece of work and seems to have been made by the ingenious constructor, although we have no specific information on this point. As the illustrations show, the set comprises a taped inductance coil and crystal detector, and is provided with means for connecting an aerial and ground and a head-set to it. Broadcasting programs were actually received on this miniature set.

Our radio readers will see this minute radio set in Fig. 8, page 427, and Figs. 9 and 10, page 428.

Ninth Prize

Electric Flatiron

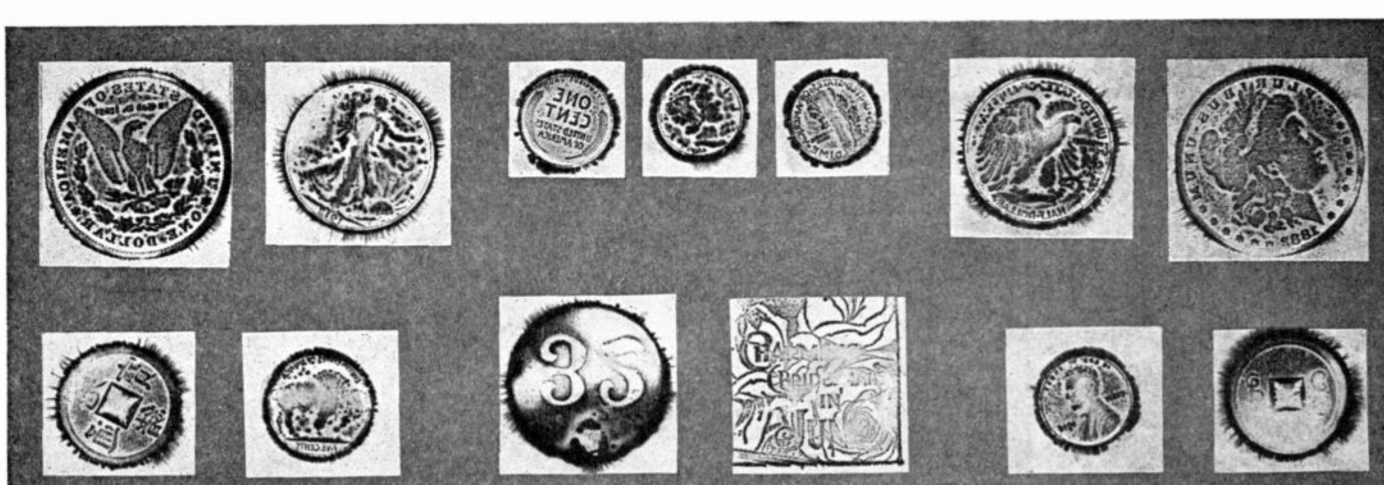
By Harold Jackson

Our frequent contributor, Mr. Harold Jackson, sends on a miniature flatiron which has been awarded a prize by the judges. The insulating handle to protect the theoretical hand from heat, the smooth base, and the receptacle for the heating coil are all to be seen, and on connecting it, heat is developed just as in the full sized instrument. Its greatest dimension is its length, which is 9/16 inch. We have connected it and found that it is operative to the extent of producing heat, as stated. As we are anxious to give no prize for an inoperative model, we were glad to find that this really did the work.

This is shown in Fig. 8, page 427, and Figs. 9 and 10, page 428.

Spark Photography

By Roscoe Betts



One of our regular contributors has sent us fifteen photographs taken by spark photography, but this time on photographic printing paper and with a long exposure. The results are really interesting photographs, but not showing the beautiful radiations incident to the other method of procedure.

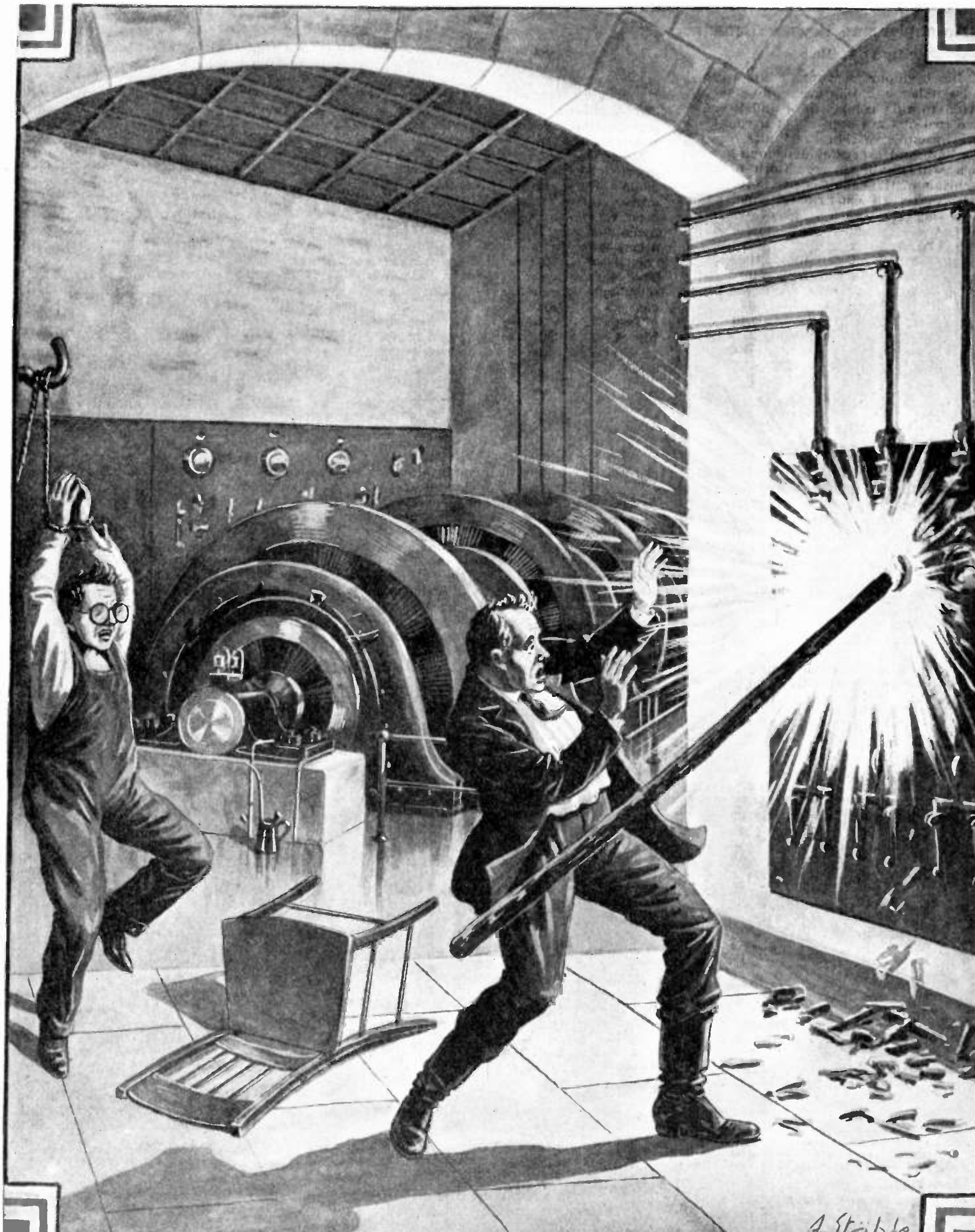
In the February issue of Practical Electrics there were published photographs taken by sparks emitted from coins and other objects lying on sensitized photographic plates. In the article readers were requested to send in accounts of their results along the same line of work.

Fifteen photographs of coins and newspaper cuts herewith were obtained by me in such experiments, our contributor writes.

Instead of using film or plates, as you did, photographic printing paper was used, and the exposure was lengthened to about ten or fifteen seconds. A Ford coil was used in the work. Although the spark ramifications are not great, the clarity of the printing is very striking.

"Specs"

By Charles Magee Adams



"Barney put up a dirty hand, rubbed one eye and then the other, and the pole, slipping from his grasp, clattered to the floor."

"Specs"

By Charles Magee Adams

THE big Valley Light and Power truck roared steadily up the last hundred yards of road, cut in the face of the steep hillside, its exhaust echoing unevenly from the opposite slope, made a sharp turn around a rocky shoulder and stopped. "Specs" MacDowell leaned out of its cab. "Hey, Barney!" he called.

There was no answer. At the left the company's Lonesome Lake Station stood crowded between the road and the face of the hill, a one-story concrete building with door and windows open, and at the right the lake stretched away up the valley behind the concrete dam, its waters sparkling in the June sun. But no one was in sight and the only sounds that broke the stillness were the whir of the motor-generator in the station and the rush and spatter of water over the spillway.

"Must be up there," Billy Clewitt decided. "Let's look," and unlatching the door he slid out.

Specs followed. Harry was the name he signed on the payroll, but everybody in the Valley Light and Power called him Specs because of the huge shell-rimmed spectacles that gave his thin face almost a glassed-in look.

The two of them stepped into the station. It consisted of three rooms, the largest containing the motor-generator and switchboard, and the two smaller being occupied by the operator in charge. But there was no operator. A coffee-pot, boiling dry, stood on the electric stove, greasy dishes were scattered over a table, and dirty blankets filled the bunk. But that was all.

"Nice mess," Specs commented disgustedly, side-stepping a smear of spilled oil and surveying the scene with an irritated frown.

Billy did not answer. He was the operating superintendent, stocky, with shrewd restless eyes, and after a quick glance around he crossed to a rear door and looked up the hill. "He got him," he reported, a ring of satisfaction in his voice.

Specs stepped to his side, shading his lenses against the sun. Coming down a vague path that zig-zagged across the rocky slope were two men, a huge bulk in dirty khaki shambling sullenly, followed by a taller more alert figure in gray whipcord with a rifle under his arm.

Specs and Billy waved to him and he waved back. It was Mulone, a State Trooper from Castleton, and the man ahead of him was Barney Sears, the operator.

"Easy picking," Mulone reported cheerfully as they crunched to the foot of the slope and stopped. "Just slipped up the hill where you dropped me and there was our friend fixing a fresh batch of mash, couple of barrels of it, fair kind of a still, and about twenty gallons of moon."

Billy nodded in satisfaction. "Thought so." He eyed the prisoner with withering contempt. "When we get through with you, you'll find out there's a few things you can't get by with, when you're working for the Valley people, you dirty fathead."

Barney simply stood, head down and gorilla arms hanging. Specs regarded him with unconcealed disgust, and noting the look, Mulone grinned. "Thanks for the hunch, brother," he said. "The bigger they are the harder they fall."

Barney's head came up with a jerk and he swung on Specs, a hard glitter in his black eyes. "So't was you, was't?" he demanded truculently.

Specs eyed him with increasing disgust. "You're right it was," he retorted. "I reported you, just the same as I'd report any piece of cheese."

Barney's heavy face twitched and his eyes flamed. "Well, I'll learn y'how t'come sneakin' 'round," he rasped. "And when I get done with'y y'won't do no more talebearin' with them damned glasses."

Mulone broke in curtly. "Anything you say'll be used against you, buddy."

"I don't give a damn," Barney growled. "I'll get him for this. I'll get him!" He was glaring at Specs, his loose mouth and huge hands working. "Y'damned spy! There ain't nobody ever done Barney Sears dirt without gettin' paid back for't, 'nd you'll get paid back too, good 'nd plenty soon's I get out, sneakin' 'nd spyin' 'round with them damned big glasses."

Specs grimaced. "All right. Come around any old time," he retorted, and swinging about walked away into the station.

Mulone and Billy looked after him a moment, then Mulone waved his prisoner forward. But as Barney shambled sullenly through, Billy came in to where Specs was examining the motor-generator set and stopped beside him. "You know, Specs, that's right about him always getting even," he said, a troubled frown on his sharp face. "I'm sorry you had to get tangled up in this."

> *EXPERIMENTERS and amateurs, we want your ideas. Tell us about that new electrical stunt you have meant to write up right along, but never got to. Perhaps you have a new idea, perhaps you have seen some new electrically arranged "do-funny"—we want these ideas, all of them. For all such contributed articles that are accepted we will pay one cent a word upon publication. The shorter the article, and the better the illustration—whether it is a sketch or photograph—the better we like it. Why not get busy at once? Write legibly, in ink, and on one side of the paper only.* EDITOR.

Specs laughed. "Don't worry," he returned. "I'm not worrying." And he meant what he said.

Arresting Barney was not even his main reason for coming up to Lonesome Lake this morning. Lonesome Lake had not been named by accident. Lonesomeness was the most conspicuous thing about it. Standing on the dam or in the doorway of the station and looking up and down the deep slot of valley there was nothing to be seen but water, a long motionless strip of it stretching to the next bend far above, walled in by dull bare hillsides with patches of sickly grass and stunted trees along their sharp summits.

Two miles back across hills as bare and as rocky there was a shack or two where hunters sometimes stayed, and three or four miles downstream where the valley widened there were a few summer camps, but here the only evidence of human penetration, aside from the station and dam, was the road clinging precariously to the hillside, with its companion line of tall poles carrying the high tension wires, and nobody ever used the road but company men. The loneliness was the reason it was so hard to keep an operator at the station.

But the Valley Light and Power had to keep one. Lonesome Lake was the most important station on the system. There were no turbines there and no huge generators. The only machinery was the motor-generator that interchanged power with the Consolidated Company across the divide. But Lonesome Lake was the biggest storage reservoir on the river.

Down at Castleton, forty miles away, where the main generating station was, there was no possibility of storage. The valley was too wide and flat and the land was too valuable. But there had to be storage somewhere.

From June to September rains could not be depended on for anything near the amount of water needed. Even the springs and brooks back in the hills ran low and farmers down the valley watered their stock from deep wells. Yet during the winter it rained so plentifully that there was more water than the turbines could use. So, after laborious hauling of material over a road blasted from the rock, a dam was finally thrown across the valley where it was deepest and narrowest and Lonesome Lake was formed, storing up the winter rains, millions on millions of acre-feet of water, reaching miles upstream along the twisting channel, and gradually releasing it during the long summer drought. But from the first it was not easy to keep an operator on the job.

They went up confidently enough. The pay was good and the work was easy. All a man had to do was to change the setting of the motor-driven gates occasionally as the load dispatcher at Castleton ordered, and start and stop the frequency changer. There were hours, whole days even, when he could do as he pleased. But none of them stayed.

Sometimes in six weeks and always before six months they came back and turned in their keys, gaunt and worn with the dreary loneliness of the place. The pay had been increased, everything possible had been done for the operator's comfort, even a radio set installed. But as the deadly isolation became notorious men came and went faster and faster till Billy Clewitt, who had the hiring of them, was driven to desperation.

"Specs," he had announced, calling the younger man into his office one day two weeks before, "if you can't help me out I'll have to close up Lonesome Lake or go up there myself."

"No man again?" Specs inquired sympathetically.

Billy nodded. "Not a real one. Sears; a bad egg. And after he's gone I don't know of another man I can wish the job on." He waved his hands helplessly. "I don't blame them. I wouldn't have it at any price. It's worse than sheep-herding. But it's got to be done."

He leaned forward. "Why can't you put in a remote patrol, handle the gates and frequency-changer and everything from down here, without a man there at all. They're doing everything else that way. What do you say?"

Specs had considered, his brown eyes intent behind the big shell-rimmed lenses. "I can try it," he replied.

Billy slapped his thigh. "Good! Then go up the first thing in the morning and look the place over."

It was no easy problem he had assigned Specs, but Specs liked problems. The eager intentness about his thin face showed that, and he had dug through a correspondence course to qualify for the engineering department when it was a good deal easier to keep on being a substation operator. But he realized that his problem at Lonesome Lake was more

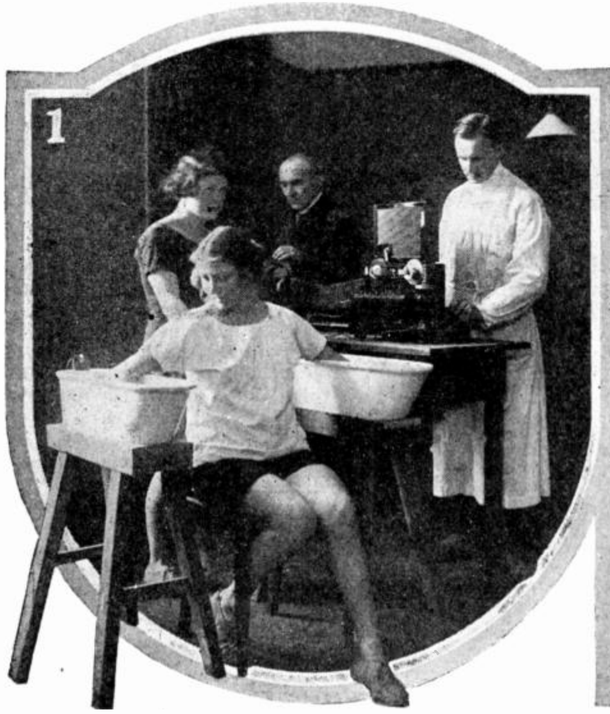
(Continued on page 466)

New Things Electric

Sport and Science

By Dr. Alfred Gradenwitz

Berlin Correspondent, PRACTICAL ELECTRICS



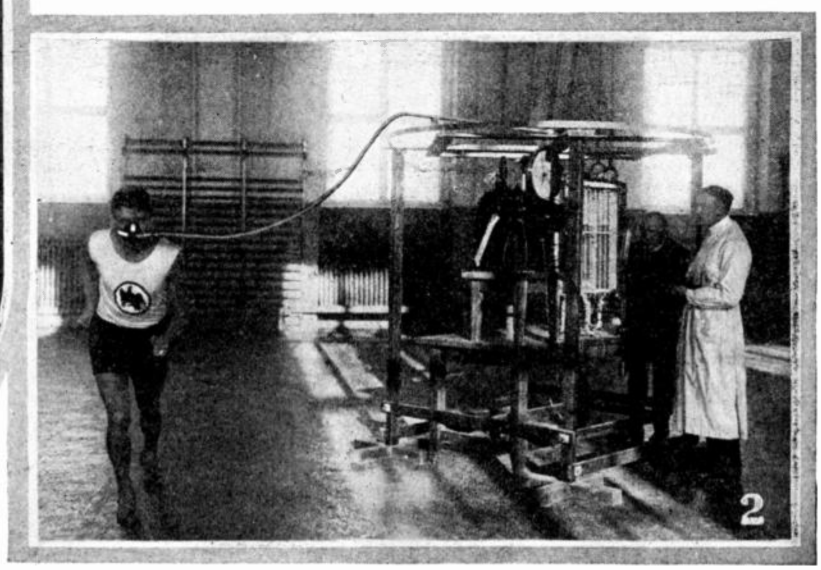


Fig. 1. The lady, after some strong physical exercise, is having the current produced by her heart, measured.

Fig. 2. Testing the breathing of a runner to determine the expiration and inspiration constants.

PROF MULLER, of the College of Sport, Spandau, near Berlin investigates in an interesting way the influence of various kinds of physical exercise on the human organism.

The activity of the heart is attended by the production of feeble electric currents corresponding to the contraction and expansion of the muscles and which, if recorded by a string galvanometer, strikingly register all characteristics and even the slightest morbid alterations of the heart's activity. Fig. 1 shows how this test is carried out: A lady student is there seen, immediately after completing some trying physical exercise, with her arms immersed in two troughs filled with water, thus sending the electric currents from her heart through a line of conductors towards the doctor's laboratory.

Fig. 2 shows how the products of respiration are analyzed which in turn affords valuable data as to the influence of sport on a person's health. A line of rubber hose connects the sportsman with the respiration outfit, while a mask in front of his face conveys any gases discharged in breathing towards a system of tubes where their composition is accurately determined. Our figure shows a runner, who practically unimpeded by the mask as well as by the rubber hose, describes a circle at top speed around the apparatus.

Fig. 3 illustrates a method for ascertaining the size and shape of the sportsman's heart, the organ primarily affected by physical training. The person to be examined is placed immediately in front of the Roentgen screen, the X-ray bulb being situated at sufficient distance for the rays to pass through his body practically parallel with each other. The experimenter on a sheet of paper covering the screen readily traces the outline of the heart as brought out by the Roentgen ray. This is a test all students of the College have to submit to at the beginning as well as at the end of the term.

(*Continued on page 472*)

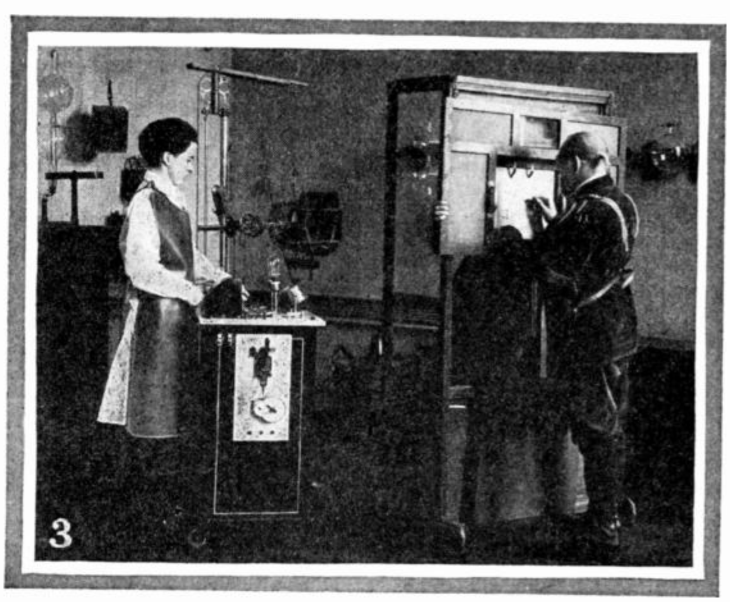


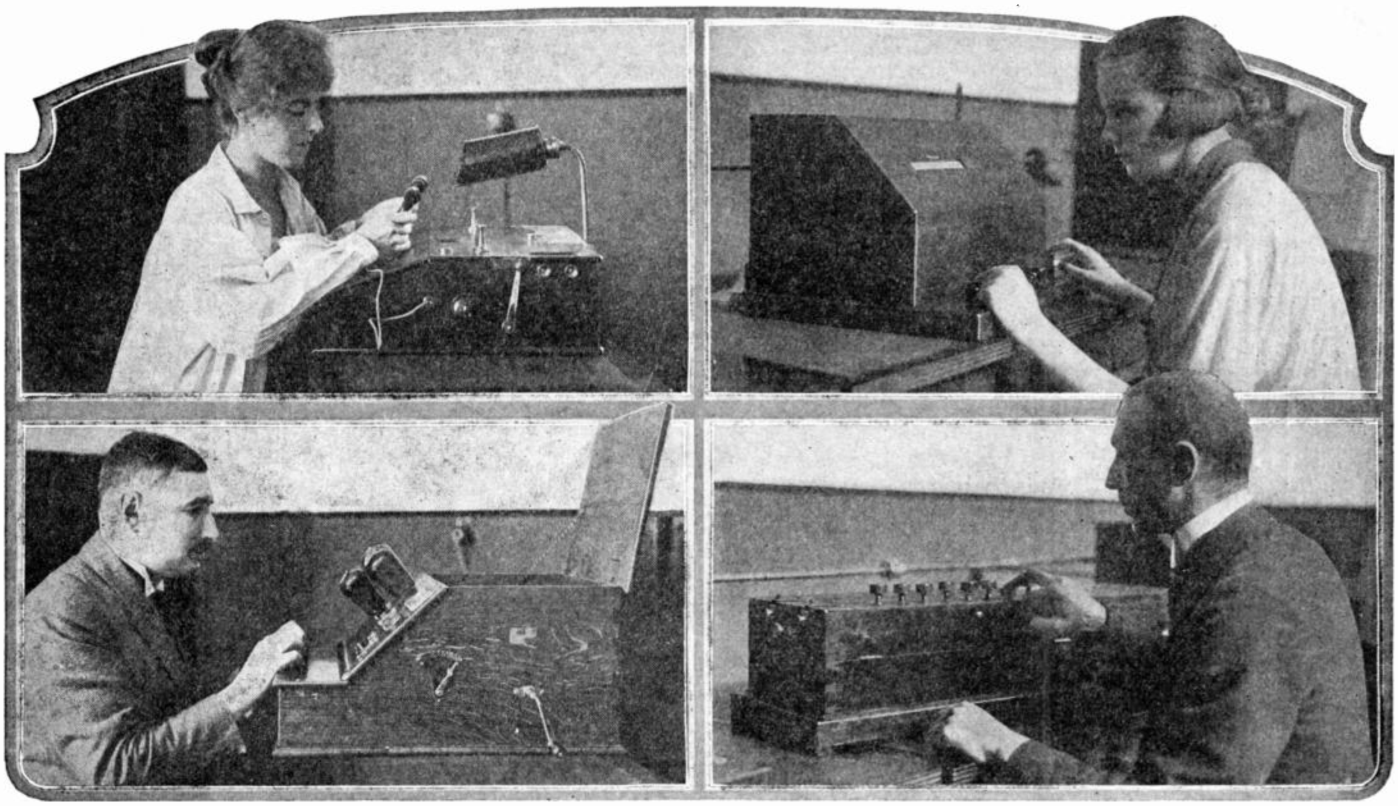
Fig. 3. Determining the size and shape of a sportsman's heart by X-ray silhouette. The outline of the heart is drawn as it is produced on a fluorescent screen.

Fig. 4. Determining the specific gravity of a subject by the old classic Archimedean method.

Testing Employees

By Dr. Alfred Gradenwitz

Berlin Correspondent of PRACTICAL ELECTRICS



The upper left view shows the two point apparatus for testing the candidate's firmness of hand in connection with rapid operations in mechanics. Below is seen Dr. Piorkowski at his automatizing apparatus. In the upper right is an apparatus for examining the candidate's permanent attention. Below is the attention and fatigue tester.

PSYCHOLOGICAL tests have been developed at the Orga Institute, of Berlin, largely through the work of its able director, Dr. C. Piorkowski.

An outfit is shown above known as the *Two-Point Apparatus* and serving to test the candidate's firmness of hand in connection with rapid operations such as soldering, welding, etc. The candidate looks at a small window back of which a tape varying from dark to light is allowed to pass. At the moment the brightest section of the tape is passing through the window, a thin point comes for just about one-half a second out of a handle held by the candidate. The latter's task consists in bringing this point at the very moment into contact with another point fixed to another handle. Each time the point (in systematic succession) issues forth, a mark is made by an electric recorder while another recorder counts each time the candidate succeeds in making a contact between the two points. The gradually growing brightness of the tape prepares the candidate's attention for the moment of response.

An apparatus is shown destined to *examine* the candidate's *permanent attention* when concentrated on a continually changing letter. The candidate is asked, for instance, to pay attention to the letters R and H and to ascertain whether they occur in a given order. Results are recorded electrically. As the candidate presses down a key in accordance with instructions a current impulse is produced in an electric recorder whereas in case of a mistake no such impulse occurs. At the same time all responses, correct or otherwise, are counted by another recording device, so that the proportion of correct responses can be found immediately. The variable series of letters are produced by ever-renewed combinations of half-series arranged on two drums rotating at different speeds.

(Concluded on page 472)

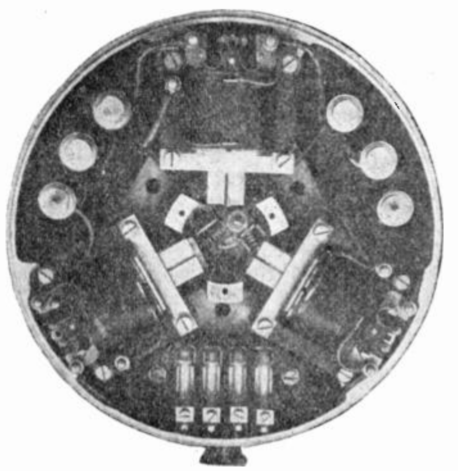
The Vaisseau-Baule Motor

By LUCIEN FOURNIER, Paris Correspondent of PRACTICAL ELECTRICS.

THIS motor is based upon a new conception of the electro-magnet. In normal construction of such apparatus, if a certain power is to be given to the magnet, a coil made of a long winding has to be adopted, which interferes with the rapidity of action of the electro-magnet; if, on the other hand a coil wound with little wire is used, the intensity of the current with danger of burning out, has to be considered.

Mr. Baule starts on the principle that the electric current does not instantly attain its normal value in a coil, but that it reaches its maximum proportionately quicker, if the coil is submitted to a very great difference of potential, in other words, to a higher voltage.

Thus, the inventor has boldly increased the excess voltage impressed on the coil of his electric motor. To get rid of the inconvenience of this super-voltage, he has a special arrangement by which the armature, when it reaches the critical point of its rotation, brings a resistance in series with the winding, a resistance which automatically protects the coils and suppresses almost completely the spark at the breaking of the circuit. The result is that the motor responds for starting and stopping with amazing rapidity, coming down to hundredths of a second.



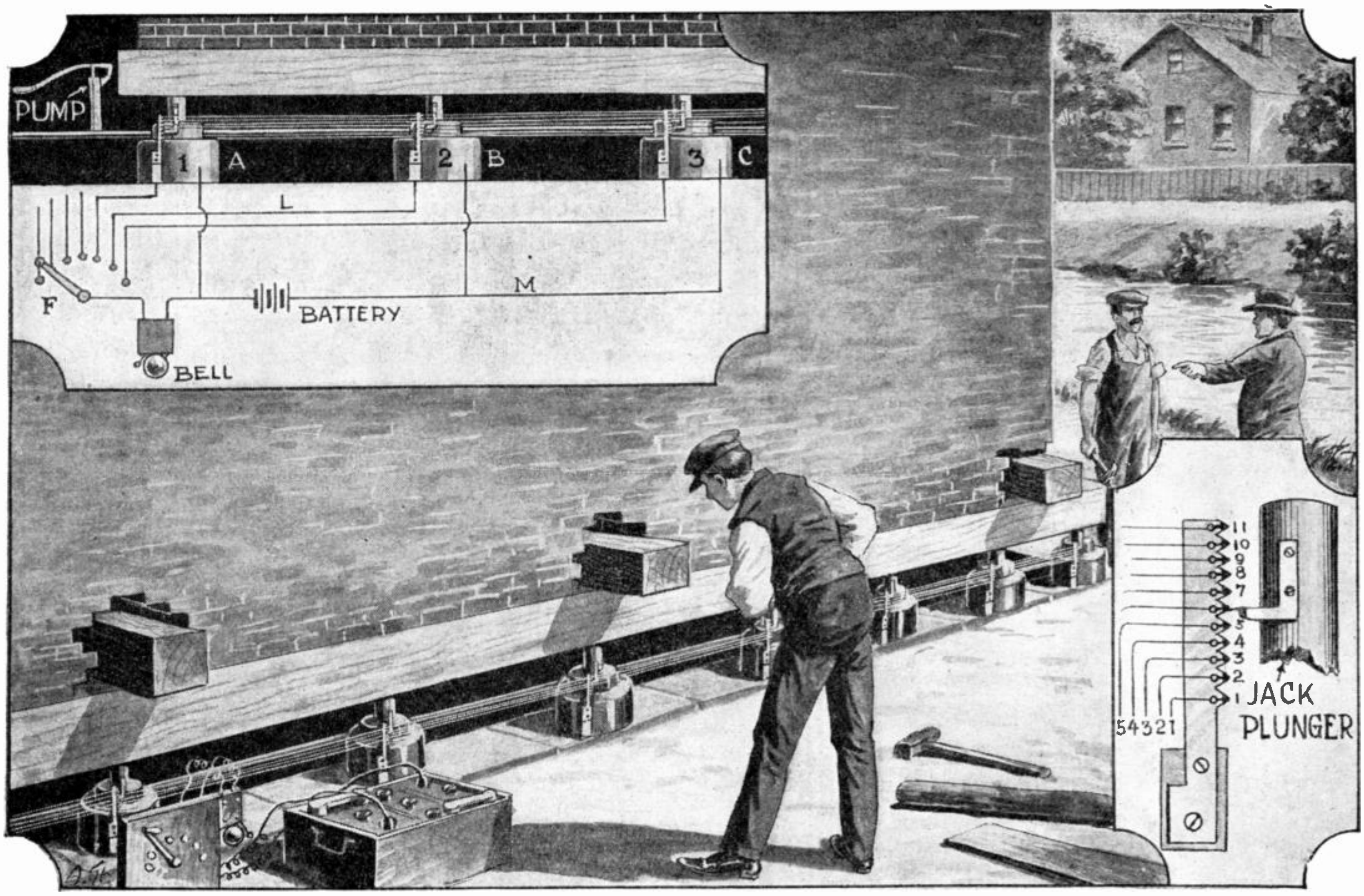
Electric motor of almost zero rotary inertia, and involving very wonderful characteristics, all described in the article.

The motor we illustrate has three electro-magnets of the Baule type journaled to a central crank and it can turn up to 1800 turns per minute, which gives 150 different positions of the rotor per second. There is no inertia of rotation; it can be stopped at will in any one of the 150 positions which it takes in a second, without going beyond the position in question. It can be used with the most irregularly operating apparatus.

If the principles involved in this motor are studied it will be seen that the suppression of inertia gives it a unique feature.

Electric Indicator for House Movers

By George G. McVicker



Watching the lifting of a building by means of electrical contacts. As the hydraulic jacks raise the building, an open circuit indicates that one of the jacks is working either faster or slower than the other. The general connection is shown in the upper left hand diagram and the lower right hand diagram shows the contacts made by the jack as it rises and falls.

WHEN lifting large buildings in preparing for moving or for new foundations, a number of hydraulic jacks are usually connected with one pump and thus the pressure is applied to all sections of the building at the same time. This would prevent any accident or cracked walls, providing all parts of the building were of the same weight and if the foundations for the restings of the jacks were all equal in bearing power.

To insure each part being lifted equally, an electric indicator may be applied as follows:

A notched standard is made of brass with the notches as far apart as would cover the inevitable difference in the lifting of adjacent points of the building, and within danger limits. In other words, if one-eighth inch advance at one spot would cause danger, then the notches may be no more than this distance apart. This standard is mounted on a solid foundation which is not likely to settle or rise. On the plunger of the hydraulic jack a brass pointer is attached so that when the plunger rises this point will make contact with the notches one by one, along the notched brass standard.

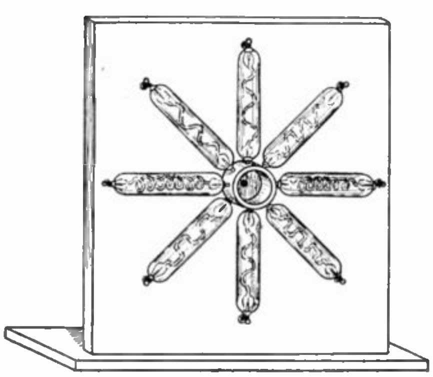
These notches are all insulated from other parts and each is wired to a button at a multiple point switch seen at the left. The ground side of the circuit is wired to the throw arm of the same switch. When the jacks are set the contacts are set with corresponding numbers on each. At intervals an operator at the switch throws the switch arm across, making contact with each of the points numbered 1, 2, 3, etc. If the contacts are made on the corresponding notches at each jack, the bell in the circuit will ring as the switch arm closes with each point, but should the bell not ring then the probabilities are that one of the jacks corresponding with the number of this point is either ahead or below the others. Investigation and comparison of numbers on the standards of the several jacks will determine the amount and whether the trouble is in the foundation or the pressure exerted by the jack.

Electric Pinwheels

NOW that dangerous and noisy fireworks for the celebration of the Fourth of July have gone out of fashion, we look for a safe and sane eye-arrester.

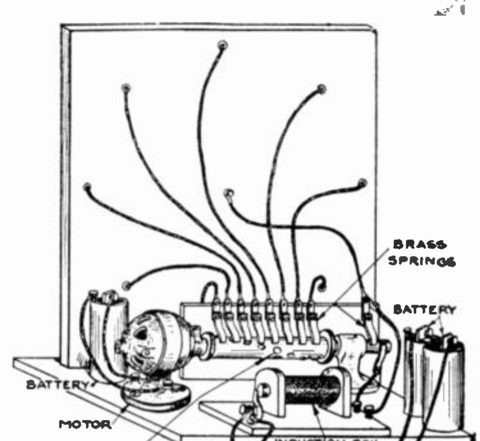
A good imitation of the firework known as the "pinwheel" may be obtained by the intermittent flashing of Geissler tubes, placed in radial form on a black-velvet covered board, as shown in the accompanying illustration. By running the motor at varying speeds, different effects may be obtained. The effect of rapid revolution of the tubes is the result of progressive flash-lighting produced by a spool-switch. If we revolve the tubes themselves, there is danger of bending or breaking the thin platinum terminals, or the glass itself.

Contributed by W. N. JENNINGS.

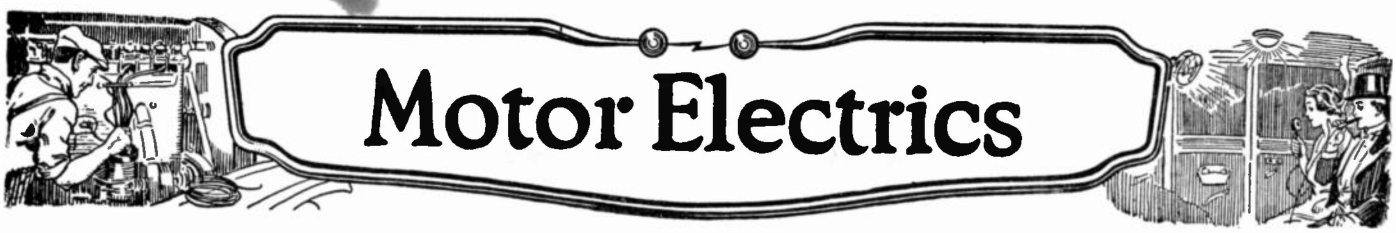


GEISSLER TUBES MOUNTED ON VELVET COVERED BOARD

Radially arranged Geissler tubes are thrown into action in rapid succession and produce the effect of a rotating pin wheel, such as used on the Fourth of July.

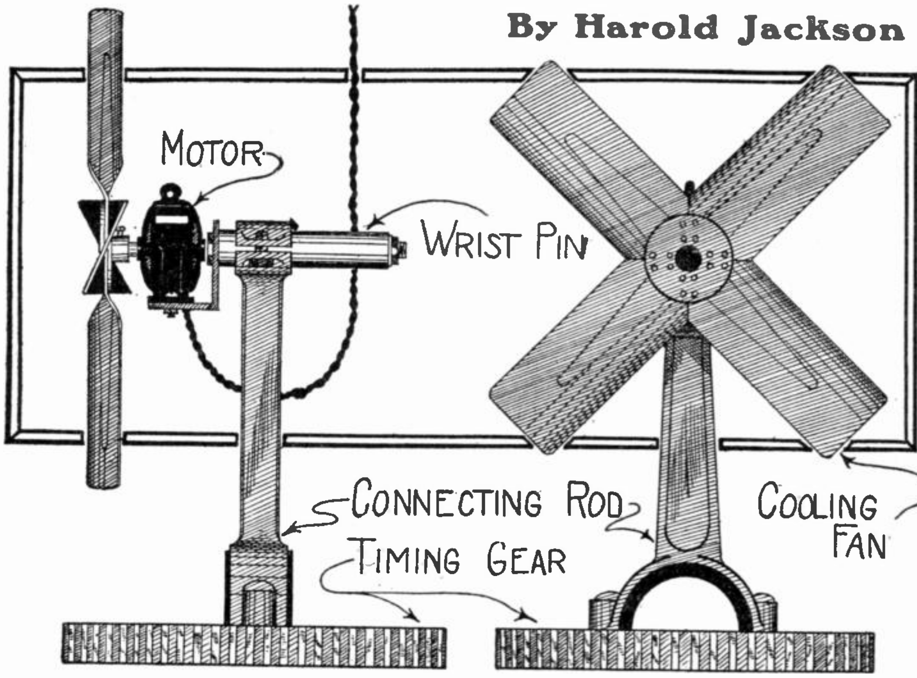


Connection for the electric pin wheel; it is worked from a species of flasher, throwing the tubes into action one by one.



Fan from Motor Parts

By Harold Jackson



Electric fan made from motor parts as a window display; it will attract attention and at the same time prove a very efficient appliance to take the place of the every-day fan.

THE electric fan shown makes a very novel and attractive advertising device for dealers in automobile repair parts. It is made almost entirely of motor parts. A timing gear is used as the base on which it stands. The standard is a connecting rod with the cap on the big end removed. The big end is used as the base of the standard. The rod and timing gear are bolted together, as shown, with short bolts.

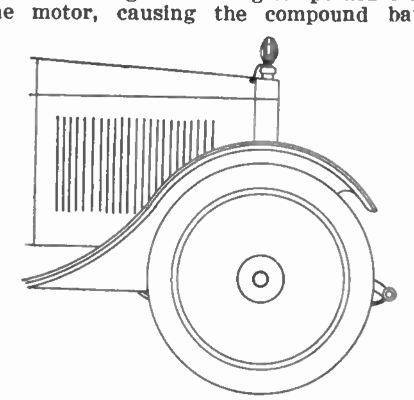
A wrist-pin is placed in the upper end of the connecting rod, to which is secured by means of a long bolt a small angle-iron bracket, upon which is mounted a small electric motor. The fan, which is a regular radiator cooling fan, is secured to the shaft of the motor. This is done by sawing off the fan pulley, leaving one inch of the hub on the fan. A small set-screw is turned into a threaded hole in the side of the hub, as shown, which holds the fan in place.

The motor can be operated by a storage battery or connected to the city mains using a small transformer. Aside from serving as a show window display, this fan can be used on the garage manager's desk on hot days. Every part is recognized at a glance.

Motor Temperature Indicator

THIS device, which is to be mounted on the radiator cap of an automobile, is a safety device known as a scopometer, taking its name from its combination—that of the crystal mirrorscope, and the meter below.

The meter part, which serves as a safe temperature indicator, is thermostatically controlled, and the indication is made with the rising or receding temperature of the motor, causing the compound bar,



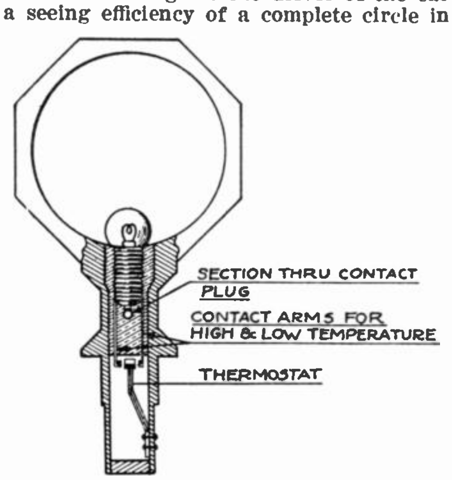
Mounting of a temperature indicator for a radiator. The interesting feature about this is that it tells when the temperature is too low, so that there is danger of freezing, as well as when it is getting so high as to indicate too hot an engine.

which comprises the thermostat, to bend or straighten, in accordance with the rising or lowering of the motor temperature; if the contact points are closed the small electric light in the base of the scopometer is lighted to give warning.

The safety feature is this: The contact points are so adjusted that there is a distinct margin of safety between the two signaling points of the device and the actual danger point in the motor, based on the boiling point of 212 degrees Fahrenheit and the freezing point of 32 degrees Fahrenheit. The compound bar closes the circuit at both these temperatures.

The reflector is constructed from a crystal mirror, having a three-quarter inch convex with a diameter of approximately three inches. The convex of the mirror defines the object reflected, so that sunlight or rays from headlights or trains, trolleys, motor cars, etc., are neither scintillating nor dazzling to the human eye, and it becomes a safety attachment rather than a hazard. The scope has a reflecting efficiency of approximately 200 degrees of a circle. This gives the driver of the car a seeing efficiency of a complete circle in looking ahead. In other words, the device is always directly in front of him, (on the radiator cap) and he can see traffic and other objects reflected in the scope from any direction.

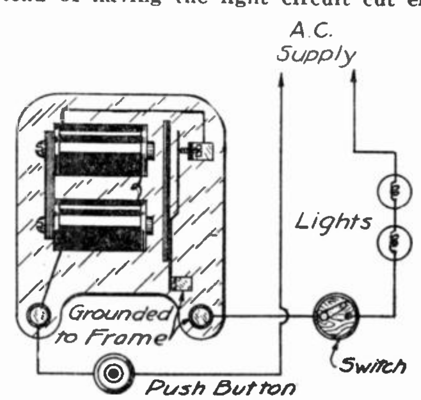
Contributed by H. A. POOCH.



The construction of the heat indicator, showing how there are two contacts, one for hot and one for cold radiator, operated by a single thermostat bar.

Ford Headlight Dimmer

IN this arrangement an old bell buzzer was used as a relay, except that instead of having the light circuit cut en-



A buzzer is used to rapidly open and close the lamp circuit to act as a headlight dimmer on a motor car.

tirely open by the movement of the arm of the relay, the circuit is opened and closed rapidly by the vibrations of the hammer of the buzzer.

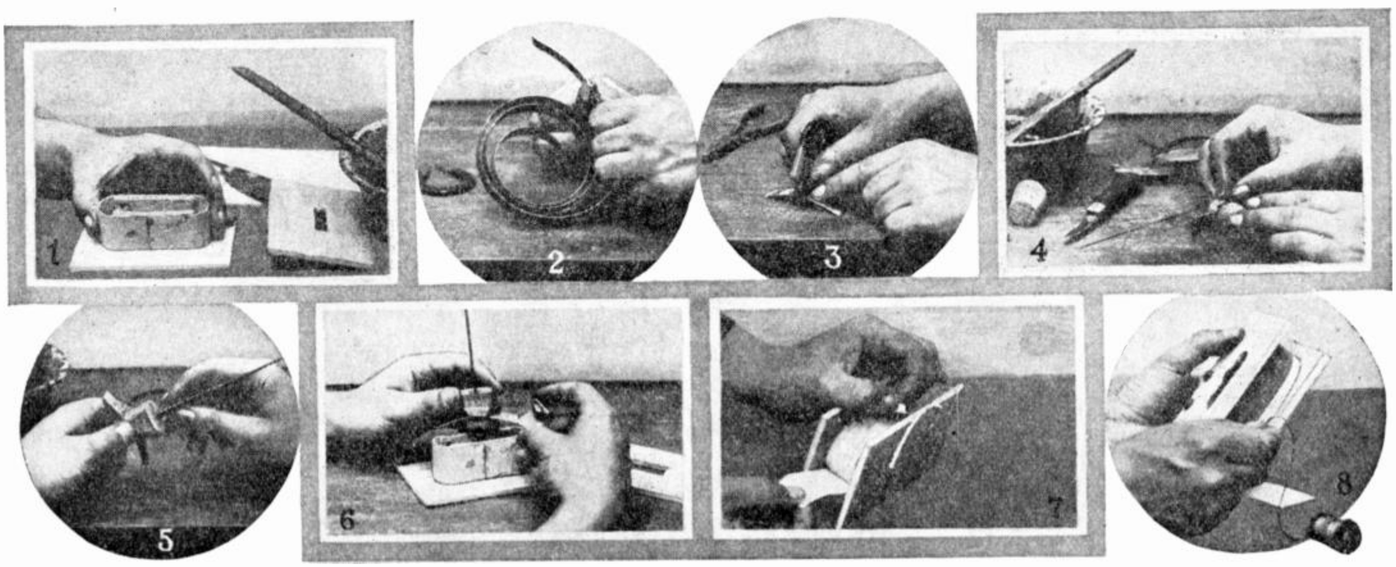
This vibrator, or in other words, the opening and closing of the circuit, has a deadening effect on the lights, allowing only half the current to pass through the lamps.

Contributed by DONALD QUEENEY.

Voltmeter and Ammeter

By Dr. E. Bade

WHEN an ordinary compass is brought near a wire carrying a few amperes of current, a deflection of the needle is noticed. It is upon this simple fact that the construction of instruments capable of measuring the intensity of the current, is based. For, when the current carrying wire is coiled around the needle a number of times, the effect of the current is increased, the action upon the needle being multiplied perhaps a hundred fold or more. Such a device which carries any number of turns of conductor around a magnet, is called a galvanometer and it is used for recognizing currents, the wire being wound at right angles to the swing of the needle.



The illustrations show the operations in putting together an ammeter which by a high resistance in series is made to operate at high voltages. The numbers indicate the succession or order of operations, which will be found described in detail in the very interesting text.

The unit of current strength is the ampere, that of the electro-motive force is called the volt. When measuring with an ammeter, the meter is connected in series with the main circuit. This instrument must have a very low resistance, because the other instruments and appliances in the circuit are to be supplied with current practically undiminished in intensity, and this current has to go through the windings. The material from which they are made must be a good conductor and copper is usually the most available. The voltmeter, on the other hand, must have a very high resistance for it is connected in parallel, and, in this position, because of its high resistance, it must consume only a minute amount of energy. Resistance is used in series with it and is usually German silver although in this case it is made from a pencil.

The ammeter must first be made and then the resistance is to be added so that it can be used or not as required. It is in this way that the combined ammeter and voltmeter is to be made.

The frame is made from thin wood such as cigarbox wood. The base is 3 by 4½ inches, the top is of the same size but this has a hole in it 1½ by ¾ inches located in the center. To the bottom a piece of cardboard, 1¼ inches high, is glued in the form of an oblong, the longer sides being braced by two strips of wood two inches in length and just as high as the cardboard.

Do not use iron nails in any part of the meter; use brass nails and screws as well as glue.

Now the movable part with its indicator is to be made. First a small magnet is secured by breaking a 2¼ inch piece of steel spring with a pair of pliers. Place the fragment of spring on the table, and, beginning at the center of the spring, rub to one end with a horseshoe magnet. One side is rubbed with the north pole and the other end is rubbed with the south pole. When the steel spring is magnetic, take a cork, make a slit in it near the bottom, and insert the magnetized steel spring fragment, care being taken to glue the magnet in its exact center to the cork. Then insert a long brass wire as an indicator to the top of the cork, push a brass pin through the cork near the center of balance, and this will be the pivot of the magnet. See that the steel spring curves downward at each side of the cork; this will help to keep it in balance. The shaft or pin is placed in a brass slot bearing which is firmly fastened to the inside of the case.

When this has been accomplished, insulated wire is wound around the cardboard core. For obtaining the amperage of a large No. 6 dry cell, three turns of No. 8 wire are wound around the core, the ends being fastened to two brass binding posts. With these three turns it is possible to measure the amperage of four large 1¼ volt dry cells connected in series as well as to obtain the amperage of just one of these cells.

Wrap a piece of paper over this wire, and, connecting a No. 18 wire to the last binding post, begin to wind on carefully a full layer of wire; insulate with a piece of paper and then begin winding downward again so that two layers of this wire are obtained. This will give a large number of turns on these two layers. The free end of the wire is brought to the third binding post. Then, the first binding post connects the three turns, the second post connects the end of the three turns and also connects the first winding of the two layers of wire, the third binding post connects the end of this layer. To this last post connect a No. 22 wire, and wind four layers, insulating each layer with a piece of paper. Connect the free end to a fourth bind-

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Interesting Articles to Appear in July Issue

The Gate for Your Voice Highway.
By Paul B. Findley.

Inter-Poles.
By Harold Jackson.

Ohm's Law.
By F. S. Yamamoto.

Making Small Generators.
By Raymond F. Yates.

Electric Chronograph and Recording Drum.
By Dr. Russell G. Harris, Harvard University.

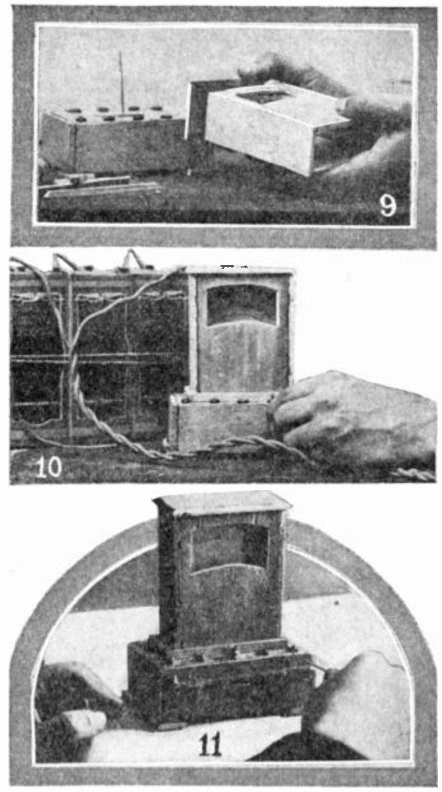
Dry Cells from Wet Batteries.
By C. A. Oldroyd, Barrow-in-Furness, England.

ing post. To this post connect a No. 28 or smaller wire and wind on ten layers, insulating each layer with a piece of paper. Connect this last and final wire to the last or fifth binding post.

When the two wires connecting the positive and the negative pole of a cell are brought in contact with the first and second binding post, then three turns are engaged; when the second and third post are touched then two layers of No. 18 wire are engaged; when the third and fourth are touched then four layers of No. 22 wire are engaged, and when the last two posts are connected, then ten turns of the finer wire are engaged. When the wire is connected to post 5 and post 2 or 1 so that all turns of wire are engaged, the indicator will swing when as little as one ten-thousandth of an ampere is in the cell. This means that a battery, which is dead to all intents and purposes, will still show life or current. In fact the current that can be detected with this instrument is so small, that it can not be measured in any other way.

When the wire has been wound, glue the sides together with thin boards, insert the magnetic indicator, and make a cover having one window of glass. Opposite this window glue a piece of paper carrying a scale. This scale can be of any size because the amperage and voltage signs must be found by experiment or comparison. Make the cover in such a way that it can be taken off when necessary and remember not to use any iron or steel nails or screws.

The instrument is now a complete ammeter and, as an ordinary large sized or No. 6 dry cell has approximately 25 amperes, it can be scaled according to the amperage given by these cells. Here the three turns of heavy wire are used, that is, the first and second binding post. Voltages are found in a different manner.



In these three views we see the complete instrument. When used as an ammeter, its low resistance windings are put in circuit, while for a voltmeter the higher resistance coils are used and a lead pencil supplies circuit resistance for making it practically safe from burning out at high voltages.

An addition of a high resistance is necessary when voltages are to be found, and the resistance is usually German silver wire. Other substances can be used, and it is not necessary to employ this wire although the results may not be quite so accurate with a commoner type of resistance. For this purpose a pencil is used. The two ends of the pencil are first cut about one inch shorter than the ammeter and voltmeter box. Then, a quarter inch of each end of the pencil is cut so as to expose a quarter inch of lead on each side. Around each exposed end a fine wire is firmly wound a number of times to make good contact. The end of one wire is brought to a binding post situated on a narrow strip of wood upon which the pencil is to be glued. This strip is glued to the front of the coil box and just below the posts for the ammeter. The other end of the wire from the pencil is led to the central or third post of the ammeter where it is to be permanently mounted.

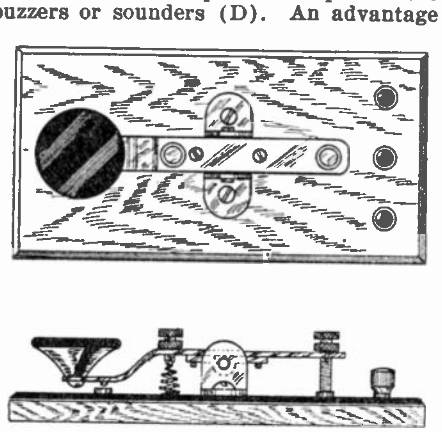
For use as a voltmeter, one wire from the battery or cell is connected to the binding post on the strip upon which the pencil is mounted. The other wire leads to binding post No. 2 so that two layers of No. 18 wire are in series with the resistance of the pencil. If the swing of the indicator is not large enough, then the wire from the battery touching post No. 2 is moved to post No. 4 where four layers of No. 22 wire are in series with the pencil. A higher resistance must be used when B-batteries are to be tested. When winding the wire, care must be taken to wind it all in the same direction.

Open Circuit Telegraph Key

By Amedeo Giolitto

THE construction of what is known as an open circuit key is given in the accompanying diagrams. In this type of key, which is highly desirable for open circuit telegraph systems, the circuit closing switch is eliminated.

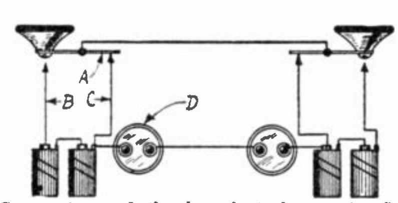
This is accomplished by connecting up the instruments as shown in the wiring diagram. It will be seen that the difference between this key and one of the ordinary style, is that it has an extra contact. When the lever (A) is pressed it breaks contact with (C) and makes contact with (B). This action introduces the batteries into the circuit, which furnish the current required to operate the buzzers or sounders (D). An advantage



Very effective construction of a telegraph key. It can be used on open circuit telegraph systems, and eliminates the need of a switch for opening and closing the circuit.

of this method of connecting up the instruments is that either one of the stations may call up the other at will, and still keep the batteries on an open circuit, when the line is not in operation.

It will be clear that this cannot be accomplished with the ordinary key, since all of the instruments would have to be connected up in series. Now if the batteries are to be kept on an open circuit, one of the circuit closers should remain



Connections of the key just described. It is best worked upon a metallic circuit.

in an open position, thus making it impossible for the other station to call up.

The diagram merely shows the connections for two stations, but more can be cut in if desired. The connections for each separate station will be the same as shown in the diagram, and all of them are to be connected in series.

Two views of the key as it appears when finished are given. The two outer binding posts are connected to the contacts at each end of the lever, while the lever itself is connected to the center binding post.

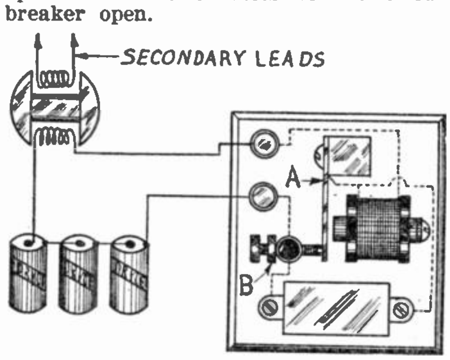
For best results a complete metallic circuit should be used, that is, two line wires should be employed, instead of a ground and a single line wire. It is not advisable to use a ground connection unless the sounders are operated in connection with a relay.

Armature as Spark Coil

By Amedeo Giolitto

THE armature of a high tension magneto can be used as a spark coil if connected up to a vibrator as shown in the diagram. In fact the armature of a high tension magneto is nothing more than a small spark coil with a primary and secondary winding.

The primary winding consists of a few turns of heavy wire and generates its own current when rotating between the magnets. On a magneto the primary current is interrupted by a circuit breaker placed on the armature shaft and mechanically operated by the rotation of the shaft. Therefore the armature operates in the same way as a spark coil, that is, as the primary current is interrupted by the circuit breaker, a high voltage is induced in the secondary winding. Part of the voltage generated in the secondary winding is due to its rotation between the magnets, but the voltage generated in this way does not amount to very much, and is small compared to the voltage developed when the contacts of the circuit breaker open.



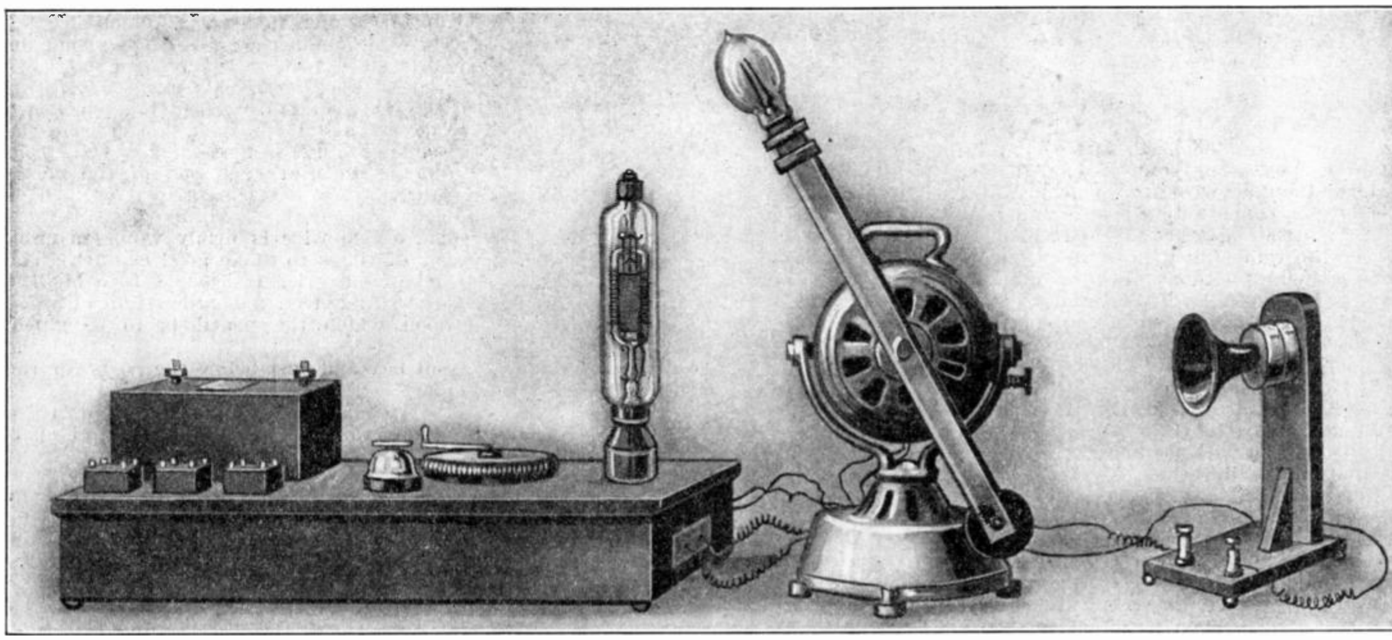
How to get induction-coil sparks, using the armature of a high tension magneto connected with a vibrator, the whole hook-up being shown in the illustration above.

If the primary winding is connected in series with a vibrator and three or four dry cells, the secondary voltage will be high enough to produce a spark across

(Concluded on page 472)

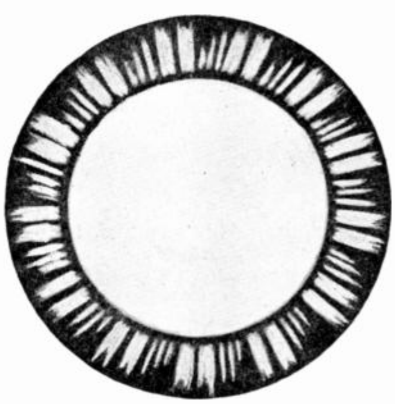
The New Flame Language

By Dr. Alfred Gradenwitz
Berlin Correspondent, PRACTICAL ELECTRICS



The complete apparatus, including the telephone, vacuum tube, motor rheostat and auxiliary apparatus, for analyzing the light given by neon lamps. The lamp is rotated with such speed that it gives a circle of light or lights which vary in appearance according to the sound producing them.

A MEDICAL practitioner, Dr. Leo Jacobsohn, of Berlin, who for some time past has been engaged in experimental research on the applications of wireless to medicine, has devised a new method for demonstrating and exhibiting the effects of sound waves; it is so well carried out that it gives a true presentation of the waves producing different sounds.



The circle of lights produced by rotating the lamp at high speed while the telephone is being spoken into.

As shown in our illustration an electric glim or neon lamp is mounted on a horizontal staff so as to be rotated by a motor. Its weight is counterbalanced by an extension of the arm carrying the counterweight, so that it rotates smoothly. If, now, a steady or direct current is turned on to the lamp, it will burn steadily, and if rotated will give to the eye the effect of a continuous circular band of light. If alternating current is turned on, the circular band will be broken up, and will indicate the alternations of current. Now the thing to be done is to light the lamp with the amplified telephonic currents, so that the luminous band of light will be broken up and indicate wave forms produced by the voice. In order to obtain currents powerful enough to light the lamp, a vacuum tube amplifier is used. The diagram shows the connections.

The microphone, which may be an ordinary telephone transmitter, receives current from a 6 volt battery, which may be the same battery that ignites the vacuum tube filament. The sound waves, striking the microphone, modulate the current flowing through it, and by means of the microphone transformer, the voltage is stepped up and applied to the grind and filament of the vacuum tube.

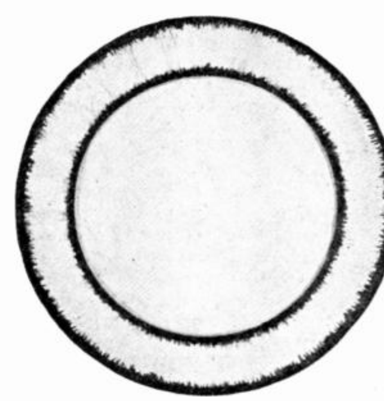
For experimental use, a small spark coil or telephone induction coil will do for the microphone transformer. A "C" battery of about 9 volts should be used to bias the grid of the tube.

In the plate circuit of the tube we have a large choke coil, about the one henry, in series with a "B" battery of about 200 volts. The secondary of an amplifying transformer forms a good choke coil. It should not be removed from the iron core. With this arrangement, variations of the grid voltage cause much greater variations of voltage between the plate and filament, to which the lamp is connected.

If the microphone is spoken into, it will vary the grid voltage, and consequently the plate current, and the lamp will have its illumination affected in unison with the sound waves. The eye can see nothing if the lamp is stationary, except that its degree of luminosity will be slightly changed. But if the motor is started the lamp whirls around and, instead of a uniform band of color, produces the effect of a whole series of radial flames, all due to persistence of vision combined with the variations in the lamp.

The position of the mouth is shown in the central portrait, which produced the flame effect shown surrounding it like a frame.

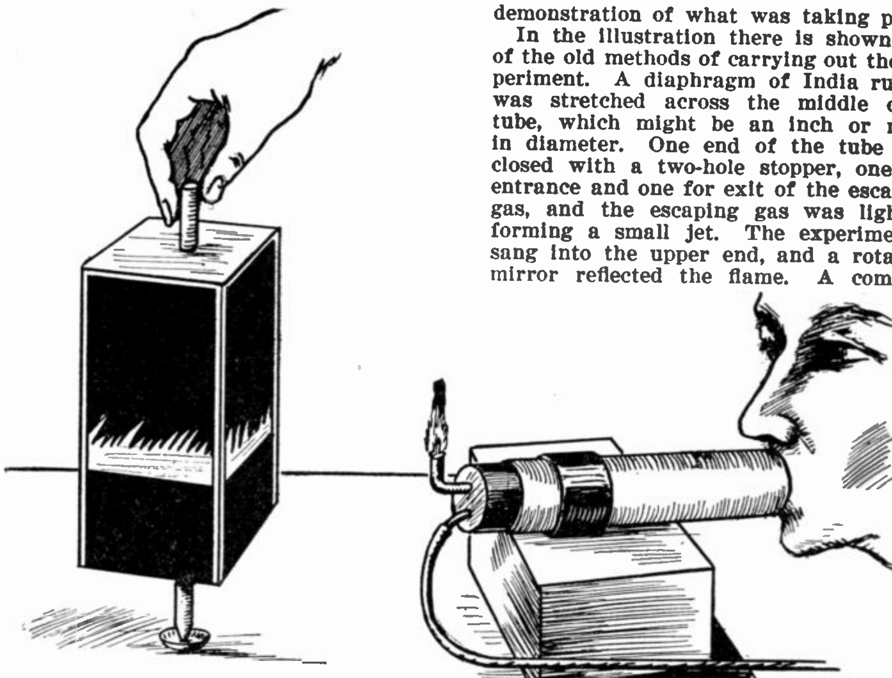
On the cover page of this magazine are shown various sound effects, corresponding to different vowels or enunciations, and in each case, the face which is reproduced, gives the contour of the lips due to the production of the sound, indicated by the characteristic circle of lights.



What we may suppose is produced by an enormously high pitched sound or possibly by the inherent vibrations in an electric current.

It is even said that these luminous bands can be combined into word pictures and each word talked or sung can be read from these "talking flames," or as Dr. Jacobsohn would have it, can be read in the form of a "flame language." This experiment is the electrical development of an old-time demonstration of what were termed manometric flames.

If a gas flame is so arranged as to be affected by sound waves, it will be made to vibrate or change rapidly in intensity, and these changes can be made visible by rotating a mirror which reflects them. A steady flame in this way would be drawn out into a band of light, while an

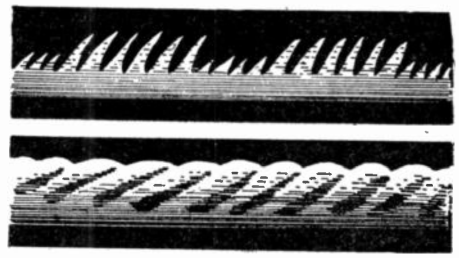


oscillating one would present a series of curves or teeth, the latter sometimes called saw-teeth, and give a very elegant demonstration of what was taking place.

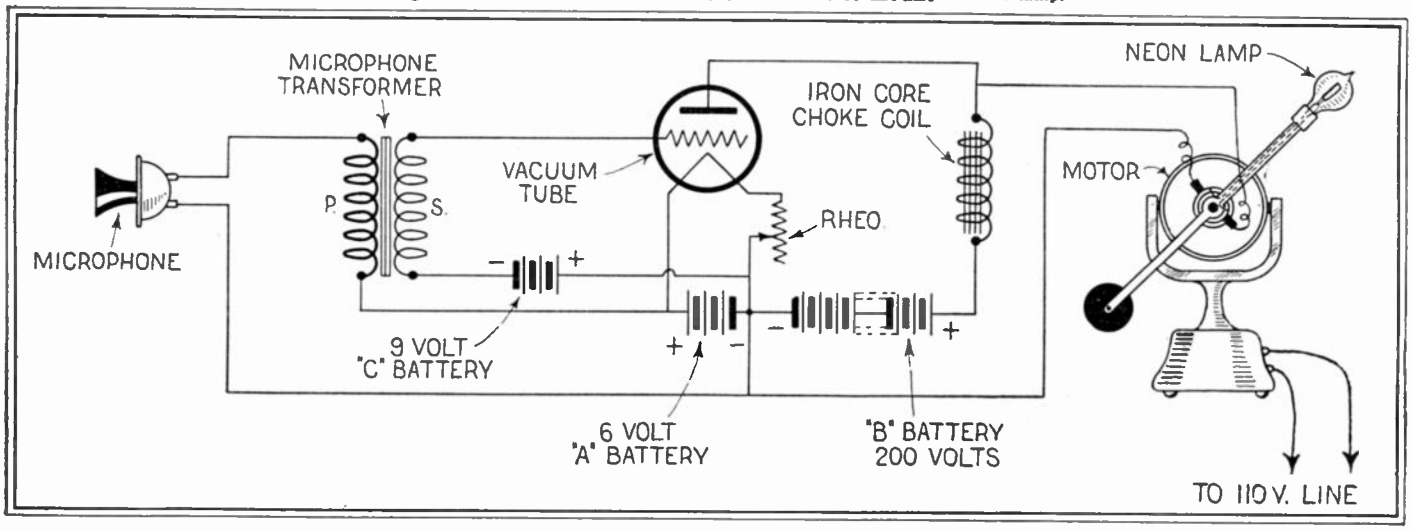
In the illustration there is shown one of the old methods of carrying out the experiment. A diaphragm of India rubber was stretched across the middle of a tube, which might be an inch or more in diameter. One end of the tube was closed with a two-hole stopper, one for entrance and one for exit of the escaping gas, and the escaping gas was lighted, forming a small jet. The experimenter sang into the upper end, and a rotating mirror reflected the flame. A common mirror could be used, mounted on a rod, so as to be rapidly turned.

The writer found it convenient to mount four oblong mirrors in a prism as shown, with the shaft running through the central axis of the prism. This was held in a vertical position, its lower end resting in a little cup or saucer, and was whirled by hand. Several views are given of the appearance produced by different vocal sounds.

We have therefore shown the old and the new. The new may be supposed to require a more or less darkened room for its adequate exhibition, while the manometric gas flame, as it may be called, shows perfectly in daylight.



Left. The manometric capsule, being actuated by sound, causes the flames to rise and fall and produces in the rotating mirrors the effects shown.
Above. Examples of sound waves as illustrated by the flame. If the tube is not affected by sound the whirling mirror would simply show a band of light.
Below. The hook-up for the production of the variable voice currents affecting the light of the neon lamp.



Experimental Relay

By Amedeo Giolitto

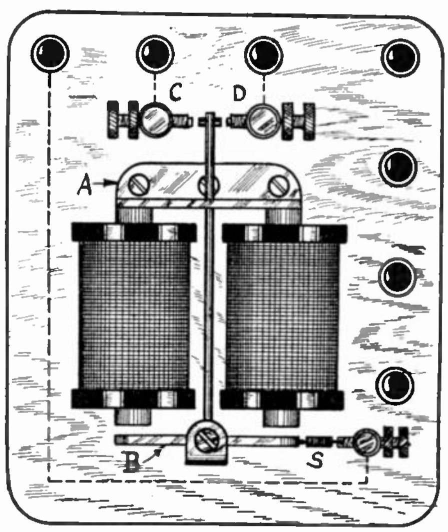
THE relay shown in the illustration can be used for a number of different purposes since all of its connections are brought out to separate binding posts.

The construction is clearly shown. The electromagnets are supported by a metal piece (A) bent in angle-iron fashion and screwed down to the wooden base. A hole in the same piece (A) is provided for the armature (B) to pass through it. The lower end of the armature is pivoted, while the upper end between (C) and (D) carries a contact piece. When the relay is not in operation the armature is held in a position midway between the two contact posts (C) and (D), by means of a spring (S), whose tension may be regulated by turning the thumb screw to which it is attached.

The four terminals leading from the coils connect to the four binding posts on the right hand side of the instrument.

Referring to the illustration it will be noted that the mechanical construction of the relay is such, that if a permanent magnet is used for the part of the armature acted upon by the electromagnets, the relay becomes a polarized one.

Another way of making it a polarized relay would be to keep its soft iron armature magnetized in one direction, by connecting one of the coils of the magnet to a source of direct current.



A polarized relay. The armature may be a permanent magnet or polarized by one D. C. magnet.

To illustrate its action when connected in this way let us imagine that the other coil is connected to an alternating current circuit.

The armature will now vibrate, providing the direct and alternating currents flowing through the coils are approximately equal. It will be understood that the frequency at which the armature vibrates will correspond to the frequency of the alternating current. It follows that the relay can be used as a rectifier, for rectifying an alternating current. This would be accomplished by connecting one set of contacts in series with the alternating current circuit, and having the coils connected as already described.

The magnets used in the construction of this relay may be taken from an old telephone bell, which have a resistance of about 500 ohms.

As already stated this relay can be connected so as to serve for many different requirements.

Generally speaking, relays are used where the currents received over a line from a given distance are too weak to operate a certain piece of apparatus.

Radio Testing Instruments

By Dr. Russell G. Harris

IN a preceding number a very simple but sensitive thermogalvanometer for measuring high frequency currents was described. This is one of the most useful instruments for determining whether radio apparatus is working as it should, but is seldom found in the hands of an amateur experimenter. With one of these in his workshop the radio fan

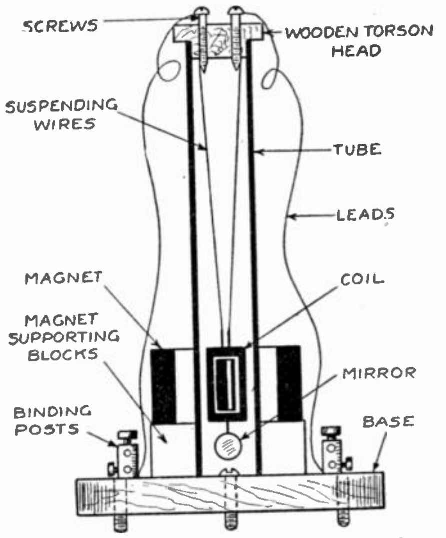


Fig. 2. Sectional view of the instrument shown in the reproduction on the right. By bringing the two screws closer together in the construction, the instrument can be made more sensitive. The position of the magnet below the coil and above the mirror is clearly shown.

need never bother about the relative merits of arguments for or against "litz" wire, or in regard to capacity losses in various coils, etc.; he can make actual measurements and find what is happening in his own particular case.

Before going into the various applications of the thermogalvanometer we shall describe a simple form of bi-filar suspension galvanometer, which, with proper shunts and resistances, forms an excellent ammeter or voltmeter. In conjunction with the thermogalvanometer we will have apparatus to measure any high frequency or direct current or voltage, within the ranges common to radio.

It was mentioned that the thermogalvanometer could be used to measure direct currents as well as alternating or high frequency currents. This is true, but the

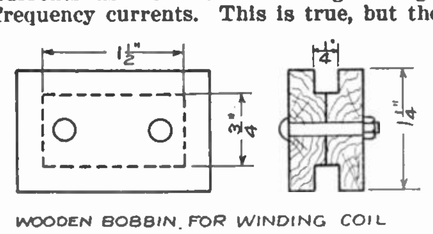


Fig. 3. The wooden form on which the coil is wound; the coil has to form a rectangle so the form is really a rectangular bobbin.

instrument to be described is more convenient to handle, more stable, easier to control and read, and has a number of other advantages. But it can be used with nothing but direct currents; hence, the well equipped laboratory has both types of instrument.

A number of forms of d'Arsonval galvanometer have been described from time to time in PRACTICAL ELECTRICS, but these have generally been nothing more than interesting bits of apparatus, useful as current indicators and for rough measurements. The present instrument, with proper care, can be made as accurate and sensitive as any heavy-duty galvanometer on the market. Such galvanometers have been used by the writer in experiments calling for an accuracy of one-tenth of one per cent.

The radiomicrometer and thermogalvanometer were made as sensitive as possible, but with the present instrument sensitivity is to be sacrificed for convenience. This galvanometer is to be merely the indicating device for ammeters, voltmeters, and a Wheatstone's bridge. The main points to strive for are constancy of zero, quickness of swing, and ruggedness of construction. We achieve these ends by using two wires to support the coil, the so-called bi-filar suspension.

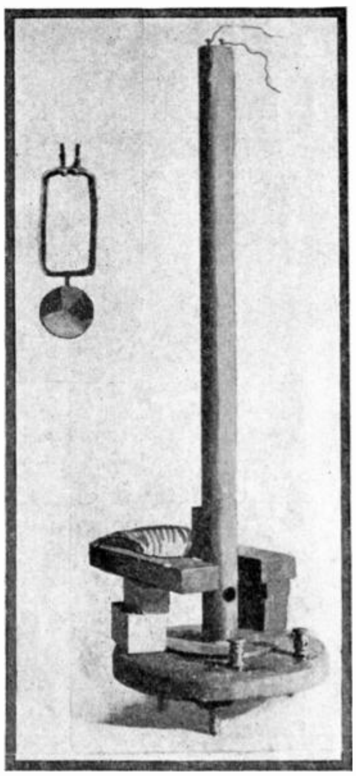


Fig. 1. A reproduction of the bi-filar D'Arsonval galvanometer. Note the position of the aperture through which the rays of light pass.

The same type of outside case can be used for this as for the two preceding instruments. A typical case is shown in the photograph (Fig. 1); the only window in the tube is for the mirror. This should be as low down as possible, as the mirror is to be below the coil instead of above it. The same lamp, scale, and lens indicating device can be used for all three instruments; they may be set up side by side on the same bench, if desired, and all read on the same scale. If this is done a lamp and lens will be required for each.

The bi-filar suspension gives us a convenient way of leading the current into and out of the coil. Ordinarily the current is led in through the suspension and out through a fine spiral of wire hanging below. This lower spiral is difficult to build and attach in such a way that the sensitivity of the instrument is not greatly decreased. It is therefore of great advantage to do away with it.

The torsion head is made of wood or hard rubber, and provided with two brass screws running through it about half an inch apart. External connections are made by soldering two wires to the top of these screws connected to the binding posts on the base. The fine wire suspensions are soldered to the lower ends of the screws, as in Figure 2. All soldering should be done very carefully with rosin as flux; no acid must come anywhere near the instrument, as it will introduce spurious currents.

The suspensions should be of the finest copper, silver, or brass wire obtainable, though steel or phosphor bronze will do if the resistance of the coil is high. Thin silver or brass ribbon can be bought, and

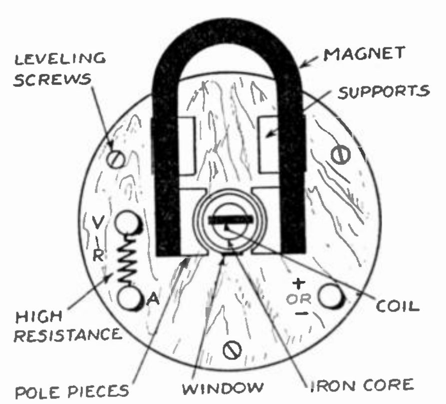


Fig. 4. Plan view and cross-section of the instrument showing how the coil is placed; the resistance coil on the left is to be noted.

should be obtained if possible, as it is very cheap. If nothing else can be obtained, try wire from an old spark coil secondary, with the insulation removed. To the lower ends of the two suspension wires solder two pieces of No. 20-No. 28 copper wire about half an inch long. These are to be bent around the coil, about an eighth of an inch apart, fastened with sealing wax, and soldered to the terminals of the coil. If they are fastened to the coil first and then to the suspensions it is difficult to get both suspensions the same length.

The coil consists of several hundred turns of copper wire with single cotton or silk insulation, of size between No. 32 and No. 40. This can be obtained from an old spark coil secondary, or from cer-

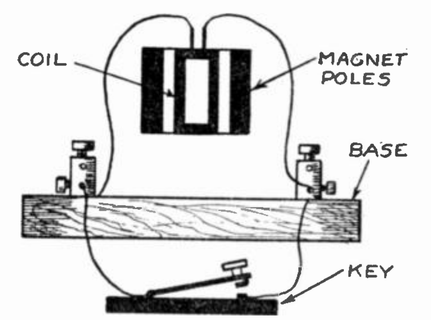


Fig. 5. Relation of the magnet poles to the coil. The field is what gives the instrument its operative effect.

tain varieties of telephones. It may be wound on a small wooden bobbin, made so as to come apart as in Figure 3. Wind on enough wire so that the coil has a cross-section about that of a heavy shoelace. The exact number of turns and size of the wire is immaterial, but the more turns the better, within limits. The mirror is attached to the bottom of the coil with a small copper strip and sealing wax, as in Figure 1. This mirror may be larger and heavier than the ones used in the previous instruments; the larger it is the stronger the spot of light on the scale will be, but the heavier it is the longer it will take to swing, and hence to get a reading.

The magnet is placed as in the two preceding instruments, outside the supporting tube. Be sure that it is level with the center of the coil when the latter is suspended in place, and that it is good and strong. The strength of the magnetic field makes more difference in the present than in the preceding cases. If desired, a pair of pole pieces can be made to close the gap between the poles and the tube, and if a great increase in sensitivity is wanted, a soft iron core may be fastened inside the tube and coil, so that the coil moves in a concentrated magnetic field, as in Figure 5.

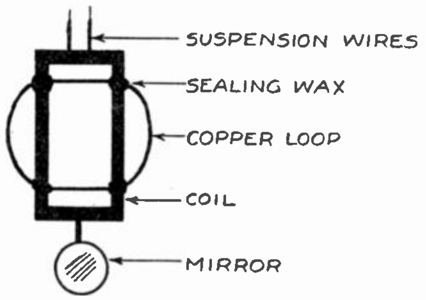


Fig. 6. Coil and mirror; the mirror, it will be noted, is suspended below the coil, and the copper loop acts as a damper.

The binding posts should be placed several inches apart, to receive the shunts, and should be of the type that has two holes, one holding the shunt connection and the other the wires from the external circuit.

Now set up the galvanometer with lamp and scale, as in the preceding cases. Arrange the lamp so that the spot falls on the zero of the scale, and protect the instrument from air currents so that the zero stands reasonably constant once the coil has come to rest. It may be found that when the coil has started swinging, if nothing is connected to the binding posts, it will keep it up for a long time. To avoid this, it is well to have a permanent key connected between the binding posts, closing the coil circuit when it is pushed, as in Figure 6a. When the circuit is closed the induced current in the coil should quickly damp and bring it to rest. If this does not occur, the magnetic field should be made stronger by winding a coil around the permanent magnet and sending a current through it in the right direction. If this does not avail, fasten a small short-circuited loop of copper to the coil with sealing wax, to act as a damper. (Figure 6).

The sensitivity of the instrument can be increased by having finer wire in the suspension, putting the two suspending wires closer together on the coil, strengthening the permanent magnet, putting more turns on the coil, or having longer suspension wires. It should be comparatively easy, however, to attain such sensitivity that a dry cell in series with a pair of 2000 ohm phones will produce full scale deflection, which is more sensitive than is needed for the present work.

After the galvanometer is complete and has been set up, we are ready to build and calibrate the shunts to use it as an ammeter, and the other resistances for using it as a voltmeter. If it has been built carefully it will make an instrument for this purpose superior to the commercial types, being inferior only in portability—and price.

For the shunts provide half a dozen pieces of hard-rubber, bakelite, or shellacked wood, about a quarter of an inch thick, three quarters wide, and slightly longer than the distance between the two binding posts. These are to be wound with heavy copper wire for the low resistance shunts, and with fine copper, German silver, nickel, or iron wire for the high resistance ones. The amount of wire in the shunt will need to be determined by trial in each case. With machine screws fasten to the ends of each shunt-form two leads of very heavy copper wire, so that they will fit into the binding posts as in Figure 7. Solder one end of the shunt wire to one of these leads, wind an amount of wire you think sufficient on the form and temporarily connect the other end of the wire to the second lead. Then test the deflection of the galvanometer when the proper current is applied; if the deflection is too great, decrease the resistance of the shunt; if it is too small, wind more wire on the shunt.

This procedure should be followed for each of the shunts constructed. The various shunts should give full scale deflections as follows:

No. 1, when dry cell in series with 15 watt lamp is connected to terminals.

No. 2, when storage cell in series with half of a six ohm rheostat is connected to terminals.

No. 3, when storage cell connected in series with two feet of No. 18 nichrome wire is used. In all these cases be sure the shunt is acting and well connected, for if it does not carry the large share of the current your galvanometer will burn out.

EXPERIMENTERS and amateurs, we want your ideas. Tell us about that new electrical stunt you have meant to write up right along, but never got to. Perhaps you have a new idea, perhaps you have seen some new electrically arranged "do-funny"—we want these ideas, all of them. For all such contributed articles that are accepted we will pay one cent a word upon publication. The shorter the article, and the better the illustration—whether it is a sketch or photograph—the better we like it. Why not get busy at once? Write legibly, in ink, and on one side of the paper only. EDITOR.

A third binding post should be put on the base of the instrument when it is to be used as a voltmeter. Between this and one of the original binding posts put a high resistance made of hundreds of turns of fine wire, such as was used in the coil. This resistance should have such a value that a single dry cell produces full scale deflection when applied directly. In order never to make the mistake of connecting a cell or high potential direct to the ammeter terminals, mark the common binding post + or —, depending on whether the carbon or zinc terminal of a dry cell produces deflections upscale. Then mark the binding post to which both high resistance and galvanometer terminal are connected, A, and the one connected to only the high resistance, V.

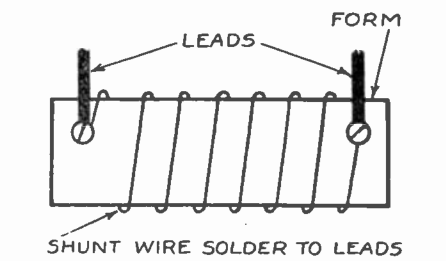


Fig. 7. Construction of the shunt wire wound on a hard rubber, bakelite or shellacked wood form for cutting down the current so as not to burn out the wires.

In order to adapt the voltmeter scale for different ranges, we must use shunts, as in the ammeter. Some of the same shunts may do, but if not, new ones should be constructed of such resistance that a 22½ volt B-battery in series with two dry cells gives full scale, and a 110 volt D. C. power line gives full scale. Any number of shunts can be made, giving the ammeter ranges from one milliampere to a thousand amperes, or the voltmeter from a millivolt to two hundred volts. Above this the insulation would be difficult to insure. Also, for the higher voltages one should use a higher series resistance in the voltmeter.

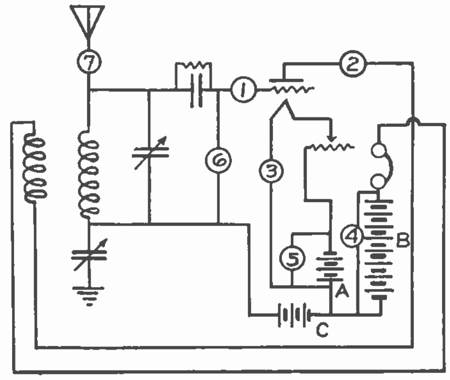


Fig. 8. How the instruments just described can be connected into a radio hook-up for measuring A-battery voltage, B-battery voltage, frequency and other data of the system.

The galvanometer with its various shunts should be calibrated in terms of some standard instruments, after it is in working order. Do not do this, however, until the shunts are at their final permanent value, and the scale distance is permanent. Any changes in the internal construction of the galvanometer, the shunts, or the scale distance will affect the calibration.

If desired, the scale may be calibrated directly in volts and amperes for the various shunts. If a large piece of tracing cloth is used for a scale, or even white paper, a number of scales can be ruled, one above the other, and a long spot of light can be used, from the whole filament of a lamp, which touches all the scales. Thus the upper scale may read milliamperes for no shunt, the second amperes for shunt No. 1, the third amperes for shunt No. 3, the fourth deflections in inches, the fifth, volts for series resistance and no shunt, the sixth volts for series resistance and shunt No. 4, and so on.

After the bi-filar galvanometer has been calibrated, the thermogalvanometer should be treated in the same way, but without shunts. It may be calibrated in series with the bi-filar galvanometer, for D. C., in which case these readings will be good for any frequency current. It should be borne in mind that with the thermogalvanometer, deflections vary approximately as the current squared, so the scale will be crowded at the lower end. Unfortunately shunts cannot be used with this instrument for calibration to A. C., as their equivalent resistance changes with frequency. One may, however, use shunts with the thermogalvanometer for obtaining relative readings, that is, in measuring antenna radiation; for instance, if the galvanometer and shunt are in the circuit, and a certain change produces increased deflection, you may know that more current flows in the antenna. And, of course, with a standard high frequency ammeter it would also be possible to calibrate the thermogalvanometer and shunt, but this would have to be done for each frequency.

Making an A. C. and D. C. Dynamo

By Otto Kühne

IN the generator to be described, while most of the work can be done by the amateur, the field ring must almost certainly be made by a blacksmith or machinist. For the amateur to construct this himself a large anvil and tools are absolutely necessary. A lathe is most useful, although a ring can undoubtedly be worked out without one. Drills of different sizes, and a brace for operating them, are necessary. Various files, flat and half round, of different coarseness, are required.

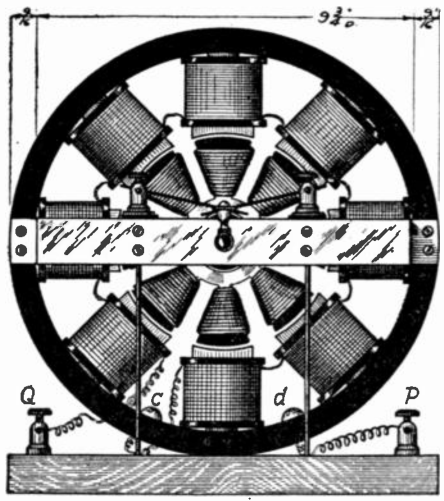


Fig. 1. General view of a multi-polar dynamo or generator arranged for giving alternating current.

Taps and dies are needed, but as these are not in everybody's reach, the requisite thread cutting can be done by a machinist. There are also needed pieces of round iron, three-quarters of an inch thick, an inch and a quarter wide, some brass rod, a shaft of round steel half an inch thick and eight inches long, from which, in order to work it, the temper must be drawn.

Eight wooden bobbins, some sheet copper, brass wire and four and a half pounds of cotton covered copper wire of 30 mils diameter and a little over a pound of double coated wire of about 25 mils diameter, will be needed.

The machinery to be described is a self-exciting, multipolar machine, giving a one phase alternating current.

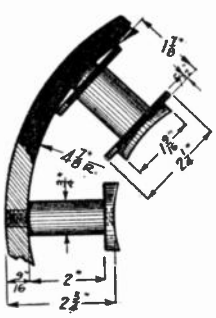


Fig. 2. (Below) One of the pole pieces, and (above) one carrying a wooden bobbin of the field or stator of the multi-polar dynamo.

1. *Field Ring and Field Magnets*

Figure 1 shows the general layout of the machine.

The field consists of a forged ring, seen clearly in Figure 1, 9¾ inches internal diameter, 2⅜ inches wide, 9/16 inch thick. It is best turned out on a lathe, otherwise it will have to be worked out with a file. It is now divided into eight equal arcs and a 5/16 inch radial hole in which a screw thread must be cut, is drilled at each division; if there is no thread cut we will have to rivet the poles in place.

For magnet poles we will either use pieces of round iron, each a little over ¾ inch in diameter, and 2¾ inches long. The small ends, ⅝ inch and 3/16 inch respectively, bring down the true core to a length of two inches. A field piece of sheet iron goes with each of the eight poles; these pieces are each 1-9/16 inches long and of the same width and 5/16 inch thick. They must be worked out on the inner surface by filing or otherwise, so that they will give a true cylindrical contour all the way around. If it is desired to avoid filing, it will do to rivet on 3/16 inch iron plates.

Before the pole pieces are put on, eight wooden bobbins, one of which is shown in Figure 2 on the upper core are put on, one on each pole. The holes through the bobbins must be 13/16 inch in diameter and the sides should be as thin as possible. The full diameter of the flanges is 2¼ inches; the length including the flanges is 1⅞ inches, and the thickness of the latter is 5/32 inch each.

2. *Winding the Field Magnet*

The bobbins before being placed upon the pole pieces, are wound with 30 mil copper wire, single cotton covered; it would be very difficult to wind them once they were in place. Each bobbin must have the same number of layers and be wound full of wire. It will take about 1,200 feet of wire for each bobbin; the windings must not be the same for every bobbin, but each one must be wound in the reverse direction to its neighbor's, so as to give alternating poles all around, as shown in Figure 3.

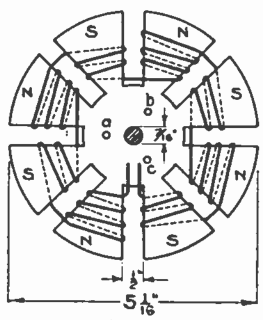


Fig. 3. Winding of the armature or rotor of the multi-color dynamo to give alternating current; note that there are only two leads from the armature.

Before fastening the bobbins in place and riveting up the field magnets, we must drill holes in the ring for receiving the screws (c), (d), Figure 1; (i) and (k), Figure 9 and (l), Figure 8. The holes (c), (d) serve to screw the ring down upon a baseboard. The others are for screwing the various fittings for the field ring.

Now we can put the bobbins in position on the poles and rivet on the pole pieces. Temporarily we tie up the free ends of the magnet windings, taking great care that they do not break off.

3. *Multi-pole Rotor*

We cut out thin iron discs 16/1000 of an inch thick, with a heavy scissors, or better with a tinner's shears. Next enough discs are piled up on one another to make up a thickness of 1-9/16 inches. We will need about ninety such discs of 5-1/16 inches diameter. Out of these discs we now cut eight radial poles such as shown in Figure 3. The space between the poles is ½ inch. In the middle of each disc a hole 7/16 inch in diameter for receiving the axle and three smaller holes (a), (b) and (c), Figure 3, for bolting or riveting the whole bundle together, are to be drilled. It is advisable to bunch all the discs together, temporarily bolting them up firmly, and to bore the central shaft hole on the lathe, and then to smooth up the periphery with a file while it is turning on the lathe, so as to get it perfectly cylindrical in shape.

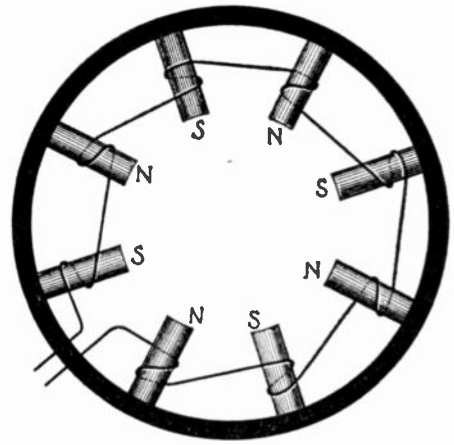


Fig. 4. Ring and poles of the stator with the direction of winding illustrated.

Now we can again separate the disc, file off the little fins on the edges, and give to each piece a good coating of thick shellac solution (shellac in 95 per cent alcohol), upon both sides. After they are perfectly dry they are again screwed together, they are driven solidly upon the shaft, and then we begin to wind the coils.

Figure 5 shows the complete core along with the slip rings but as yet unwound. First we are to give a second coat over the whole of the core once more with shellac solution, wind it with silk strips, give these the third coat of shellac and let all dry thoroughly.

We now come to the winding. Each pole is to receive two layers of double cotton covered wire, 26 mils diameter, beginning to wind it from the base outward. As shown in Figure 6, each alternate core is wound in a reverse direction, so that the cores are of north and south poles alternating all around. Each layer of wire is gone over with shellac solution and allowed to dry perfectly before the second layer is put on. The two ends of each winding are temporarily left free and disconnected.

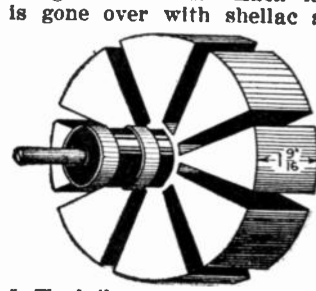


Fig. 5. The built-up core mounted on its shaft with its slip ring ready for the winding.

The shaft is best made of steel; a round piece of bar steel, eight inches long, and nearly half an inch in diameter is used. At Figure 8 (a) 1¼ inches of the shaft, at (b) 2¾ inches of the shaft are turned down to a thickness of 5/16 inch. It is necessary to draw the temper and to anneal the steel in order to be able to work it. This is done by heating it to a red heat and letting it cool slowly by burying in hot ashes and allowing the whole mass to cool, or by embedding it in pulverized quick lime and allowing it to cool there. If we have carried out the operation correctly, we can harden it again by bringing it to a red heat and then immersing it quickly in oil. In Figure 8 the rotor is seen with its two slip rings on the left for the collector.

4. *The Collector*

This is a wooden cylinder 1⅝ inches in diameter, which is seated permanently on the shaft, butting against the rotor core. Two brass rings of about ½ inch in diameter and spaced about ½ inch from each other, are tightly driven on. These are on the left of the core. The be-

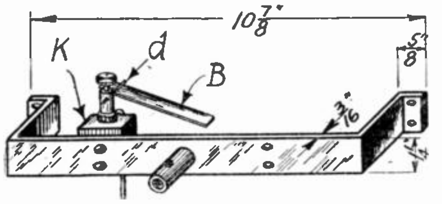


Fig. 6. Shaft bearing and brush support to be seen also in Figs. 1, 8 and 9.

ginning and end of the rotor windings are now brought to the slip rings, one end to each ring, and are soldered thereto. Care must be taken that the end which is fastened to the outside ring and passes through a groove or pole drilled in the inner ring, be insulated therefrom by fibre or the equivalent. The driving pulley on the extreme right of the shaft in Figure 8 is firmly keyed or fastened. It is made of wood and is about 1⅝ to 2 inches in diameter and of the same width.

5. *Shaft Bearings*

The bearing frame which crosses the ring at its horizontal diameter is seen in Figures 1, 6, 8 and 9. We use for this strips of brass 3/16 inch thick and 1¼ inch wide. One piece to be seen on the right of Figures 8 and 9 is a straight piece 10⅞ inches long; it has in the center the hole for the shaft bearing and at its ends four holes for screws or tap bolts to fasten it to the field ring. The front bearing strip is bent and offset at each end as shown in Figure 6. The ends which receive the screws for fastening to the ring are each ⅝ inch long so that the straight part must be 9⅝ inches long. The hole for the shaft bearing is in its center.

The shaft bearings are made of brass tube of rather thick wall, in which the shaft turns freely, but without shake. These tubes are soldered in the brass cross-pieces. It is all important that the rotor shall be perfectly centered with reference to the pole faces of the stator. In Figure 6 will be seen a hole in the brass tube for lubrication.

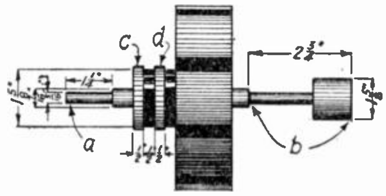


Fig. 7. View of the armature core, slip rings and shaft, carrying its drive pulley and with the shaft ends reduced in diameter as shown.

In Figures 1 and 8 oil cups are shown which give the machine a workmanlike appearance which can be obtained at a low price.

6. *The Brushes*

On both slip rings of the collector, brushes (B) rest, one on the right and the other on the left. They consist of thin copper strips, hard tempered, ⅜ inch wide and 3½ inches long. They are soldered to small transverse pieces of brass wire (d), Figure 6, which are held by binding posts. These binding posts Figure 6, are attached to blocks of wood (K), which are screwed to the brass strip carrying the shaft bearings. These blocks, one of which is seen in Figure 6, are made of hard wood about 1½ inches high, 1 inch wide and 1 inch thick. From the binding posts two copper wires 80 mils thick run down to the baseboard. Each brush rubs upon its own collector ring and takes current therefrom.

If the machine is to remain in one place permanently, it must be bolted down by screws as shown in Figure 1. These screws are seen to right and left of the lowest of the magnet poles, running obliquely into the base, but if the machine is to be portable, it is necessary to fasten it to a solid, heavy wooden base.

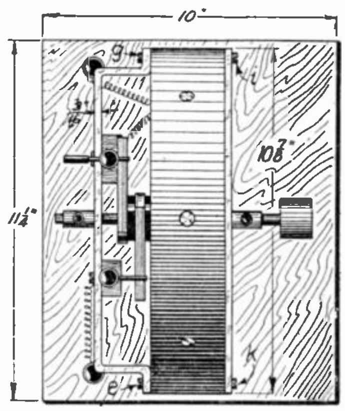


Fig. 8. Plan view of the completed generator, showing the brushes and the holes receiving the ends of the stator cores.

7. *The Baseboard*

We cut out of oak wood a board 11¼ inches long, 10 inches wide, 1¼ to 1½ inches thick, and smooth it perfectly with

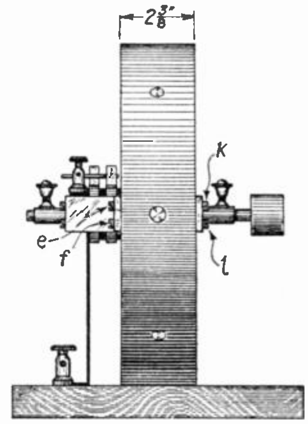


Fig. 9. End view of the same, showing substantially the same parts.

sandpaper. Next it must be given a coat of varnish, which we allow to penetrate thoroughly. The machine is now screwed down upon this board. On two corners two binding posts (Q) and (P) are attached, one for each side, shown in Figure 1, and these are connected to the leads from the upper binding posts by copper wire, which connects them one to one end of the field magnet winding and the other to the other end. The apparatus to be operated by it is connected to the lower binding post.

8. *Direct Current Dynamo*

In many cases we cannot employ the alternating current generator, as for instance in chemical decomposition, as well as for charging storage batteries. The alternating current has no chemical action and as both ions emanate from both electrodes and reunite by slight excitation, some little detonating gas is evolved from both electrodes.

We now make an attempt with some slight changes on the machine to build a direct current generator. All that needs to be changed are the winding of the rotor and the collector. We wind the rotor with the same care as regards insulating with silk and shellac as already described. Each core is wound with six layers double cotton covered wire of 26 mils diameter; each core winding must have its own terminals. The collector we also make out of wood but instead of the two brass rings we cut out eight strips of copper about 4/100 of an inch thick and

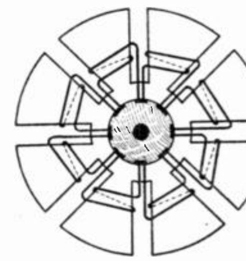


Fig. 10. Armature winding and connections to commutator for direct current machine.

1½ inches long and ⅜ inch wide. Two holes are drilled in each of these strips for screwing down to the wooden collector drum. We divide the commutator strips symmetrically, for this is the commutator, according to the diameter of the wooden cylinder, and embed them in the wood so that the periphery of the commutator, after rubbing with a file, is even all the way round, brass and wood. It is shown in Figure 11. To this we connect the 16 ends of the winding of the rotor as follows:

The end of one coil is connected with the beginning of the other, and clamped under one of the commutator strips. Then the beginning of the second coil and the end of the third under the second of the strips, etc., until each of the commutator bars, for such the strips are, is connected to two of the wires. The commutator bars must be so placed that each one is in line with the gaps between the radial cores of the armature. Figure 10 shows the system of winding for the direct current armature and commutator. Finally, we must place the second binding post which carries a brush not above, but under the block of wood, so that one brush is above and the other below the commutator, both pressing thereon. In any case it is well if not only the ends of the armature winding are soldered to the ends of the commutator bars, but in all places on which the ends of the wires of the circuit are connected they should also be well soldered.

Our direct current generator is a series wound machine because the current generated in the armature is in direct circuit

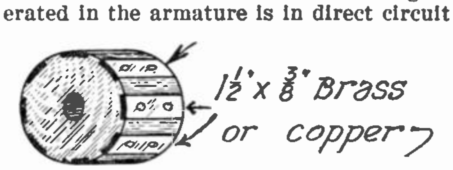


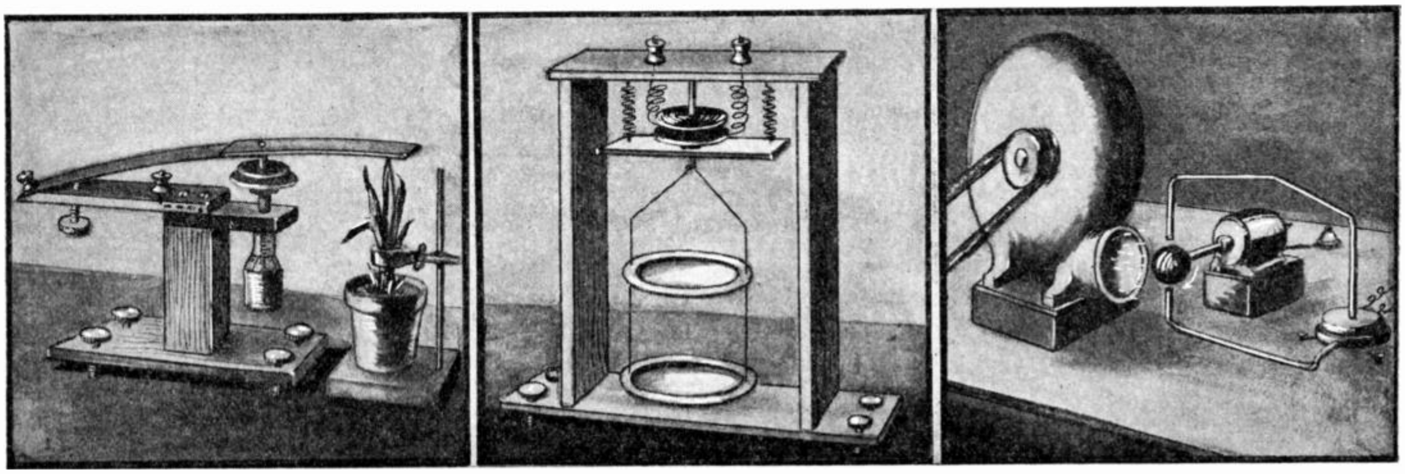
Fig. 11. Simple commutator to receive the connections indicated in Fig. 10.

or in series with the windings of the magnet and the entire current flows through the outer circuit. Besides these, there are shunt and compound winding. For the first 5 to 8 per cent of the armature current is carried around the field magnet. In compound winding the field magnet has two coils; the thicker wire in series with the outer circuit.

—*Translated from the German.*

Recording Ultra-Micrometer

By Prof. John J. Dowling
National University, Dublin



Figs. 4, 5 and 6. Interesting experiments with the ultra-micrometer whose action is based on the varying of capacity, by changing the pressure exerted on the plates of a condenser. The growth of a plant, very accurate weighing and the action of a baseball or golf ball are studied by this apparatus, which can measure with ten million times the primary sensitiveness.

THE advance of science has always been step for step with the improvement of methods of measurement. This is particularly so in respect to the measurement of very small quantities. Minute length measurement has hitherto been mainly carried out by microscopes or other optical devices; and excessively small movements have presented a peculiar difficulty. To properly study these it is necessary to follow them continuously so as to be able to reproduce them on a magnified scale. This has scarcely been possible, without elaborate apparatus, unless the displacements exceeded one ten-thousandth of an inch.

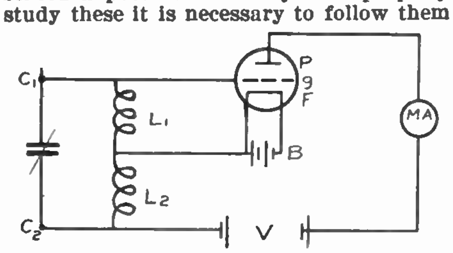


Fig. 1. Application of the apparatus for measuring up data in a radio circuit.

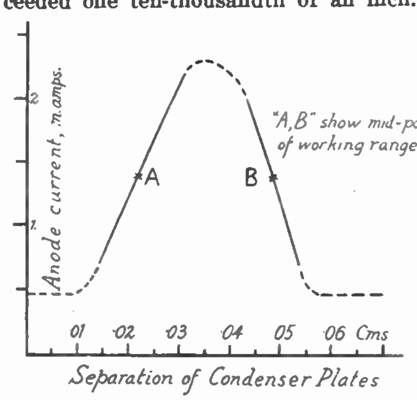


Fig. 2. A graph indicating the action of the apparatus, and how the readings are affected by separating the condenser plates.

The possibility of utilizing in some way the changes in the *electrical capacity* of a parallel plate condenser, due to the movement of its plates (in or out) as a means of indicating small motions is not very new; but the device herein described employs this property for the first time in a really successful manner.

Fig. 1 shows a simple Radio Oscillating circuit, the condenser of which ($C_1 C_2$) is formed of two metal disks about 5 centimeters in diameter and, perhaps one-fifth of a millimeter apart. When these plates move, in or out, the current in the milliammeter (MA) alters as shown in Fig. 2. There are two parts of this curve that are almost perfectly straight, provided that the coil ($L_1 L_2$) and the battery voltage (V) are properly chosen and adjusted. Figure 3 displays the complete arrangement employed when the very greatest sensitivity is desired. The dotted lines indicate the part of the apparatus that is boxed in as a unit.

Instead of the milliammeter a highly sensitive galvanometer (G), furnished with a suitable shunt (S) is employed. An additional battery (E) in series with an adjustable resistance Rr is connected as shown across the galvanometer shunt terminals. It may be easily shown that the whole anode current (=A) will pass through ERr, and *none at all through the galvanometer* if $A = \frac{E}{R}$ where R stands for the total resistance in use. I therefore call this battery and resistance the "zero-shunt."

If, for any reason, the anode current changes from this value A, to say, A + a (or A — a) then the whole of the *difference* (a) will go through the galvanometer provided the resistance of Rr is very much bigger than that of the galvanometer. Finally it will be clear, that if A corresponds to any point on the straight parts of the curve Fig. 2, then *the deflection of the galvanometer is exactly proportional to the slight displacement of the condenser plate.*

The "magnification" is of course the ratio of the movement of spot-light to that of the condenser plate and may easily exceed *ten-million* fold. The degree of magnification is instantly controlled by means of S.

The first application I made of this appliance was to verify Sir J. C. Bose's observations of the pulses of plant growth. This experiment was made as shown in Figure 4. The pressure on the leaf-tip was only one milligramme and no injury resulted to the delicate plant structure, yet the apparatus recorded faithfully the microscopic pulses of growth that occurred every three or four minutes.

Fig. 5 shows how the ultramicrometer can be used with a sort of spring balance to enable highly accurate weighings to be made in a few seconds. Weights are added to the pan (P) until the total load comes to, say, 100 grams, the smallest weight used being one-tenth of a gram. The galvanometer indicates to within one ten-thousandth of a gram how far the total still differs from the standard 100 gram load. The same principle can be employed to make a weighing of 100 kilograms or of one gram with an accuracy of one part in a million. Thus, in the former case, a doctor could record the weight of the breath expelled in each respiration by a man sitting in the weighing machine!

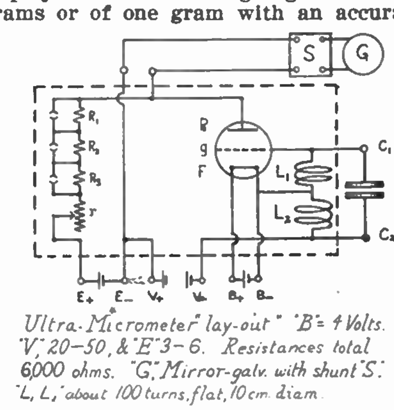


Fig. 3. The ultra-micrometer layout or hook-up, all described in the legend above.

Figure 6 shows yet another type of measurement rendered possible. The measurement of very slight pressure differences and particularly the *recording* of these has always been a difficulty. Here, a stout rubber, or thin corrugated steel, diaphragm, carries one of the condenser plates. Despite the ruggedness of the apparatus it is sensitive to a pressure difference of one ten-millionth atmosphere. It is nevertheless very consistent in action and responds almost instantaneously.

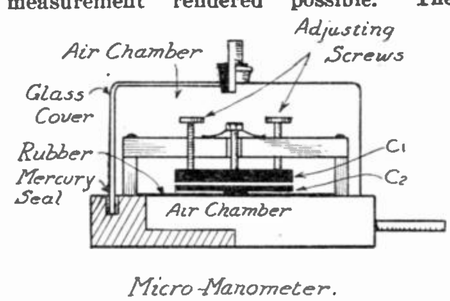


Fig. 7. Apparatus for measuring air pressure by its action on the plates of a condenser.

(*Concluded on page 472*)

Odd Telephones (Concluded)

By Clyde J. Fitch

TRANSMITTERS, as well as receivers, based upon molecular agitation have also been developed. Figure 28 shows one patented in 1886, by Morton. This transmitter is of the magneto or generating type and employs a neutrally magnetized steel diaphragm placed in front of a coil. The

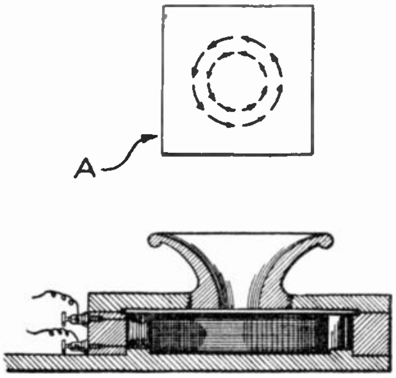


FIG 28

Construction of a molecular receiver as embodied in its case, with multiplication of diaphragms.

diaphragm is neutrally magnetized by magnetizing it in such a way that the magnetic flux forms a complete path inside the diaphragm itself, as shown at (A); in the illustration, and no flux passes outside of it into the surrounding air. It is apparent, therefore, that any bodily movement of the diaphragm will have no effect and will induce no current in the coil, but molecular movement inside of the diaphragm will produce more or less flux changes in it and these will generate current in the coil. The sound waves, striking the diaphragm, cause molecular movement within it.

Another interesting transmitter based on a combination of molecular movement and microphonic contact for varying the resistance in a circuit is shown in Figure 29. This transmitter was patented in 1894, by Drew. The object is to overcome the damping effect of the diaphragm in the ordinary transmitter caused by continuous pressure against the microphone element. In this transmitter the diaphragm is placed in front of a permanent magnet and vibrations of the diaphragm

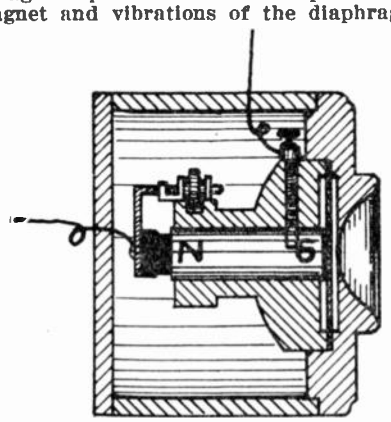


FIG 29

In this receiver, vibrations of the diaphragm change the reluctance of the system, varying the magnetization of the magnet and producing a speaking current.

affect the reluctance of the magnetic path and hence the magnetization of the magnet; as the magnetization increases, the length of the magnet also increases, therefore, the vibrating iron diaphragm will cause corresponding changes in the length of the magnet. This linear expansion and contraction of the magnet causes changes in resistance of a microphone button placed against the other end of the magnet as shown in the illustration.

Another molecular transmitter used for receiving submarine sounds is shown in Figure 30. This was patented in 1909, by Garrett and Lucas. It consists of a nickel rod about eight inches long, heat treated by being raised to a red heat and slowly cooled. This is wound with 2,700 turns of fine wire in four layers. One end of the rod is attached to a diaphragm and the other to a brass mass or weight, of a size suitable to tune the instrument to a definite sound frequency. The action of the transmitter is based upon the fact that variations of longitudinal stress of a magnetized nickel rod cause corresponding changes in its magnetization. Hence, vibrations striking the diaphragm will effect the flow of current through the coil of wire on the nickel rod. It is recommended for detecting submarines because its sensitiveness does not change.

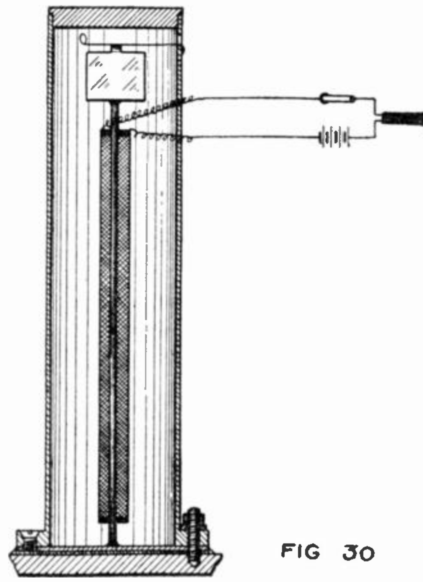


FIG 30

In this receiver a nickel rod with a fine wire coil is attached to a diaphragm; the brass weight at the upper end tunes the instrument to a definite frequency. It is used to detect submarines.

Of interest to radio experimenters is the receiver and amplifier shown in Figure 31. This instrument, patented in 1888, by Wright, consists of an electro-magnet through which the telephonic currents pass, thus causing molecular expansion and contraction of the iron core. The movement of the core acts upon a carbon button in such a way to cause variations in pressure and consequently in resistance, thus modifying and varying the flow of a current from a local source through it, which actuates a telephone receiver of any type. This is shown diagrammatically in Figure 31, and Figure 32 shows the two instruments combined into one, one core serving for both. Although any carbon button may be used in this amplifier, it is suggested that carbon discs, such as are used in carbon compression rheostats, may be employed.

The original Bell telephone patent dated March 7, 1876, two hours after Mr. Bell's application had been filed, Elisha Gray applied for a caviat on a telephone. But he took out no patent on account of Bell's previous application. It is probably the nearest approach of dates on record in the Patent Office between two rival inventors.

It seems probable that neither one of them had the least idea that the telephone would ever have any great value. Gray's

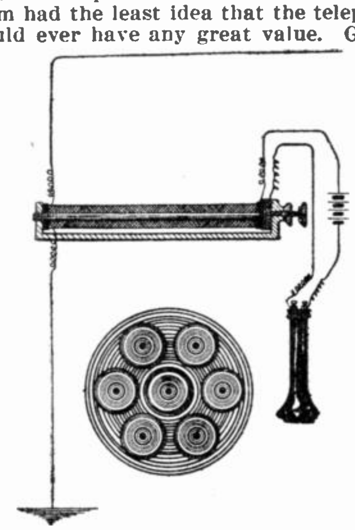


FIG 31

This is a receiver and amplifier; the iron core surrounded by the coil acts upon a carbon button, making a very sensitive apparatus.

telephone was radically different from Bell's, as it was supposed to operate as regards the transmitter on a varying resistance system and not by magnetic induction, as Bell's operated. Gray's receiver except for details was merely the receiver of the present day.

It is said that the device of the original Bell patent never spoke. It was seven months after the date of the patent that articular speech was first gotten through. It was at the Philadelphia Exposition of 1876 that Sir William Thompson, later Lord Kelvin, heard the telephone speak and Bell's name, like the shot fired on Concord Bridge, was heard around the world. The centennial apparatus was materially different from the device of the patent and it really seems as if Gray should have been a sharer in the glory of the invention of the telephone.

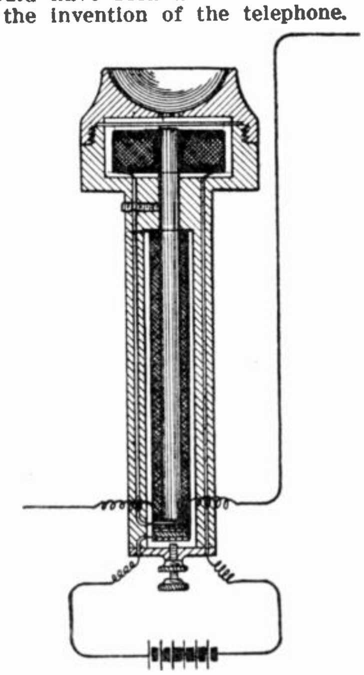
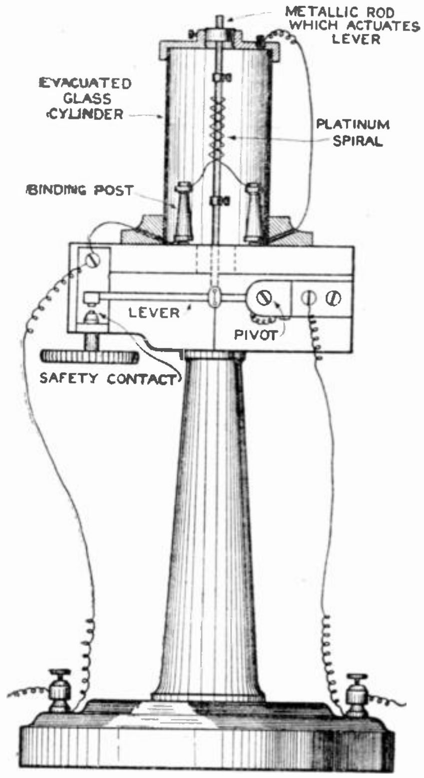


FIG 32

The above instrument shows the two parts of Fig. 31 combined in one; this instrument is supposed to be of special interest to radio experts.

Historic Incandescent Lamps (Concluded)

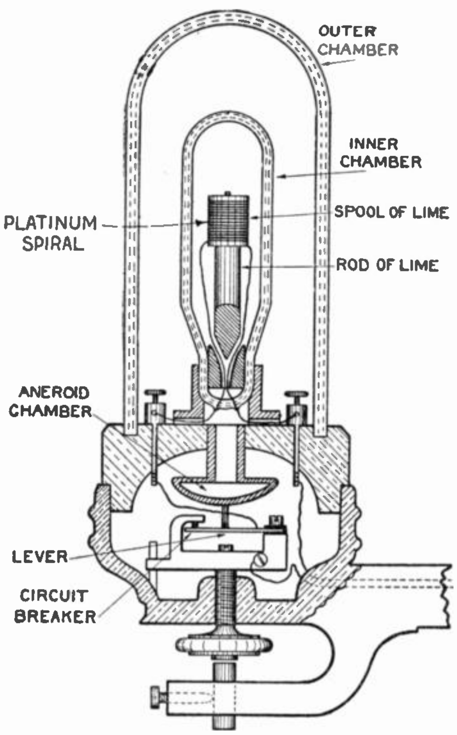
By T. O'Conor Sloane, Ph. D.



One of Edison's earliest platinum wire lamps, which provides a lever for opening and closing the circuit to prevent the wire getting too hot or too cold.

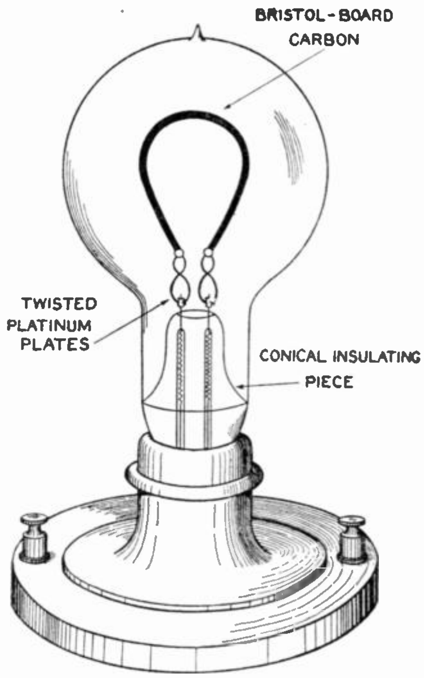
In another very early lamp we have a spiral of platinum wire again, this time in a vacuum, and the platinum spiral surrounds a metallic rod which, expanding as the wire became too hot, short-circuited the current so as to reduce the temperature. The lever by which this is effected will be seen in the base of the lamp.

Another platinum lamp employed a spool of lime on which the platinum was wound, and here the expansion of air was relied on to open the circuit when the heat was so great as to menace the platinum.

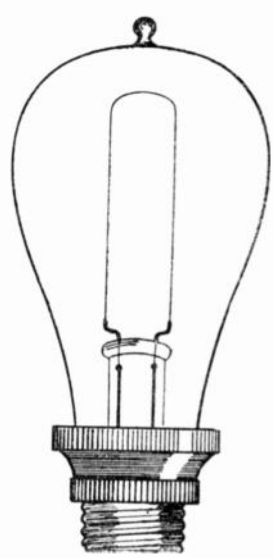


Another early lamp in which the wire was wound around a pencil of quicklime.

It is said that in these lamps the contact opened an almost infinitesimal amount and opened and shut with high frequency. It seems impossible that the separation following the contact could have lasted long, on account of arcing.



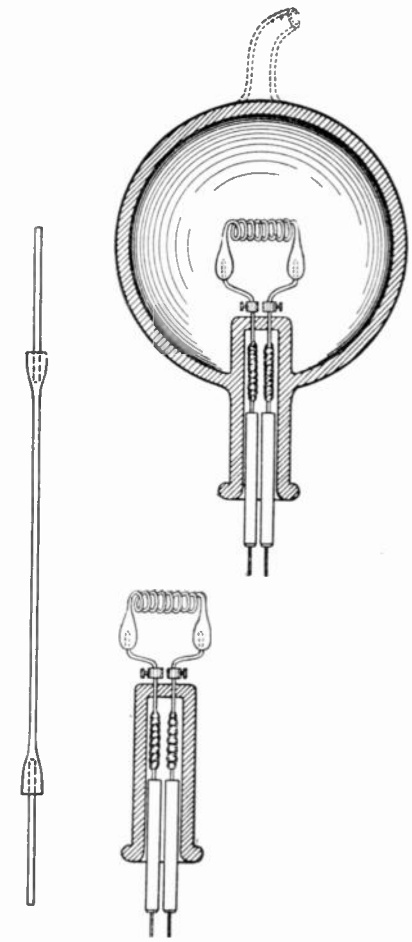
An early Bristol board filament Edison lamp showing one of the original horseshoe filaments. The Bristol board was carbonized by heat.



In this lamp, also due to Edison, the bamboo filament, a filament made by carbonizing a piece of bamboo, appears, and was used by the inventor for many years.

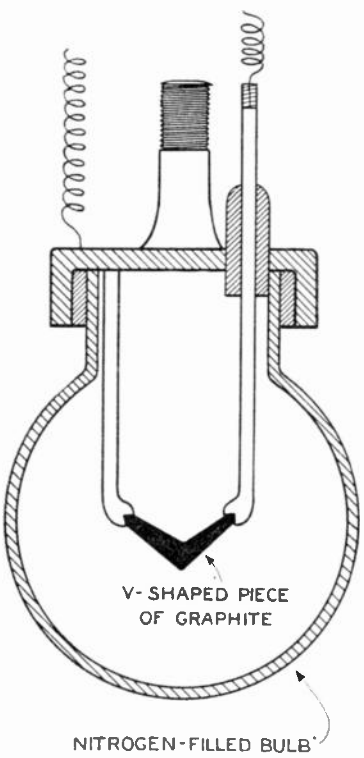
The great inventor experimented with almost innumerable substances for his filament. He made a great many Bristol board lamps in which the Bristol board was carbonized.

One of the illustrations shows the horse-shoe filament; another shows a filament of bamboo of the shape of a hairpin, the "red hot hairpin" as it was jocosely termed in the old days. In one of the lamps a straight filament was twisted up into a very fine coil and then carbonized.



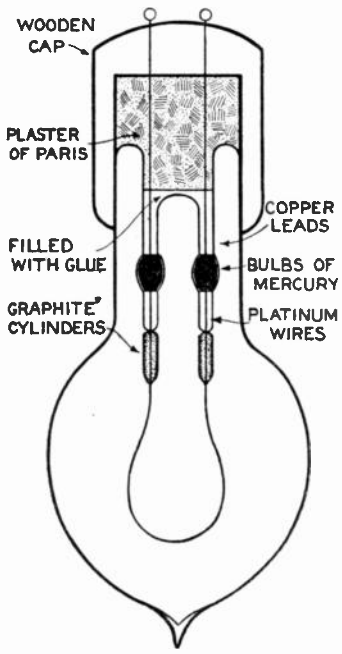
Another early Edison lamp in which a close wound horizontal spiral was used to give the light.

If a filament of carbon was immersed in a hydrocarbon gas and ignited therein graphitic carbon would be deposited all through the filament in its minutest pores and as this continued the resistance of



The Lodyguine lamp. A very early lamp of the nitrogen filled type; several efforts to produce nitrogen filled lamps were made in early days.

the filament constantly decreased. In this way a lamp could be given any desired resistance and an output of lamps could be given a uniform resistance. This process was termed flashing. The old carbon

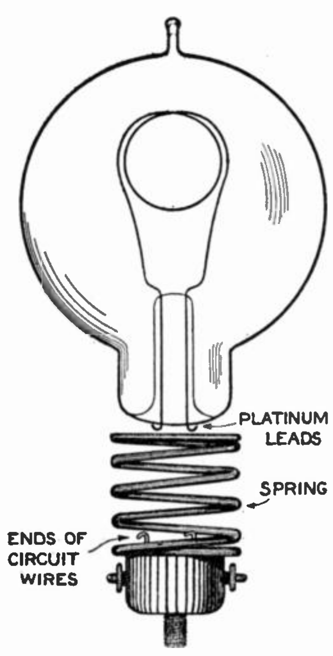


The Lane-Fox lamp, using bulbs of mercury to make contact with the filament.

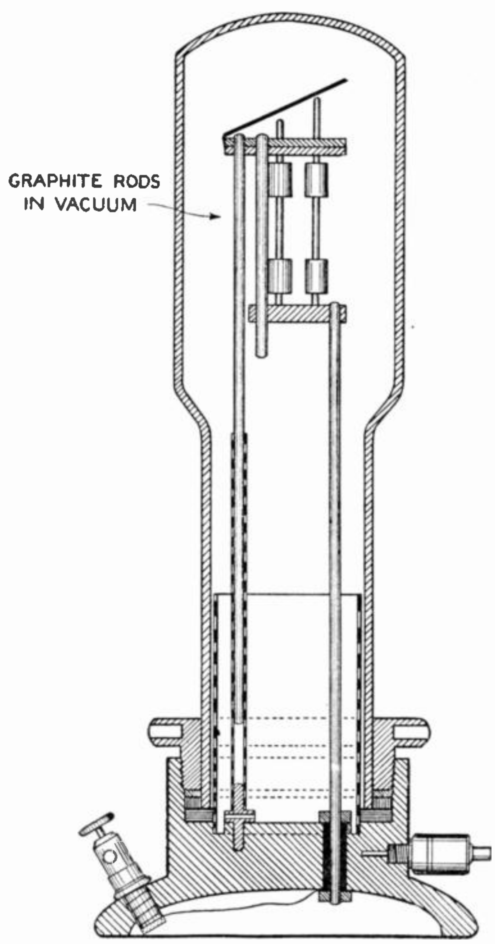
filaments, due largely to flashing, were very remarkable examples of carbon. They were extremely elastic and when a long one was started into vibration the frequency of motion was such that it was almost invisible.

One of the illustrations shows the Swan lamp. Swan and Edison came so close together in their work that the adjective Ediswan was coined, to describe the lamp as sold in England. It is interesting from its mount. The neck of the bulb is forced down into the spring below, and compressing it, the ends of the leading-in wire are hooked to the circuit wires near the base of the spring. Hiram Maxim, one of the few Americans, who received knighthood in England, and came to be known as Sir Hiram Maxim, which never seemed to fit so American a name, evolved the lamp shown here. The filament was stamped out from paper by a die. The ends, left large, were used for bolting it to the inner ends of the leading-in wire. This is an early example of the use of paper.

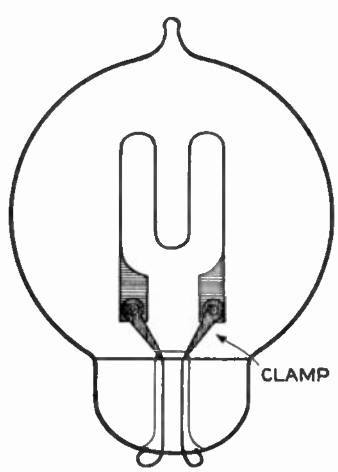
The Lane-Fox lamp is also shown. The very characteristic and peculiar feature about it is that the connection between the copper and platinum wires was made by bulbs of mercury in the two glass tubes. A wooden cap set in with plaster of Paris forms the base.



The Swan lamp, having a peculiar spring system of base contact; the Ediswan lamp derived one syllable from this inventor.

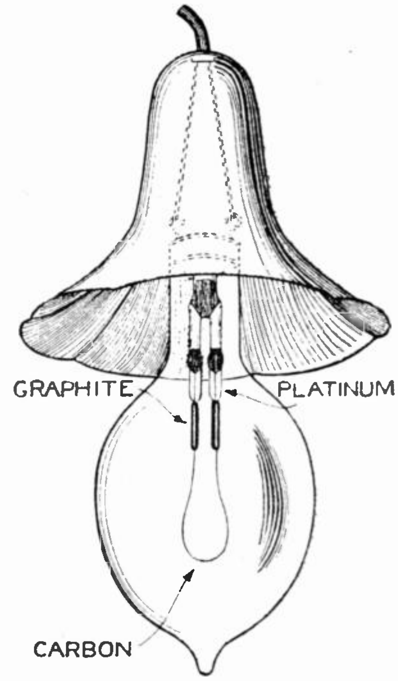


The Kohn lamp, using two carbon rods, so arranged that when one burned out the other would come into the circuit and prolong the giving of light.



The Maxim lamp, quite famous in its day, though now extinct. The attachments for the end of the filament are characteristic.

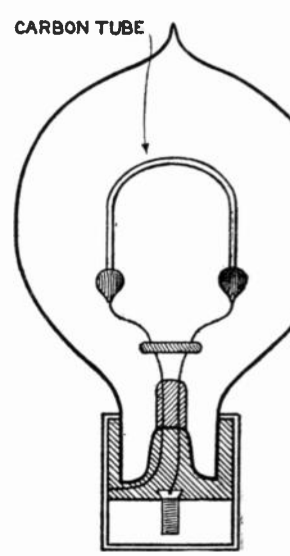
The Bernstein lamp was rather an oddity, as the filament was really a carbon tube. The carbon cylinders were made in the early stages of the invention by carbonizing straws. Then the deposition of carbon upon the metal wires and dissolving out of the wires was tried. Finally paper was resorted to, and the tubes were made by winding paper around a metal mandril, and sticking the pieces together with gum or paste; the paper afterwards was carbonized; eventually cotton or silk fabric were used in place of the paper.



Another example of the Lane-Fox lamp showing how it was suspended from the apex of an inverted lily-shaped shade.

From the queer name wolfram given to its mineral by German miners, it is evident that they had very little respect for the ore of the metal tungsten. Tungsten is the Scandinavian for "heavy stone," because the tungsten ore was of high specific gravity. After a while metallurgists found that the addition of metallic tungsten to iron gave a wonderful steel, which revolutionized machine shop practice. Now carbon lamps are relegated to the past, very few are being manufactured, and the tungsten wire has taken the place of the carbon filament, effecting another revolution and giving enormously better results from every point of view.

But now the carbon lamp has gone to the rear, and the tungsten lamp with all the minor features such as the use of thorium salt and the introduction of various gases in the bulb, seems to represent almost the culmination of the incandescent lamp. The next improvement which we may look for will very probably be in a totally different direction.



The Bernstein lamp, interesting as having a central and a peripheral terminal for its lead.

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

First Prize, $25	Second Prize, $15	Third Prize, $10
Roy C. Hunter,	Leroy Cox,	Joseph Varnum,
Elk City, Okla.	Placentia, Calif.	Boonville, Missouri

First Prize
Electric Induction Furnace
By Roy C. Hunter

THIS electric furnace is somewhat different from the ordinary furnace. It works on the principle of induction and is an ideal apparatus for heating small amounts of ore or

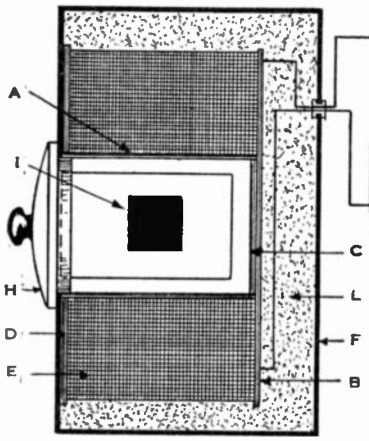


Fig. 1. Simple induction furnace; the heating compartment is thoroughly insulated and surrounded by a large coil of wire. It is intended to heat a metallic substance in a non-conducting crucible or a non-metallic substance in a conducting crucible.

metals. It only heats metals directly, but anything can be heated if placed in a metal crucible.

The furnace is shown in the illustration. (E) is a coil of wire which is connected to a 110 volt alternating current line. This coil might be called the primary. The metal (I), to be heated, which may be called the secondary is placed in the tube (A). When alternating current flows in the primary it induces currents in the metal which acts as though it were the secondary of a transformer. As it has comparatively no resistance, and no outlet for the current, it forms a short circuited secondary, with many hundred amperes in it, which are enough to raise its temperature in a short time. A reactance coil is used to control the current in the primary.

An asbestos board tube 4 inches long and 3 inches in diameter (A) is used to wind the coil on. The circular head (B) is 7¼ inches in diameter. A piece of the asbestos board (C) that will just fit tightly into the tube is attached to the center of (B). It is then put in place as shown. The other head (D) is also 7¼ inches in diameter. A hole 3 inches in diameter is cut out of it so it will fit tightly over the end of (A) and is cemented. The piece cut out of (D) can be used for (C).

The coil is now wound on the tube (A); the windings consist of 500 turns of No. 14 B. and S. gauge copper wire. The best kind to use is enameled wire which is to be covered with asbestos, although other kinds can be used. The leads are run out as shown.

A box (F) is made to place the furnace in. It should be 9 inches by 5½ inches and 9 inches deep. The box is assembled with glue, no metal being used in its construction. A hole is cut in one side 2¾ inches in diameter as shown. A door to the furnace is made as shown (H). It can be turned out on the lathe and should fit tightly into the tube (A) through the hole in the box.

The furnace is placed in the box and packed all around with asbestos plaster (L) and thoroughly dried. The box is stained to improve its appearance. A shelf is made as shown in Figure 2. It is a wooden block (P) which is 3½ inches by 2¼ inches and ¾ inch thick at its thickest part. It is curved so that it will rest nicely in the tube. It is fixed to (H) by a slot and glue. Two layers of asbestos paper are wrapped around it and cemented fast. The object to be heated is placed on the shelf and slipped into the tube.

The current flowing in the coil is controlled by a reactance coil. It is shown in Figure 3. On a fibre tube 10 inches long (Z) and 2½ inches inside diameter wind 100 turns of No. 8 D.C.C. copper wire (X). A core (W) composed of soft iron wire is made that will just slide into the tube. The current flowing in the

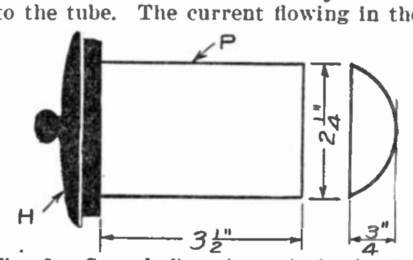


Fig. 2. General dimensions of the heating chamber of the induction furnace exhibiting a laboratory size apparatus and showing shelf.

coil of the furnace is regulated by moving the core in and out of the reactance. The farther the core is in the coil the less current will flow in the furnace.

If it is desired to heat a liquid it should be poured into a metal vessel placed on the shelf (P) and slipped into the coil. The core of the reactance coil is slid in its full length and the current is turned on. The core of the reactance can then be drawn out to give the furnace more current. A platinum dish is the best to use but is very expensive. If a metal is to be melted it can be placed

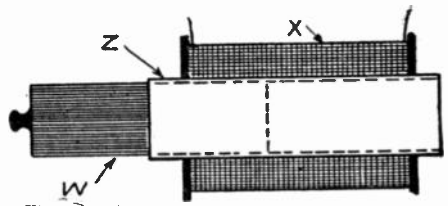


Fig. 3. An induction coil or choke coil designed to control the current supplied to the heating coil of this induction furnace.

in a porcelain dish or crucible. If it is to be heated only red hot it can be just placed on the shelf.

Many interesting experiments can also be performed with the furnace, such as lighting small electric lights by induction. As the coil does not get hot and as the heat is localized in the crucible, shellac can be used as the cement unless long and high heating is in question.

$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.

If in any way possible, a clear photograph, should be sent with the idea; but if that is not possible, a good sketch will do.

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 *Editor, Electrical Wrinkle Contest*, in care of this publication. Contest closes on the 15th of each month of issue.

Second Prize
Electric Recorder
By Leroy Cox

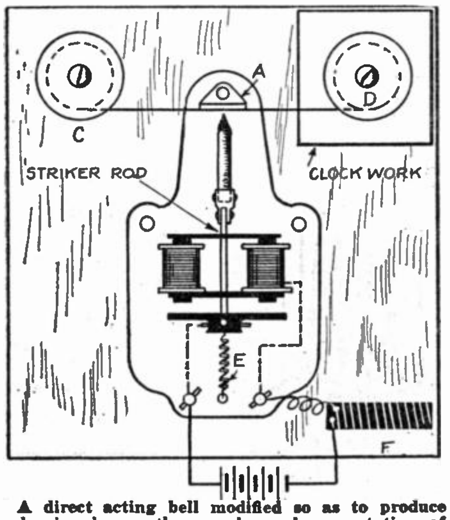
THIS apparatus will record the opening of any private safe or room without giving an alarm. It is constructed in the following way:

A direct stroke door bell is procured. The make and break contacts are bent together so that a closed circuit is formed. At the hole where the bell was originally placed, a piece of stiff metal is bolted down and bent up to form a back (A). On the end of the striker rod a very small pencil is fastened (B). The whole thing is then mounted on a convenient board.

Next a spool of ⅜ inch paper ribbon is mounted in the position shown by (C). An empty ribbon spool is fastened on some clockwork, on the minute hand shaft of a clock. The whole is then mounted as in (D). The spool (C) is adjusted to have a very little bit of tension. The paper is brought across the back (A) and is fastened to the spool. The clockwork is regulated to a suitable speed. This must be very slow. The spring (E) is a very weak one.

If operated by a selenium cell (F) as shown in the illustration, the apparatus may be placed anywhere, but the selenium cell must be placed where light will strike it upon opening the door or whatever it is to protect. The cell upon exposure to the light, passes enough current to attract and raise the armature, which presses the pencil against the paper, making a line as the paper is drawn through, until the door is closed or the selenium cell is put in the dark.

The best way to operate it is to put a switch on the door, which is closed upon opening the said door. A line is then drawn on the paper until the door is closed again. If the clock is regulated to a known speed, and the beginning and



A direct acting bell modified so as to produce code signals or other marks such as notation of time, upon a traveling tape, by pressing a pencil against it.

end of the line are measured to the end of the strip, it will be known just when the record was made.

This recorder may be used in many other ways also. For instance, a man wishes to keep track of the number of people entering certain fair grounds. Whenever a person goes in he would touch a push button which would put a dot on the strip. At the end of the day all the manager would have to do would be to count the dots.

If this recorder is made more sensitive, it may be used as a recorder of wireless code, after which the message may be read.

Third Prize

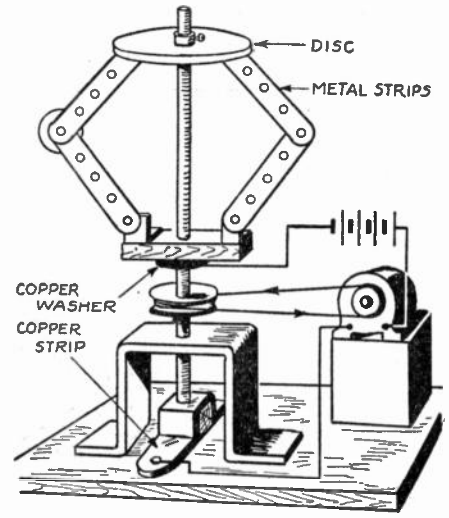
Centrifugal Governor

By Joseph Varnum

To construct this apparatus I used a base made of wood about six inches wide and a foot long. I mounted an Erector motor upon one end. On the other end I mounted a centrifugal governor. It is made out of Erector parts, but could easily be made from iron or other metal. The strips are loosely fastened together so that free motion will be obtained. The lower strip is made of wood to insulate the strips from the shaft. The hole that the shaft passes through is a little larger than the shaft. About this hole and surrounding the shaft is a copper washer. This is connected to the iron strips.

The whole is mounted on the base and then a block of wood is mounted close by with a copper strip extending from the block. When the governor is at rest or running at slow speed the copper washer rests on the strip, which serves the purpose of a brush.

One of the line wires is connected direct to one motor terminal, the other to the copper brush. The other motor terminal is connected to the base of the governor. The shaft and the motor pulleys are belted together.



A centrifugal make-and-break governor made of Meccano or Erector parts; it operates by making and breaking the circuit.

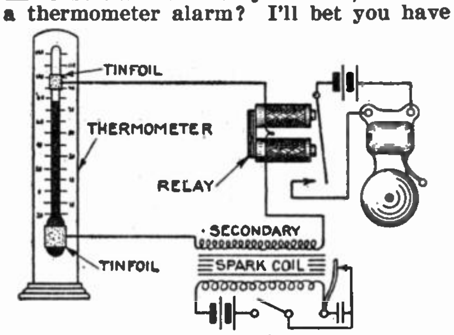
When the motor rotates the governor raises and shuts off the current if the motor goes too fast.

Any speed desired can be obtained by adding weights to the governor or raising the disc.

More Investigation

By Esten Moen

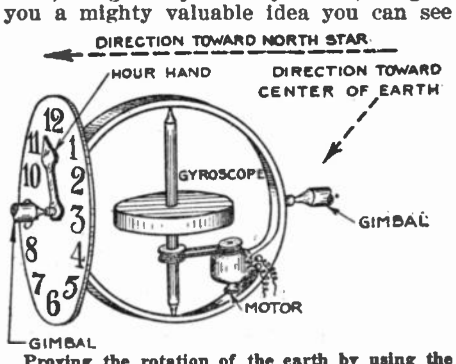
REMEMBER the time when you busted open a thermometer to insert a fine wire—you know, to make a thermometer alarm? I'll bet you have



Our interesting investigator's method of making a thermometer alarm based on condenser action between mercury and tin foil coatings.

often wanted a thermometer alarm. You know it's a tough job to jam a fine wire into the small tube of a therm. Not reckoning the problem of getting a contact with the mercury itself.

So, being that you're my friend, I'll give you a mighty valuable idea you can see



Proving the rotation of the earth by using the gyroscope. The method is attended by certain difficulties, which the author thinks should be overcome or cheerfully waived in the interest of high science.

for yourself here. The idea is just to use the mercury as one side of a condenser—the thermometer tube is of glass, you know. The expansion of the mercury, creates a "new condenser" which fact is advertised by the alarm! But, er—it's a rather expensive method, you say? Quite so, I'm most distressingly sorry to say——

Now supposin' you was in a tight squeeze, as to how you should go about to prove that the earth rotated on its axis. (That's alright, I said, just SUPPOSIN') How would you do it? You can't use a clock, because—well, it might run faster than it should (and prove you're a liar). So the problem is, how can the earth move a clock?

Let's see what I've got next. The main thing is a gyroscope—yes, that's the secret—you see, we place the gyroscope, so its axle is at right angles to the earth's axis; and because a gyro refuses to be turned contrary to the way it wishes —well, she just "bucks."

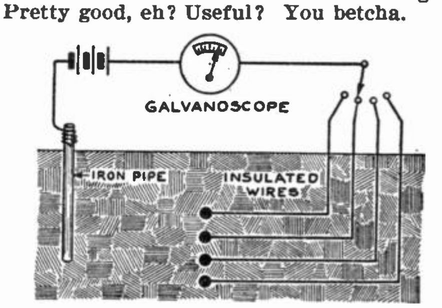
So, all you have to do is keep the gyro spinning—my, my! you say it's expensive to keep a motor running so long, in these days of H. C. L.? Aw gwan, you gotta serve science, once in a while.

My reminder tells me I haven't told you a scheme for measurin' rainfall. I know I spoke of one a while ago but this one is different.

The idea as seen above is to measure the resistance of the earth at various depths, to see how much moisture is present. Usually rain can be predicted when a fellow becomes an adept at using such a device.

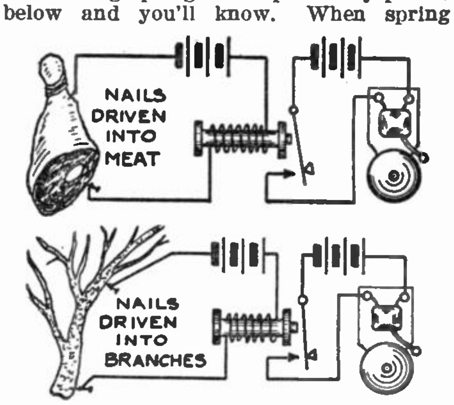
Funny how many uses such a device can be put to. Listen to this one: In the winter, you usually buy a section of a cow or pig, and as the weather is cold, it can be kept in the woodshed: the object being to avoid the expensive butcher's demands. But in the spring, a piece left over, a thaw, and—look out.

Here at last you'll get the drift of my talk. As long as the meat remains frozen, the electrical resistance is high; but when it thaws—then the bell rings! Pretty good, eh? Useful? You betcha.



Determining the resistance of the earth relatively speaking at different levels, the idea being the possibility of predicting rain.

But hey, here's the peach of them all. Let's eliminate the ground-hog method of announcing spring. Glimpse at my puzzle below and you'll know. When spring



Two more uses of the resistance of objects. A frozen joint of meat becomes a conductor and rings a bell if a thaw comes along. And finding the resistance of a tree is supposed to tell if spring is coming; this eliminates the ground-hog.

(*Concluded on page 472*)

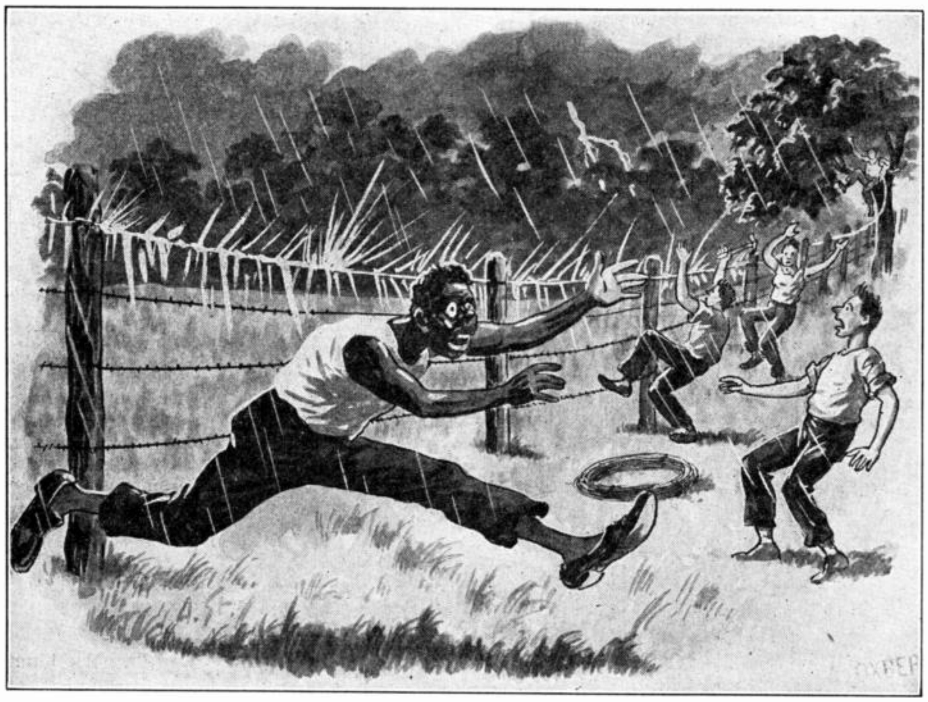
Awards in Odd Electrical Experience Contest

First Prize, $20	Second Prize, $10	Third Prize, $5	Fourth Prize, $2.50
J. E. S. Saunders,	Aeolus Trammell,	Ollis Allen,	George H. Stevens,
2832 Prairie Ave.,	General Delivery,	Box 118, St. John County	1728 Denman St.,
Chicago, Ill.	Springfield, Ohio	Fairville, N. B., Canada	Victoria, B. C., Canada

Honorable Mention—Jacob Schmidt, 225 S. Caroline St., Baltimore, Md.

First Prize
Barbed Wire and Lightning
By J. E. S. Saunders

IN the early days of May, 1916, while working on a farm in North Carolina, I was instructed by my employer to complete a barbed wire fence around a large farm. This job had been started several months before and had for some time been referred to among the laborers as the "Rainy Day Job," being left to be completed when the soil was too wet to be cultivated, and this was now the case just after several days of rain, and the atmosphere was very hot and oppressive.



Remarkable experience in a thunderstorm; a barbed wire line on top of a fence produced a quantity of discharges, frightening and shocking the workmen. Fortunately no harm was done to anyone.

Acting under instructions, I proceeded to have the laborers get the material and the necessary equipment, and after spending two or more hours arranging our outfit and distributing the wire along the line, we were ready to start placing it.

We were getting along nicely until about 11:45 o'clock, when I observed a black rack of clouds well up over our heads, and soon drops of rain began to fall. Not thinking that it would rain hard enough for us to go to shelter, we proceeded to stretch the last strand of wire to a tree on the banks of a small stream or branch. It being a long pull, I put two men on the stretcher and another to nail, while the fourth I had sent up the line about seventy five yards to hang the wire over some nails that had been driven in the post to hold it in position and relieve it of some of its own weight while being stretched.

Electrical clouds being rather numerous that spring we had come to the point where we enjoyed rather than feared them. But this time I was rather hasty in making my decision, for as I was testing the tension of the wire and giving signals to drive the staples, I was startled to hear a crash of thunder, and simultaneously the whole earth seemed to burst forth in a bright flame and all was over with us for a while; all but two were prostrated. The man whom I had sent up the line, having completed his task, had retired some little distance from the fence to prevent danger of entanglement in the recoil in case the wire broke, and this prevented him from being shocked. Seeing our condition he immediately started for assistance.

In the meantime I had partly revived and can just remember that when the rescue party arrived I was sitting in an upright position on the ground, with my head resting in the palms of my hands, in a half dazed condition wondering what had happened. I was told that another of the party was sitting by the stream in a similar position while another was stretched out upon the ground apparently dead, but the fourth member of the party could not be found. Jake, the old darky, who had been a witness to the "knock out" and had gone for assistance, upon finding one of the men missing, insisted that the other members did not know how bad it was, as he had stood there and seen it all and had seen one of them go up in the air.

However, a half minute of investigation revealed the fact that the missing man was only stunned and while in that condition, refusing to argue with his subconscious mind, but following its dictates, had sped across a freshly plowed field and could be easily tracked. The rescue party detailed one of their members to search for the missing man, another to see that two of us got to the house, while the others rushed the apparently dead party in and summoned medical aid.

When the physician arrived he found two of us getting along nicely while the last man in seemed to be in a serious condition; later he was found to be in no danger. While the physician was outlining a few simple instructions for us to follow, the searching party walked in with the missing man and asked for his examination, but his case was clear cut. He had out-run the lightning, so the physician stated.

None of us received any permanent injuries but some valuable experience. The wire was grounded in the water and that was all that saved us.

$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 Electral Experiences,* care PRACTICAL ELECTRICS, 53 Park Place, New York City, N. Y.

Second Prize
Ball Lightning
By Aeolus Trammel

THIS experience occurred on my mother's poultry farm in Brooksville, Fla., one summer day before the world war.

An awful thunderstorm was brewing, with the suddenness of action which is so characteristic of summer storms in Florida, and the sky was nearly obscured by the banks of lead colored clouds. The darkness was punctured at frequent intervals by erratic zigzags and riffles of lightning, and the close, heavy atmosphere rocked with incessant and foreboding thunderings. What a splendid opportunity appeared to be coming to try for some of that free "juice" Mr. Franklin told us about.

I contemplated using a metal chimney instead of a kite string; but before I got the chance to use either one, I enjoyed (?) a demonstration that would have made Ben's puny little spark sneak back up the string and hide itself.

It was in that hushed moment of suspense that comes just before the big drops begin to fall, and I ran out of the backyard under some old oaks to get a copper rod about three feet long which I had left there. As I was returning with it in my hand there came a glare of lightning and a clap of thunder so overwhelming that I paused for an instant in bewilderment. I became aware of a globe of rose-colored fire eight or ten inches in diameter descending from somewhere above and hovering about 20 inches from the side of my head. It moved on downward with a queer, uneasy manner as if

Very remarkable description of a case of ball lightning, where the brilliant globe circulated uncomfortably close to the head of the observer, yet did him no harm.

it were controlled by the promptings of some evil intelligence within itself, always keeping the same distance from the side of my body. When it reached the ground it splattered out by my foot and vanished with a report like a gun.

I felt no electrical shock of any kind, but I was barefooted and it felt hot to my legs.

Third Prize

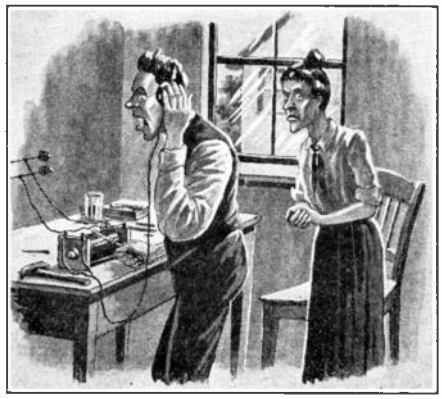
Electrical Eaves-dropping

By Ollis Allen

A WIRELESS operator residing next door offered to teach me the Morse code. We hooked up the instruments as shown in the diagram; the line was about two feet long and the circuit consisted of two wires. For a sounder I used my head phones. My part was to listen, while my friend transmitted. For the battery, we used two salammoniac cells (home made, of course). On these the carbons were about three-eighths of an inch in diameter and projected above the jars about two inches.

My mother put the phones on one evening and heard voices. Thinking that the voice was coming from the phones she called and told me. I came and also heard someone talking; some words were clear while others were just a jumble of voices.

I then went to my friend's house and told him about it. Upon investigation we found that a book had been placed accidentally on the key, thus short-circuiting the battery through the line and head phones which were in my house, but we



A queer case of listening in; a loose and broken carbon resting on top of a battery cell, acted as a microphone, so that conversation was mysteriously received in another house.

did not see how this could transmit words. On looking at the battery we found the carbon of the positive end of the battery to be broken off just above the cover of the battery (the ends of the carbon were still in contact); this was acting like a microphone and transmitting the talk my friend and his father were having. This seemed like a queer tattle-tale, but no damage was done except that the battery was nearly exhausted.

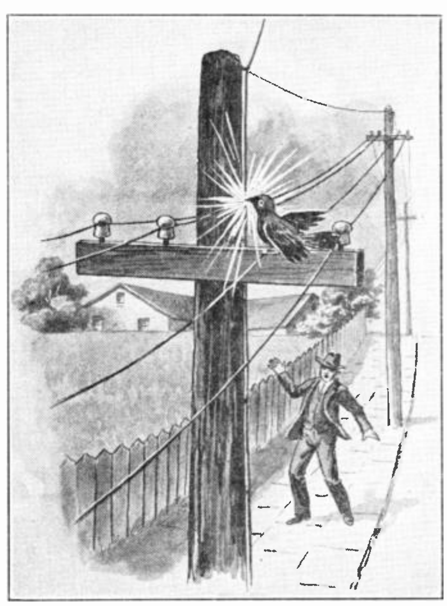
Fourth Prize

An Experience in "Short Circuits"

By George H. Stevens

THE layman is usually ignorant of the danger present in a telephone line on high tension poles.

I was employed by a light and power company which had a 44,000 volt power line 4 miles in length. The telephone line was a metallic line built on the power



A bird perched upon a statically charged telephone wire pecking at a grounded lightning protector wire, received a charge which killed it, absolutely burning its bill.

line poles about fifteen feet below the high tension wires. On the top of the poles was a single wire which was a lightning arrester. This wire was grounded every two poles by a bare wire running down the pole to the ground.

The telephone line has been tested and carries about 3,000 volts static electricity.

One day when I was on the high line, I saw a bird alight on one of the phone wires. He reached out his bill for an insect and touched the ground wire. There was a slight flash and he dropped to the earth. When I examined his bill I found it had been burnt off.

He had made a circuit from one side of the phone to the ground.

This presents to the layman the danger encountered in a high tension telephone line.

Honorable Mention

Shock in a Barber's Chair

By Jacob Schmidt

ONE afternoon as I was strolling along the waterfront of Baltimore, the sky suddenly became overcast and there was every sign of an impending storm.

As I did not want to be caught in the rain, I began to look around for a doorway or some other shelter in which to weather the inevitable storm. I had not

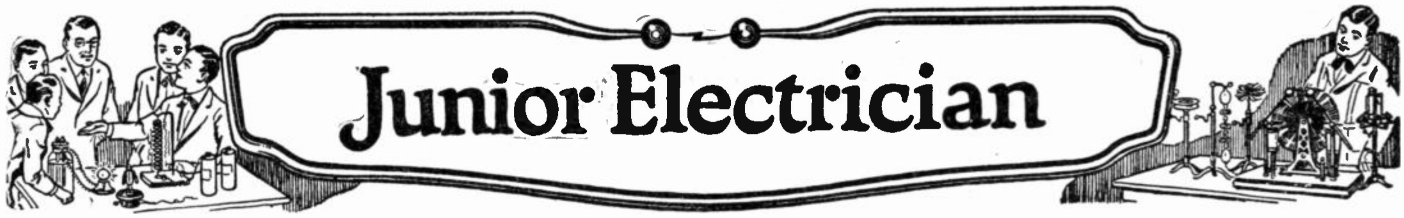
Strange adventure involving an electric shock in a barber shop; the peculiarity was that it occurred on Friday, the 13th of the month, which confirmed the superstition of some of the observers.

walked more than 50 paces when I saw a rather neat looking barber shop (about as neat a one as can be encountered near a waterfront). I therefore decided that rather than waste my time standing in some doorway I would stop in and get a haircut and a shave "While U-wait" as one may say.

No sooner thought of than done. I had just closed the door of the barber shop when a heavy downpour of rain drenched unlucky ones who were hurrying to and fro in the street. Streaks of lightning, accompanied by crashing thunderbolts, flashed through the sky. The combination of the above raging elements made me feel happy to be within doors. I therefore took out the evening paper from my pocket, settled myself comfortably, and began to read until my turn to be waited upon.

In "Tonsorial Parlors" of this type one can hear all kinds of discussions, from deciding if such and such an owl is properly stuffed to what they (the frequenters of these places) call "politics." As this particular "shop" was no exception to the general rule there were such heated and peculiarly interesting discussions and arguments going on, that my mind was distracted from the reading of the newspaper and I listened to what was going on around me.

(*Continued on page 472*)

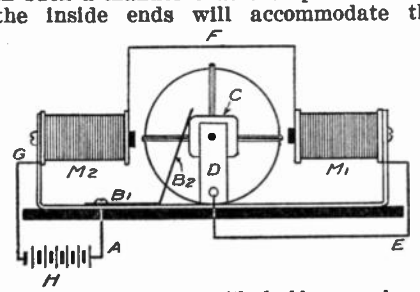


Junior Electrician

Simple Motor

A SMALL electric motor of very simple construction and surprising power may be made from odds and ends found in any experimenter's shop.

The base is of wood. The fields are two electro-magnets taken from a door bell or made by winding about 200 turns of No. 20 magnet wire upon a soft iron core such as a bolt or rivet. These are supported upon a U-shaped soft iron bracket in such a manner that the space between the inside ends will accommodate the rotor. The bracket is in turn screwed to the wooden base.

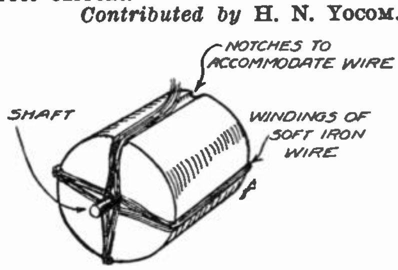


Simple electric motor with double opposed magnets giving a balanced construction.

The rotor is made from a disc-shaped piece of thin fiber upon which has been wound two coils of several turns each of fine smooth soft iron wire at right angles to each other as shown. The rotor is supported on its shaft between two iron brackets so that it is directly in line between the poles of the two magnets. The commutator is cut from heavy sheet copper and mounted on the rotor shaft. The brush is of sheet brass screwed to the wooden base and insulated from the rest of the frame. It is adjusted to bear on the commutator so that it "breaks" just as the rotor reaches "center" and "makes" when the rotor reaches the middle of the next division.

The magnets must be connected so that opposite (attracting) poles face each other. They are connected in series with the commutator, brush and battery. The motor will then operate at high speed. It will also operate on alternating current but requires higher voltage than on direct current.

Contributed by H. N. YOCOM.



The rotor of the above motor which simply provides soft iron armatures for the magnets to attract.

Printing Box

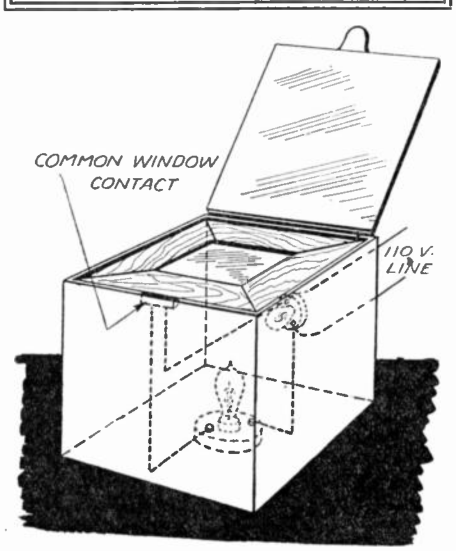
THIS is a printing box which is very simple yet speedy in operation. The dimensions are 8x8x7 inches. A 50 watt lamp is placed in the center of the bottom, and is connected in series with a window contact such as is used for burglar alarm work. A red lamp placed in the center of the back of the box connected across the main line, is lighted while work is going on.

There is a cover which works on hinges; on top of the box there is a frame covered with a dark soft cloth. The frame holds the glass. A mark is made on the glass showing the size required by the picture, and the film is then placed under the mark. Paper is placed over the film and when the lid is closed down on the paper it pushes the window contact down, which closes the circuit, and the white lamp lights at once. The red lamp lights up but does not interfere with the white lamp. As soon as the lid is raised the white lamp goes out and the paper is ready for the baths.

The idea of using the red lamp is to enable you to see the film and tell whether it is clear or not.

This is the wiring: Bring wires in at back of box, run one side of line direct to white lamp, the other side direct to one side of window contact, run a wire from other end of contact to other side of white lamp, and where wires enter box connect across the line a small red lamp.

Contributed by L. J. HUBER.



A very efficient and convenient box for use in taking photographic prints. There are two lamps, a red and a colorless one, operated by opening and closing the lid.

Electric Drawer Lock

THE following is a description of a device which serves as a secret electric drawer lock. The superiority of this contrivance over other electrical ones is that no buttons are used, a fact which makes it difficult to guess that it is an electric device, and renders it practically impregnable.

FIG 1

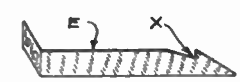


FIG 2

Latch and catch of the lock for an electric drawer, to be operated by completing the circuit with a nail or key, by touching two unsuspected contact points.

Fig. 1 shows the appearance of the catch which is screwed to the inside back wall of the chiffonier at a height about the middle of the drawer. The pointed end of this passes through an opening made in the back of the drawer. Fig. 2 shows the appearance of the latch or strip, one end of which is screwed to the inside of the rear end of the drawer. (D) is a screw upon which the other end rests. (C) is the battery, (A) is a little nail, (B) is the screw of the lock-plate. (E) is the catch already noted which penetrates the back of the drawer.

In its natural position the latch (illustrated in Figs. 2 and 3) rests on the screw at (D), and holds the drawer attached to the catch. This makes it impossible for the drawer to be opened. When, however, the circuit is completed by putting a metal object which may be a nail, a key, a penknife, a coin or the like, on (A) and (B), the circuit is closed, the electro-magnet attracts the latch strip, lifting it away from the catch, thus making it possible for the drawer to be removed.

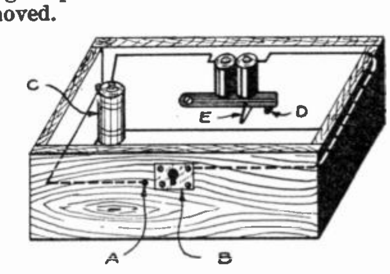


FIG 3

How the drawer lock is arranged to have the catch opened and shut by electricity, the entire appliance being self-contained, even to the battery.

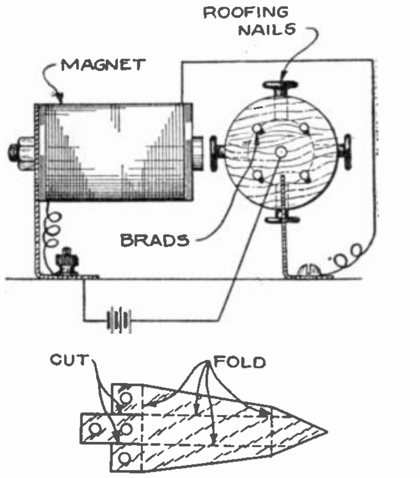
It is very simple to keep an inconspicuous key or nail at hand in order to complete the circuit. It is understood that it is not necessary to use the lock-plate and neither is it necessary to put the nail (A) at the place shown on the drawing. A couple of nails or screws can be driven in at convenient points and the same result will be obtained. This device has been found to work well in practice.

Contributed by JACOB SCHMIDT.

Spool Motor

By Harry L. Elder

THE largest size sewing thread spool has a line drawn around its center, then four small holes are bored at equal distances around this line, which give the locations for the short large headed nails that are to be driven in so that their heads project all the same distance from the spool. The sort of nails that are used



One of the simplest motors we have yet shown. A spool is the rotor, with large headed nails for armatures.

for fastening paper roofs are the kind to use, although large headed tacks are nearly as good.

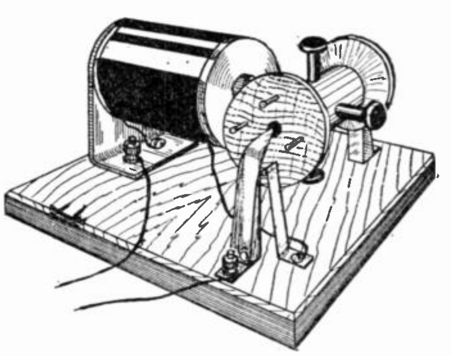
The diagram shows clearly how these are arranged. The electromagnet is made by winding several layers of insulated wire on an iron bolt. The bolt is then fastened to a bent piece of tin which when fastened to the wooden base allows the bolt head to just clear the heads of the nails as the spool turns.

Each end of the spool is covered with tin fastened in place with small tacks. A small dent in each end forms a pivot upon which the spool turns. In addition to these tacks, one end of the spool has four brads driven on a line drawn with a compass using the dent as the center. Each brad is driven on this line so that it is half way between the nail heads as shown in the figure. The brads must project one-eighth inch from the surface of the tin.

Fig. 1 is a pattern for the two end supports upon which the spool turns. They are bent as shown by the dotted line.

Fig. 2 is a cross section of the motor.

Fig. 3 is a diagram of the assembled motor.



Perspective view of the spool motor, showing the four make-and-break points of the commutator and the nails which act as armatures.

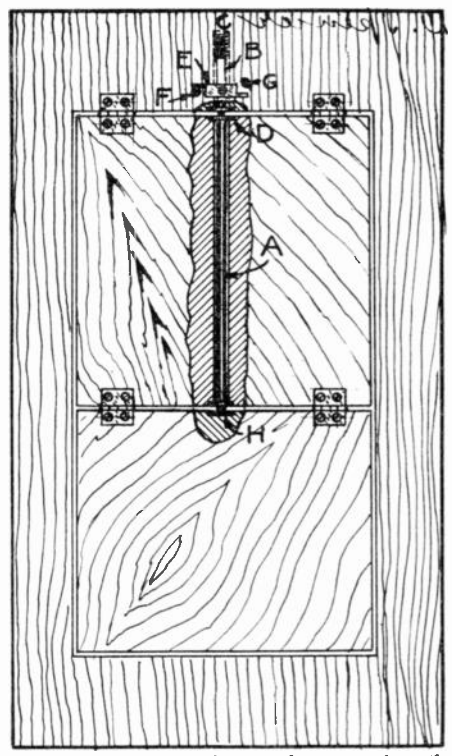
To start this motor, turn the spool so that one of the brads touches the thin spring and then turn on the juice. The nail head that is above the magnet will be pulled towards it. This will break the circuit so that the nail will not stay opposite the magnet. The weight of the spool appurtenances as put in motion will cause the spool to turn so far that the next brad will touch the brush and repeat the operation. Soon the spool will be spinning rapidly.

Automatic Printer

By Alton L. Spencer

A NEAT and efficient printing box for making photographic prints has as its principal feature an automatic switch which turns on a red light when the cover is raised, and turns off the red light and turns on the white light when the cover is closed. All the wiring and mechanism is concealed. The cover is made in two sections as shown in the illustration.

Bore a hole from H to D through the rear section of the cover. Bore another hole D to C in the fixed portion of the top to which the cover is hinged. A metal rod A is filed at either end to form shoulders. The reduced ends pass into holes in metal plates or washers countersunk in the cover. The rod should have an eighth-inch play. The metal rod B is flat on one end and has a shoulder on the other. The end with the shoulder fits into a hole in a countersunk washer just opposite the plate at D. Rod B is pressed by the spring C, thus being held tight against the metal plate except when rod A is forced against it. Thus a contact is produced, when the front section



Printing box for photographers, turning the light on and off automatically, as required, by the opening and closing of the lid.

of the cover is closed, the metal plate at H pushing against the rod A as the cover is pressed down, rod A in turn pressing against rod B.

Cut out a slot underneath the D. C. hole about a quarter inch long to meet rod B. Thread a hole in the side of rod B to admit a screw about an inch long. To this screw attach a piece of metal shaped like that shown at E then fasten screw to rod B. At F and G place spring metal clips in an upright position.

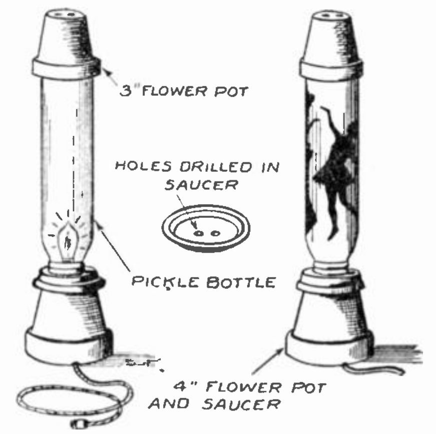
Now for the wiring. Run one side of the line to one side of both lamps. Run the other side of the line to rod B. Then run one wire from F to the other side of the red lamp and another from G to the other side of the white lamp.

It will now be seen that when the front portion of the cover is open, contact will be made at F, lighting the red lamp. When the cover is pressed down, contact at F is broken, and contact is made at G, lighting the white lamp.

Electric Torches

A PAIR of artistic torches can be made from two three-inch flower pots, two four-inch flower pots with saucers and two wide-mouth pickle bottles. Two holes are drilled with a file in the saucers as shown.

The pots are painted brown with burnt sienna and varnished. The bottles are first shellacked and after they are dried are painted with equal parts of raw sienna



Very picturesque construction of an out-door electric lamp; although it might be used indoors with good effect with the Mission type of furniture.

and American red mixed with varnish. The figures are cut out of black paper and stuck on while the paint is still wet.

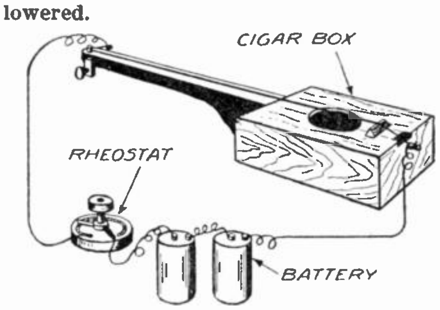
The saucer is inverted over the inverted four-inch pot and the connection of the socket made. The bottle is placed over the light and the small pot is inverted over the bottle and stuck on with putty. An incandescent lamp is placed in the bottle.

Contributed by L. I. Dupuy.

Hot Wire Guitar

AN interesting musical instrument of electrical operation can be constructed out of a cigar box and a few parts similar to those used on the ordinary stringed musical instruments. The illustration gives an idea of how the instrument is constructed.

The one shown has but one steel string. The tension of this string is increased until it will vibrate at the highest musical note desired. The string is fastened to binding posts at each end, and a battery and rheostat are connected to the binding posts. As the current flows through the string, it heats the string, which expands, the tension decreases and the note is lowered.



A one-string guitar, which is made to give the different notes of the musical scale by being heated more or less by passing an electric current through the wire.

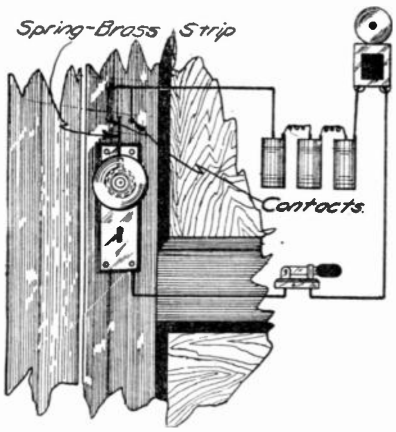
By means of the rheostat the amount of current passing through the string is steadily controlled and hence any musical note desired can be obtained. By controlling the rheostat with one hand and picking the string with the other, music similar to that obtained from a Hawaiian guitar can be produced after a little practice. If desired, two or more strings may be employed, with a rheostat for each string.

Burglar Alarm

THIS is an extremely simple yet efficacious alarm which operates by the least movement of the knob of a door. To the stem of the knob a straight projecting spring is attached and two nails are driven into the door, one on each side of the projecting piece, to act as contacts.

A bell and battery are connected in series with the two nails as one terminal, and the metal work of the lock as the other terminal. It is necessary that the projecting piece be a spring so that the motion of the knob will not be interfered with by the nails. If anyone attempts to enter the house, as they turn the knob either way, the projecting piece will touch one of the nails, complete the circuit and ring the bell.

Contributed by JOHN ODENBACH.

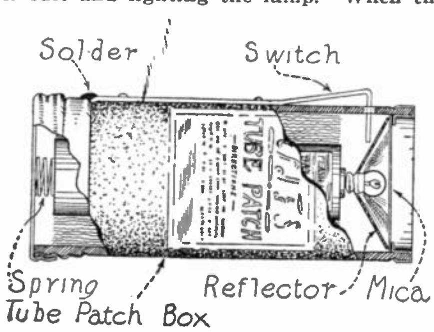


Very simple burglar alarm. If the knob of the door is turned the least bit to right or left, it rings an alarm bell.

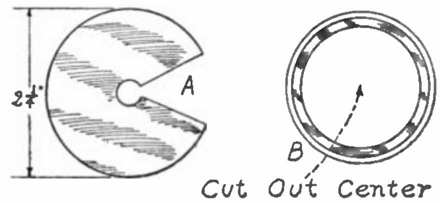
Flashlight

THE case of this home-made flashlight is an empty automobile inner tube patch box or other similar round cardboard box with a screw cover. The box should be about five inches long and two inches in diameter. As shown at (B) the bottom of the box is cut out with the exception of a narrow flange. Back of this flange is placed a mica disc, to pass the light and protect the bulb. A 2.5 volt flashlight bulb is soldered in the center of a cone-shaped reflector, which is placed back of the mica window as shown.

The pattern for the reflector is shown at (A); it is made of bright tin. A two-cell flashlight battery is wrapped with paper until it is a snug fit for the box. The battery is held in contact with the bulb by the action of a short spring soldered to the inside of the cover as shown. A switch is then provided by a strip of spring tempered brass secured to the side of the box. One end is soldered to the metal ferrule while the other end is bent as indicated so that pressure on the raised part of the brass strip will cause it to make contact with the metal reflector, thus completing the circuit and lighting the lamp. When the



Effectual flashlight made out of a round box as the case, with home-made lamp reflector and battery therein.



How the reflector is made out of a piece of bright metal in the simplest possible way.

pressure is released the switch springs up, breaking the circuit and extinguishing the lamp.

Contributed by HAROLD JACKSON.

Electric Wax Melter

THE apparatus illustrated is easy to construct and is very useful in a shop when batteries are to be sealed, or in the home when canning fruit.

The center can which holds the wax is three inches in diameter and four inches high with a one-half inch hole in the center of the bottom to let the wax flow out, when the slide handle is pushed to one side.

Around the center can a thin layer of asbestos about one-eighth inch thick is applied, and then about three feet of coiled resistance wire is wound on, after which another layer of asbestos is put on but much thicker than the other.

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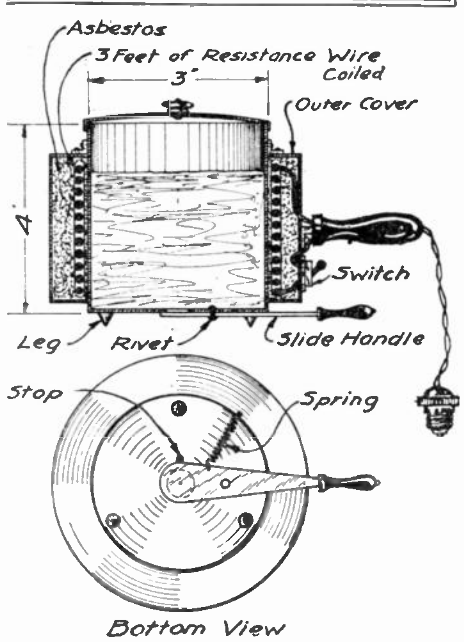


Electric heater for melting wax or cement, useful where storage batteries are being repaired.

A tin sleeve is put over this layer of asbestos and riveted by three lugs at the top to the center can which holds and protects the wire.

To this outer cover the handle is fastened with the leads going through the handle from the coil to the cord and plug.

The hole is covered by a pivoted slide with a handle on the projecting handle-end to prevent burning of the fingers. This slide is held over the hole by a small spring which is not too strong; when the handle is pushed to the left the wax is free to flow but as soon as the handle is released it goes back over the hole.

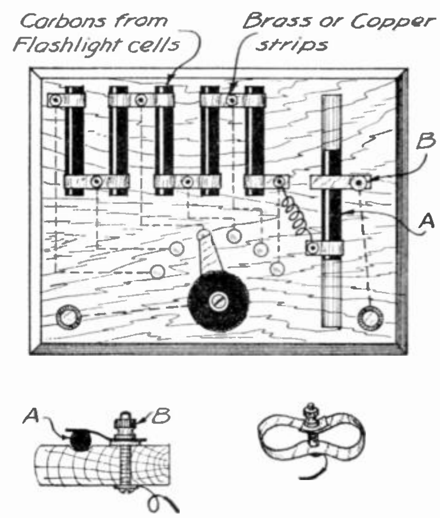
A switch may be placed on the outer cover if so desired so that the heat can be regulated to keep the wax from getting too hot.

Small legs are screwed to the bottom in order that the apparatus may be set down without spilling.

If the constructor can obtain a lid for the center can it is advisable as it keeps the wax clean from dust and other collectings.

Contributed by E. MUHLIG.

Carbon Rheostat



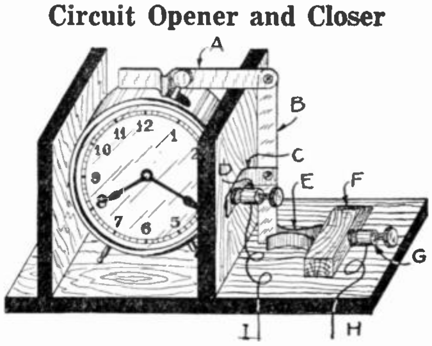
Multiple point rheostat, changing the resistance by installments, but with an extra carbon sliding contact to graduate the resistance to the finest degree.

THE illustration shows an inexpensive rheostat which is capable of rather fine adjustment. The materials required for its construction are: 6 flashlight cell carbons, 1 switch arm, 6 contact points, 7 short strips of thin copper or brass, 1 piece of spring brass 1½ inches in length, 7 old dry-cell binding-posts, 3 binding-posts, some wire and a half-inch board 5 by 7 inches in size.

The illustration can be easily followed. Fig. 1 shows the completed rheostat. Fig 2 is a diagram of the mounting for the carbon (A), which slides in a groove and is used for finer adjustment. Fig. 3 shows how the copper strips and the dry-cell binding-posts are fixed to connect the carbons. Wires which are connected to these strips by the binding-posts pass through holes in the base and then to the contact points. They thus serve to hold the carbons in place as well as to act as conductors.

Contributed by GERALD P. HAWKE.

Circuit Opener and Closer



Alarm clock which either opens or closes a switch according to the way in which the appliance is set.

THE appliance shown here operates by an ordinary alarm clock and it may be set so as to open or close a circuit when the alarm goes off.

The gong is removed; the lever (B), fulcrumed near its center and pulled to the left closes the circuit, and when pulled to the right opens it. All this is clear from the illustration. A horizontal strip (A) is pivoted to the upper end of (B) and there is a small projection arranged on its side, held in place by friction, so that it can be pushed to right or left. If pushed to the right, when the clock alarm mechanism commences to work, the vibrating clapper will pull the upper end of (B) to the left and close the circuit. But if it is set on the other side of the clapper, the upper end of (B) will be pushed to the right and the circuit will be opened.

The device can be made with an alarm clock, a few old pieces of board, some strips of metal, two binding posts, two stove bolts and a few nails, and may be easily made with simple tools.

This apparatus may be used to turn on lights in chicken houses early in the morning, or to turn lights on or off in show windows or offices when employees are not about. By its use egg production has been increased profitably.

Contributed by NORMAN L. FREY.

Storage Battery Circuit Breaker

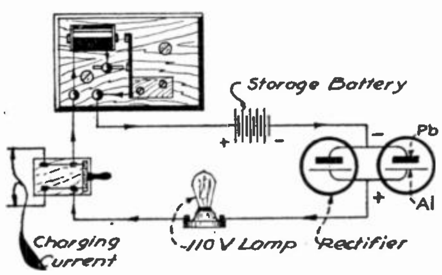
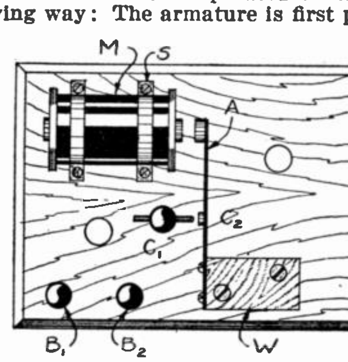


Diagram of connections for storage battery circuit breaker, operating on alternating current; the circuit will be opened if the potential falls.

WHEN charging storage batteries at home it is sometimes convenient to have a simple circuit breaker which will operate efficiently and without attention.

Referring to the diagram in Figure 1, (M) is an electromagnet taken from a bell or buzzer and secured to the base by the brass strips (SS); the armature (A) is a 3½ inch length of an alarm clock spring, whose end at (A) is first annealed and then bent two or three times in the shape shown. If desired, a small steel nut may be soldered to the end instead. The other end is fastened to a block of wood five-eighths inch high. C_1 C_2 are the contact points, C_1 being a binding post with a short piece of No. 14 copper wire through it, and C_2 a drop of solder on the armature. The diagram explains the circuit and connections.

The instrument is operated in the following way: The armature is first pushed



Enlarged view of the cut-out fully explained in the text

against the magnet (M) and the current turned on. Since the binding posts B_1 B_2 form a part of the charging circuit, assume that the current enters at B_1 and flows through the magnet (M), through contact points and out at B_2. As long as current flows through the electromagnet the armature is held by the magnet, thus keeping the circuit closed. When the battery is fully charged, resistance is offered to the charging current to the extent of neutralizing the flow so that the magnet no longer holds the armature (A) and releasing it, opens the circuit.

When first building the set the armature must be adjusted so that it will fly back only when a weak current flows through the electromagnet. A piece of paper or thin leather may be cemented to the magnet poles to prevent adherence.

Figure 2 shows the circuit breaker in use.

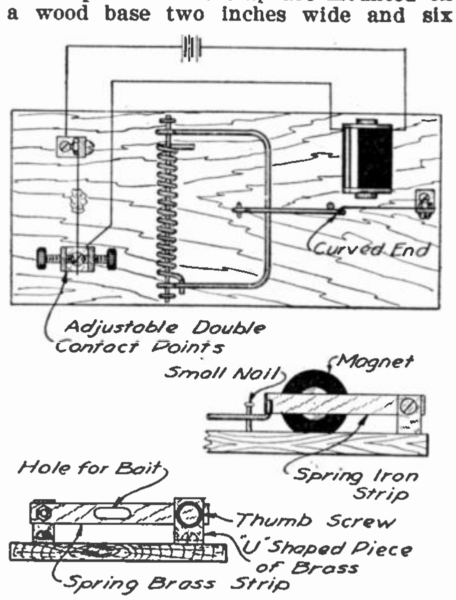
Contributed by A. SINISEAL.

Another Mouse Trap

By H. P. CLAY

THE lever release of the ordinary mouse trap requires an appreciable effort on the part of the mouse to operate it and if the animal is duly cautious and possesses adequate intelligence the bait can be removed without much danger, as the trigger only works in one direction. This electrical trap works two ways and the spring is released by an electro-magnet energized whenever the mouse closes a very delicate "switch."

The parts of the trap are mounted on a wood base two inches wide and six



Electric mouse trap; this time the mouse closes a very delicate electric switch and inevitably brings about its own death by release of the spring loop.

inches long. As shown in the illustration the spring of an ordinary mouse trap is mounted on the base two inches from the end, the wire lever is also used but it is shortened to an inch in length and is mounted in a reverse position.

The "switch" is simple to make, but it must be very sensitive to slight disturbance in order to be practical. A strip of springy and thin brass one and one-quarter inch wide is held with a small L-shaped piece of brass. The double contact points are two small thumb screws sharpened to a point and held by a U-shaped piece of brass. This switch is placed three-fourths of an inch from the end of the base as shown. The "loop" must clear the switch with a safe margin. A hole is cut in the brass strip to hold the bait.

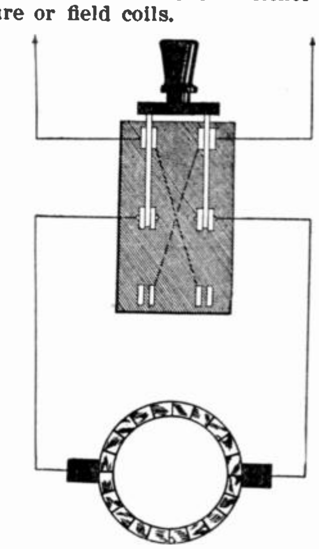
The lever release is a springy iron strip an inch long and half an inch wide. The strip is held by an L-shaped piece of brass placed so that the other end of the strip barely touches the end of the wire lever. It is advisable to make a small "L" bend at the end of the iron strip where the wire lever is held, to provide a better holding surface. A small electro-magnet is mounted close to the strip. Drive in a small nail by the side of the wire lever to prevent it from being drawn against the magnet, which might prevent its release.

For use adjust the thumb screws of the switch to a hair's breadth separation from the brass strip. Next place the "loop" back and hold it with the wire lever; the end of the lever is put in a "critical" position under the end of the iron strip.

The slightest disturbance of the bait closes the circuit and the iron strip is drawn toward the magnet, releasing the wire lever.

Motor Reversing Switch Connections

THE direction of rotation of a D. C. motor can be reversed by changing the direction of the current in either the armature or field coils.



Very simple arrangement by which one throw of a switch reverses the direction of rotation of a motor, by reversing the current through the armature.

The illustration shows the simplest way to accomplish this reversal of the current. A double-pole double-throw knife switch is used. The line and motor terminals are connected as shown by the solid lines. The dotted lines show the connections at the back of the switch. As can be readily seen, with the switch in one position the current will flow in one direction, in the other position, the current will be reversed.

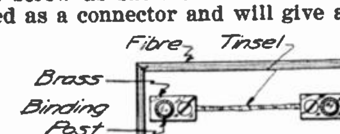
Contributed by HAROLD JACKSON.

Safety Fuse

THE illustration shows a fuse which is easily constructed.

A piece of fibre about two inches long, one inch wide and one-eighth inch thick is the base. A hole is drilled at each end for binding posts, and two pieces of thin brass one-half inch wide are held down on the fibre by the posts.

A piece of Christmas tree tinsel is put under the brass pieces and secured with the screw as shown. The device may be used as a connector and will give a longer



Exceedingly simple safety fuse constructed of a bit of tinsel or other similar material.

life to batteries where used to run trains, motors, etc., as the fuse can be replaced many times.

Contributed by JOHN SABODA.

Three Switch Lighting Circuit

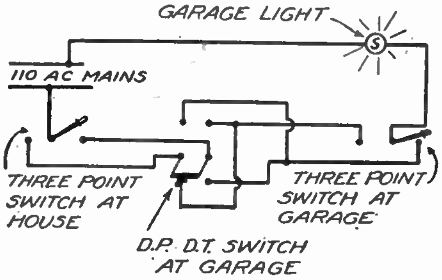
THE system of making it possible to open and close a circuit from two distant points by using three wires and two switches, is quite well known.

Here we have a variation in which there are three switches used. There is a two-pole switch at the house which will light the garage lamp; we have another at the garage which will light the same lamp; both of these are identical.

At an intermediate point in the line where it is also desirable to have the power of turning the lamp on and off, there is a double pole, double throw switch.

If the circuit is studied out, it will be seen that as long as the switches are kept closed, no matter how, they will either keep the light going or by reversing the position of any one of them, if the light is not going, the light will then be brought into action. The one point is that the switches must always be closed.

It is fair to assume that the windows of the garage would show whether the light is burning or not, so that one will know how to throw the switch.

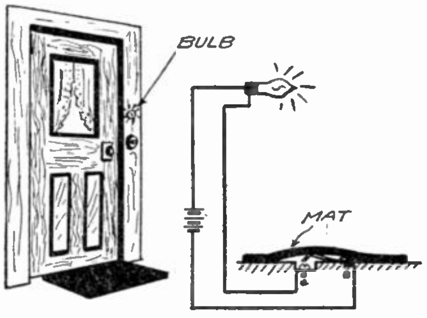


An improved three wire, three switch connection for a garage or outbuilding, so that it can have its lamps lighted and extinguished from three different places.

Contributed by J. G. KYPER.

Light for Push Button

IT seems that my callers who are in a hurry cannot find my door bell button at night, and hammer on the door, when a bell would waken me much quicker.



Stepping on the door mat presses on a switch, closes the circuit and lights the little lamp immediately above the push button, to show where it is.

I therefore placed a small flashlight bulb just above the push button, in such a position that it lights up as soon as a visitor steps on the door mat. Now my night visitors do not have to pound on the door to wake me. They soon perceive the push button which rings the door bell.

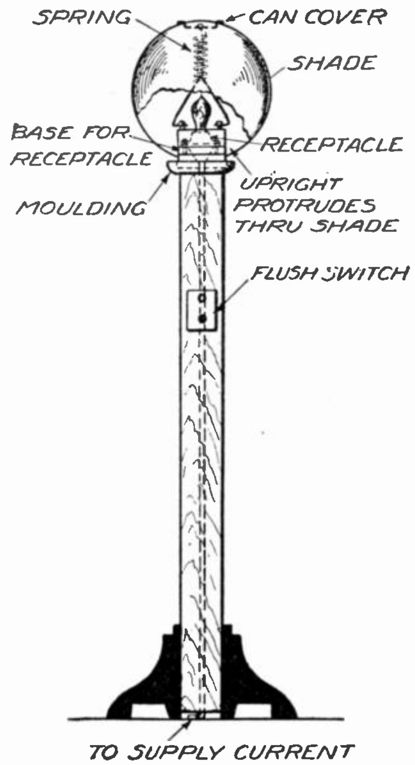
There is a spring switch under the mat which operates the little lamp.

Contributed by TRUMON KNAPP BUCKLEY.

Standard Hall Lamp

THIS device was made especially for use in a hall where, at times, a rather dim light was desired for an extended period. For want of a better name it can be dubbed a Hall Light. It can also be used in bedrooms and other parts of the house to advantage. With a little variation in design it can be made to serve a number of other purposes, such as that of a floor lamp, etc.

The upright and base supports are of wood. The upright is about five and one-half feet high and made of one-half inch material and nailed to form a three inch square. The base supports can be sawed from one and one-half or one and three-quarter inch material. These supports may be sawed in many forms and as much time as desired may be spent on them. It is possible that the legs of some old furniture can be used. The base supports are screwed to the upright as shown.



Simple and solid construction of a standard hall lamp, which can be considerably modified in the direction of more or less ornamentation or period character.

An opening is made for the flush switch at the desired height, no receptacle box is necessary. Ordinary lamp cord is used for wiring. After connections are made to flush switch and it is screwed in place the wires are brought to the top of the upright.

Two holes are bored in the wooden base of the electric light receptacle at the top, to allow wires to pass through; the base is then nailed in place in upright. The receptacle is screwed to the pillar top and wires are connected to the receptacle.

This particular shade is colored and was formerly used on a kerosene lamp and has holes at top and bottom. The moulding running around the upright is fitted to receive the shade. The upright protrudes three or four inches into the shade, as shown. This makes it impossible for it to come off except when lifted above the upright.

To further insure against the shade coming off, when carried, and to eliminate rattling, a wire fastened to two screws in the upright is brought above the electric light bulb, as shown. The wire is fastened to a spring (a piece of curtain spring will do). A small hook is screwed into a can cover, such as a paint can cover, which just about fits the hole in the top of the shade with the edges overlapping. The hook should be soldered to the cover or a little lead may be poured over the screw part of the hook where it protrudes through. The cover is then hooked into the spring which draws it into place and holds the shade firmly.

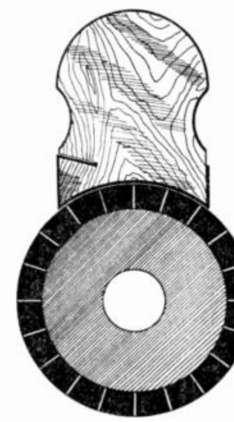
With screws and nails countersunk and holes puttied and two or three coats of mahogany or other stain and the addition of a switch plate, a very neat fixture is the result. The two wardrobe hooks may be added if desired. They will be found very handy and useful if the device is used in halls or bedrooms.

If a rosette ceiling fixture is available the cap may be unscrewed and direct connection made to it, therefore making this light independent of the other. If not a swivel plug should be used so that a connection can be made to a two way plug or base receptacle. Enough wire should be used to make the lamp portable.

Finally it would be well, although not necessary, to weight the lamp with lead at bottom.

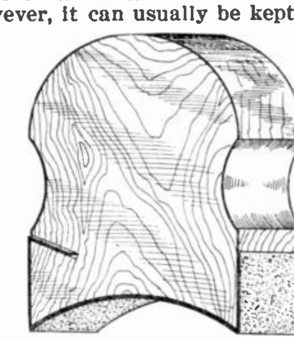
Contributed by CHARLES C. BARTLETT.

Commutator Polishing Block


End view of a polishing block resting on a commutator, to show how it operates to smooth the surface. The saw-cut for holding one end of the strip of sand paper will be seen on the left.

THE surface of the commutator on a motor or dynamo should always be bright and smooth. Of course the proper way to resurface the face of a commutator is to have it turned down from time to time on a lathe.

However, it can usually be kept in good shape with the tool shown here which is made of a block of wood, preferably white pine, about two inches thick. It is cut into the shape shown with the lower end curved to fit the commutator. After being sawed to an approximate fit, it is brought down to a perfect fit by placing a sheet of sand paper on the commutator, sand side up; the block is then rocked back and forth on the sand paper until the block fits perfectly. A strip of No. 00 sand paper as wide as the block is then applied in the manner shown, one end being secured in the saw cut at one side.


Enlarged view of the polishing block; the great point is to have its curve exactly fit the periphery of the commutator.

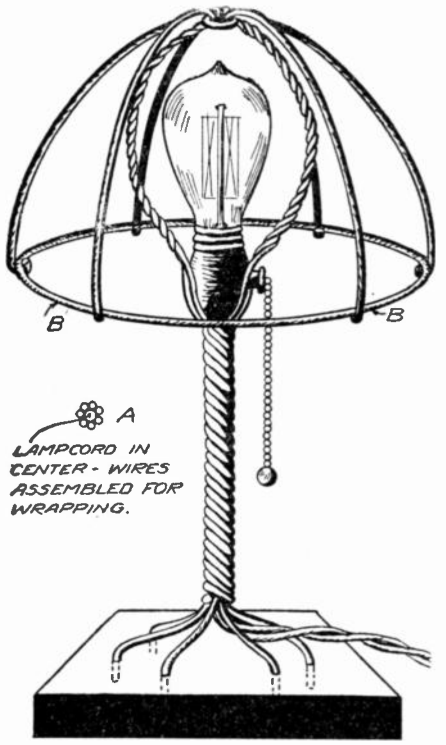
The block is held against the commutator while in motion and is moved in and out so as to cover the whole length of the commutator. Such treatment will keep the surface in good condition if applied whenever the surface becomes discolored.

Contributed by HAROLD JACKSON.

Wire Table-Lamp

AN efficient and ornamental table-lamp may be made of brass wire, as shown in the accompanying illustration.

Six long strands of the wire are assembled as indicated by the cross-section-



A table lamp whose standard shade support and foot are all made of wire.

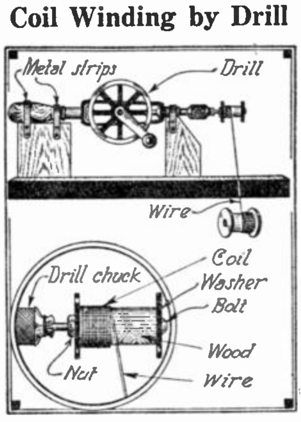
al view (A), a length of lamp cord forming the central core or heart. About these, for the length of several inches, a separate strand, the seventh of the brass strands, is wrapped in close coils.

The short projecting strand ends at the foot are spread and fastened in a block of hard-wood, as shown, to provide a substantial base. The upper strands, which are longer, are separated and twisted into two spirals, each containing three wires. These are bent in arcs to join, at a point eight inches above, where they pass through a steel washer and spread downward, individually, to become attached to the hoop (B). This provides the skeleton-form for the shade which may be a covering of silk, paper or other material.

The socket and lamp are then placed in position, attaching the lamp cord, and the lamp is complete.

Contributed by G. E. HENDRICKSON.

Coil Winding by Drill



A hand drill, which always has multiplying gear, is used by mounting on a support to wind coils of wire for electric purposes.

AN ordinary drill may be used very successfully in winding coils, especially if a very small wire is employed. By the method shown herewith, I have been able to re-wind the wire from the secondary of a Ford spark coil, into efficient audio frequency transformers for use in radio sets, with a great saving of time. Besides, coils wound in this way will be better looking than if done by hand.

All that is necessary in mounting the drill for this purpose is a base, of hard wood, and two wooden blocks, cut as shown in the accompanying illustration. These blocks allow for the freedom of turning the drill, and give plenty of room for winding the wire. The drill is fastened solidly to the blocks by small metal strips as shown. The drill should be mounted so that the left hand turns the drill and the right hand is free to feed and guide the wire, (provided you are right handed).

A very efficient form is shown for winding the coils on. This may be a long bolt, or a piece of threaded brass rod, with a wooden or metal cylinder slipped on it, with a washer on each end to prevent the wire from running or sliding off. The washers and cylinder are fastened solidly to the bolt or rod with nuts. It is a very easy matter to guide the wire straight, as one turn will fall closely beside the other.

Contributed by EVERMONT FISEL.

Electric Alarm Clock

By OSCAR S. MERNE, Cork, Ireland

FOR a person who has to rise at the same hour each morning and requires the assistance of an alarm clock, the electric alarm clock shown will be found simple and effective.

All that is required besides an ordinary clock, electric bell and battery, is an old clock wheel, two brass pins and two narrow copper strips (three-sixteenth inch).

File all the teeth but one off the clock wheel and fasten it on the pinion of the hour hand. Fix the two pins (A) and (B) through the dial at about the level of the top of the wheel (B) a little higher than (A). Solder the two strips of copper to these pins so that their free ends overlap and make the connections to bell and battery at the other ends of the pins at the back of dial. The arrangement is clear from the diagram.

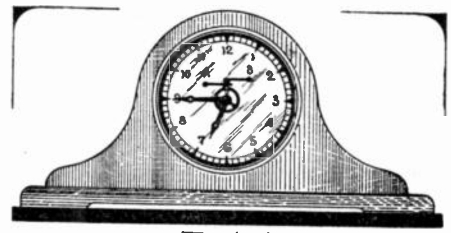


Fig. 1

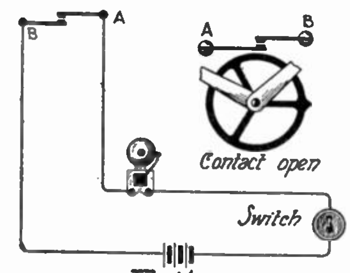


Fig. 2

A simple contact for an alarm clock; a wheel with all the teeth filed off except one is the effective agent for producing a good electric contact by cam action for ringing the alarm.

To set the clock, move the hands around to the hour at which an alarm is required to ring. Then adjust the special wheel so that the tooth points at 12 and bend copper strips so that they just touch. When the tooth moves around they will spring apart again and break the contact. (The clock in the diagram is set to give an alarm at 6 hours 45 minutes).

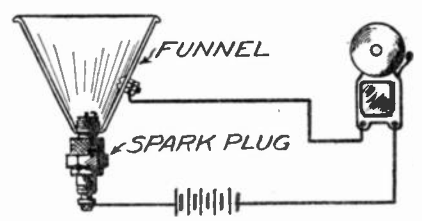
The clock may be in any place, but bell and switch should be near the bed. The switch is to prevent prolonged ringing after one has awakened and also to prevent ringing at the corresponding time in the evening. It need only be thrown in when one is retiring.

Unless the dial is made of a non-conductor the brass pins (A) and (B) should be insulated.

One advantage of this method is that alarms in several rooms may be rung from the one clock.

Spark Plug Rain Alarm

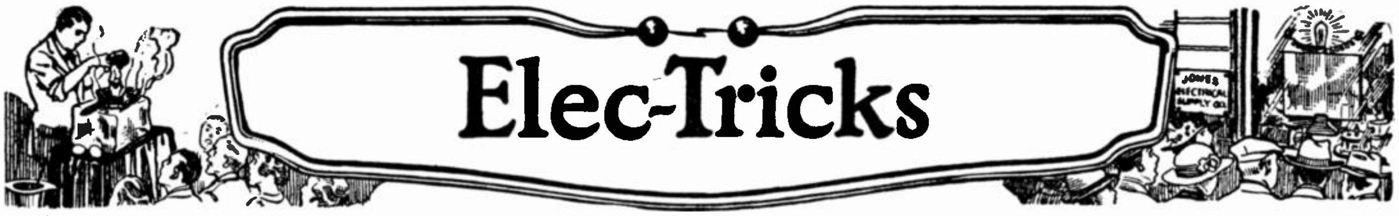
A FUNNEL (A) of convenient size is secured or is cut off at the spout and enough for a spark plug to fit snugly into it. Salt is put into the hollow of the spark plug.



A spark plug at the bottom of a funnel provides a very sensitive rain alarm.

It is then put in a convenient place and connected to battery and bell as shown. The alarm will sound a very short time after it starts raining. A jam nut can be extemporized to hold the plug firmly in place.

Contributed by D. CURREY, JR.



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.

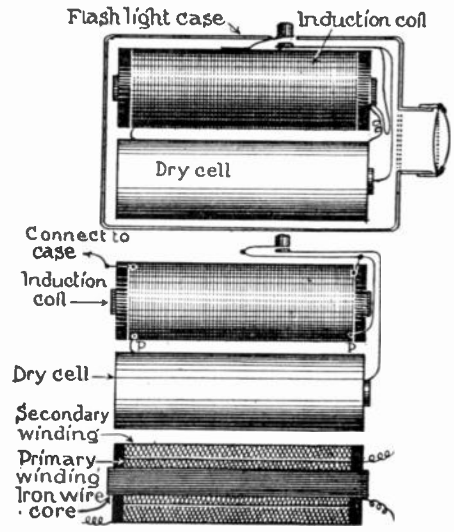
Electric Shock Lamp

Results of incautiously picking up the trick flash-lamp. The victim gets a severe enough shock to certainly startle him, if we may trust appearances.

MUCH amusement can be had with the little shock lamp shown in the illustrations. It is simply an electric flashlight case in which are placed a dry cell and an induction coil, so connected that when a person pushes the button to light the lamp, he receives an unpleasant shock. By laying it in plain sight on a table or stand it is very innocent looking and when one sees it nine chances out of ten he will pick it up and press the button.

The construction of the instrument depends upon the type of flashlight case used. A metal one is preferable, as the metal case acts as one electrode through which the shock is received. The case is connected to one of the secondary leads of the induction coil. The other lead connects to the push button, which must have a metal top well insulated from the case. The push button also closes the circuit through the primary of the coil. No lamp is used. When the button is pressed, current flows through the coil. On releasing the pressure the circuit is interrupted and a high voltage is applied between the button and case, which is held in the individual's hand, and he receives a harmless shock.

Of course only one flashlight cell is used, and the induction coil must not be any larger than the cell. It should be made up of a bundle of iron wires as long as the cell and one-quarter inch in diameter. Fiber washers at each end hold the windings. The primary may be wound with two layers of No. 26 enameled wire and the secondary wound over this. The



Details of construction of the trick flashlight, which gives a shock when anyone presses the alleged lighting switch.

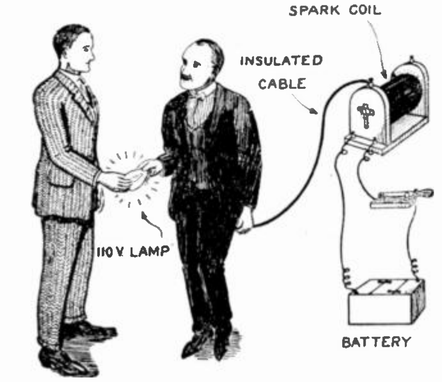
secondary is wound with very fine wire, about No. 36, and the bobbin should be completely filled with this. A layer of tape should be wound over this winding as a protection.

Mysterious Lamp

TAKE a spark coil and put it on either 14, 8, or 6 volts A. C. or D. C. Run a wire from one of the secondary terminals to a little metal plate so you can touch it unobserved.

Then, when ready to surprise and impress the audience, touch this plate with one hand and hold an electric light bulb by the base in the other. Request someone to step forward and all you have to do is put it against his body anywhere and it will light up with a pretty bluish-violet light, like a violet ray. Put a small metal cap or tinfoil on top of each bulb and connect it to the coil.

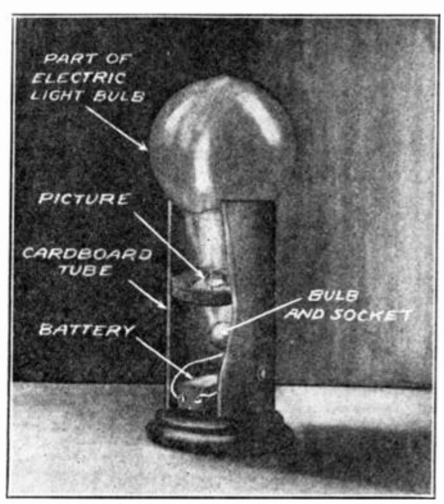
Contributed by LESLIE F. CARPENTER.



A neat experiment available for the conjuror or for display in a store window. A lamp is mysteriously suffused with a violet light.

Crystal Gazing Globe

THIS is a novel use for burned out electric light bulbs which presents an interesting pastime. A burned out bulb without a tip, a card board mailing tube,



Reproduction with a discarded electric light bulb of the astrologists' famous crystal gazing globe.

a flashlight bulb with socket and a battery are the main parts of this outfit, "a crystal gazing globe."

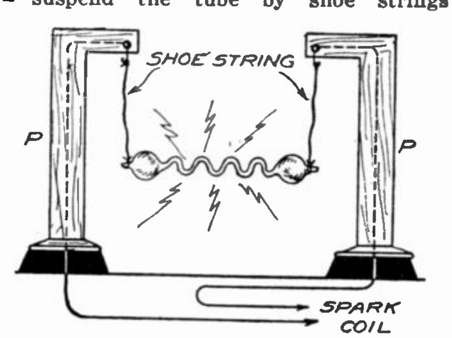
The brass base of the bulb is carefully removed from the stem. A small hole is filed into the former bottom of the globe. A piece of cardboard mailing tube four inches long is covered inside with black velvet and set upon a turned wooden base. About midway between top and bottom of the tube a piece of wood is fitted with a hole in the center; beneath this is a lamp and battery. A picture transparency on a piece of film is placed over the hole. A small push button switch is concealed beneath the velvet. Next the polished globe is glued to the top of the globe.

To operate the "gazing globe" the person looks into the globe and the operator presses the switch. The picture is shown quite clearly in the glass.

Contributed by WILMOT WOOD.

Trick Geissler Tube

PROCURE two upright posts (P) and suspend the tube by shoe strings

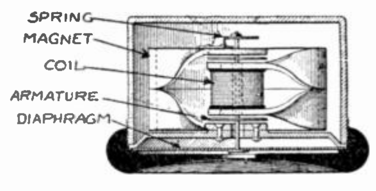


Shoestring suspension of a Geissler tube, giving a mystifying effect, as the wires which operate it are carried down inside the shoestring so as to be concealed completely.

(*Concluded on page 473*)

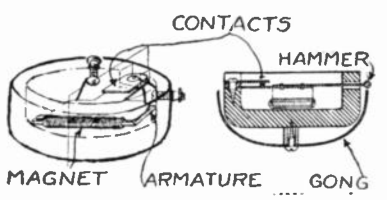
Latest Electrical Patents

Telephone Receiver



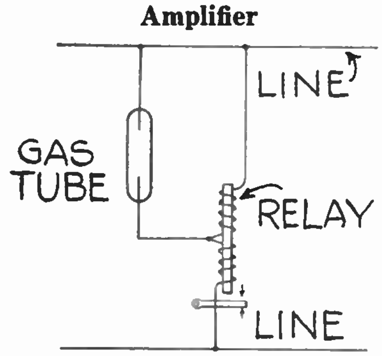
The telephone receiver shown is claimed to be very efficient. The permanent magnet is curved as shown and the electromagnet, through which the armature passes, is supported by it. The armature is supported by a spring and is alternately attracted to the north and south poles of the permanent magnet as telephonic currents pass through it.
Patent 1,482,588 issued to George M. Stratton.

Simple Buzzer



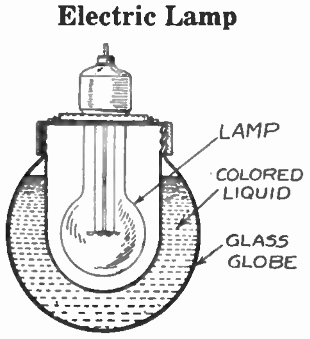
Cheapening the cost of manufacture is the main object of this invention. The buzzer magnet has a straight flat iron core and the armature is also of sheet metal parallel to it. The ends are bent down, forming the pole tips. The sectional drawing shows its use for ringing a bell.
Patent 1,483,682 issued to Joseph R. Rostron.

Amplifier



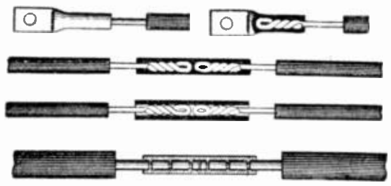
A relay depends for its action upon the percentage change in its effective ampere turns. To make the instrument more sensitive to changes in line voltages, which affect the ampere values, the circuit illustrated herewith may be used. The relay has two windings opposing one another, connected directly across the line, so that magnetic attraction to the armature is zero. Across the upper coil is a gas tube, such as a neon tube, which has a voltage current characteristic curve nearly parallel with the current axis. This tube maintains the potential across the upper coil practically constant while that of the lower coil varies and causes a varying attractive force on the armature.
Patent 1,477,668, issued to F. Schroter.

Electric Lamp



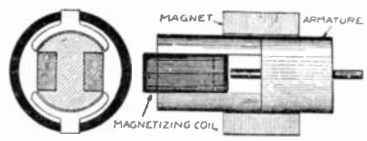
Very pleasing effects are claimed from this lamp. Between the lamp and the outer globe is a chamber filled with colored liquid, that diffuses the light and gives it a uniform color.
Patent 1,483,716 issued to Bruno B. Cholnski.

Electric Connectors



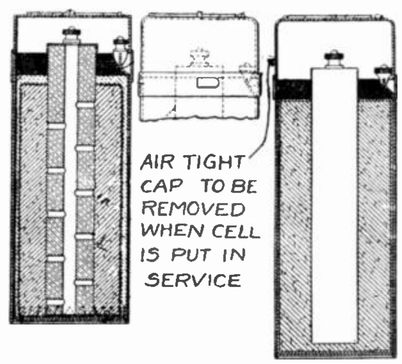
Often it is desirable to make firm electric connections without the use of solder. In the illustrations, sleeves are provided which are firmly pressed around the conductors. The wires are first twisted or corrugated as shown.
Patent 1,482,288 issued to Charles A. Deuscher.

Permanent Magnet Charger



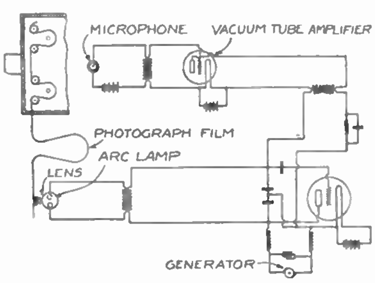
A permanent magnet is much stronger if its magnetic circuit is not broken after it is charged. This charger is designed to charge magneto magnets, and is of similar shape to the armatures used in these magnetos. After the magnet is charged, the regular armature is slid into the permanent magnets in place of the temporary charging armatures without interrupting the magnetic circuit.
Patent 1,484,619 issued to Eli J. Blake.

Dry Cell



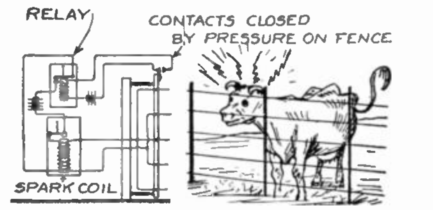
To increase the shelf life of dry cells, a hermetically sealed cap is placed on them and the air is partially exhausted. The partial vacuum is obtained by the condensation and cooling of vapors of alcohol, ether, etc. By doing this, gases evolved in the cell are partially withdrawn. In one of the illustrations is shown a cell with a hollow carbon so that liquid can be inserted, which is rapidly absorbed by the cell previously kept partially evacuated.
Patent 1,484,779 issued to George W. Heise.

Photographic Sound Recorder



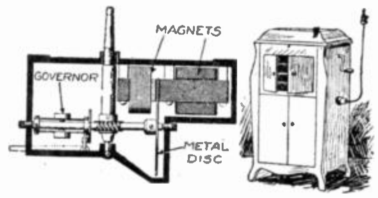
This device is used primarily for talking moving pictures. The sound waves striking the microphone are reproduced electrically and amplified by the two vacuum tubes. The currents then affect a miniature arc light in a gas filled chamber. The arc is supplied by high frequency, inaudible currents from the second vacuum tube. These currents are modulated by the first tube. The light therefore fluctuates in accordance with the sound vibrations and the varying light is photographed in the film.
Patent 1,482,119 issued to Lee De Forest.

Electric Fence



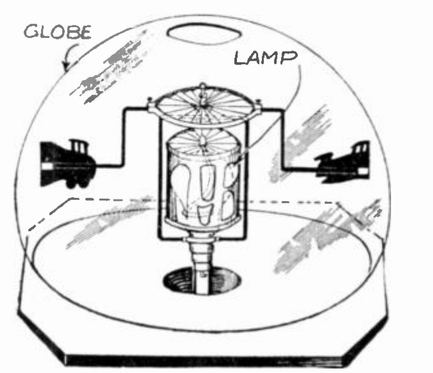
The object of this invention is to provide an electrified fence to confine live stock within certain limits. The fence is electrified only when the animal attempts to pass. Pressure on the fence closes a relay circuit which in turn operates a high tension induction coil.
Patent 1,483,005 issued to Albert Duy McNair.

Electric Phonograph Drive



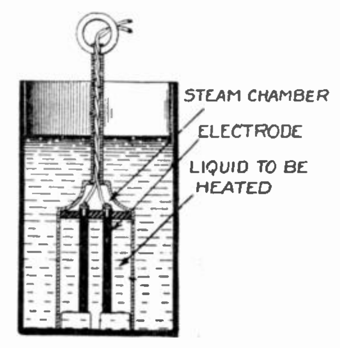
This mechanism comprises a special induction motor that has a metal disc rotating between two A. C. magnets. This disc, or armature is geared to the turn table. A governor is also provided to regulate the speed.
Patent 1,481,898 issued to Chester I. Hall.

Advertising Device



The rising current of air due to the heat of an electric lamp causes the peculiar lighting effects in this device. Directly over the lamp is a cylinder having perforations so as to cast shadows on the outer globe as it rotates in one direction, and over this is supported another propeller wheel carrying miniature aeroplanes which rotates in the opposite direction.
Patent 1,483,269 issued to W. G. Barker and F. O. Read.

Electric Heater



In this heater the liquid to be heated acts as the heating unit. The electrodes are placed in a special chamber, so that as steam is generated the pressure forces the liquid out of the chamber and automatically reduces the current flow or shuts it off entirely, as steam is an insulator.
Patent 1,483,280 issued to Floyd H. Cherry.

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 lies the body
Of Old Bill Zime.
He changed both fuses
At one time.
—HENRY AHLEMAN.

This tombstone marks the spot
Where lies Joseph McPheeter.
Whose feet were grounded
When his hat touched the meter.
—ENRIQUE CORRAL.

We say good-bye
To Mary Flynn.
Into her heating pad
She stuck a pin.
—EVELYN M. WATSON.

Cold 'neath this sod,
Lies Willie the Bug.
His water gun shot
At the connecting plug.
—BYRON LAYCOCK.

HOUSTON WELL DRILLER KILLED BY LIVE WIRE

HOUSTON, March 20.—James Echols, well driller, was electrocuted this afternoon while at work on a water well in a suburb.

He lifted a pipe which came in contact with a live wire.

The wire broke and a strand wrapped around his leg.

GETS SHOCK FROM ELECTRIC HEATER

GALT, Jan. 21.—An accident similar to one which recently proved fatal in London was reported here to-day. Mrs. A. Simmons, 77 Water street south, was taking a bath. There was a small electric heater in the room, and as it was slightly cold she decided to bring the heater closer to the tub. She took hold of the handle and received a shock, which threw her down in the tub, striking her head and also pulling the heater upon her, with the current still on. Her cries for help were heard by her husband in another part of the house, but his first attempt at rescue was blocked, the bathroom door being locked. He went outside, and obtaining a latter, broke in the bathroom window. The heater was still burning. He promptly turned off the current, but not before his wife had been painfully burned about her chest, limbs and one hand. It is stated that her injuries were not serious

Down under this sod
Lies old Bill Hughes.
He held to a pipe
While fixing a fuse.
—ORVILLE N. BONNETT.

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.

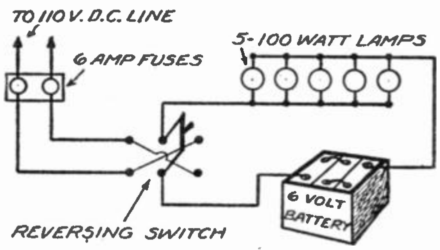
1. Not more than three questions can be answered for each correspondent.
2. Write on only one side of the paper; all matter should be typewritten, or else written in ink. No attention can be paid to penciled letters.
3. Sketches, diagrams, etc., must always be on separate sheets.
4. This department does 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.

Battery Charger

(424)—G. E. Forest, Flushing, N. Y., writes:

Q. 1.—I have a charger that operates on a 110-volt 60-cycle line, but recently I tried to charge a battery in New York City with the result that the fuses were blown out. Was this because direct current was used?



Apparatus for charging a storage battery; a bank of lamps is used to cut down the current and the switch is to be thrown into such a position that the lamps will light with less than normal brilliancy.

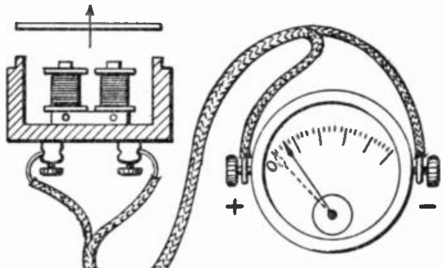
A. 1.—Yes. Many of the electric lighting circuits in New York City are direct current, and an A. C. charger will not work on D. C.

Q. 2.—How can I charge the battery on a D. C. line?

A. 2.—All that is necessary is to connect the battery to the line in series with a resistance which may be five 100 watt lamps placed in parallel. This will allow about five amperes to pass and charge the battery. Care should be taken to connect the battery properly to the line so that it will charge and not discharge. With a double-pole double-throw knife switch connected as shown in the diagram, the connections can be reversed so that the current passes in the proper direction. With the switch thrown to one side the lamps will light up more brilliantly than when the switch is thrown to the other side. The switch should be left in the position in which the lamps are lighted less brilliantly.

Polarity of Telephone Magnets

(425)—William Dumont, Los Angeles, Cal., asks:



How to test the polarity of a telephone, to connect it so that use will not weaken its polarity.

Q. 1.—Please give a simple diagram showing how to test the polarity of telephone receiver magnets, so that when connecting two or more telephones in series the battery current flowing through them will tend to strengthen rather than weaken the permanent magnets in the telephones.

A. 1.—There are many methods of determining the polarity of telephone receivers. Most of them are quite complicated. The diagram shows a simple method, taken from *Radio Electricité* of Paris. For this test a sensitive D. C. milliammeter is required, one which has a full scale reading of not more than one milliampere. The telephone receiver is connected to the ammeter as shown, and the cap of the receiver is removed. While carefully observing the meter, the diaphragm of the receiver is quickly removed. The meter needle will be deflected, and the direction at which it is deflected depends upon the telephone connections. Upon placing the diaphragm back on the receiver, the pointer will be deflected in the opposite direction. If one winding of the receiver opposes the other winding of the receiver, there will be no indication on the meter, and the connections to one of the coils should be reversed.

This much refers to double pole receivers tested singly. We now come to head sets.

To determine if two receivers of a double head set are properly connected, connect the terminals of the head set to the ammeter and remove the diaphragm of one of the receivers and then that of the other, and note if the needle is deflected in the same direction in both cases. If not, reverse the connections to one of the receivers.

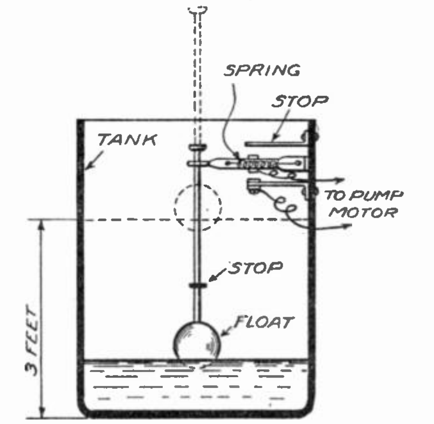
The explanation of this phenomenon is very simple. While removing or replacing the iron diaphragm of the receiver, the reluctance of the magnetic circuit is increased or decreased, and the flux passing through the coils is decreased or increased, as the case may be. This induces a current in the windings of the receiver and the direction of the current flow is indicated by the meter. Of course this phenomenon will take place only with polarized receivers, or those having permanent magnets. A non-polarized receiver may be polarized by passing the current from a battery through the coil.

Pump Switch

(426)—Armand Cyr, Chicago, Ill., asks:

Q. 1.—Kindly explain fully how to make a switch operating a small pump motor to be controlled by a water tank as follows: The switch is to be closed when the tank is almost empty and opened when the water in the tank is approximately three feet deep.

A. 1.—There are several ways in which this can be accomplished with the use of floats, but the exact mechanical construction depends upon the size and shape of tank used. The illustration shows one method which may be used or it may suggest other methods to suit your individual requirements. A float at the end of a rod that passes through a hole in the switch handle operates the switch. On the rod are two stops, three feet apart. When the tank is almost empty, the upper stop pulls the switch lever down, which closes the circuit and the pump starts; when the water is three feet deep the lower stop



Simple arrangement for shutting off a motor which pumps water into a tank. When the water reaches the upper level a float rises and shuts off the current.

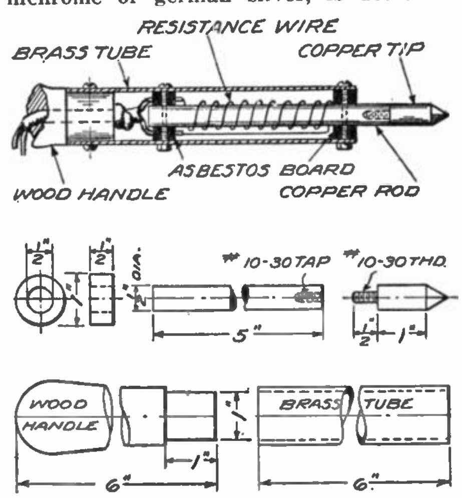
pushes the lever up and opens the circuit, thus shutting off the pump. A spring on the switch lever gives it a snapping action so that it will open the circuit quickly and prevent a slow burning arc.

Soldering Iron

(427)—Earnest Riederhausen, Nashville, Tenn., asks:

Q. 1.—Please show how to construct a small electric soldering iron, having a one-half inch copper tip, for use on 110 volts.

A. 1.—The illustrations show the construction of such an iron. The heating unit is wound on a copper rod, as shown. The rod should first be insulated with asbestos paper. The amount and size of wire should be determined by trial. Two or more layers may be added by thoroughly insulating them with asbestos paper as bare resistance wire, such as nichrome or german silver, is used. A



Detailed presentation of a soldering iron heated by a resistance wire coiled around its stem.

copper tip is screwed to the end of the copper rod as shown, so that new tips can be substituted from time to time as they wear. The rod with the heating coil is supported in a brass tube with two asbestos board spacers, cut to the dimensions shown. The holes through the asbestos board, rod, and tube should be drilled after assembling the parts. The two connecting wires pass through one of the asbestos insulators, and a knot is tied in the cord so that it will not pull through the wooden handle.

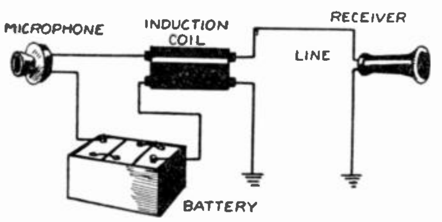
To determine the amount of resistance wire to wind on the rod, first select a length of a certain sized wire, about 28 or 30 B. & S. and connect a long length of it to the 110-volt line, using six-ampere fuses in the circuit. The wire will become warm. Then gradually decrease the length of the wire until it gets so hot that it glows at a dull red. If an ammeter is handy the current should be measured, and should not exceed two or three amperes. After the proper length of wire is determined, it is wound on the copper rod in two or three layers and well insulated with asbestos paper.

Telephone Queries

(428) — Howard G. Meyers, Elmhurst, N. Y., inquires:

Q. 1.—Can a Packard spark coil be used as a telephone induction coil? If so, how?

A. 1.—Yes. It may be connected in the circuit the same as an ordinary induction



Using a Packard induction coil on a telephone circuit, with a battery of 6 to 12 volts and two grounds.

coil. That is, the primary should be connected to a battery of 6 to 12 volts and a microphone. An ordinary telephone transmitter is the best type of microphone to use. The diagram shows the connections.

Q. 2.—Can an audio frequency amplifying transformer be used for the same purpose? If so, what would be the most efficient ratio?

A. 2.—The audio transformer may be used for the same purpose, but it will not be very efficient on account of the high resistance of the primary winding. This resistance is in the neighborhood of 1,200 ohms, and when used with the ordinary microphone of about 20 ohms the results will not be satisfactory. The transformer will not pass enough current. If one is used, one of a high ratio is preferable, one of about 10 to 1 ratio.

Q. 2.—Is the Skinderviken button really as good as advertised? How much current is needed to allow it to pick up anything said in a room 12 by 12 by 12 feet and carry the words about 200 feet?

A. 2.—This depends upon who advertises it. It is no better or rather no more sensitive than the ordinary telephone transmitter, but on account of its small size it is easily placed in out of the way places and is very convenient for experimental use. It may be used in the above room, but a vacuum tube amplifier is recommended with its use. About one-quarter ampere should pass through the button for best results.

Rectifier Query

(429) — Harry Kelly, Lowell, Mass., asks:

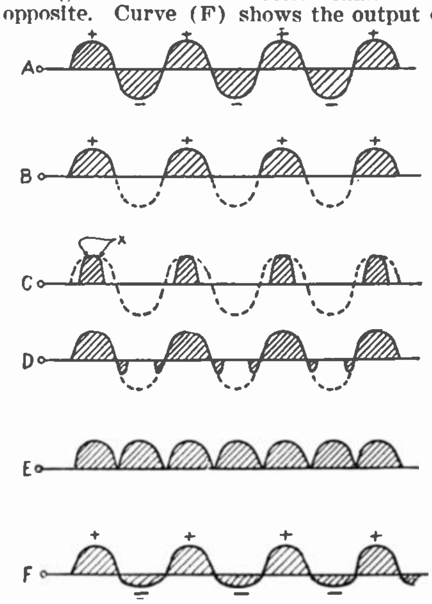
Q. 1.—What is the proper way of measuring the A. C. input and the D. C. output of a mechanical rectifier?

A. 1.—The A. C. input of the rectifier should be measured with a wattmeter when the rectifier is operating at full capacity. The wattmeter will indicate the correct amount of watts delivered to the device, but if a wattmeter is not available an ammeter and voltmeter may be used. Simply measure the voltage across the rectifier and the current passing through it. Multiply the two and the product will be the watts. This will not be exactly correct because the rectifier will not be operating at unity power factor. It will be accurate enough for most purposes.

The D. C. output should be measured in the same way; that is, by using a voltmeter and ammeter. The ratio of the output in watts to the input will be the efficiency of the instrument.

Q. 2.—Is all the current on the D. C. side suitable for charging storage batteries or does any A. C. pass?

A. 2.—This depends upon the rectifier. In your case we will describe a mechanical rectifier, and refer to the curves. At (A) is shown the A. C. sine wave curve delivered to the rectifier. If the rectifier is a half wave rectifier and is adjusted so that the circuit is opened and closed when the current passes through zero, the current delivered to the battery will be as shown at (B). Only the upper or positive halves of the waves reach and charge the battery. This condition is hard to realize in practice and sometimes the circuit is interrupted in the positive halves of the waves as shown in curve (C). The full lines in this curve indicate the current delivered to the battery. Curve (D) shows the results when the circuit is interrupted in the negative halves of the waves. In this case the battery is being charged during one-half of the wave and then discharges slightly. Curve (E) shows the current received by a battery when charged from a perfect full wave rectifier. Some chemical rectifiers are not perfect rectifiers. They merely have a higher resistance to current flowing through them in one direction than in the opposite. Curve (F) shows the output of



Various illustrations of undulatory currents producing different effects and merging into pulsating ones.

such a rectifier. The battery receives a strong charge during the positive half of the cycle and then discharges slightly during the negative half. This curve is that of a half wave rectifier.

Ford Spark Coil

(430)—Edgar Lusconlie, Chicago, Ill., asks:

Q. 1.—Please show the wiring diagram of a Ford spark coil and explain why only three terminals are needed for both primary and secondary.

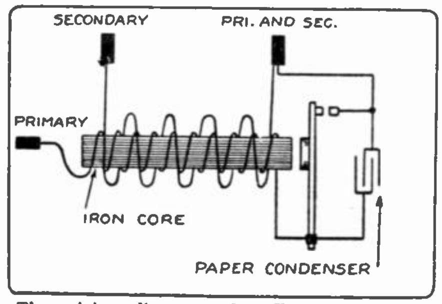
A. 1.—Instead of using four terminals as generally used in a spark coil, one of the secondary leads is connected to one of the primary leads, forming a common terminal. The inside lead of the secondary winding is connected to the primary circuit because it is so close to the primary coil that it could not very well be insulated. Hence by employing three terminals the cost of the coil is not only reduced but there is no danger of making a mistake in connecting the coil to the spark plugs and puncturing the insulation between primary and secondary circuit. The diagram shows the connections.

Q. 2.—Please tell me the approximate voltage given by the secondary when a six-volt battery is connected to the primary.

A. 2.—The voltage varies with different adjustments of the vibrator. It can be approximated by measuring the length of the secondary spark passing between needle points, and allowing 20,000 volts for a one-inch gap. Normally a half-inch spark can be obtained, so that the voltage would be 10,000 volts.

Q. 3.—How much current in amperes will the coil draw when connected to a six-volt battery?

A. 3.—About one-half ampere, depending also upon the vibrator adjustment.



The wiring diagram of a Ford spark coil to show why it only has three terminals while most coils have four.

Rewinding Telephone Head Set

(431)—B. M. Hulbert, Ithaca, N. Y., asks:

Q. 1.—How can I transform a pair of 75 ohm head receivers into a pair of 2,000 ohm head receivers?

A. 1.—This is a difficult task, but can be accomplished with a bit of patience and skill. The soft iron pole pieces of the receivers should be removed and the wire cut off or unwound. The empty bobbins should then be wound full with No. 40 B. and S. enameled magnet wire. This wire is very fine and will require many turns; it is best put on with a small lathe or winding machine. The ends of the wires should be soldered to larger wires for making the terminal connections. Care should be taken to connect the coils so that they will not oppose each other. A simple method of testing is given in another query in this department.

Electrolytic Rectifier

(432)—A. E. Bernhard, McFarland, Calif., asks:

I wish to charge a six volt battery from A. C. mains, using the electrolytic rectifier described in the September issue.

Q. 1.—Will 20 mule team borax be satisfactory for the solution?

A. 1.—Yes. This will give good results.

Q. 2.—What does the lamp bank consist of?

A. 2.—The lamp bank should consist of six 50 watt lamps connected in parallel or its equivalent; that is, three 100 watt lamps may be used instead. With this arrangement a six volt storage battery will be charged at about a three ampere rate from a 110 volt line.

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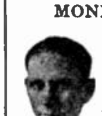
S. Moy
Brooklyn, N. Y.

MONEY WELL SPENT



"I think the investment I made for your course is money well spent. Will visit you when up that way. Wishing you continued success."

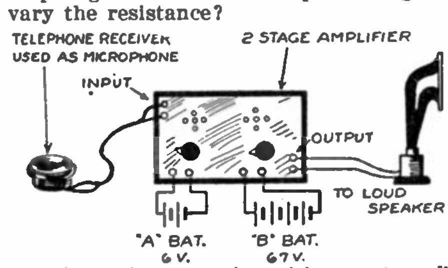
James A. Cooke
Ft. Bragg, N. C.

Howler

(433)—Robert Phillips, Mineola, L. I., writes:

I have used the hook-up in the enclosed diagram and have obtained wonderful results. By speaking into the telephone receiver the voice was greatly amplified. I am at a loss as to the operation of the apparatus. Had the "transmitter" been a real microphone and not an ordinary high resistance telephone receiver I could easily understand the phenomenon. In that case the vibrations of the voice on the diaphragm of the microphone would vary the resistance and cause currents to be induced into the secondary of the first transformer.

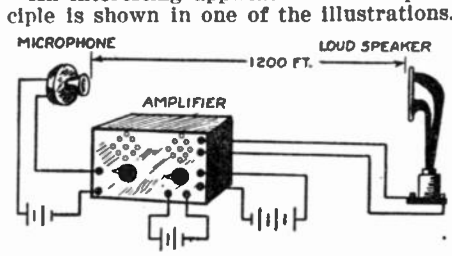
Q. 1.—How can the vibrations of the diaphragm in front of a couple of magnets vary the resistance?



An interesting connection, giving great amplification, explained.

A. 1.—The vibrations of the iron diaphragm in front of the permanent magnet pole pieces of the receiver cause corresponding vibrations of the magnetic flux through the magnet cores, which in turn generates currents in the coils around these cores. This current is amplified by the two stage amplifier and the sound is reproduced in the loud speaker. Bell's original telephone had no microphone, but acted on this principle. This device is not very efficient as a microphone. You may have found in your experiments that if the receiver is held near the loud speaker, the sound waves from the loud speaker feed back into the receiver and set up a loud howl.

An interesting application of this principle is shown in one of the illustrations.



A suggested connection for producing a mysterious perpetual repetition in an endless cycle.

Sound travels approximately 1,200 feet per second. It would be interesting to note what would happen if the distance between the microphone and the receiver were increased to about 1,200 feet. We will also assume that the amplifier and loud speaker are powerful enough to project the sound 1,200 feet so that the sound from the loud speaker will be picked up by the microphone. We will first arrange the apparatus in an open, quiet field and then say "hello" into the microphone. This "hello" is instantly reproduced by the loud speaker, but the sound waves from the loud speaker have to travel 1,200 feet before they strike the microphone and hence reach the microphone one second after we first say "hello." This "hello" from the loud speaker therefore strikes the microphone and is instantly reproduced again. The second "hello" strikes the microphone one second later and is also reproduced again. This action continues, and the device continues to talk to itself and say "hello" indefinitely, or until the word is not intelligible, as each time it is reproduced the distortion will be a little greater. The idea would be to use the apparatus for celebrating the Fourth. One revolver shot would sound like a machine gun.

Lead-burning Kink

IN a garage or shop where a lead-burning outfit is not handy, and new posts or a set of connectors have to be put on a battery, the only available material being a couple of pieces of drop cord wire, a fully charged battery and a piece of carbon from a dry cell, cut down to the size of a lead pencil, and about five inches long will effect the mending.

Place the two batteries side by side on a bench; connect the negative posts of both batteries together with one piece of the drop cord wire. With the other piece of wire connect to the positive post of the fully charged battery, then fasten the carbon rod to the other end of this wire. Prepare the post or connector to be repaired, and touch the end of the carbon rod to the part to be filled with lead and withdraw it instantly, thus striking an arc.

The carbon rod will become white hot, almost immediately, and by adding the lead and working fast, a quick, neat job can be turned out in a very short time. A few layers of tape or a short piece of hose may be placed over the wire near the carbon rod to keep the hand from becoming too warm.

Contributed by JAMES T. McDONALD.

Illumination of Outdoor Hockey Rink

THE Hockey Team of Union College at Schenectady, N. Y., was handicapped in the early part of the winter of 1923-1924 by darkness interfering with practice. The General Electric Company was appealed to, and recommended eight reflectors with 1,000 watt gas filled Mazda lamps. These were strung in two lines down the length of the rink, equally spaced. The rink is 75 feet wide by 160 feet long. Two poles were erected at each end of the rink and the lights were suspended on guy wires which held the lights 30 feet above the surface of the ice. Additional offset guy wires were strung, to which the reflectors were attached to prevent swaying in the wind.

The results, according to Ambrose M. Clark, hockey coach of the college, were very satisfactory indeed. There was an entire absence of shadows, usually so disconcerting to the players. The puck, made of black rubber, was as easily seen as in the daylight, even when it was in the air several feet above the ice.

The effect produced was so similar to daylight that opposing teams, playing under these artificial lights for the first time, experienced no difficulty whatsoever.

Making Old Bulbs Brighter

A NOVEL and interesting experiment is to take a number of strong magnets or a coil with an opening large enough to admit a light bulb, and place them around a light bulb which is lighted with thirty volts.

Nothing much happens for a few seconds but after a short time the filament begins to vibrate to and fro. The bulb should be left in the magnetic field until three pairs of filaments are united.

If the bulb is now taken out and put in the regular 110 volt line, it will burn about three times the usual brightness.

This is due to the fact that the filaments have united, thus increasing the resistance.

This also decreases the life of the bulb. The lamp must be lighted by an alternating current.

"Specs"

By Charles Magee Adams

(*Continued from page 431*)

Barney Sears than designing control equipment as soon as he stopped the little company car in front of the station and caught Barney peering warily through a window.

Other operators had been glad to see anybody. They had used every sort of pretext to attract visitors to the station, even lured line patrols into staying there three or four days. But Barney was distinctly not glad to see Specs and took no pains to conceal the fact. In the first half hour he announced irritably that Specs would have to get his own meals, something Specs vastly preferred when he got a glimpse of the kitchen, refused sullenly to give any help in assembling data, and became more and more truculent during the ten days of Specs's stay, all of which disturbed Specs and hurt him a little till he detected the unmistakable odor of mash and finally caught Barney slipping up the hill one night.

He frowned resentfully now as he cleared away some of the dirt and began inspecting the equipment. To him a motor-generator or an oil switch was something to be cared for as patiently and painstakingly as if it were alive, and judging from appearances Barney had scarcely touched anything all the weeks he had been here. He was glad he had gone to state police headquarters and reported him. Moonshining was bad enough, but this letting things go was just as bad.

It took him two days to clean and oil and adjust what Barney hadn't, and two more to make the living quarters more nearly endurable. But by the time all this was finished and he was free to begin the installation of the control apparatus which he and Billy had brought up in the truck, he had regained his usual good humor.

The loneliness of the place did not disturb him. He rather liked it. He could get up as early as he pleased and work as late as he pleased, and in the evenings sit at the door and smoke, with nothing but the occasional clang of the telephone to break in on the murmur of water over the spillway.

The control apparatus, though not bulky, was intricate and its installation would occupy at least several weeks. So Specs had volunteered to act also as operator and the dispatcher at Castleton telephoned three or four times a day with instructions about starting and stopping the motor-generator and setting the gates. But these duties were not troublesome.

The gates, massive valves set in tunnels driven through the bottom of the dam, were motor-operated, and it was merely necessary to throw switches on the station switchboard and watch the dials that showed their position. So the first week or two passed quickly.

Billy came up to check the progress of work and bring supplies, and reported disgustedly that Barney Sears had been sentenced to only three months in the Castleton jail. Specs was disappointed at that too. He had hoped the surly former operator would be punished more in proportion to the trouble he had caused. But he was not the sort to harbor a grudge and the matter of water supply had begun to interest him.

He had never seen Lonesome Lake during the summer and the long walled-in expanse of water behind the dam proved peculiarly attractive. It looked so reassuring, millions on millions of acre-feet held back, silent and motionless, waiting to be let through the gates as water was needed. There seemed to be enough to drive the turbines at Castleton indefinitely. But he knew that was not true.

In September, before the equinoctial downpours swept over the parched hills, the surface would be far down between the rock walls, and being an engineer he was curious to observe how the stored supply dwindled and forecast how far down the surface would be when the rains came.

The dwindling had already begun, in fact. It still rained, sharp showers and now and then a general storm across the whole divide. But the amount of rain that fell was insignificant and by the middle of June the sheet of surplus pouring over the spillway had disappeared. The gauges which indicated the depth of water began showing the first slight lowering of its level, and as July came on this became perceptible to the eye.

Specs was not concerned at all. The lake would not fail. If it did, service on the whole system would fail, but it never had. It had always carried everything safely through to the equinox, sometimes through seasons that had been memorably dry, and there was more than enough water in those still depths to carry things through this season.

So he went ahead with his installation, simply pausing once or twice to climb down and inspect the gates and masonry for possible leaks. But about the middle of July he began to notice signs that this summer might prove below normal in water supply.

The level of the lake seemed to be falling a little too rapidly, uncovering a widening band of rock wall previously submerged every morning. So Specs got out the station records.

Making and recording daily gauge readings was part of the operator's duties, and comparing his observations with those of previous summers he found that the lake was lower than it usually was at the corresponding date. Still he was not concerned. The difference was not enough to be alarming, but it was enough to make him repeat his comparisons, and as he did and the discrepancy grew steadily wider in the first week of August, he was forced to admit with an uneasy frown that the Valley Light and Power was facing what promised to be a season of unparalleled drought.

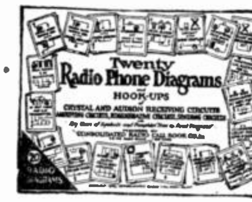
He went straight to the telephone and called Billy as soon as he saw that, but Billy already knew. "Yes. Looks like we're going to have a run for our money," he said. "But there's no use worrying. There's always been enough in the old puddle and we're working out a scheme to save every gallon we can."

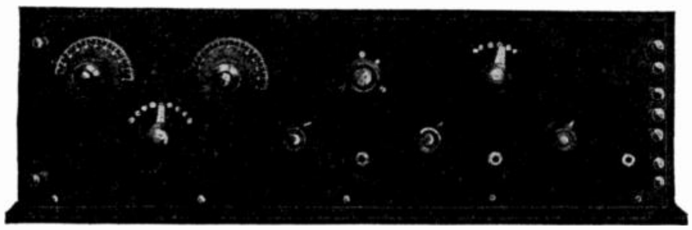
He explained. The loading was to be changed, power was to be brought from the Consolidated, and if the worst came to the worst customers were to be asked to curtail consumption, all of which eased Specs.

They were alive to the danger. But they could not put fresh water in the lake. That telltale band of moist rock became ominously wider and by the middle of the month the gauge readings were falling farther and farther short of normal. Work on the control apparatus had progressed to the point where he had run a few partial tests, all satisfactory, but he kept thinking uneasily about the water supply.

What would people do if the lake failed? Where would they get power for their lamps and appliances and motors? And failure was no mere possibility. Only the most unfailing springs back in the hills were still flowing, feebly. The surface of the lake was dropping deeper and deeper between the rock walls, and the sun shone with monotonous brilliance.

One morning the first week of September Billy called up. "Barney Sears was





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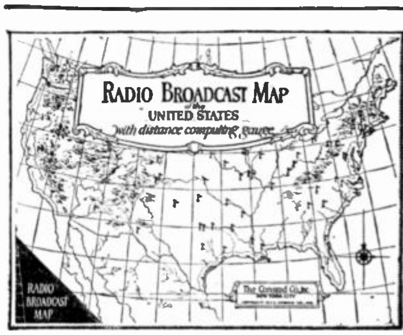

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let out of jail yesterday," he said. "End of his term, you know. Thought I'd put you on the lookout for him."

"What for?" Specs asked, a little puzzled.

"Don't you remember he said he'd get even with you for telling about his moonshining? He generally gets even. You've got an automatic up there. Shoot first and find out what he wants afterward."

"All right," Specs replied, but the interest was all in his question, "Any signs of rain down there?"

"No. Not yet," and Specs only made sure which drawer of the desk the pistol was in.

Billy meant well and Barney was big enough and treacherous enough to make good his threat, but Specs was more concerned about the water supply than he was about any threat of vengeance from Barney.

He kept watching and waiting more and more anxiously, looking for even a spot of cloud in the flawless sky and listening in for weather reports on the radio set. It was less than two weeks to the equinox now, but there was no comfort in that. The lake looked like a narrow pool far down in a canyon and as he tried uneasily to measure the water that was left against the remaining days, it seemed a long perilous gap to be bridged.

The gates were much larger than was usually needed, being designed for flood relief. Opened to full they could have drained the lake of all it held now in a few hours, and Specs, of course, kept them closed to where barely enough water passed for Castleton's needs, and even grudged that much. But the level kept falling and falling till he dreaded to take the gauge readings, and it was the fifteenth before the first faint ray of hope appeared.

"Cloudy tomorrow," he heard, listening in on the weather report again, and it came true, technically. There was little more than a haze, barely dimming the glare of the sun, but that was something. All that day and the next and the next he watched, alternately more hopeful and more gloomy. Rain was coming but he wished it would hurry.

Trees left on the bottom of the lake when the dam was built were thrusting their dead tops above the surface and wild animals from back in the hills were coming down openly to drink. There was nothing more he could do, nothing anybody could do. But on the eighteenth his ray of hope brightened.

"The weather man says increasing cloudiness tomorrow followed by rain," Billy reported cheerfully, calling him up.

"Well, here's hoping he's right," Specs answered, almost prayerfully. "If it don't rain, we're through."

"Oh, it will," Billy assured him. "Just hold on a day or two more." His tone changed. "Haven't seen our friend Sears, have you?"

"No."

"Well, remember what I told you," Billy warned. But Specs was thinking about the rain.

During the night he got up three times to look at the sky, at daybreak was out scanning it again, and the forecast was true. As soon as it was light he could see that the haze had thickened considerably. It blurred the sun when it rose and as the morning advanced clouds that grew steadily darker began piling up and Specs's spirits rose with them.

At last it was going to rain. That did not make the scant supply behind the dam any less precious. Even a general downpour would not refill the lake immediately. The ground was so thirsty and the water would have to flow down so many miles of twisting creeks that it would be many hours, perhaps a whole day, before its level would begin rising. But the strain and uncertainty were over and he went back to the control equipment with his old preoccupied whistling, the lines in his thin face already beginning to smooth out.

The equipment was practically finished and he connected it to the 2,300-volt buses ready for a service test, pausing now and then to look out the window. But by noon the sun was blotted out, and as the afternoon wore on cloud masses spread over more and more of the sky. The barometer was falling. There was a foreboding sultriness in the air. It would rain before night.

A satisfying relief took possession of Specs. It had been a hard fight and a mighty close one. He didn't like to think of what would have happened if the rain had held off two more days. There simply wasn't enough water left to last that long, skimp as they would. But it was going to rain, and they had kept up service through the worst drought the system had ever experienced.

He quit work a little after four when premature twilight fell, put away his tools and went outside for a final look around. The clouds were so low he seemed almost able to touch them and the smell of rain was already in the air. He sniffed it eagerly. He would get his supper, then sit in the doorway and smoke and watch it rain, even let it splash on him a little, just to see how it felt again.

He turned, stepped leisurely inside, and halted with surprised suddenness, face to face with Barney Sears.

He had not heard him come in, not even thought of him since Billy's last warning. But there he was, a hulking figure planted in the middle of the floor, an insolent glint in his black eyes, and what was most to the point, the station's automatic in his hand. "Stick'em up," he ordered curtly, levelling the weapon at Specs.

Specs obeyed. There was nothing else for him to do, caught completely off his guard as he was, but that old contempt for the bigger man rose in him even as he did. "What's the big idea?" he demanded, his eyes undismayed.

Barney's loose mouth twitched. "You'll find out damned quick enough!" he snapped. "Didn't I tell y' I'd come back 'nd get even with y', y' damned four-eyes!"

MacDowell's spectacles had always seemed to infuriate him peculiarly and now he glared at them as if they were as much an affront as Specs's unconcealed contempt. "Turn around."

Specs complied. He did not know whether to expect a shot or a blow on the head. Barney was quite capable of either it occurred to him. But he was too much irritated at having the dirty former operator near and being trapped so easily, to be alarmed, and Barney was contemplating no immediate violence, it seemed.

He pulled a noose of rope from somewhere in his torn clothes, dropped it over Specs's wrists and jerked it tight. "Come here," he growled, pulling him toward the wall.

About eight feet from the floor there was a heavy pipe bracket forming a rack for material, and throwing the end of the rope over this Barney pulled till Specs's heels barely touched the concrete, then made it fast, leaving the smaller man trussed helplessly against the wall. "Wasn't lookin' for me, was y'?" he demanded as he stepped back, grinning evilly. "Didn't think I meant that 'bout always gettin' even?"

Specs did not answer. He could smell liquor on Barney's breath and there was a thick coating of dust on his clothes. He had probably hidden up in the hills.

then slipped through the back door as opportunity offered.

Barney's grin faded and he leaned closer. "When I get through with y' y'll believe me," he prophesied, waving the automatic menacingly. "You 'nd some more of'em besides. That's all I come up here for."

Still Specs did not reply. The hulking moonshiner was in a position to make good any sort of threat, but Specs's eyes behind the big spectacles were burning more hotly and more openly every moment. "Well, go ahead!" he snapped. "You notice I'm not stopping you."

A hard glitter came into Barney's eyes, then a crafty look replaced it. "You'll get't all right," he rasped. "But you can wait."

He turned and stepped to the switchboard, stopped at the panel carrying the gate-motor apparatus, and eyed the indicator dials, that crafty look growing. "See? I ain't forgot," he said, grinning. "Know all about things yet." His grin widened, with a malicious cunning in it. "But y'ain't got'em fixed right," and reaching up he threw the switches to the opening position.

Instantly Specs surged forward on his rope. "You fool!" he burst out. "Stop that! Don't you know you're opening them?"

Barney faced him, leering in mock dismay. "Y'don't say so?" he mimicked. "Well, ain't that too bad?"

Specs tugged at the rope, squirming with excitement. "But you are! Close them, I tell you! Close them!" he commanded, savagely in earnest. "You're wasting the water. There's only a hatful and it's got to last till the rain runs in! don't you understand?"

Barney burst into a jeering guffaw. "Sure I do," he rasped. "Sure!" He threw back his greasy head and went on guffawing till the noise of it drowned the hum of the motor-generator, then stopped, stepped over, and thrust his face close to Specs's, a gleam of malicious satisfaction in his eyes. "Listen, four-eyes!" he snapped. "I know I'm wastin' the water! I want t'waste't! Every damned drop of't! Y'see?" He shook a dirty forefinger under Specs's nose. "That's how I'm gettin' even with that damned Clewitt and the rest of'em down there!"

Specs simply looked at him, his eyes wide and dazed. "You—you what?" he demanded incredulously.

Barney's mouth twisted. "You heard me," he retorted. "Y'heard me." Every damned drop of it!"

Specs stared at him, numb and bewildered. "But you—you don't mean it?" he protested.

Barney cackled. "Want me t'take y'down 'nd drop y' in't?" he demanded.

Specs gasped and let his weight sag limply from his wrists. Waste the water! The water the whole valley was depending on these next few hours for power, deliberately, simply to gratify a blind lust for vengeance! It was unthinkable, impossible. He jerked suddenly erect.

"Listen! Listen!" he commanded fiercely. "Shut it off! Do you hear? You're not getting even! You're just making other people suffer! Don't you see?"

Barney only leered. "Sure, I see," he mocked. "Y'hear't runnin' out, too, don't y'?"

Specs slumped back against the wall quivering and weak. He could hear it, the hissing rush from the opened gates and it seemed fairly to thunder at him. Wasted! Brutally, blindly wasted! When they were within these few short hours of coming safely through! He felt sick, utterly beaten. But what could he do?

Barney had turned and was eyeing the switchboard. "What's that?" he demanded.

Specs did not answer. He would probably be beaten, maybe left trussed up till they came from Castleton for him, perhaps killed. But if Barney only hadn't wasted the water.

"Hey!" A heavy hand dealt him a stinging blow. "What's this I said?"

Barney was pointing to the new panels on the switchboard.

"Remote control," Specs answered dully.

Barney frowned in suspicion. "What's that?" he demanded.

Specs told him. Why hadn't he listened to Billy's warning? But it was too late now. He thought he could see the gauge needles falling.

Barney eyed the shining complication of switches, relays, dials and connecting buses a moment. "So that's what y'been doin'?" His eyes narrowed, and stepping to a corner he picked up the pike pole, a long seasoned stick for handling live wires. "Let's see how she does," he suggested evilly, and thrust the end of it into the midst of the apparatus.

There was a flash. Barney chuckled sardonically and thrust again. There was another flash and the crack of a tripped circuit-breaker.

Specs did not look up or even move. It had cost him months of hard work to install what this heavy-handed hulk was wrecking, but he could replace it. What he couldn't replace and what was a thousand times more precious just now was the water hissing to waste through the gates, and he couldn't even check that.

Barney went on jabbing and prodding, upsetting delicate adjustments, and ruining carefully fitted parts with every stroke, but causing no more flashes on account of the tripped circuit-breaker till, his evil grin growing, he shifted farther up the panel and drove a heavy blow at the main supply bus.

Then there was a flash, a hissing crackle, and a blinding glare flooded the room.

He stepped back, guffawing triumphantly. "Nice, ain't't?" he demanded.

Specs only slumped a little lower. This was no momentary flash like the first two. Barney had bent the main buses together, causing a sure-enough arc with 2,300 volts behind it and the only way it could be stopped was by cutting out the transformers, something Barney couldn't do and wouldn't if he could.

The quivering band of flame spread in an instant, leaping along the solid copper with a spitting venomous hum that drowned the hiss of the water, while its blinding light turned the premature dusk a sickly gray.

"Ought t'have some more. Kind o'dark," Barney chuckled, and stepping forward began poking and prodding again, grinning maliciously over his shoulder.

Specs made no reply. It would only be minutes now till the shining panels were a charred, twisted wreck. He could hear the arc crackling more and more viciously and smell the burning copper. But if the water just hadn't been wasted.

The full glare of the arc was beating on Barney like a point-blank spotlight as he hacked and pried at what was left of the apparatus, squinting against the brightness, and all at once something about the way he moved struck Specs. He twisted his head between his arms and looked.

One of Barney's blows had seemed to miss, but that must have been an illusion. He watched. The long gorilla arms drew back for another blow, drove the pole forward again viciously, and Specs straightened with a jerk, suddenly all attention.

This was no illusion. It was a clean miss, so wide of the slate, and the panel was no small target, that Barney lost his balance and pawed the air frantically to regain it.

Specs sprang forward abruptly. Something was wrong. Even Barney seemed to realize that. Recovering, he stood now shifting uncertainty, black eyes wide open under the glare of the hissing arc, a baffled blank stare in them.

Specs watched, taut and motionless. Barney put up a dirty hand, rubbed first one eye then the other, and slipping from his grasp the pole clattered to the floor a foot from him, where the dazzling rays of the arc beat full on it. But he stooped and groped fumblingly for it this way and that, and a prickling thrill of excitement ran through Specs.

Flattening against the wall he snapped to tip-toe and thrust himself as far up as he could, at the same time driving his wrists apart from braced palms, jerked, and twisted one free of the noose, then the other. Barney had found the pole and was turning round and round uncertainly, the stick thrust out before him. "Hey, you!" he called hoarsely. "You, Specs!"

Specs did not answer. For a moment he stood poised, eyes on the big man, then leaving the wall stole noiselessly across the room, side-stepping the flailing pole, reached the tool rack, picked up a heavy wrench, and turned.

"Where are y'? Where are y'?" Barney was clamoring, naked fear in his voice and staring eyes.

Still Specs did not answer. Advancing silently, a primitive grimness about him, he waited till the threshing pole gave a momentary opening, then stepped in, dealt the bigger man a thudding blow on the head, and even before he tottered, sprang to the switchboard and shut off the precious water.

* * * * * * *

It was raining, a drumming monotonous downpour, as the little service car snorted to a stop in front of the station two hours later and Billy Clewitt and Mulone of the state police tumbled out.

"Come in," Specs called genially, stepping to the door and waving.

They came, slickers buttoned tight, gained the doorway, and stopped short. In a chair at the opposite side of the room sat Barney Sears, head dropped forward till his face was hidden and body hanging heavily against the ropes that bound him. "Well," Billy snapped, scorn in his blue eyes, "so you thought you'd start something, did you?"

Barney did not answer, did not seem to hear.

Mulone turned to Specs. "What happened? How'd you get him yourself?" he inquired.

"Why he went blind," Specs explained cheerfully.

"Blind?" Mulone and Billy swung on Specs, their faces startled and grave.

Specs grinned. "Sure," he replied, still cheerfully. "Can't see a thing, can you?" turning to Barney.

Barney rolled his head weakly and moaned. Billy and Mulone looked at him, then back at Specs, frowning in quick reproof. But Specs faced them smiling.

"You don't have to look at me like that," he objected mildly. "I haven't told him yet, just to throw a healthy scare into him, but he'll be all right in a few days. It's just the arc."

Barney's head came up, the terror fading from his face, and Billy looked quickly at the wrecked switchboard. "Sure. Of course," he said, relieved and comprehending. "What happened?"

Specs told him, and as he finished Billy whacked his thigh and burst into a ringing laugh. "That's good!" he exclaimed. "A good one, sure enough! Beating himself just because he didn't know any better!" He swung on Barney, beginning to straighten in his chair. "You fat-head!" he scoffed. "Fat-head! And tried to make us believe you were an operator!"

Barney mumbled something sullenly,

but Mulone broke in. "Maybe I'm a fathead, too," he conceded, smiling and puzzled. "But if this arc he started did make him go blind for a while as you say, why didn't it make you too? You were here."

Specs nodded and smiled. "Easy," he replied, tapping the huge shell-rimmed spectacles that gave him such a glassed-in look. "The only reason an arc hurts you is on account of the ultra-violet rays, but it happens that glass filters them out, just like a screen, won't let them through. And that is what my specs did. They saved me."

Mulone hesitated, then nodded. "I see," he said, and the three of them stood silent a moment while the rain drummed on the roof and Barney shifted.

Billy looked at him and his face sobered. "Say," he declared slowly, turning to the two others, "he came mighty near putting us where he wanted us, didn't he?"

Specs considered that for a space, took off his spectacles, wiped them with a clean piece of waste, and put them on again. "There was nothing in his way but a couple of pieces of glass," he smiled.

Talking Figures

(*Continued from page 424*)

real danger is that the gentleman might prove so interesting that the unhappy operator would be kept busy answering questions.

The section of the figure shows the distribution of the apparatus within it. From the terminals of the receiver and loud speaker the circuit is carried to the more or less distant operator.

The mysterious figure which seems to listen to questions and to answer them.

The receiver is a very sensitive microphone. Speaking to it in an ordinary tone of voice from a distance of several feet, it transmits the words perfectly. There is no need for raising the voice or for any very special care in pronunciation or enunciation. It is fair to say that from the standpoint of our readers, this receiver is the especially interesting feature, because we are all very familiar with loud speakers. But the loud speaker used with this figure is one which has given very remarkable results as regards clearness and intelligibility. It will be noticed too that the loud speaker emits the sound from the mouth of the figure. It is the chest which receives the query of the person seeking information.

Many suggestions are made for different uses of this idea. Birds or animals may be made to talk. Even a bunch of flowers may be made to do its share of a conversation.

Sport and Science

(*Continued from page 432*)

Fig. 4 gives another example. The apparatus represented determines the person's specific gravity, thus ascertaining the surplus weight over an equal volume of water. Physical training reduces the amount of water contained in the tissues, and strengthens the heavier muscular system, thus increasing the specific gravity of the body. The same apparatus, of course, serves to ascertain the personal fitness of would-be swimmers, and the gradual improvement of that fitness by continued swimming practice.

Testing Employes

(*Continued from page 433*)

We next show an *Automatizing Apparatus.*

Some small metal balls maintained in perpetual circulation are made to roll over electrical contact surfaces, thus lighting lamps of various colors and at the same time actuating an electric recorder. The candidate is directed to actuate a given lever at the very moment a lamp of a given color is lighted, this operation being registered by another recorder. The difference between the readings of the two recorders shows at a glance how many correct responses have been made.

Finally is shown Dr. Piorkowski's *Attention and Fatigue Tester:* This comprises eight or ten endless tapes with as many series of marks arranged at irregular distances and which on passing by ten small windows become visible for a short while. A key provided in front of each window is kept locked and can be actuated only at the moment a mark happens to pass through the corresponding window. The number of correct and incorrect operations is likewise ascertained by a comparison of two counting devices.

All these apparatus and many others serve not only for testing actual fitness but for systematically training the abilities of candidates.

Armature as Spark Coil

(*Continued from page 437*)

a small air gap. A vibrator for this purpose can be easily constructed as shown in the diagram. An electromagnet, which comprises about 30 feet of No. 22 B. & S. gauge wire wound on an iron core, is mounted on a wooden base. A piece of clock spring (A) is fitted with a contact and screwed to a wooden block, the wooden block being in turn fastened to the base to one side of the electromagnet in the position as shown. The spring makes and breaks contact with the adjustable contact (B). For best results a condenser should be connected across the spring and the adjustable contact (B). This condenser prevents sparking at the contacts and at the same time improves the secondary spark. The adjustable contact (B) should be adjusted until a good spark can be obtained between the secondary leads.

Recording Ultra-Micrometer

(*Continued from page 444*)

Space forbids a mention of other ways in which the device may be employed. Seismometers, vitrometers, stress-recorders, extensimeters, cavity-meters are among the possibilities I have explored. I hope some few of my readers will desist from radio work to try their hands a while with a device like this. It is wonderfully fascinating to watch the growth of a bean shoot. More skilled experimenters may try to measure the difference in the air pressures on opposite sides of a ball rotating in an air stream. These pressure effects cause the swerve of a baseball or a golf ball and are naturally of great interest. Figure 7 shows how it may be done.

More Investigation

(*Continued from page 449*)

comes, the sap starts to flow in the tree, lowers the electrical resistance and—well, sir, 'sno use sayin' th' rest, but ye see, instead of a bell, you use a phonograph with some kind of record like, "Spring Is Here." Gee, it would tickle you to hear music about "spring is here" some morning in spring, especially on a warm day. Then again—if you should wish to use the phonograph, but found it "fertilized" with all kinds of instru-mentality— I smell a rat so I'll beat it.

Shock in a Barber's Chair

(*Continued from page 451*)

The barber, an old weather-beaten man of about 60, with a once white coat and a still dirtier collar was massaging a man with an electric vibrator and at the same time telling some story of an accident that occurred one Friday the 13th. (By the way this happened also on a Friday the 13th). His listeners all ridiculed him and told him that only old men, such as he, could believe in the pet superstition that Friday 13th was an unusually eventful day in the way of accidents.

The barber, having finished massaging the man with the vibrator, began to prepare a soap lather for the man's shave. After a while the barber, still arguing about some point or other, succeeded in preparing a rich lather and after soaping his customer's face took a long and ferocious looking razor into his hand to shave the man. No sooner did he touch the razor to the man's face than there was a loud, startled exclamation, the barber jumped backwards, tripped and fell to the floor while the customer jumped out of his seat.

We rushed to the old man, picked him up and seated him on a chair. He was so pale and frightened, that for the next few moments he did not utter a word of explanation for his strange action. After a few moments, however, he told us that he had received a painful electric shock. Our attention was so centered on the old man that we had failed to notice the other one. Having calmed the old man we now saw that the other man was trying to stop the blood that was flowing from an ugly gash on his cheek. He, too, said that he had received a shock which caused him to jump out of his seat at the same time being cut by the razor which the barber jammed into his cheek when he got the shock.

By this time the old man had fully recovered from his fright and asked with an "Is it not as I told you so?" air, what they *now* thought about Friday 13th.

While they were talking I sought a practical explanation of what had just happened. I noticed that the vibrator was lying on a shelf about six inches from the metal foot-rest on which the person's feet had been placed. From this vibrator the long wire drooped downwards, and was so worn, that at one point there was no insulation at all. This point was resting on the foot-rest, thus bringing the electric circuit in contact with the man's body. This, however, was too weak to harm him for he was sitting on a leather seat which insulated him, but as soon as the barber, who was standing on a stone floor, touched the man with the razor the circuit was completed and they both received a shock. As regards their not receiving any shock when the barber rubbed in the soap on the man's face with his hand I can only offer the explanation that the wire did not this time touch the foot-rest as it did later when it slipped.

About an hour later I left the barber-shop with a haircut, a shave, and the knowledge of a not only odd but interesting experience while the others undoubtedly left with a confirmed superstition about Friday the 13th.

Trick Geissler Tube

(Continued from page 458)

through which a wire has been previously passed.

A wire is connected to the staples and run down through the supports, through the table or floor to the spark coil.

This is a good idea for a window display; use about eight volts on the spark coil.

Contributed by Leslie Carpenter.

Electric-Farming in Russia

By R. Borlase Matthews

ONE of Lenin's great visions was to see the whole of his country electrified. He early realized that whatever might be the natural resources of a country, she could not hold her place in the world unless she had the mechanical equipment for developing those resources. Further, this equipment should preferably be ahead of the practice of the world, for it is always better to lead than to follow. It is not the copyists who succeed.

As the result of consultations with experts, Lenin decided upon the policy of arranging to supply electricity to farmers, as electricity was the form of power that would best meet their circumstances. To this end he appointed an Engineering Commission, consisting of the leading electrical, civil, hydraulic, and mechanical engineers. This commission corresponds to the British Electricity Commissioners, but the Russian engineers have much more power. The rural distribution schemes are, of course, interlinked with the urban undertakings. In addition, Lenin appointed a special Commission to deal with the special applications of electricity to agriculture. This was a very farsighted move, for the weak point in every country at present is that the electrical engineers do not fully understand the farmers' problems, and the farmers do not comprehend the nature of electricity supply. This is a very simple matter apparently, but only those who have investigated the subject as carefully as the present writer can realize the inherent difficulties of proper co-ordination. The average electrical engineer is apt to lightly dismiss the question of using electric motors on farms, as merely the trifling one of belting up a standard industrial motor to a farm machine—wherein he is greatly mistaken, as so many Continental engineers have discovered to their cost, having been obliged to develop special motors for agricultural use.

Electric Tests for the Washing of Photographic Negatives

IT is quite difficult to determine if the washing of photographic negatives is complete, once they have been developed and fixed. It is important not to leave the least trace of hyposulfite in the gelatin.

It is possible to use salts which act chemically upon the hyposulfite and get rid of it in this way completely.

But these processes are not as good as the ordinary washing in running water, which insures the durability, not only of glass negatives, but also of bromide prints.

An inventor has devised a method, certainly a little complicated, but of absolute efficacy, for it enables one to recognize at each instant of its progress, whether there are still traces of hyposulfite in the wash water which is passed over the negative. The principle of this method, invented by M. Richmann, is based on the difference of electric resistance for water and for saline solutions.

If the water from the washing of the negative is passed through a tube so arranged that the electric current passes through the liquid between two fixed electrodes, the electric resistance will be weaker as there will be more hyposulfite in the water. The deviation of a sensitive galvanometer gives the indication if a very small current even passes through the liquid.

To obtain still more precision, a comparison can be arranged by having the current at the same time go through the tube just described, and then through an identical tube in which absolutely pure water is circulated. These two resistances may be made two branches of a Wheatstone bridge, following out the method used regularly in laboratories for measuring resistances, and any difference can be determined, no matter how small, between pure water and the water from the negative.

Electricity in Walnut Drying

AN interesting application of industrial electrical heating has been made in the walnut industry in California. The usual practice is to place the nuts in large trays in the sun for curing. This requires from five to fifteen days properly to dry a tray full of nuts, depending upon the weather.

Several attempts have been made at artificial drying, using distillate as a fuel for heating air, but the many difficulties of this process have prevented its adoption and the solution seems to have been found in the use of electric heat.

Three installations of this nature were made during 1923 on different walnut farms. A connected load of 45 kilowatts on each dryer was installed, giving a sufficient capacity to heat 4,000 cubic feet of air a minute when it is necessary to raise the temperature 40 degrees F. Standard General Electric oven heaters were used, rated at five kilowatts. The heaters are placed in a metal duct and a fan blows air across them and through the necessary ducts to the several bins containing the nuts. A General Electric thermostat, type CR-2990, maintains the temperature of the air at about 100 degrees F. Three type CR-7006—D-5 General Electric control panels are used on the 45 kilowatt installation, each handling 15 kilowatts.

The nuts are thus uniformly dried and, with four bins operating, it is possible to maintain an output of eight tons in about 48 hours. The equipment requires no watching, as in the case of the fuel-fired dryers, and drying begins immediately upon the turning of the switch. Much time is usually wasted with the fuel-fired

equipment each morning in adjusting the distillate burner. The air compressor necessary for the burning of distillate is also eliminated.

Improving Edison B Batteries

RADIO B batteries of the Edison cell type may be greatly improved by using in place of the regular solution a 20 per cent solution of phosphoric acid to which enough ordinary household ammonia has been added to neutralize the acid. Test the solution with a strip of litmus paper. If there is too much acid, the litmus will turn red, and you must add ammonia. If the litmus paper turns blue, you have put in too much ammonia and must, therefore, add more acid. When the solution is neutral, the color of the litmus paper will not change: red litmus paper dipped into the solution will remain red and blue litmus paper will remain blue. A layer of pure mineral oil, such as Nujol, over the solution will prevent evaporation.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of PRACTICAL ELECTRICS, Published Monthly at New York, N. Y. for April 1, 1924

STATE OF NEW YORK—
COUNTY OF NEW YORK, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of the PRACTICAL ELECTRICS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Experimenter Publishing Co., Inc., 53 Park Place, New York City.

Editor, Hugo Gernsback, 53 Park Place, New York City.

Managing Editor, Thomas O'Conor Sloane, 53 Park Place, New York City.

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2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given.) Germott Publishing Co., Inc., successors to Practical Electrics Co., Inc., whose stockholders consist of: Hugo Gernsback, 53 Park Place, New York City; Sidney Gernsback, 53 Park Place, New York City; Robert W. DeMott, 53 Park Place, New York City.

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5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is:

(This information is required from daily publications only.)

H. GERNSBACK.

Sworn to and subscribed before me this 25th day of March, 1924.

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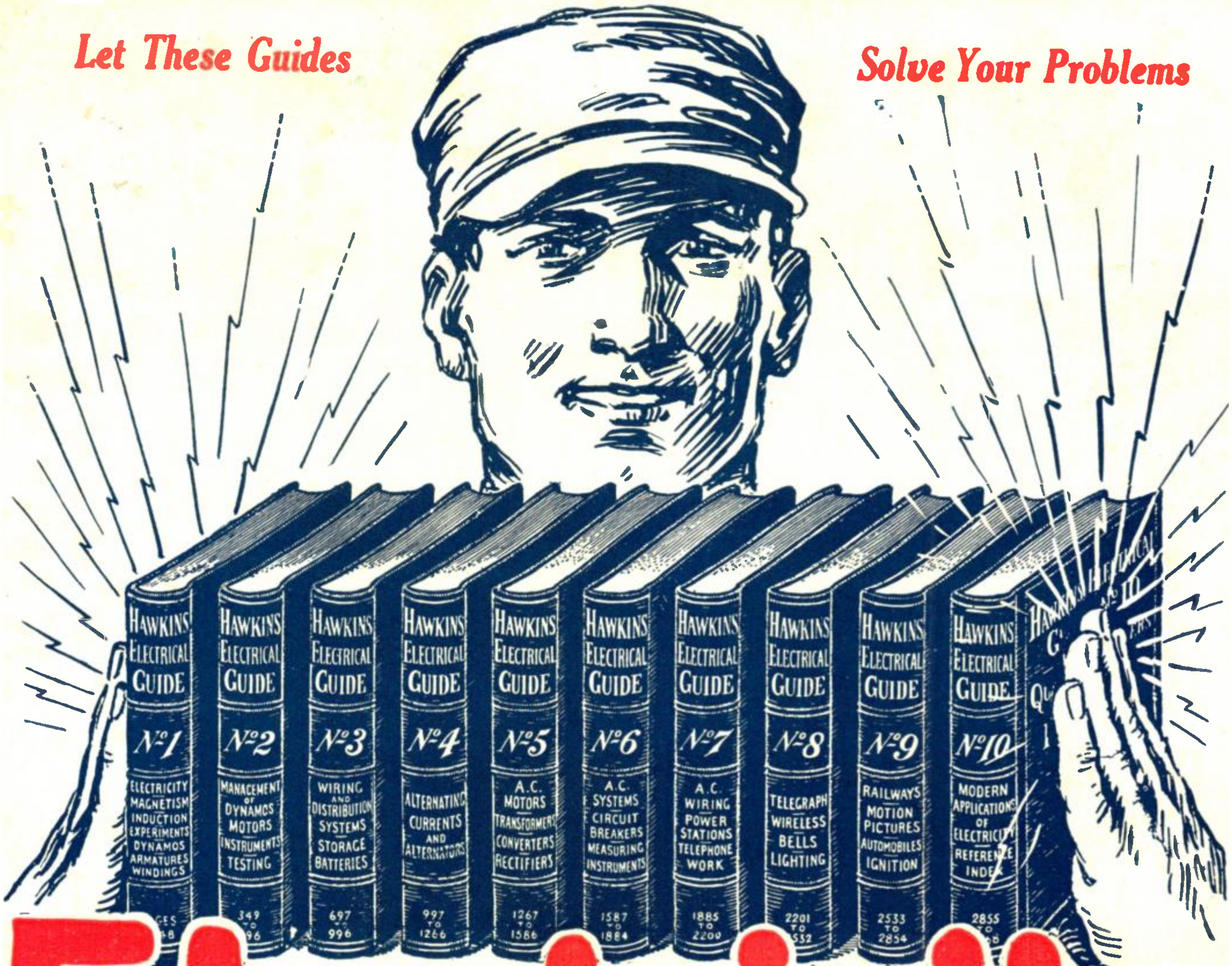

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