PRICE 10 CENTS **TALE OF THE ENGINE THAT SPINS** In This Issue

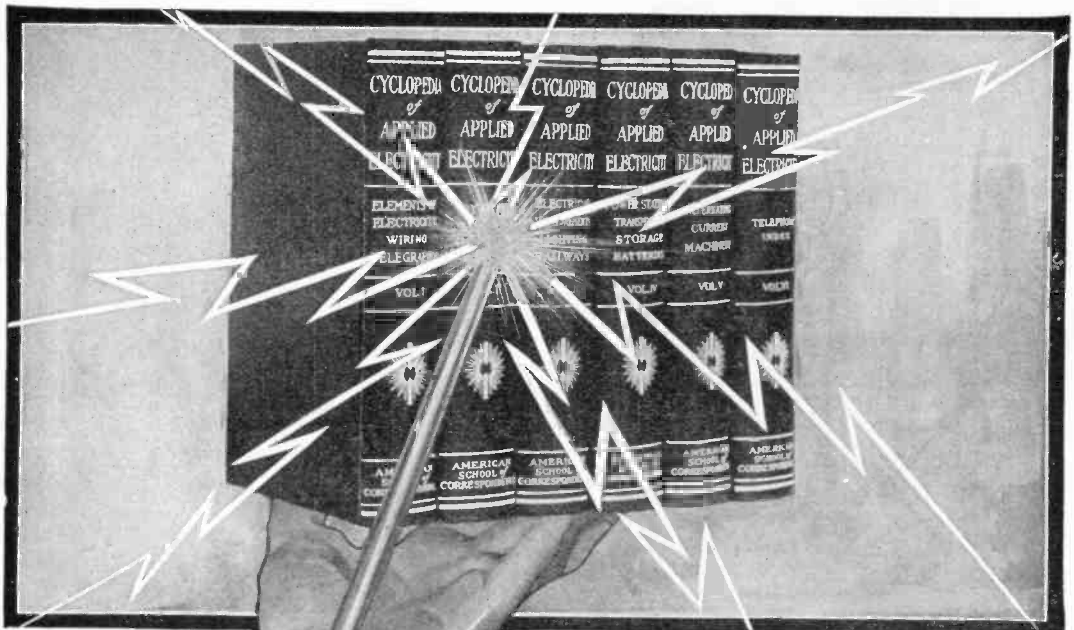
# POPULAR ELECTRICITY

Trade Mark

## IN PLAIN ENGLISH

SHOOTING WITHOUT AMMUNITION P. 315

Vol. III AUGUST 1910 No. 4


CYCLOPEDIA of APPLIED ELECTRICITY
VOL. I
AMERICAN SCHOOL of CORRESPONDENCE

# Electrical Talks—Flash No. 2

THE last six years publishers have awakened to the fact that it was necessary to popularize a class field, the reason due to the fact that mechanical and electrical devices and appliances have become more of a general public commodity.

It has also been proven in the last few years that the burden of selling should not be entirely upon the dealer or the jobber, but that the manufacturer should in almost every case exploit his article to the man who buys and the man who uses.

It has ceased to be a fact that the only persons who ought to know about electricity are the people directly interested in the manufacturer of devices or the maker of current—the reason for which is that the public has taken readily to electric current as its salvation in performing thousands of duties that otherwise have not been performed.

It is just as important for a manufacturer of electrical appliances to exploit his wares to the consumer as it is for a new manufacturer of breakfast foods to advertise his wares to the public. The life of a cereal manufacturer would be short-lived if he only put his goods in the hands of a jobber or dealer and let them stay there and never tell about it to anyone.

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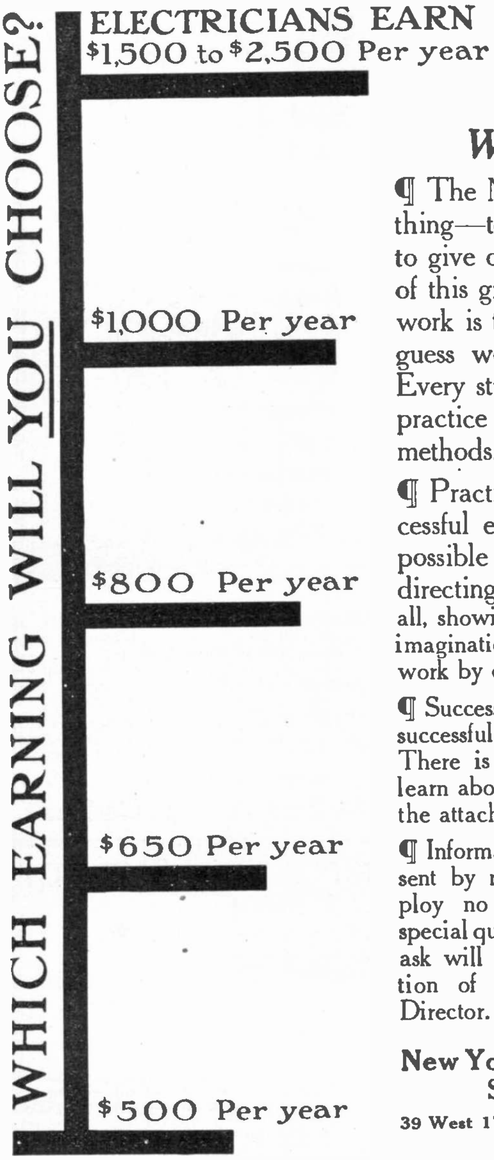


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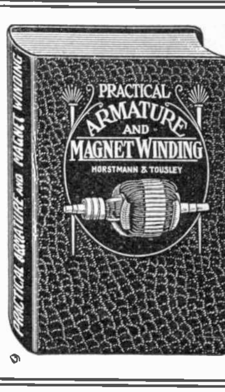


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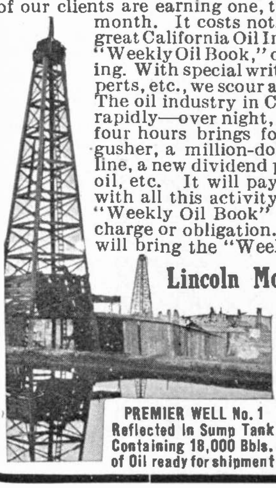

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# POPULAR ELECTRICITY
## IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor.

Vol. III | August, 1910 | No. 4

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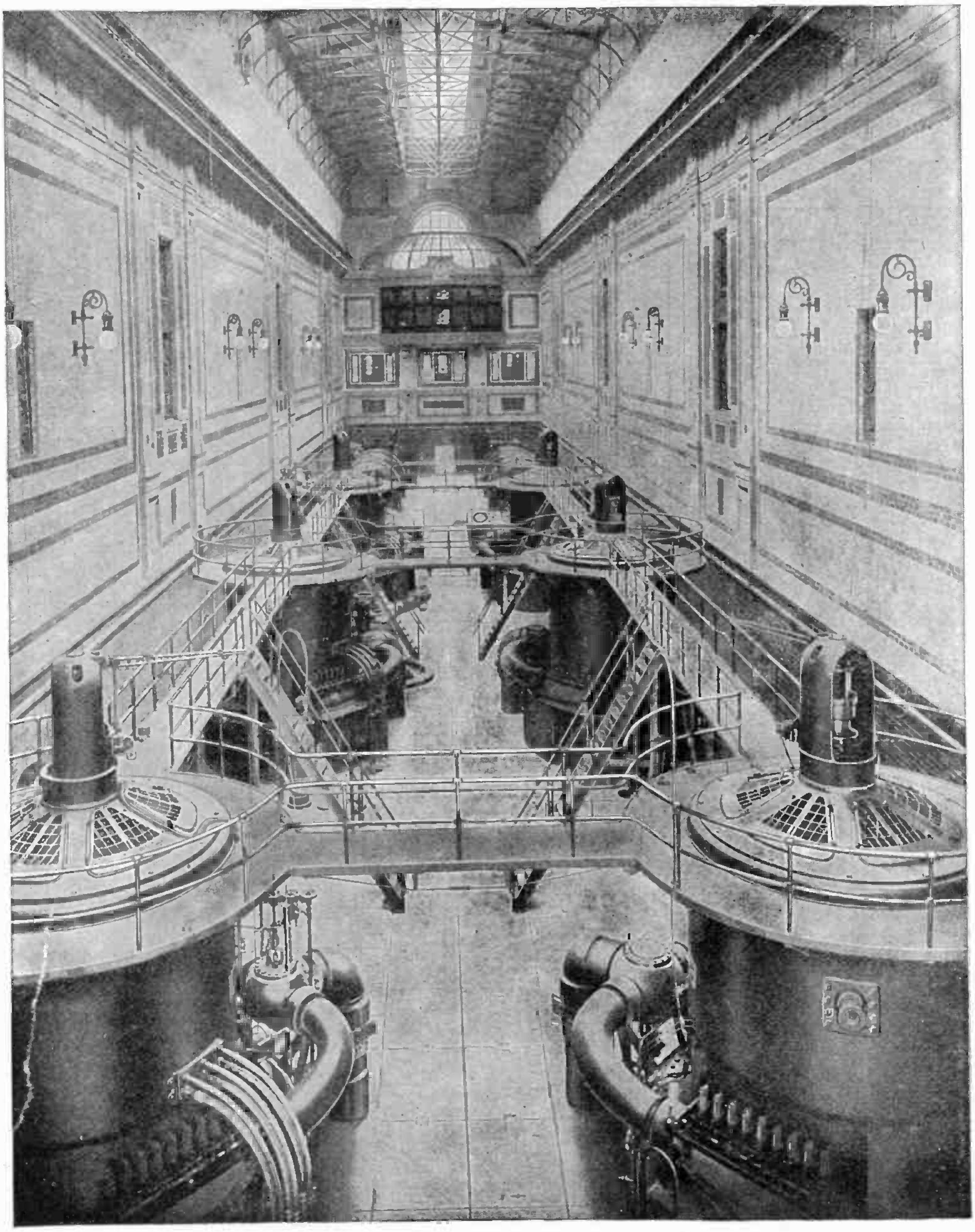


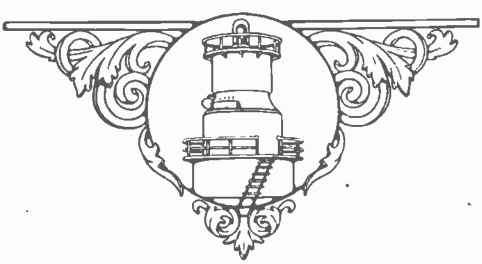
NEW YORK EDISON COMPANY'S WATERSIDE STATION NO. 2—8,000 AND 14,000 KILOWATT TURBINE-GENERATORS INSTALLED

Popular Electricity
In Plain English

VOL. III AUGUST 1910 No. 4

# Tale of the Engine that Spins

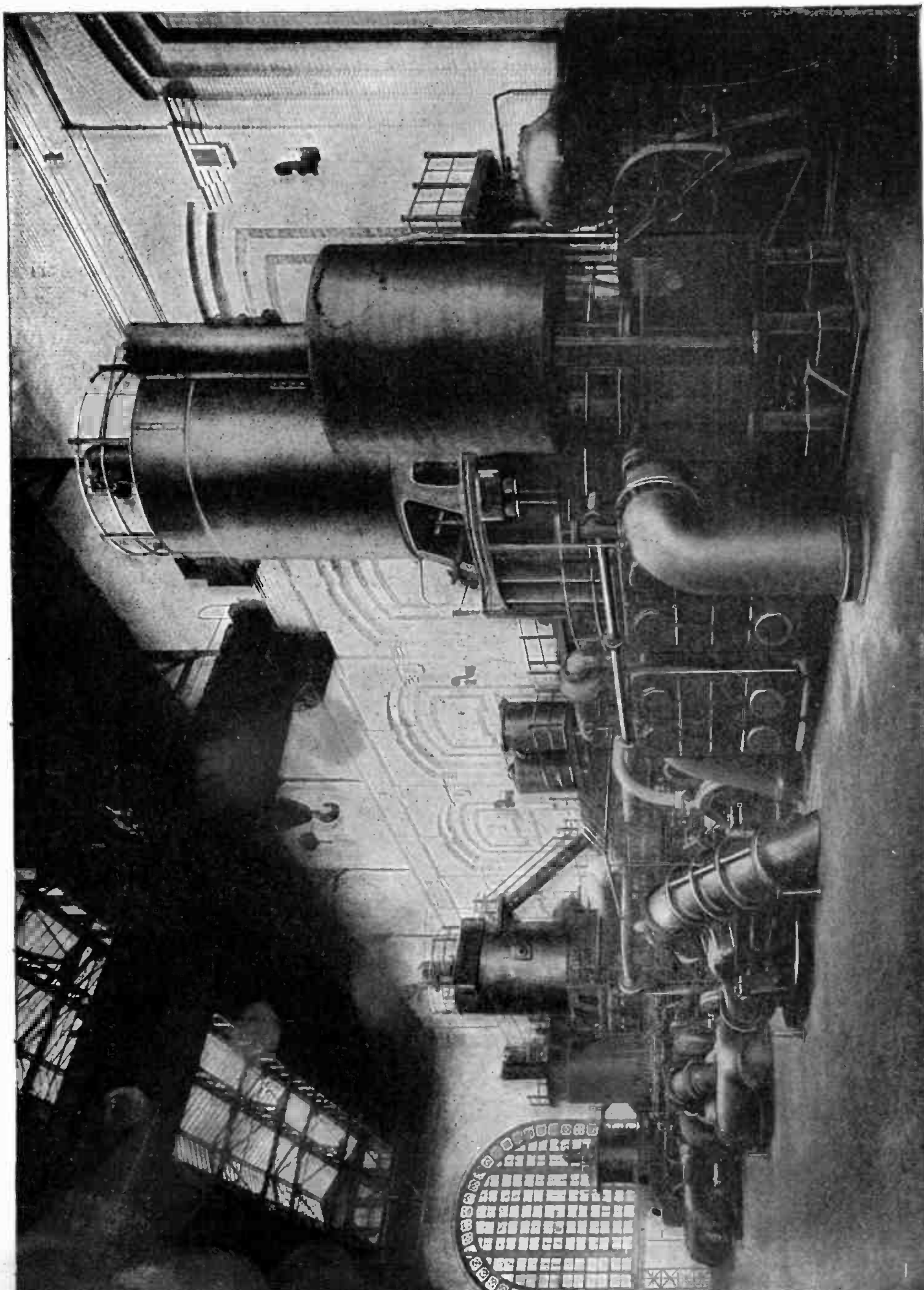
**The steam turbine-generator has brought about a revolution in power plant practice that many do not realize. The pictures show some remarkable turbine-plants of the day.**



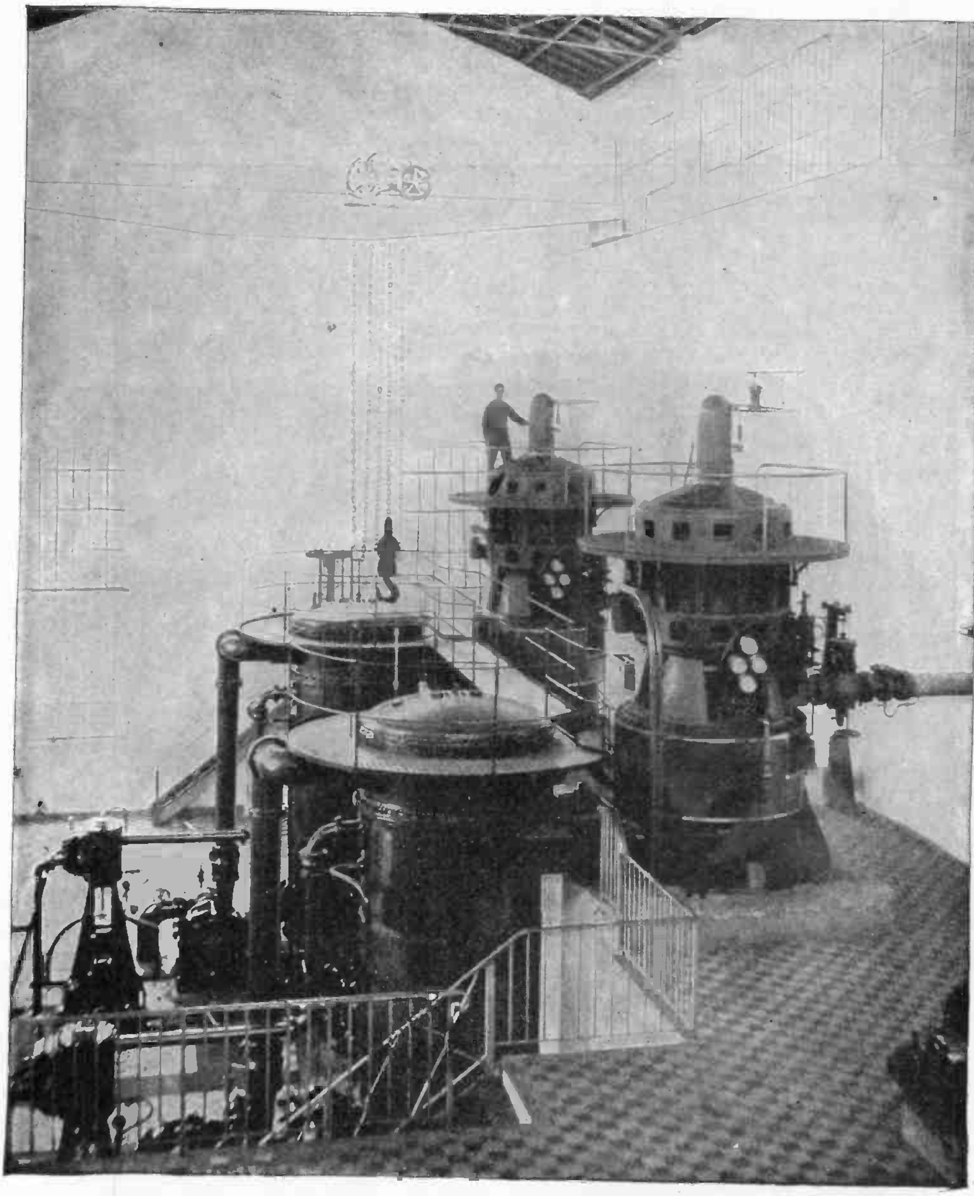
When Watt first made a steam engine he constructed it with a reciprocating piston inside of a hollow cylinder. Steam was admitted first on one side of the piston head and then on the other, giving the desired reciprocatory motion. At first he manipulated the valves by hand, and it must have been lively work even with the tea-kettle prototype of the great prime movers of today. It wasn't long, however, before the sliding valve was developed, worked by an eccentric, which did very well for a couple of centuries, giving way in later years to what is known as the Corliss valve, which came into almost universal use outside of railroad locomotives. But the principle of converting the energy of the steam into mechanical motion remained steadfastly the same—the motion of the moving parts was a back and forth one.

The reciprocating engines grew and grew in size, until about 10 years ago, when the monsters of six or eight thousand horsepower were installed in the plant of the Manhattan Elevated Railway System in New York. They were and are mammoths of their kind, standing over 50 feet high, to the top of the high-pressure cylinders, and the low-pressure cylinders, extending out horizontally, would make good-sized living rooms. But like the mammoths of glacial times they represented the last of their race, as far as the production of great quantities of power is concerned. A little invader was entering the field; as little, in comparison of sizes, as was the Monitor which destroyed the Merrimac, but with a strength out of all proportion to its stature. This new-comer was the steam turbine.

You naturally ask what all this has to do with electricity. This much—the turbine engine has revolutionized electric central station operation where great quantities of electricity are generated. Whereas a few years ago it was a matter of discussion and much calculation in the building of a large plant whether or not to use the new turbine-generators or turbo-generators, as they are often called; now they are installed in almost every instance without question being raised. Why is this the case? For one reason they are more efficient than the reciprocating engine; another, they take up but a small fraction of the space; third, units of enormously greater power are possible; fourth, they are cheaper per unit output and more



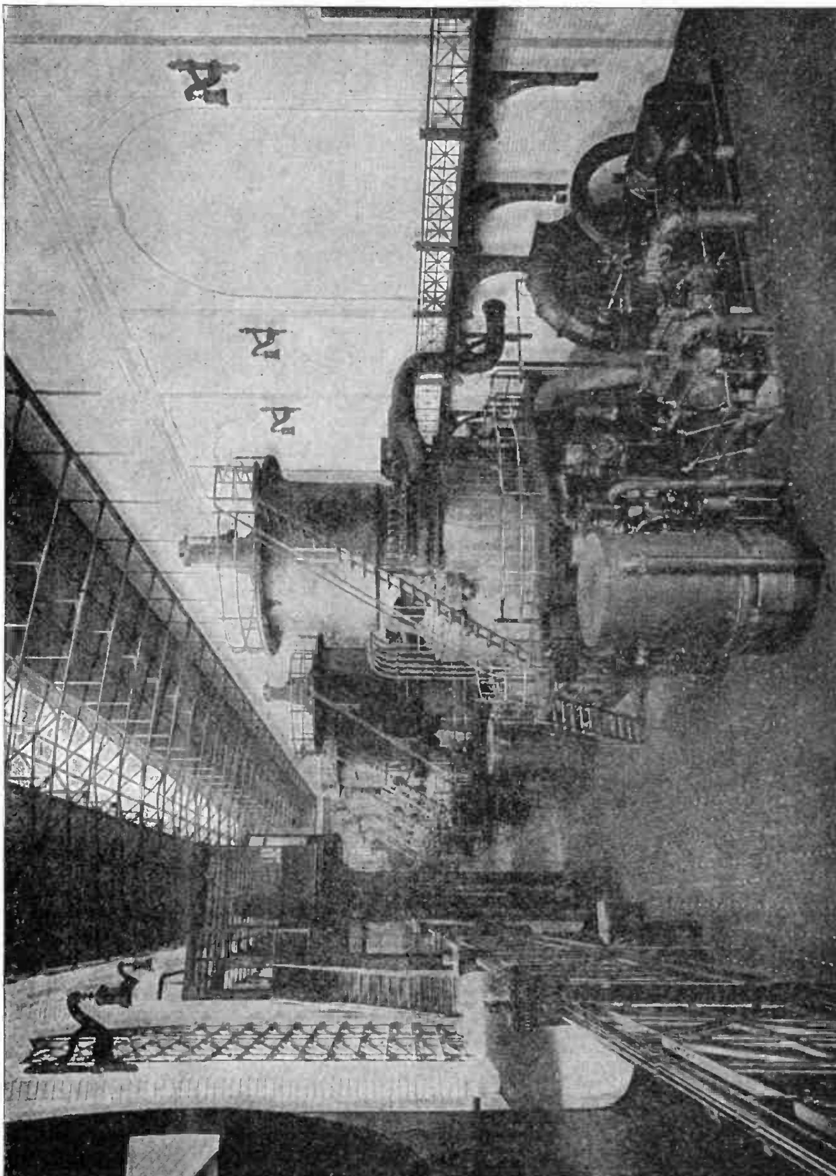
INSIDE THE BOSTON EDISON COMPANY'S PLANT WHERE 12,000 KILOWATT (16,000 HORSEPOWER) TURBINE-GENERATORS ARE INSTALLED



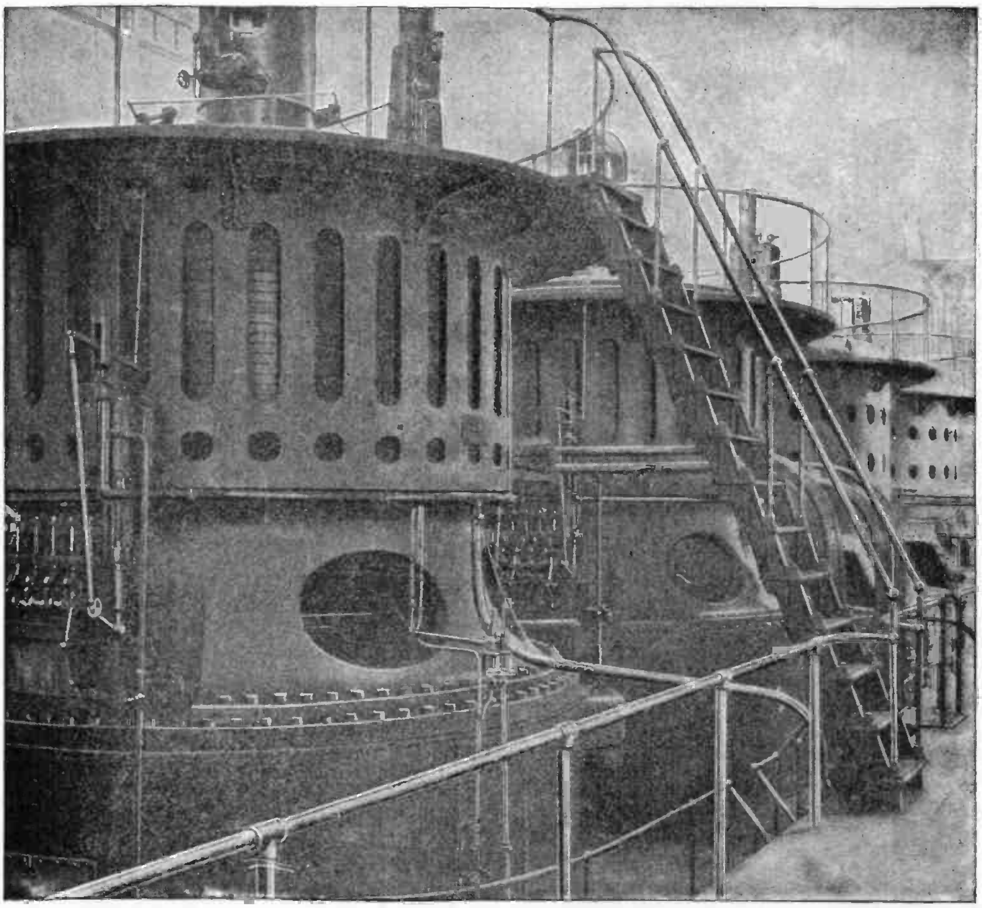
USINE DE L'HARRACH PLANT IN ALGIERS, NORTH AFRICA. TURBINE-GENERATORS OF 1,000 KILOWATT (1,340 HORSEPOWER) CAPACITY

easily handled, and besides, will run at a 50 per cent overload for many hours without hurting themselves.

The first steam turbine generator of the Curtis type, which is the type shown in all the illustrations, and is made by the General Electric Company, was of 500 kilowatts capacity (between 600 and 700 horse power). It was shipped in February, 1903, to the Newport and Fall River Street Railway, Newport, R. I. The first 5000 kilowatt (6700 horse power) unit was installed in Fisk Street Station of the Commonwealth Edison Company, Chicago, and was put in commission in October, 1903. This latter was the first of the "big ones" and the Fisk Street Station, with its later sister station at Quarry Street, hold within their



SHOWING A ROW OF 12,000 KILOWATT (16,000 HORSEPOWER) TURBINE-GENERATORS IN FISK STREET STATION OF THE COMMONWEALTH EDISON COMPANY, CHICAGO, ILL.

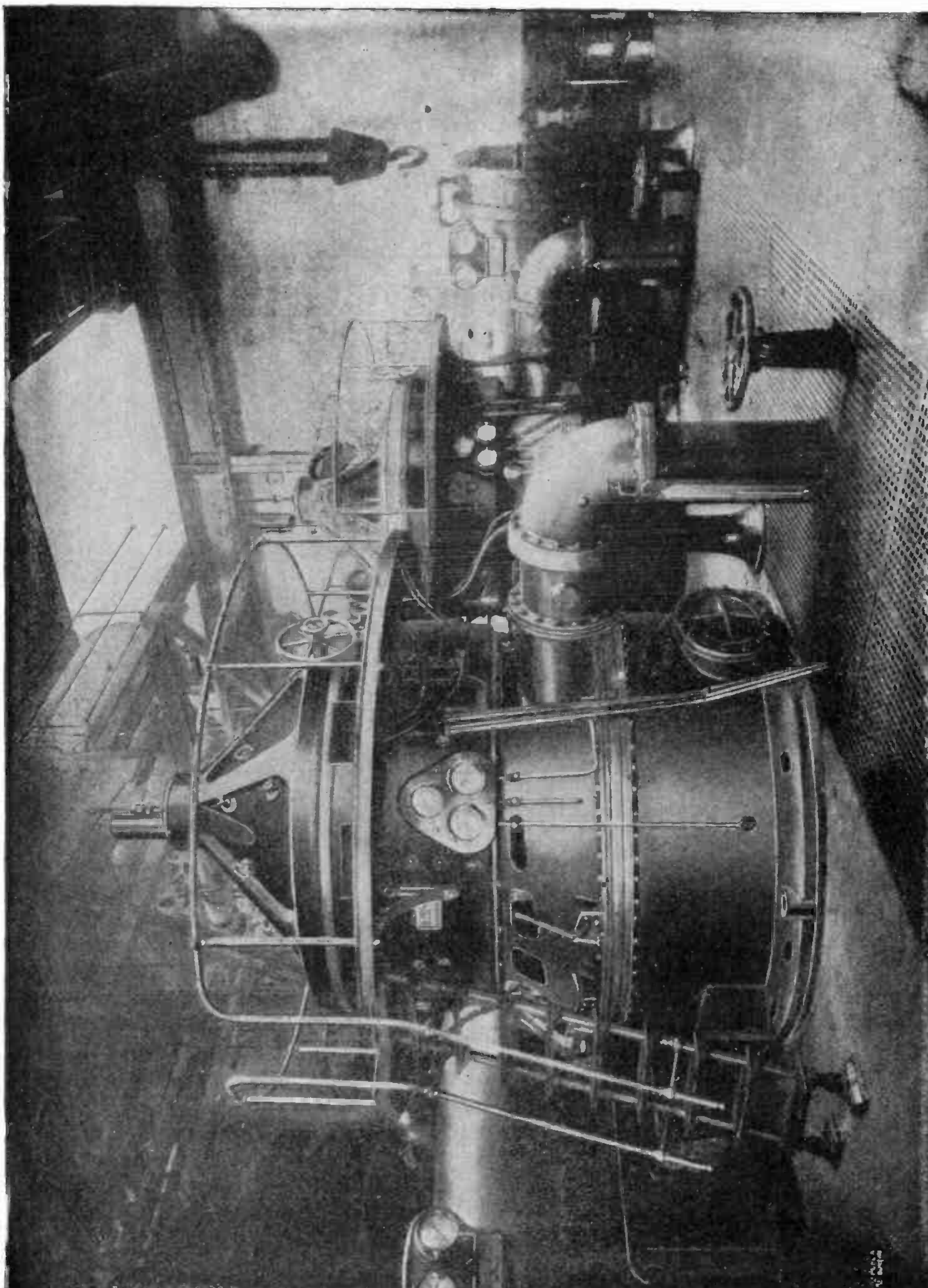


A GLIMPSE IN THE GENERATING ROOM OF THE UNION ELECTRIC LIGHT AND POWER COMPANY, ST. LOUIS. THESE MACHINES DEVELOP 5,000 KILOWATTS (6,700 HORSE-POWER) EACH

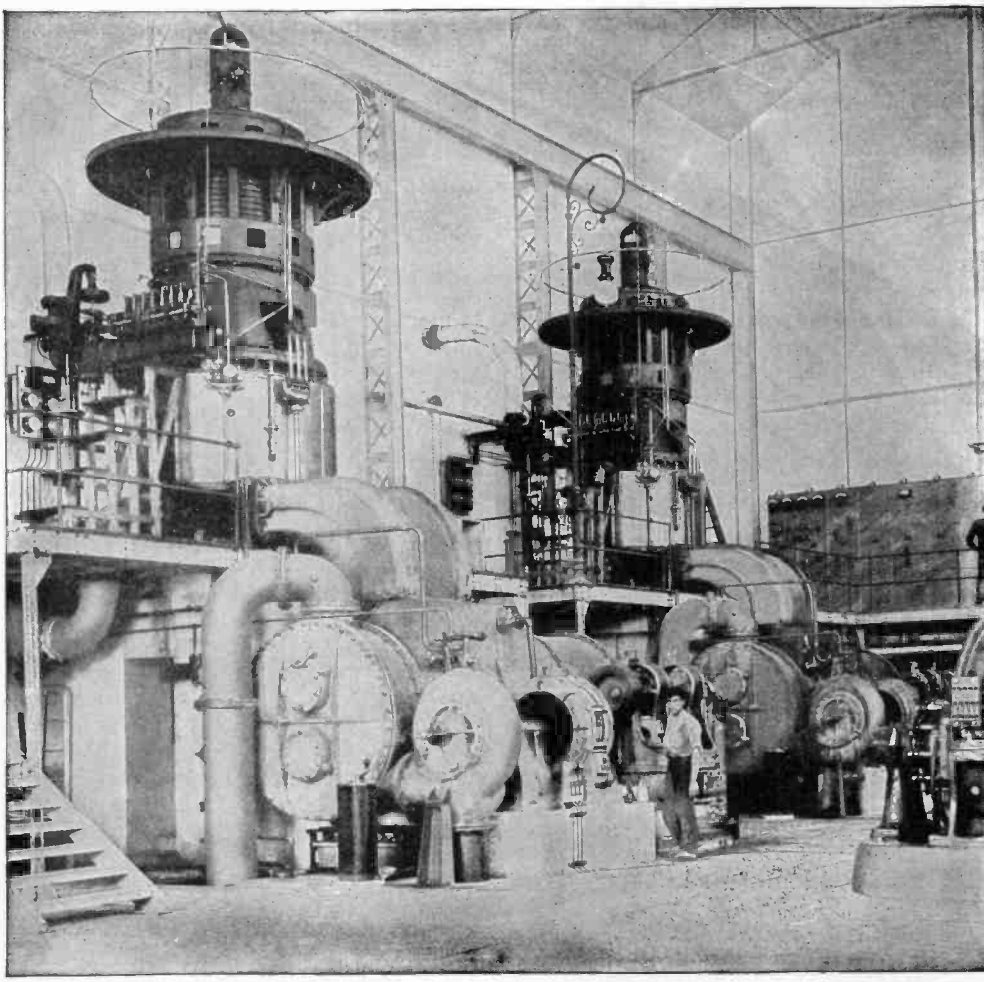
walls almost the complete history of the development of the Curtis turbo-generator to date. Beginning with Fisk Street in 1903, and later with Quarry Street, new units were added every year to the constantly lengthening stations, which were always left unfinished at one end to allow the structures to be pushed out farther and farther to accommodate new units.

The steam turbine practically began where the reciprocating engine left off—at 5000 kilowatts. It crept up and up in size—eight, ten, twelve, fifteen thousand kilowatts, which is about 20,000 horsepower. Such are operating today. Within a year units of thirty thousand horsepower will be turning. Think of it, the power of thirty thousand horses equaled by a single engine. The power of thirty railroad locomotives all produced in a space not much larger than a single mogul of our mountain railroad lines.

After all, what is the Curtis turbo-generator and how does it behave? Well, to use a rough analogy, it is not far away in principle from the ordinary windmill with which most people are familiar. There is a cylindrical steel casing something like a big cheese box. Standing vertically inside the casing is a shaft on which is mounted a tier of disks, one above the other and spaced about their own thickness apart. When they turn the shaft must turn with them. These disks extend outward from the shaft to the casing. Then on the inner side of the casing is another set of disks extending



EIGHT HUNDRED KILOWATT (1,000 HORSEPOWER), LOW-PRESSURE TURBINES IN THE STATION OF THE PHILADELPHIA RAPID TRANSIT CO.



TWO 1,000 KILOWATT (1,340 HORSEPOWER) TURBINES INSTALLED FOR USINE DE LA GOULETTE, TUNIS, AFRICA.

inwardly, and they dovetail in with the first set, but are stationary.

On the outer edge of the disks or wheels which drive the shaft are bolted rows of curved buckets or blades. They are shaped something like the curved blades on some steel windmills. In the stationary disks under each revolving disk are similar buckets called guides, which curve in the opposite direction. Now all these things are enclosed in the casing and superheated, "dry" steam at enormous pressure is admitted through nozzles and impinges with terrific force against the buckets of the first moving disk, setting all the disks to spinning. The steam after it has rushed through the first set of buckets strikes the guide blades in the stationary disk following, and these blades being curved in the opposite direction, the steam is deflected back into its original line of motion and strikes the buckets of the next moving disk. In this way the steam "worms" its way down through the successive stages of the turbine, losing pressure and power with each stage until it is finally exhausted at low pressure into a condenser.

In the mean time the shaft with its movable disks spins like a huge top at 750 revolutions a minute.

The shaft of the turbine is vertical and on its upper end, which extends outside the turbine casing, it carries the armature of an electrical generator or dynamo. This armature spins with a low humming sound inside the stationary fields and generates its thousands of horse-power of electrical energy.

But the weight of the shaft, and blades, and armature, many tons, must be borne in some way. This is done in an ingenious manner and almost without friction, by what is known as the step bearing. The lower end of the shaft stands in a receptacle and oil is pumped into the latter under high pressure, sufficient to lift the shaft bodily and support it on a thin film of oil. There it spins so easily that the tons of weight may be turned by a man's hand. Once started the turbine will spin for hours by its own momentum, if the load is taken off.

Such in brief is the nature of the steam turbine generator which, within the last decade, has quietly usurped the power of plunging pistons and ponderous fly wheels in the great modern power plants. Most of those who read this have heard of the steam turbine, but comparatively few outside of engineers and mechanicians realize how great has been the change. To the popular mind a power plant means mighty machinery with fly-wheels and reciprocating parts. This is not true to conditions in the large plants of today. The pictures here show to many of us scenes which are new. To step inside one of these palatial generating rooms is to be impressed with the almost total lack of visible motion, yet, notwithstanding, the very air of these places is pervaded with a subtle something suggestive of mighty forces, and the dull roar bespeaks the power of a Niagara.

## Handling Radium

Because of its great value and also on account of its chemical action and its power to produce ulcerated wounds hard to heal, the traffic in radium is confined to scientific institutions and physicists. In Austria radium is certified and guaranteed by the Vienna University and is sold and handled in what is called a radium cell, a case of nickeled brass in two parts which screw together. The bottom of the case is run full of lead in which a square hole is made and in this hole is placed the radium. Over the top is laid a mica plate so that it is not necessary to open the cell entirely to use the radium ray, which is unaffected by the mica cover, but does not readily penetrate the lead.

## Fireworks in Arc Lamps

The reason the long green tubes which we call mercury vapor lamps are being introduced more and more into shops and drafting rooms is because of their high efficiency and their distributing the lighting surface of the illuminant so as almost to do away with shadows. The reason they are not adapted for more general uses lies in the strongly green coloring which characterizes the mercury arc and which vitiates any red tints in objects viewed by this light. It gives to flesh tints that ghastly hue which even in a lesser degree has been so objectionable in Welsbach gas mantles.

Nevertheless the mercurial lamps have been introduced in spite of their obnoxious coloring and if this could be offset by adding a decided red from some other source of light, the combination should be more widely useful. Attempts to do this by combining tungsten lamps with the mercury vapor units have already shown fair results, but the green really needs a stronger red to balance it than can be expected of the tungsten lamp when run at high efficiency. It is as if on the Fourth of July a neighbor persisted in lighting the house fronts with a greenish Bengal light, in which case we would need not a white light but a "red fire" to offset it.

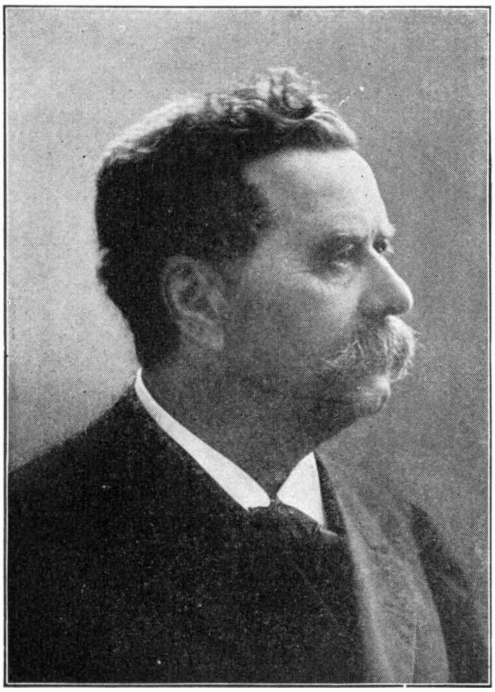
Now one of the elements commonly used in the red Bengal lights is lithium, which gives a pleasing red tint to a flame, hence if this could be burnt in the mercury vapor tube it might serve the purpose. Realizing this, that most versatile of our Americanized electrical inventors, Mr. Steinmetz, has devised an arc lamp which is double ended in color, having a mercurial green at one end of the arc and the lithiated red at the other end. To accomplish this he uses mercury for the lower terminal of his arc lamp, while the upper terminal is a carbon impregnated with a salt of lithium. In other words, he tinges the arc of a lamp with red and green fireworks blending with each other into a color effect which is said to be very pleasing in its results.

Owing to the difficulty of getting glass to stand the intense heat of an arc confined in so small a sealed chamber as is needed for the mercurial arc, the new bicolor lamp has not yet been placed on the market but its practical development will be awaited with much interest.

# The Future of Electrical Agriculture

By FREDERIC LEES

Use of electricity in plant growing is no new thing. Numerous experiments have been made in all parts of the world, and often with remarkable results. Yet these do not appear to have made any lasting impression on agriculturists. Why so? Is it that practical difficulties stand in the way of an economical application of electricity to agriculture? Though the argument may hold good in some cases, I do not think that it does in all, and I hold with Professor Daniel Berthelot, of the Meudon experimental station, near Paris, that electricity, if properly applied, may be found of the very greatest utility in the raising of certain produce, and at no great cost to the producer.



THE LATE PROFESSOR LEMSTRÖM

But before giving a description of Professor Berthelot's recent experiments, let me briefly touch upon the various methods which have been employed in electroculture. One class comprises methods which utilize atmospheric electricity. The apparatus consists of a sort of lightning rod, supported by a pole in the center of the field, and connected with a network of subterranean wires. F. Paulin's *géomagnétifère* was of this type. Its use showed rather remarkable results. In a case of a field of spinach, there was an increase from 43.3 pounds to 53.6 pounds for every 57.8 square feet, and at a cost for installation of only about $8 for 2.47 acres. The use of underground wires, however, presents difficulties and the system can hardly be recommended to the practical farmer.

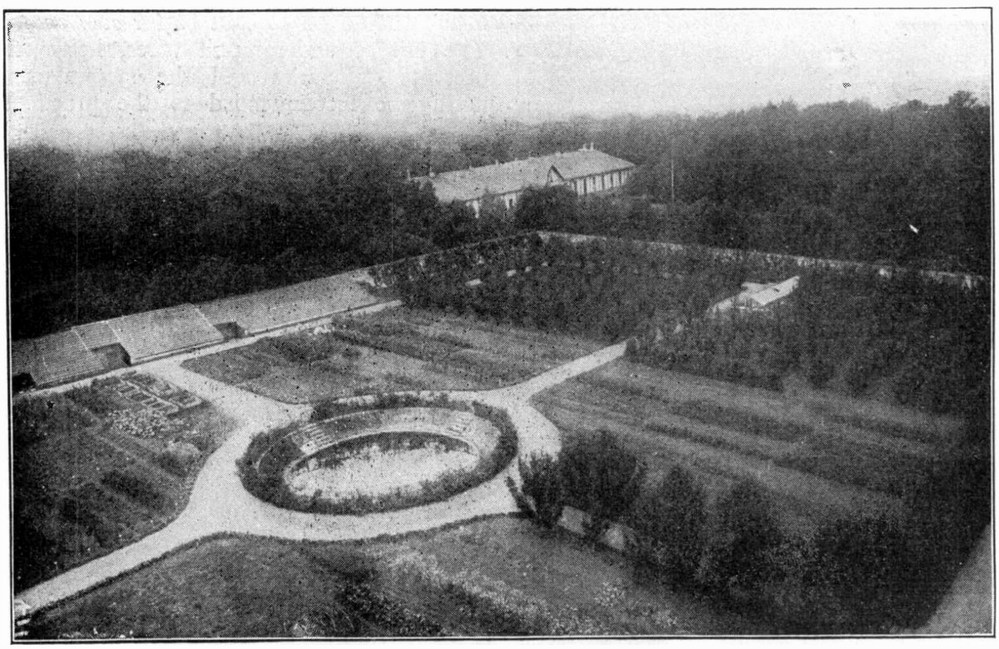
Another group of experimenters have utilized dynamic electricity—in other words, an electric current produced by plates of zinc and copper placed in the ground and connected by metallic conductors, insulated or not.

THE LATE MARCELIN BERTHELOT

A third group have used electric machines, and among these investigators was the late Professor S. Lemström, of Helsingfors University. After many years of experimental work, he came to the conclusion that in a large number of cases crops grown in an electrified atmosphere are far above the average both in quality and quantity. During the years 1902 and 1903 he had experimental fields in England, in connection with Durham College of Science, in Germany, near Breslau, and at Alvidaberg, in Sweden, where he grew many plants under electric treatment. Strawberries in electrified fields showed an increase of 50 to 128 per cent over those grown in ordinary fields; corn showed an increase of 35 to 40 per cent; potatoes 20 per cent; beets 26 per cent and so on.

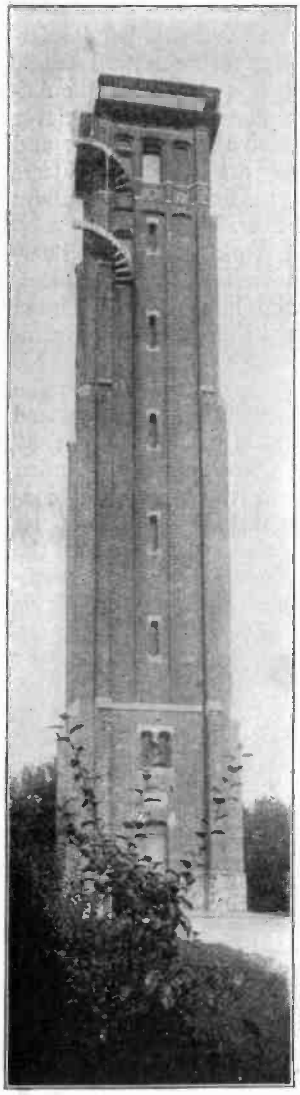
It must be remembered, too, that in many of these cases the treatment was merely tentative, so that even better results are possible. In fact, Professor Lemström contended that if his method were rigorously carried out an average increase of 45 per cent over the normal for all crops grown on land of ordinary fertility might be expected.

The electric current he applied in the following way: A wire net was first of all stretched across the field a little above the surface; and this was then connected with an electrical machine placed in a shed at some distance. The high potential current charged the net and exercised its action on the growing plants, in a form known as a static or brush discharge; to use a rather far fetched analogy it was like "spraying" the plants with electricity. As the seeds sprouted and the little plants began to grow, the net was raised, as on no account must it touch them. But this raising of the net, said Lemström, need not be done more than once or twice during the summer.



GENERAL VIEW OF THE GARDENS OF MEUDON

On wet days the electrical machine was stopped, for through the damp the wire net lost its charge directly. He also found that it was injurious to the crops to work the machine when the sun was shining brilliantly. The probable reasons for this electric influence are as follows: In the first place the positive current passing from the points of the wire net to the earth causes the production of ozone and nitric compounds which are beneficial to the plant. Secondly, the negative electricity passing up from the earth to the points of the net tends to draw up with it through the plant the sap from the root, and thus increased circulation of

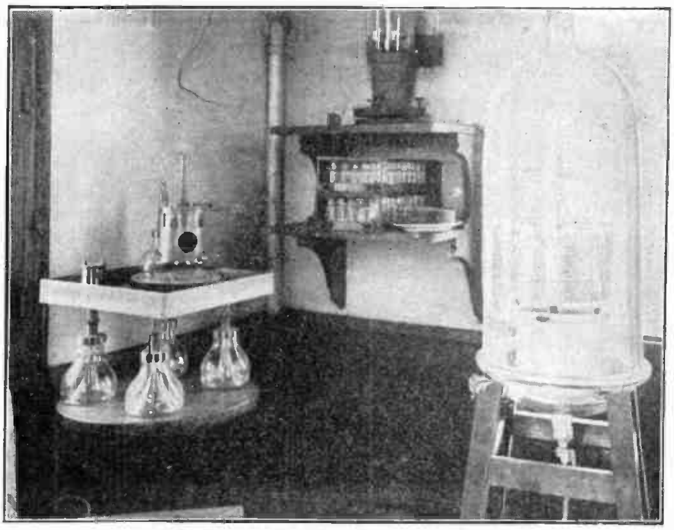


TOWER OF MARCELIN BERTHELOT

the juices gives increased energy of growth. As to the cost of Professor Lemström's apparatus, this was rather high, but he showed that the results justified it. "It appears to me without doubt," he said, "that my experiments have led to results of the greatest practical importance, for the cost is small in comparison with the advantages."

The method of growing plants under electric influence employed by Professor Daniel Berthelot is quite different from any of the three systems described above. It is that invented by his father, the late Marcelin Berthelot, the great scientist who started the Meudon experimental station and built there the 90-foot tower which still bears his name. Berthelot pointed out in one of his epoch-making works that the use of electric machines might exercise an invigoration influence on certain plants and might bear some resemblance to the action of atmospheric electricity in stormy weather, but it was far from resembling the normal action of the free electricity of the air. He preferred, therefore, to note the growth of plants placed merely within an "electric field"—that is not actually in contact with a current. He was anxious to learn the fundamental truths that underlie plant growth; not to make hap-hazard experiments with the object of proving to the farmer that he might increase his crops by the use of electricity but to discover some of those secrets of Nature upon which all true progress must be based. After sixteen years of work at Meudon he did actually find out some of these secrets. He discovered, for instance, that certain microbes at the roots of leguminous

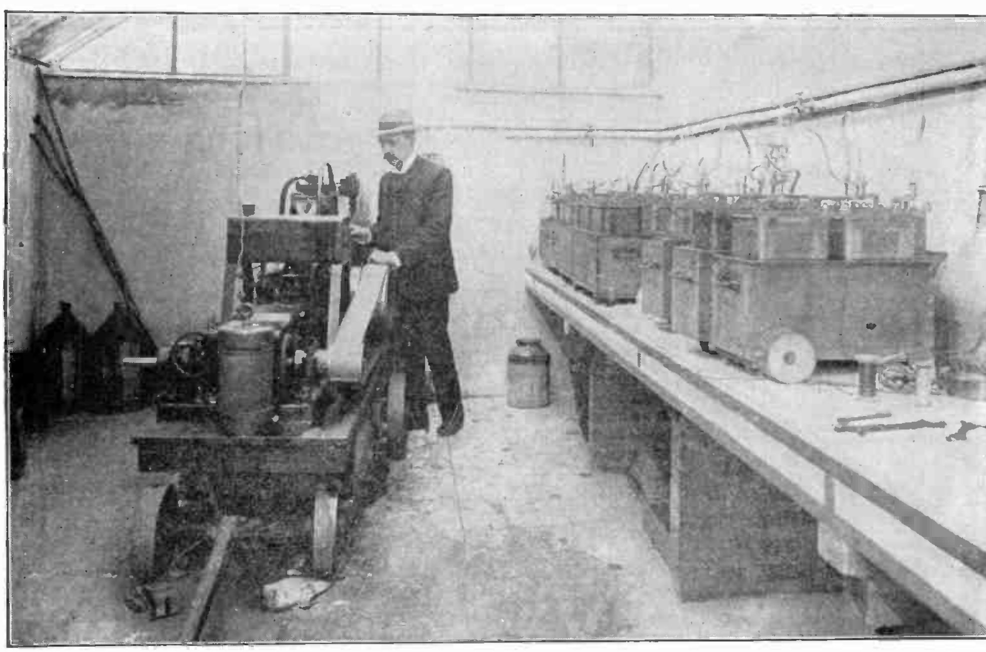
PROFESSOR DANIEL BERTHELOT OBSERVING THE RESULTS OF HIS EXPERIMENTS



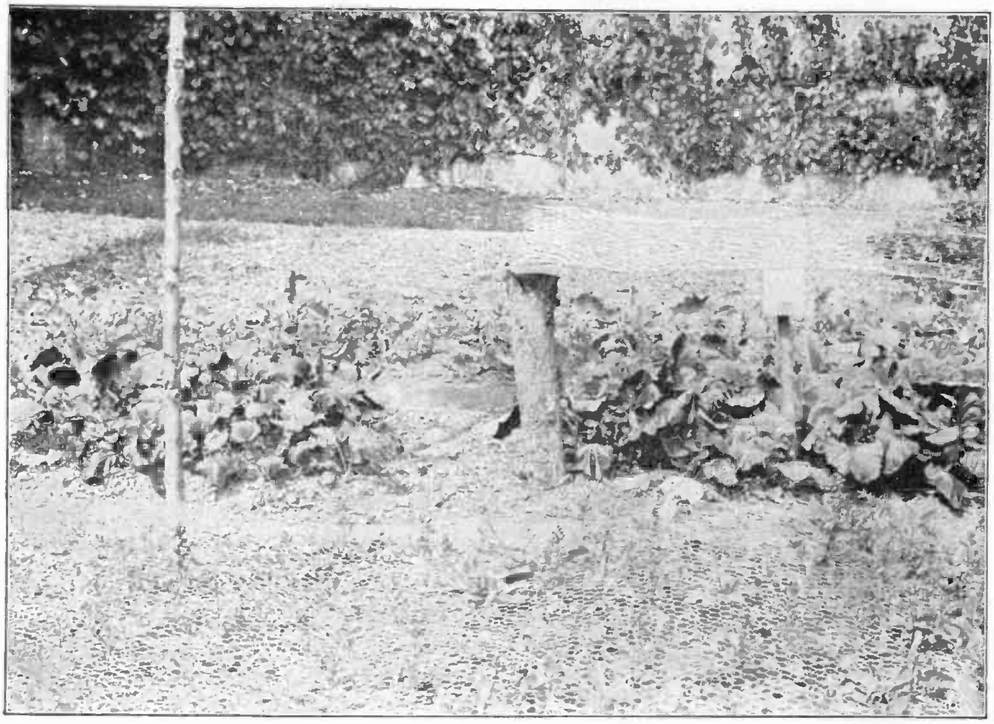
ROOM AT THE TOP OF BERTHELOT TOWER

plants exercised a beneficial influence on their growth, and also that the natural electricity of the air invariably lent its aid. Plants placed at the top of his tower, where as he termed it, the potential electricity of the air was higher, thrived better than those grown at its base. Here was the explanation of the indefinite fertility of mountain fields, such as those in the Auvergne—fields that never receive any fertilizer and yet are better producers than those in the valleys below.

Working on these lines, Professor Daniel Berthelot, who has been appointed by the French Government to continue his father's work, studies the growth of plants placed within an "electric field." A wire net is suspended over the plant and connected with one of the poles of the electrical source, the other pole being in communication with the earth in which it is grown. Side by side with each experimental pot or field, he has a plant or plants, growing without the aid of electricity, so that he can note the relative progress made by each. The results which he has obtained confirm those of his father



ELECTRIC STATION AT MEUDON WHICH SUPPLIES POWER FOR THE PLANT EXPERIMENTS



TURNIPS GROWN WITH AND WITHOUT ELECTRICITY

—nay, they enable him to go further than did Marcelin Berthelot, since he has no hesitation in declaring that market gardeners could profitably adopt the method he has employed in a small way at Meudon. Peas grown in an electric field are in pod before others grown under ordinary conditions have done flowering, and the same is the case with French beans and other leguminous plants. Gardeners whose establishments are near electric stations or electric tramways could easily make an arrangement for connecting the insulated wire netting suspended over their plants with the companies' overhead wires. Electric companies could make but a mere nominal charge for this privilege, which entails no appreciable expenditure of current. The only real cost, therefore, would be that occasioned by the metallic net and its placing in position. But wire netting is not at all costly. As to insulators, all that is needed is a number of jam-pots and posts. With this inexpensive outfit and permission to attach a wire to a neighboring conductor of electric current, gardeners could get their early vegetables to market long before less enterprising competitors. Of this M. Daniel Berthelot is convinced, and the result of his experiments proves that he is right.

FRENCH BEANS GROWING WITH AND WITHOUT ELECTRICITY

# Current From—Where?

BY EDGAR FRANKLIN

## CHAPTER VII.

### DOOM SEALED

There followed a period of days—days that ran into weeks. And it was a period quite as exasperating, quite as unusual, as several other periods had been, in the early days of the Bronton Electric Company.

Race was gone. As regarded complete certainties, that was about all that Dunbar and Carey could figure upon.

He had risked his neck by jumping to the coupling block of a rear platform, and he had climbed aboard apparently sound of limb—and where the ensuing dust cloud had taken him Heaven alone knew.

Not that there had been no word from Race; so keen a business man could hardly have neglected sending back tidings of himself. Therefore, on the morning after his disappearance, a telegram had reached the office. It announced merely:

"No time to write.
RACE."

And with the oddly uniform way that unfortunate happenings had occurred in the neighborhood of the railroad station, the sheet bore only the date of sending—and not the location.

Dunbar and his uncle studied it long and carefully. In the end, they knew as much as at the beginning. Race, indeed, had seemed slightly pressed for time at his last appearance; evidently business was keeping up quite as briskly—and Mr. Carey hazarded the opinion that his nephew's partner had gone mad and was confined somewhere with or without his three thousand dollars.

As regarded the apparently deliberate omission of the telegraph operator, they agreed that investigation would be worse than useless. They might be supposed to know the whereabouts of their own president; and advertising their ignorance would hardly help things. For the message itself, they gave over speculation after a little. It might have some subtle meaning which they were supposed to interpret; it might be a plain statement of fact; it might be anything else.

So that, their future wholly in the dark, Mr. Dunbar and Mr. Carey gave their splendid imitation of two optimistic, close-mouthed men attending strictly to business—business with which they were wholly content—business which made them smile with compassionate tolerance, when one or another citizen of Bronton hinted that maybe they wouldn't be ready on time, eh?

It was in the second week that Dunbar sat staring gloomily at an electrical magazine for want of better occupation that Mr. Carey looked up from his newspaper and said:

"William?"

"Eh?" The nephew turned to him.

"I——" Mr. Carey avoided his eye; and then he snapped his fingers and said merely: "Bosh!"

"What is it?"

The elder man ceased gnawing on his moustache.

"Well, it's just this," he confessed, "if any other man but Bob Race had exhausted our bank account and disappeared in that fashion, I should say that he'd grabbed what he could and made the best of a bad job—for himself."

Mr. Dunbar sat up with much energy.

"See here, uncle," he said. "Did you ever know Bob Race to do one crooked act in all his life?"

"I never did, William, but——"

"There are no buts about it. If Bob isn't doing what's best for the concern, he's gone crazy fretting over this infernal business and landed in an asylum somewhere. If you haven't confidence enough——"

"I have confidence enough to have put ten thousand dollars in cash in the bank—all of which he can draw from anywhere if he happens to have a blank check with him," Carey suggested quietly.

"Well, of course you have! And now—"

The telephone bell tinkled—rather startlingly, too, for the telephone had not overworked itself lately. Dunbar answered hurriedly—and when he hung up the receiver it was with rather an ugly look.

"Baker!" he announced. "He says there's freight for us down there. I asked him what it was and he said to come down and see for ourselves—and rung off."

Carey smiled faintly.

"Is there anything—er—pressing to prevent our taking a stroll in that direction?" he asked.

Their sole piece of mail that day—a catalog delineating styles of portable electric lamps—offered no hindrance. They locked the office and walked stationward, silently, until Mr. Carey murmured:

"What do you suppose it is?"

"Some of the little odds and ends we've been waiting for," said Dunbar, bitterly. "The engines are off in Tahiti now."

Another five minutes, though, and he quickened. That mass of stuff by the freight shed was no mere collection of "little odds and ends."

He hustled forward his uncle; he crossed the tracks and vaulted to the platform while the elder man sought a less energetic way of reaching it. And when Mr. Carey came up he was staring moodily at as battered a collection of freight packages as could remain undesired.

Mr. Carey reached him with:

"Anything broken?"

Dunbar's finger pointed downward.

"There's a cylinder that's felt a sledge hammer since it started on its travels," he said tersely. "There's a crank-shaft that might do to prop up a fence—it's no good for anything else in its present shape—there is a crank, too, that's worth—well, whatever junk steel is worth."

"Out of commission?"

"Up here, away from anything in the way of a big machine-shop, they are absolutely out of commission."

"Any hope of having them put into shape on time, if I buy coal for the station?" Carey demanded with rising anger.

A curious calm had come over Dunbar.

"Not the slightest," he said quietly. "These engines were built to specification for somebody else—they happened to fit into our plans by the wildest kind of luck. The things we should have to replace, would have to be made to order. Uncle, it is absolutely *all* up now."

"Well, I——" Carey began fiercely.

Heavy steps behind caused them to turn abruptly.

It was Mr. Bowers—Mr. Bowers, who had not taken his wonted interest in their affairs of late. And Mr. Bowers said heartily:

"Well, where have you fellows been lately?' I stopped at the office yesterday——'

His eyes opened as they fell upon the engines.

"Hello! Got 'em at last, did you?" He stepped forward. "Why—say! This here's busted, Dunbar!"

Mr. Race, in all probability, would have descended upon the heavy gentleman and annihilated him. Dunbar, quiet always, almost apathetic under the last blow, answered:

"It is damaged—yes."

"Nothin' you can't fix up, is it?" said Bowers, solicitously.

Something in Dunbar's eye stopped him. Mr. Bowers' countenance took on an expression of child-like wonder.

"Good Lord! Don't look at me as if I did it!" he laughed. And then, as oppressive silence continued, Bowers hands went into his pockets, and he said: "Why the dickens didn't you sell out to me when I offered to buy you?"

Dunbar did not answer.

"It was your only hope." Mr. Bowers pursued. "I dunno what a hoodoo is, but there's one around you folks somewhere or other."

"There is unquestionably a hoodoo!" Carey began forcefully. "And when it comes time to put a name on that hoodoo—"

Bowers stared at him wonderingly; and just here Dunbar gave further evidence of his tremendous business acumen—for he had accepted the fight as lost and he was considering what possible raise Bowers might make in his offer; and he said:

"If you'll bid a reasonable figure on our plant, Mr. Bowers, it is——"

Bowers started. And his eyes narrowed down to a sly slit as he smiled.

"Reasonable? Good Lord! Wasn't fifteen thousand dollars reasonable? I expected to get a couple of good Corliss engines at that, that I'd use some time or other. This here stuff's junk."

"Bowers!" burst in Mr. Carey. "Before this concern would consider selling out to you, we'd tear down every pole and wire in the city and throw it away! We'd——"

"Hold on!" The other faced him quickly. "Pardon me, but I ain't talking to you. I'm talking t' Dunbar. Them two fellers have their money in it—not you, yet." He turned back to Dunbar. "I've been thinking it over," he said, flatly. "T'aint worth fifteen thousand to me, son. It was only a kind of charitable spasm, that was. All the same, rather than see you two stranded for money for a new start somewhere else, I'll give you ten thousand cash for everything as it stands and take a chance."

"Well——" Dunbar muttered.

"We will do nothing of the sort!" Carey exploded. "Don't imagine for a moment, Bowers, that your whole scheme isn't known to us—that you're planning to light the city with our plant—that——"

Mr. Bowers' voice was the heavier, for it drowned Carey as he said:

"I guess you think you know what you're talking about, Mr. Carey. I'm sure I don't. Mr. Dunbar, listen here. Your—your uncle's excited about something, I s'pose. But I'm sayin' to *you* that that offer holds good till noon tomorrow and no more! *Ten thousand cold money—noon!*" ended Mr. Bowers as he turned and walked abruptly away.

All but frothing, Carey watched him step into his brilliant red automobile at the far end of the platform and whirr gaily up the grade to the city. Then he turned on Dunbar with:

"William, you're a magnificent electrician, but—but when I see a member of my own family with as little business in him—"

"It seems to me that I've got pretty good business sense in this," Dunbar replied, with a rather injured stare. "We're licked. We know we're licked. Ten thousand dollars is better than no dollars."

"But why run up a white flag like that before you're absolutely forced to?"

"Would you rather have ten thousand dollars in your pocket tomorrow afternoon, or no dollars," Dunbar inquired, gloomily.

"I——" Mr. Carey seemed to wilt. "Good God! I don't know!" he gasped.

"And what's more, if we'd been able to finance a fresh plant and coal and all, as Keller suggested——" Dunbar began, with more force.

Now, between Bronton's wealthy man and his nephew there seemed to be an opening for an unpleasant discussion, as concerned the risking of large sums, the value of sporting blood and the wisdom of collecting what fragments of currency were in sight.

It was the ripest kind of time to interrupt a conversation—and the interruption came mercifully. Down track, a long, shrill whistle announced the coming of a locomotive—and both men started.

"Nothing due this time of day, is there?" Carey exclaimed.

"Not unless they've put a new train in the schedule," said his nephew.

Curiously, he peered down the cut to the curve. The steady rumble of a fast train climbing the grade grew louder. A locomotive poked her nose around and headed for them in a cloud of black smoke; and vaguely they saw the shape of a box car—a shabby passenger coach—another box car, trailing behind.

And then the indistinct figure which had clambered down to the steps of the engine, took a wild leap to the platform before them and:

"How d'ye do?" said Mr. Race!

The pair stood petrified! From the passenger coach, as it stopped, there tumbled forth a stream of roughly-clad men—Italians at the first glance. Not two or three, but ten—twenty—thirty, came pouring out, staring about and chattering. The door of the forward box-car opened, and an even less wholesome looking pair of laborers emerged; and Race said softly:

"See the two tough ones? They used to work for a man named Pinkerton."

"Bob! Is—is it——" Dunbar was able to stammer.

"My garden party! Look 'em over!" Race chuckled excitedly. "Come in here, you!"

He seized Dunbar's arm and propelled him into the shadow of the freight-car.

And a full minute later, when Mr. Carey had blinked his way to a realization that something extraordinarily odd and mysterious had happened, he heard his nephew's voice, coming squeakily, in a thunderstruck:

"Gee Whizz!"

## CHAPTER VIII.

### LIGHT ON THE MATTER

Little Bronton forgot herself that night.

For probably the first time in its history the town was wide awake after eleven o'clock, on the night of June thirtieth. People walked the streets in crowds, stores were open, watches were consulted every second.

Mr. Isaac Berg, strolling on the pavement before his department store, encountered Freel, the big hardware man, and for a time they stood chatting animatedly.

"Funny, ain't it?" Freel was saying. "The whole blamed town's excited, and they don't one of 'em know what's going to happen."

"Some of them do," said Berg, wisely.

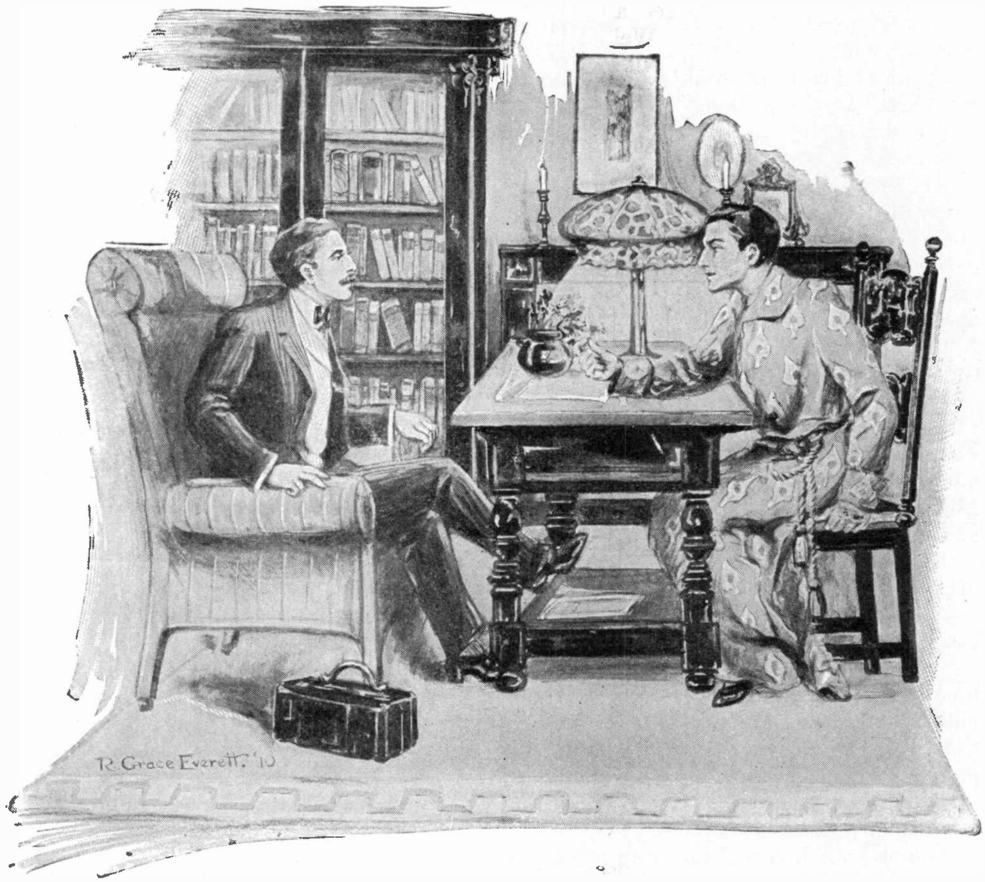
"Ain't a sign of life over at their office either," pursued Freel. "I ain't seen anyone but old Carey go in there in two weeks, and he only stops about fifteen minutes and then hustles off. I wonder if they *are* doing anything?"

Berg cleared his throat importantly.

"They've put every lamp in its place," he stated. "I got Mr. Race's positive assurance this morning, when they stuck tungsten lamps all over my place, that all I had to do was wait for twelve tonight. He wouldn't tell me no more Then, up to the *Herald* office, when I went with my tomorrow's advertising, I asked 'em what was going to come off tonight—and all they said was that their paper was coming off the presses about three in the morning, if it didn't set fire to the place."

Mr. Freel nodded.

"They're a funny bunch, them electric chaps. Everybody in town's been saying they couldn't get started no way—they'd lose their charter an' everything else—an' they go right ahead just the same."




FOR A TIME RACE STUDIED HIS MEDICAL ADVISER

"But the funny part is what the dickens they've been doing. *Nobody* knows! Here this Race goes out of town and nobody knows where he's gone; then he comes back with a freight train and a lot of machinery and Dagoes; and they march the Dagoes and the machinery into the power-house—and that's all. Nobody's seen anything more of 'em since. No Sir! they just seemed to vanish utterly."

"And you can't even get on old Carey's property," Freel pursued. "They've put signs everywhere. You can't get in sight of the place without somebody coming and chasing you off."

"Well, I tell you one thing," escaped Berg. "I give it to the *Herald* for news, so you needn't say it to anyone. Two days ago, I got so curious, I sent my Moe down at night, to see if he could get a chance to look in the power-house. Well, he got there and he got chased off, but he also got a look inside."

"Yeah?" Freel grew curious.

"There wasn't a thing inside but mattresses and a lot of dirty clothes hanging around."

Mr. Freel straightened up.

"Well, I don't believe they're working their Dagoes nowhere. They ain't bought so much as a pair of pincers from me in two weeks—and I've the only full line o' hardware in town."

"It's a mystery," Mr. Berg announced, thrillingly.

* * *

At about the same time, Mr. Robert Race was lying stretched on his couch, with a light blanket over him, while young Dr. Morton lounged unprofessionally in a big arm-chair and smoked.

"I'm going to get up now," announced Mr. Race, calmly.

"You are not," Dr. Morton replied, quite as calmly.

"Thomas, were it not for your value to the community, I should arise and dismember you," said the president of the electric company. "I've slept from nine this morning till ten tonight. Now I'm dressed and going——"

"You are dressed, only because I chose to humor you, Robert," said the physician, cheerfully. "You are an all-in man—nerves, body and all. You're going to stay in bed about one month, I think."

"But tonight, you——" Race cried.

"Be calm, please," said the doctor, as he shifted his cigar. "Otherwise, I shall drive a hypodermic spike through your epidermis and watch you sleep till the middle of next week . . . ." He paused in contemplation of the cigar. Then he eyed Mr. Race with a mysterious smile, and a significant one, too. "And tonight, as you were saying?" he murmured. "Just *what* is going to happen tonight? Everyone seems so interested and expectant, and yet no one knows. Um."

For a time Mr. Race studied his medical adviser, with a keen, calculating eye.

"Do I infer from this that you are inordinately curious?" he asked.

"It is always a satisfaction to get a whack at big news before anyone else hears of it," said the doctor, airily.

"And do I further infer that, if I put you wise to some of the mystery, I get up at half past eleven and go down to the Square?"

Morton pursed his lips and smiled.

"If there is anything to justify such a course, it is possible that we may come to some agreement by which we can walk together to the Square and back, about that time." And he added earnestly: "But if we do, Bob, you'll agree to come straight back and go to bed and stay there?"

"Done!" sighed Mr. Race, as he stretched his weary legs.

"It is now nineteen minutes past," suggested the doctor.

"Well, you know we were pretty nearly put out of business—no coal, no engines, nothing but some smashed dynamo stuff?"

"That's town talk."

"I know it is," snarled the president. "Well, here's something that isn't town talk. You know where our power-house stands—tight up against the base of the hills?"

"Yes."

"Ever been up those hills?"

"No," admitted Morton.

"Did you ever hear of anyone going up them? No? Well, I never did either. As a matter of fact, I doubt if they've ever been thoroughly explored, because the going's worse than Hades and there's nothing to go after. Anyway, that's neither here nor there. The main thing is, *I* went there! I went there to walk off a grouch!"

"Ah? Well, now cut out the landscape dissertation and get around——"

"Dry up!" said Mr. Race. "I went there because I wanted to find a locality big enough and tough enough to stand what I had to say out loud. I climbed straight up that first rise; then I meandered over rocks, boulders, snakes, tree-stumps and so on till I began to climb the second high spot—the big, almost perpendicular rise that goes up to the high level beyond. Then I sat down, because I'd walked about four miles to get one mile away from town and I was sort of tired."

"Go on." said the doctor.

"I did not get up. I just sat there, and it was mighty still. It was so still that after a minute or two I began to imagine that I heard a roaring sound, somewhere in the distance. Then it got to be so strong an impression that I tried to get up—and——"

Mr. Race sat up and his face shone with the memory.

"Tom," he said, "I'll bet there wasn't a worse scared man in the whole United States."

"Why?"

Because instead of getting up, my two feet went straight through the ground and I dropped into a cold, wet, pitch-black hole—and that roaring, all of a sudden, sounded like a train going full speed! Well, it was about two minutes before I was steady enough to light a match."

"Going down all the time?" queried the doctor.

"I ceased going down after dropping about nine feet, and I landed on the soles of my shoes at that." responded Mr. Race. "I got the match lit and there was nothing in the immediate foreground but empty, wet, rocky blackness—and that infernal roaring was off in the blackness, too.

"Well, I haven't any more spunk than I need, but that roar didn't scare me a little bit. Instead, it began to tingle through me. I had the little flash-lamp we use in tinkering the machine, and I lit that up—and there was still more blackness ahead, so I walked on."

"Is your head hot?" asked Morton, not altogether in jest.

"And I kept on walking ahead for close to three hundred feet, and the old cave grew higher and wider and wetter and more slimy at every step, until at last I came to a little corner and turned it. *And there it was!*"

"What?"

"A grand old foaming, roaring waterfall, fifty feet high if it was an inch, and pouring about a billion gallons a second down into the Bottomless Pit—which I'd missed stepping into by about one yard! It may possibly have been slightly less than a billion," conceded Mr. Race.

"*Water-power!*" gasped Morton.

"Great and astute physician, you have grasped it!" grinned the electrical man. "Well, I started to climb up the rocks beside the fall and I made the top at last. There's an underground pond in the middle of that hill, so beautifully big that, without a boat, we haven't yet explored the other end—and you can't hear the water coming in. That's all."

Mr. Race rose.

"But——"

"Why, that's all there is to it. I don't know much about using water falls, but I wasn't taking any chances. I wanted to get the afternoon train so as to make Chicago next day. Therefore, I merely grabbed the plans of the whole works, hit the trail for the East and left without a soul knowing where I'd been or what I'd seen. I thought that what had been undiscovered so long might as well stay undiscovered a little longer.

"I've been wandering as far as New York," pursued, Mr. Race, as he arose and found a collar. "I've been tripping it around Pennsylvania, too, and freshened up my memory of Chicago and a few other places. I just headed straight for the best maker of water turbines I could find—laid the whole proposition before them—and had what I wanted hustled into shape. I got a new armature in place of the one we smashed. I bought in everything everybody could suggest as being necessary. Brought labor and everything else along and marched the whole collection into our supposed central station—and nobody's seen 'em since!"

"I know that! How——"

"You see, about the handiest way of starting uphill was directly behind the shanty—and if you'll observe closely, you will note that you can't see the rear of that place without getting pretty close. Nobody got pretty close. And the merciful undergrowth did the rest—bushes and saplings are thicker than blazes on that hill."

He began jerking his tie into shape.

"Not that it hasn't been the devil's own job," he murmured. "We've had every man-jack going as many hours out of the twenty-four as he could stand, and they're mostly all closer to the grave than I am now. *But it's done!*" he yelled joyfully, as he turned on the doctor with the last jerk. "They've got a turbine outfit up there that actually isn't on the market yet. They've got a lot of the cavern cut away on top and *electricity lighting the rest of it at this minute!*"

"But why all the mystery?"

Mr. Race sat down.

"For one thing, we were sick of unforeseen accidents happening to everything we owned. For another, I believe, the State control of water-power rights is still all up in the air. You see, as nearly as we can figure it, all this blessing comes from Lake Barton, thirty miles up in the hills—she's fed by springs, she's never low nor high and nobody has ever found her outlet, or wanted to, I guess. Anyway, the water we're using is on Carey's property—and it undoubtedly ends up down Thornton way, where the subterranean stream has been pouring into the big river since the memory of man hereabouts began . . . And now Bill and his uncle are up in the new central station and our working force, with a few additions we have made by accidents, and I'm down here to watch the effect."

"Well, you'll have darned small chance to watch the effect," said the doctor, as he noted the rather unsteady gait of his patient. "You'll be back in bed by quarter past twelve, if I have to stun you and haul you back."

Mr. Race had donned his coat and hat and, with some lingering professional doubts, Morton accompanied him to the street, silently giving him credit for remarkable self-control of the excitement which must be within him. Mr. Race, who had reached a point of weariness where an earthquake could hardly rouse his enthusiasm, led the way slowly down toward the Square.

People stared at him as he approached and chattered when he had passed. Some tried to speak to him; Mr. Race passed on. He chanced to be looking for someone—and surely enough, with one arm in a sling, Mr. Bowers was standing in the dark doorway of his little office building.

With Morton, Race slipped gently out of the crowd and gained his side with a polite:

"Good evening."

"What the hell do you——"

"Now, my dear sir," smiled the president of the electric company, "don't be impolite, be——"

"You——"

"Because you're not in a position to be impolite," Race went on, his voice fairly vibrating with glee. "I hope your arm is setting nicely? You know, I supposed, with everyone else, that you'd broken it when your automobile back-fired—until my man Ryan reported that he had smashed it with a club when you drew a pistol on him in your efforts to wander around Mr. Carey's property that night, two weeks ago, or so?"

A stifled roar escaped Bowers.

"You came to look for the half dozen friends you'd sent up our hill before—the ones that never came back, eh? I'll tell you where they are. We caught each one and put him to work, without pay. They won't make any trouble for us; in fact, they've been good enough to sign affidavits, regarding the reason for their visit to us. In the name of the company, I thank you for their help."

Mr. Race bowed. Bowers took a step forward, growling wildly:

"I—don't know—I—your damned charter calls for a plant run by steam on the spot where——"

"Well, now, I don't believe there's going to be one bit of trouble about that," Race purred on, genially. "You see, I've had a couple of really capable detectives working around here lately—probably Bronton's first. And they have done excellent work. Why, Wilkes, down at the Junction, was arrested about supper time—they took Mr. Baker into custody an hour or so ago—they've got sworn statements from about two dozen other people, as to your dealings with them—and none of them are likely to run away from the witness chair now, anyway. You know, it's bad policy to bribe people, Bowers. The kind of people you can bribe are the kind that'll turn on you when they're caught."

Mr. Bowers, incapable of speech, was breathing hard.

"And that applies to the esteemed Mayor and his Board of Aldermen, too." sighed Race. "You haven't seen Schwartz lately, have you? That's because we scared a confession out of him—and he's been in his sub-cellar ever since, I think. Why, we even got up enough energy to convince the Mayor's clerk that his only right course would be to get at the new charter you actually had down in writing, mulcting the whole town for their current, make a copy of it and swear to it!"

Bowers was leaning limply against the wall; shot and shell were coming in a torrent that staggered him.

"I wouldn't leave town if I were you," Race smiled. "There's a man watching you now——"

"Race, for the love o' God, what'll ye take in money to keep it quiet?" wheezed from the dazed man. "Take everything I've——"

"It *can't* be kept quiet now," said Race, gravely. "Electricity makes big changes in a town. This town needed an airing. Tomorrow morning's *Herald*, Mr. Bowers, will contain the whole story, from our broken armature to your broken arm—and you can't get into the office, because there's a policeman at each door." He caught Bowers, as he tottered, and straightened him up. "You didn't know it, but you've done a good job," he said. "Crooked politics and corruption in this town have been electrocuted."

And he stepped to the sidewalk, with Morton fairly gasping for breath.

"Is it—true?" he managed to say.

"As true as gospel—and every word in the *Herald* will be supported by affidavits," Race said grimly.

"But what in Heaven's name——"

Morton's words were cut short.

From the buzzing, humming crowds a sudden, frenzied shouting went up. Hats were hurled into the air—men roared cheers——windows went up—and Bronton had suddenly gone mad.

For the whole Square was blazing with arc-lamps. Houses were illuminated as if by magic fire. Shop window after shop window flared out into brilliancy. Dusky, shaded, half-lit streets glowed with streaming white light, bringing out in a single second the whole dancing, cheering throng. In the center of the Square, with a circle of arc-lamps above them, the quietly imported brass band, blared out with "Hail The Conquering Hero Comes!"

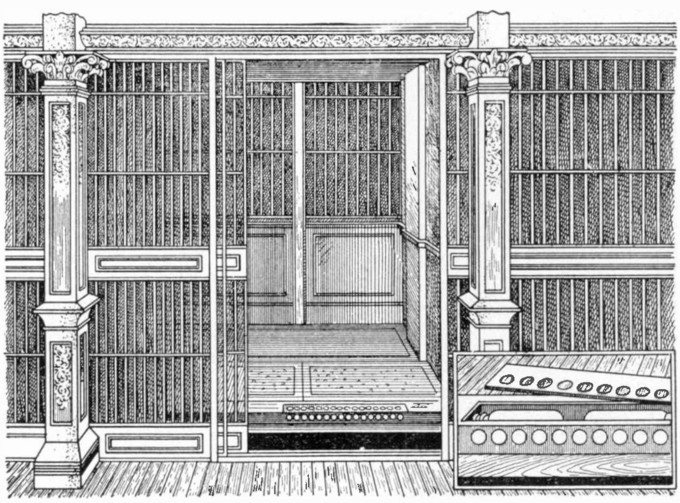
But the conquering hero did not come. Instead, as the big clock boomed out its first stroke, Race leaned rather weakly on Dr. Morton and drew him into the shadow.

"It's twelve o'clock, Tom," he said, with a weary unconcern that was far from affectation. "Take me home to bed. We can see this any time—now."

(The End.)

## FOR THE ABSTRACTED ELEVATOR PASSENGER

In a certain 12-story office building in Chicago equipped with seven passenger elevators each car makes an average of 250 round-trips per day and 16 stops per trip or an average of 4000 stops in a day. A record shows that these seven elevators carry 33,000 passengers in this time or 4700 passengers per car. During this time the operator finds many persons so absorbed in thought or conversation that his "step up, please" or "down, please" goes unheeded. To stop his car just at the floor level every time is not possible and for a mis-step or fall he is often blamed.



An estimated average of two elevator accidents occur every day in the year with nine out of ten due to careless passengers. To make the passenger "see" where he is stepping and also to aid the operator in stopping at the floor level the device shown in the illustration is said to be most satisfactory. It consists of a cast metal plate on the floor of the car at the entrance, into the holes of which are fitted glass lenses. Under this in the floor are placed two tubular lamps. Lights so arranged attract the passenger's attention when entering the elevator and also warn him not to stand too close to the door when inside. To change the lamps when burned out a small section of the floor is made removable to give access to them.

# Elementary Electricity

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

CHAPTER XXVIII.—TANTALUM, TUNGSTEN AND OSMIUM INCANDESCENT ELECTRIC LAMPS

The efficiency of the ordinary carbon filament incandescent electric lamp, or the ratio of the luminous energy emitted by the lamp to the energy absorbed by it, can be taken as 3.5 watts per candle-power. This is the efficiency when the lamp is operated at a pressure no greater than that which will permit it to have a useful life for a period of about 800 hours.

Many efforts have been made to increase the efficiency of the incandescent electric lamp by the employment of materials for filaments that can be safely raised to a higher temperature than has heretofore been employed.

One of the first improvements in the above direction consisted in the production of an incandescent electric lamp with a form of filament known as a metallized filament. This filament consists of an ordinary carbon filament that has been made to possess a greater refractory power by intense heating in an electric furnace. This lamp is generally known in the art as a "Gem lamp," or a "metallized filament lamp." Its increased candle-power is due to the fact that its temperature can be safely raised to a higher point than usual without a marked decrease in its length of life.

The next marked improvement in incandescent electric lamps consisted in the use of a substance other than carbon for the incandescing filament. One of the first successful materials employed for this purpose was metallic tantalum.

Tantalum is an element that occurs in tantalite, a mineral containing tantalum, niobium, tin, iron and manganese, and many other minerals. The name tantalum was given to this metal because, when surrounded by various acids, such as nitric, sulphuric, hydrochloric or aqua regia, it is, like Tantalus of old, unable to drink in or saturate itself with them.

Tantalum is a highly refractory metal and can therefore be raised to a much higher temperature than can the carbon filament. By its use it is possible greatly to increase the efficiency of the lamp without decreasing its life. Indeed, the life of the tantalum filament lamp is greater than that of the carbon filament lamp. The efficiency of the tantalum filament being as high as two watts per candle.

But besides the advantages of an increased efficiency, and a somewhat increased length of life, there is a marked improvement in the character of the light produced. The higher temperature at which the tantalum filament is employed results in a character of light more closely resembling the light of the sun in its color values than does the old carbon filament.

Careful measurements show that the energy expended on a 35-watt carbon lamp producing 10 candle-power, when expended on a 25-watt tantalum lamp produces 12½ candle-power. Here, as will be observed, the tantalum lamp consumes 20 per cent less current but gives 25 per cent more light. Besides this, the tantalum lamp possesses the great advantage of producing light that is more nearly equal in its color values to that of sunlight.

Since the resistivity of tantalum, or its electric resistance per unit of length is small as compared with that of carbon, it is necessary to employ fairly long threads or wires of the metal, and this, even though such threads can be made of very small diameter. Consequently, the incandescing tantalum filament has a length so great that it requires a number of separate supports. This can be seen in Fig. 176, which represents a 20-candle-power tantalum lamp of the General Electric Company's manufacture, requiring an expenditure of 40 watts and therefore possessing an efficiency of two watts per candle.

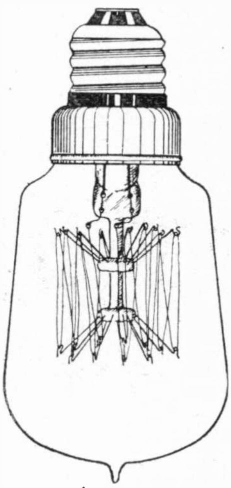
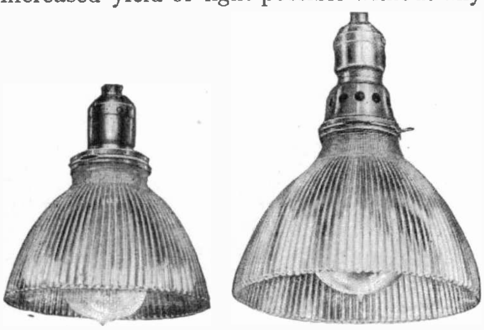


FIG. 176. TANTALUM LAMP

The many separate supports that are necessary to hold the long filament can easily be seen from an inspection of the figure.

The higher efficiency of the tantalum lamp as compared with the ordinary carbon lamp, made it possible when this lamp was first introduced to employ it satisfactorily in such places as apartment houses, hotels, and office buildings, desiring an increased lighting capacity, but in which the owners, by reason of the expense, were unwilling to make the necessary additions to the generating plant. The use of the tantalum lamp renders an increased yield of light possible without any



NO. 1 NO. 2

FIG. 177. LAMPS WITH HOLOPLANE GLOBES

addition whatever to the generating plant; for, the tantalum lamp can give 20 candles instead of 16 by a consumption of 40 watts in place of 50 or 56 watts.

It is interesting to note in connection with the above that the Metropolitan Life Insurance Building, in New York City, one of the highest buildings in the world, its tower rising 700 feet above the level of the street, is lighted with 10,000 40-watt, 20-candle-power tantalum lamps.

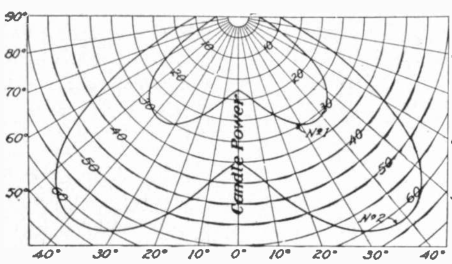



FIG. 178. DISTRIBUTION OF LIGHT

When supplied, as is usually the case, with a frosted globe and holophane shades, tantalum lamps are especially suited for isolated plants, producing as they do an excellent distribution of the light. In the two forms of lamps and holophanes shown in Fig. 177, the candle-power distribution for the No. 1 and No. 2 lamp units, requiring, respectively, 40 and 80 watts, is shown in Fig. 178.

The tantalum lamp represented in Fig. 179 is especially suited for the lighting of railroad trains. This figure represents a 12-candlepower tantalum lamp requiring for its maintenance a pressure of 32 volts.

The current required for train lighting is generally produced by a special generating plant placed on the train. The generating outfit consists of a small horizontal steam turbine generator set operated by steam from the locomotive and located in a part of the baggage car or on top of the locomotive boiler.

A still greater improvement in the efficiency of the incandescent electric lamp, as well as in the character of the light it

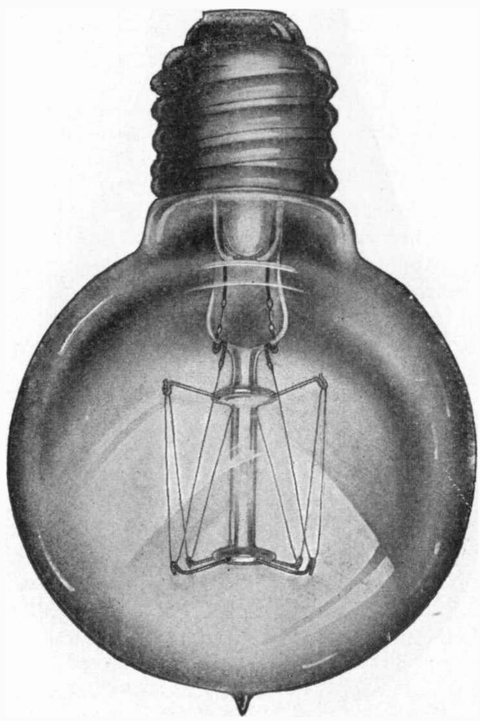


FIG. 179. TANTALUM LAMP FOR TRAIN LIGHTING

produces, is obtained by the use of another metallic filament; i. e., tungsten. While possessing a length of life of 800 hours, this lamp possesses a higher efficiency than any incandescent lamp yet described, this efficiency being from 1 to 1.25 watts per candle.

Tungsten, or, as it is sometimes called, wolframium, occurs principally in Nature in the minerals heavy stone or tungstate of calcium and in tungstate of lead. When heated in air it burns, producing an oxide of tungsten. The filament must, therefore, be placed in a lamp chamber in which a high vacuum is maintained. Pure, metallic tungsten has a bright gray color and a metallic lustre.

The increased efficiency of the tungsten lamp is due to the high temperature to which

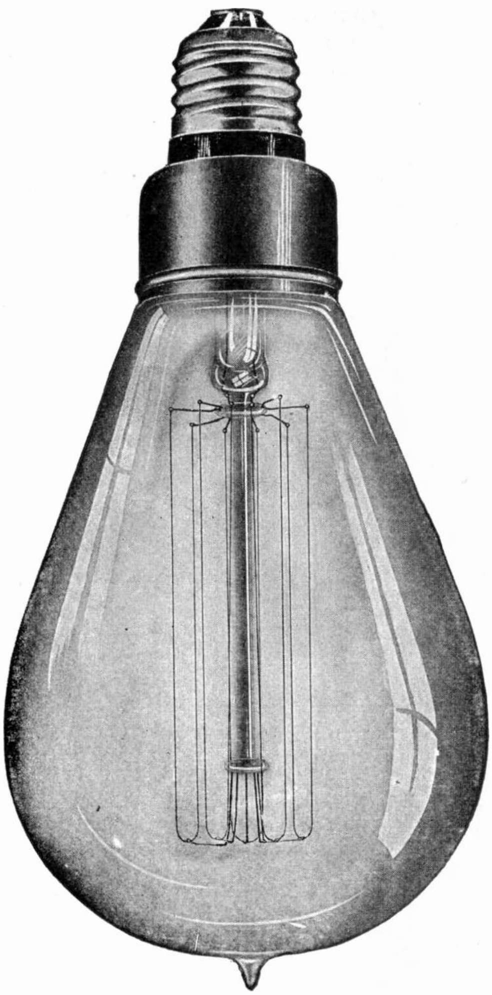


FIG. 180. TUNGSTEN LAMP

it is possible to raise the filament, for metallic tungsten is very refractory and does not fuse or melt until a temperature of 3050° C. (5522° F.) has been reached.

In the manufacture of the tungsten filament a paste formed of powdered metallic tungsten mixed with a suitable binding material is forced or squirted through diamond dies. The threads so formed are dried, when the separate particles of tungsten are electrically welded together and so formed into a continuous wire or filament.

Tungsten filaments possess so low a resistance that lamps intended for use on a 120-volt circuit require very long filaments. This filament is generally made up of four or five hair-pin loops connected in series in the manner shown in Fig. 180, which is that of a lamp that produces 80 candle-power (mean horizontal) by the consumption of 100 watts when subjected to a pressure of 100 to 125 volts.

Like many other metals, tungsten possesses a positive temperature co-efficient. In other words, its resistance increases with an increase of temperature. Consequently, a change of pressure in the lamp circuit is not, as in the case of the carbon filament, proportional to the change in voltage. In other words, the tungsten lamp undergoes smaller changes in candle-power efficiency and life, with changes in the line voltage. It will be understood that this gives the tungsten lamp valuable advantages.

Tungsten lamps are now especially manufactured for use on mains the voltage of which is either from 100 to 120 or from 200 to 250. Those for mains of 100 to 120 volts are made in the following sizes and candle-powers, i. e.:

| | |
|---|---|
| 18 watts | 16 candle-power |
| 25 " | 20 " |
| 40 " | 32 " |
| 50 " | 40 " |
| 60 " | 50 " |
| 115 " | 100 " |
| 450 " | 400 " |

For use on mains, the voltage of which varies from 200 to 250 they are made as follows—:

| | |
|---|---|
| 40 watts | 32 candle-power |
| 65 " | 50 " |
| 115 " | 100 " |
| 250 " | 200 " |

In Fig. 181 is shown the lamp economy of the ordinary carbon incandescing filament, the metallized carbon filament; that is, the Gem lamp, the tantalum filament and the tungsten filament. When an amount of energy capable of producing 32 candle-power in the ordinary carbon lamp filament, is passed through a metallized filament, or a Gem lamp, there will be produced 40 candle-power; when expended in a tantalum filament, 50 candle-power, and in a tungsten filament 80 candle-power.

The great gain in efficiency of the tungsten lamp accompanied as it is by the advantages already pointed out cannot, it would seem, but result in carbon incandescing lamp filaments soon becoming things of the past. Indeed, it would seem that the following results must attend the invention of this very high efficiency lamp.

1. Electricity can now compete with gas and other illuminants on an equal basis of cost. This will necessarily result in the opening of a great field that has not yet been occupied.

2. A more liberal use of light both as regards larger units and longer hours of service is now possible without an excessive cost.

3. Much of this increase can be had without necessitating an increase in the generating power of the central station or its distributing system.

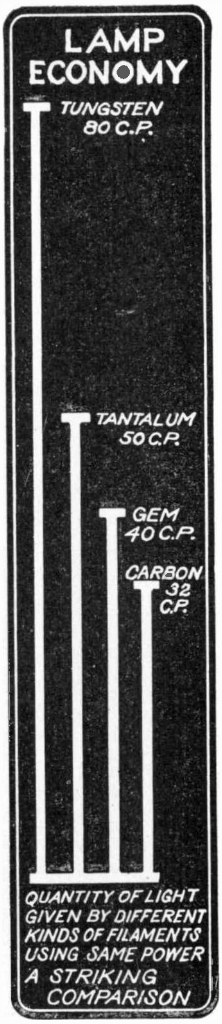



FIG. 181

For the lighting of small rooms single tungsten lamps are employed, but for larger areas it is preferable to place a number of separate lamps inside a frosted glass globe provided with five or six lobes and placed below a diffuser. This device is known as the tungsten economy diffuser and is especially suitable for the lighting of stores and other large areas.

The lamps employed in tungsten diffusers are of course provided with clear bulbs. The frosted globe in which they are enclosed is made with either five or six lobes as desired.

As shown in Fig. 182, means are provided for the ventilation of the group of lamps in the economy diffuser. The curved arrows show the direction of the ventilating currents through the system.

But the tungsten lamp is not only suitable for the lighting of interior, but can also be employed economically when connected in series for the illumination of such exteriors as streets, railroad yards, etc. For this purpose the tungsten lamps are made with a large area of cross-section. Consequently, the filaments have a greater mechanical strength than the filaments of the lamps employed for interior lighting. Moreover, an average life of from 1200 to 1500 hours is possible.

Since the tungsten lamps produce a light whose color values are more nearly that of sunlight, streets and roads are now frequently illuminated by them after the manner shown in Fig. 183.

Either the direct or the alternating current can be employed on the tungsten lamp. The efficiency operation of the constant current transformer has led to its use for ensuring automatic current regulation whenever alternating currents are employed.

Series-connected incandescent tungsten lamps are especially suited for street lighting by reason of their great length of life; for they can be operated at a great length of life without a great decrease in the strength of illumination. From careful tests made

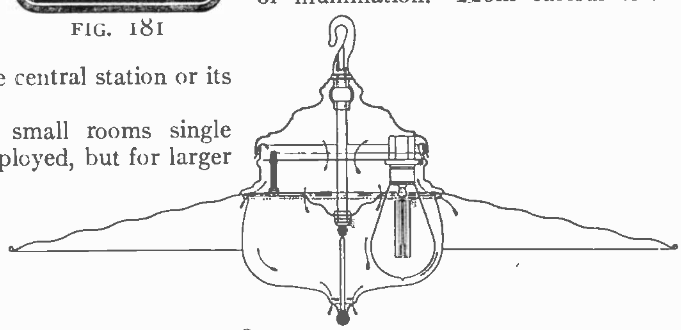


FIG. 182. ECONOMY DIFFUSER

it has been found that in one installation of 172 series-connected tungsten lamps for street lighting, there was an average length of life of each lamp of 1350 hours. In a test on 18 lamps, 12 continued running over 2000 hours without breakage or perceptible decrease in efficiency.

Tungsten incandescent lamps are also especially suited for the lighting of signs. Generally speaking, the lamps employed for electric signs are of small candle-power. Tungsten lamps are now constructed giving four candle-power with five watts. In the case of the tungsten filament a small candle-power lamp is only possible with a low voltage.

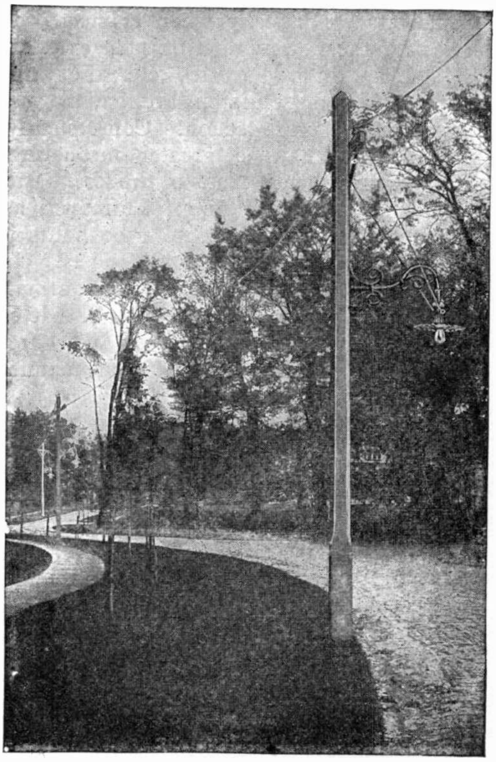


FIG. 183. TUNGSTEN LAMP AS USED FOR STREET LIGHTING

One of the forms of tungsten incandescent electric lamps as produced by the Westinghouse Company, is shown in Fig.184.

It will be observed from an examination of the preceding figures of various sizes and candle-powers of tungsten lamps that the portion of the bulb to which the base is attached is of larger diameter than usual. This is necessary from the thread given to the arbor wires to which the filament is attached.

There is one peculiarity about tungsten lamps to which reference might be made. When they are first burned their candle-power is considerably above the normal, but falls to normal after about three hours' burning. It is, therefore, advisable to subject the lamps to what is known as seasoning. This consists merely in burning the lamps until their candle-power runs down, and this generally requires about three hours.

Another form of metallic filament incandescent lamp is known as the osmium lamp. Here, the filament is made of the rare metal osmium, that generally occurs associated with the platinum metals.

Metallic osmium is the heaviest metal known. It has a specific gravity of 22.47, and is exceedingly refractory. It has a bluish-white color, and is harder than glass.

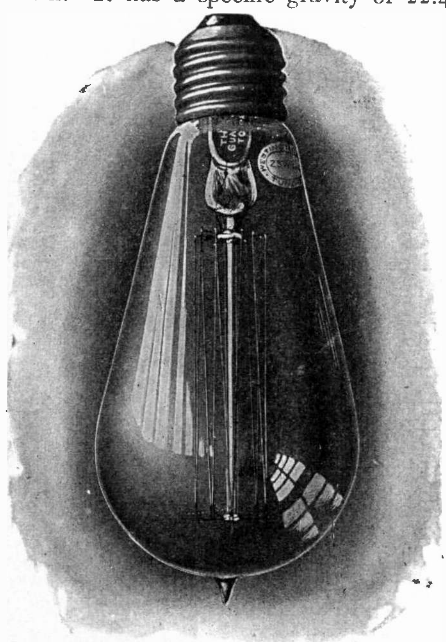


FIG. 184. WESTINGHOUSE TUNGSTEN

Experiments have recently been made with lamp filaments made of this metal. Great care, however, must be observed lest the glowing filament becomes oxidized by exposure to the air. For this oxide is volatile, and may result in a permanent loss of sight from the formation of a film of metallic osmium on the eyes.

Owing to osmium possessing a higher refractory power than either tantalum or tungsten, it is capable of producing a lamp of higher efficiency than the tungsten lamp.

Osmium lamps have been produced in the laboratory, but have not yet been placed to any extent on the market.

(To be Continued.)

# Electrical Securities

By "CONTANGO"

TROLLEY LINES AND THEIR FUTURE—THE NECESSITY FOR CONNECTING SYSTEMS—ADVANTAGES OF CENTRAL STATION POWER FOR THE SOURCE OF ENERGY.

This article of the series dealing with electrical securities, covers the traction proposition quite closely. The telephone situation has purposely been left to the imagination of the reader, for the simple reason that the divergence of interests between the regular, or so-called trust, telephonic connections and the independent lines makes it difficult to arrive at uncomplicated conclusions regarding them. But the traction field is different, it is in reality a very simple proposition although some companies have gone into the hands of receivers, and accidents, and the subsequent damage suits, have at times disturbed public confidence.

If one takes the whole country over it is clear that the greatest development of electric railways has been in the central states, in particular in Ohio, Illinois, Indiana and New York State, nor should the South be forgotten. The mileage developed along electric traction lines in the Central States in the last decade has been extraordinary and it now amounts to nearly twelve thousand miles in the three states named.

What is the keynote to the electrical traction situation in the country to-day? It is the same simple proposition that has confronted all congested areas of population—the traffic from passengers. The steam railroads of this country have for years been depending for their great profit on the freight they carry. The steam railroads of Europe on the other hand have for many a long time past been getting their big returns from the passenger traffic, and most noticeably is this the case in the British Isles

Now the whole matter of the worthiness or unworthiness of electric traction lines must be found in the connections they have, that is to say, the absolute certainty that there is a leading line going from the small links that make up the gradual and whole development. If you take the states mentioned you will find that one after the other the lines made and built in small communities are being closely connected up and delivered to the main feeders, so that they form part of a "system," and it is the system that brings results in the electric railways of the country. When it comes to the patient organization of small connecting lines between villages and towns, then there must always be kept in view the point that its presence or absence must be the final test of their worth or lack of worth—they must become part of the system. It would mean giving the present history of the country, in its industrial progress to give a complete idea of what has been, for the two or three years past, and is now going on in this very wonderful movement. Involved in it is the opening up of all sections of the country from one end to the other, resulting in an intercommunicating network that must in the end bring about a most extraordinary awakening, not only of all the conntry side but in the electric end of things—the source of energy, the central station, that final source of reserve for all the power needed.

After giving this actual statement of probable future and actual present conditions, not unduly rosy but decidedly matter of fact, it is certain that weak spots will crop up, but even so, the wonder is that more people are not stirred up to an interest in the way of direct investment in electric railway securities.

As a matter of fact a great part of the population made up of the more or less prominent citizens of each hamlet and village tapped, is at some time or another asked to subscribe to the bonds of this or that projected line that is going to do all manner of wonderful things for their respective localities. How far may they dare go? What then is the worth of an electric traction company's bond? What is the worth of its stock?

In fairness to the properties which are worthy, it must be said that in many cases in the past they have proved to be worth very little and have only brought sorrow and suffering to the hundreds who have taken their hard earned money from the banks to "invest" it in a project beginning nowhere and leading nowhere.

Let it be again repeated that it must always be a case with a connecting line of certainty that ultimately the line will become part of a system. Why is it that to-day the McKinley system, to mention the line of electric railways that is now tapping the whole state of Illinois and is helping to make that state, is able to build a bridge over the Mississippi and spend a great deal of money on the work? Because it has taken the simple, sane business precaution of seeing that its feeders and feelers all connect in a concentrated whole. A system fast spreading into other states. Lines between points are as nought unless they go beyond those points and connect and so spread the good gospel of electricity over the whole country and locality.

A passenger does not want to land at A, just to be told that coming from C he cannot go on to D because there is no connection. There is a break and a jump. That is not the reason for a traction company's existence, nor is it a good one for investing in its bonds. Therefore look to your company before you put in your money.

In the present day there is no excuse for errors in roadbed, equipment and the like, all matters of known quantity and standard efficiency. It is not the purpose here to deal with electric lines within city limits of even moderate size. It is the question of the interurban, pure and simple, which means that the character of the population has a great deal to do with subsequent results. For example as has been before suggested a series of small towns or villages scattered along the route is of much more importance than having at each end of the line a quite large sized city. It is in the constant come and go of the interurban that its most paying qualities will be found, and an investor must look into this at once before putting in his money. Of course if he is merely a local investor, that is, a man undertaking to subscribe - given amount to the "proposed new electric," he will have long before subscribing to stock been informed as to where the line begins and where it ends. If it is to be in a thickly populated district where many people go back and forth from one center to another, and back and forth and beyond, there is the cream of the business. But it must be without stupid wearying changes and must have direct and connecting accessibility.

Sometimes an interurban has rights of way clear through connecting towns, but this is merely another way of stating that it is part of a system. This will be found to be the most paying property of all. Considering the bonds of such companies—of the securities generally—it may be said that the stock is usually a local proposition whereby the local capitalists and leading citizens are induced with certain promoters to organize and start the proposed new line, but after all it is usually the bond-holders who take mortgages on the line which pay for its building. They must then see that they have security and are not putting their money into a bottomless pit or buying a pig in a poke.

The first thing to ascertain is that there is and has been an actual investment by the promoting people. Then after that is established the point is how much of this money has been put up and how much should be invested in a mortgage which stands on the cash cost of the property. By the rules of the public service commissions in some states governing these conditions there is an established principle that no more than 80 per cent of the cash cost of the railway can be hypothecated, so to say, in bonds. Having started with this it would be well then to look into the gross earnings and net earnings of the properties as they compare with interest charges. Thus the gross earnings for say a period of twelve months should have exceeded the interest charges by five times and the net earnings should exceed something like twice over. And this is only suggesting a very absolute security. As in other electrical enterprises there should be a good amount set aside for depreciation and in connection with electric lines this would seem an absolute necessity, for the very clear reason that all manner of untoward circumstances may intervene in the case of ordinary properties.

The average bond of an interurban company is paying five per cent and selling a little below par. It is good or not according to the observance of the foregoing conditions.

Much of the financing of these companies is done among the people who benefit by their operation in a direct or indirect way by proximity to the line, yet as the county becomes a perfect network of such enterprises such securities are being offered more and more extensively by leading stock and bond houses throughout the country.

A few words of advice then. As near as you can do, be sure you obtain information as to the people behind the projected or existing electric railway into which you are asked to put your money—not of necessity their financial standing alone, but more particularly as to the practical character of the men engineering the project or financing the company. Know your ground or let your banker show you facts about it if it is not nearby, and be as nearly certain as possible that the line is part of a system. Don't put your money into a road leading simply from Sleepy Hollow to Podunk.

As it is now, the electric traction development is likely to be one of the most marvelous and interesting problems of the next five years. Just remember that to all intents and purposes through sleepers are now being run from Springfield, Ill. to St. Louis and from St. Louis to Indianapolis and all over the state of Ohio.

From the point of view of the immediate future the greatest opportunities seem to be at this time in the state of Iowa. It has been but a matter of the last eighteen months since the electric traction proposition was really brought to a reasonable position there. With the connection with the Illinois systems, now so well understood, and their connections with Ohio and Indiana and then on to the Eastern States, the outcome can but be most satisfactory to those who get in on the ground floor. But again let it be said—beware of the little single line from Frozen Out in Texas to Burnt Out in Arizona. And also beware of the big air lines whose principal assets consist of Sunday Supplement publicity and other forms of "air."

The subject of electric railways must not be dismissed without reference to the losses occasioned by expensive individual power stations when in many cases all the necessary energy may be obtained from a central station. Indeed this elimination of unnecessary plants is one of the fundamental advantages of systems. In any case the tendency of the times is to take power from some hydro-electric or other large distributing station. The investor will find his returns so much the more secure and remunerative by giving careful attention to the source of the supply of the electric current. The larger and better the electric railway system the greater the certainty of saving in this direction.

It is for this reason that large central station controlling companies are now found owning both light and traction systems, the central station supplying electrical energy for both light and power. Or it may be the case that the generating company, independent in itself, sells current to the traction companies as well as to subsidiary light companies. In Chicago there is an excellent example of a large central station—possibly the best example in the world—supplying current at a wholesale rate in bulk to the great street railway and elevated railway companies, while it supplies at retail, current for electric light to the business houses and residences, and also power for commercial use in factories and similar institutions.

In London there is in particular one great central station in the county of Essex which distributes electricity in bulk and sells it at a wholesale price to other companies which in turn sell it at retail. The big company in this case is not allowed to sell direct to the final user, it only deals with the wholesale supply. These facts are mentioned because it has been determined finally that in the long run the big power producer dealing in current and nothing else can produce more cheaply than even the large transportation companies with their own large stations.

It is the age of trolleys, East, West, North, and South. They are covering the country with a perfect network of interurban lines connecting up one with the other, absorbing and being absorbed, and they need and will need for a long time to come a big share of the public money.

In conclusion the success of electric traction lines depends mainly on the position they occupy as part of systems; the source of their electrical energy; elimination of small plants; character of the country traversed as to density of population; passenger traffic; relation of bonded indebtedness to earnings, and as is the case with every organization, the men conducting the enterprise.

# Where Electricity Stands in the Practice of Medicine

By NOBLE M. EBERHART, A. M., M. S., M. D.

## CHAPTER VIII.—MECHANO-THERAPY OR VIBRATION

Vibration, being in itself mechanical, would not come within the scope of this series were it not for the fact that it ordinarily requires electricity to produce it. Vibration is probably the most popular and most universally used of all of that group coming under the general term of physical or physiological methods. Stripped of all technicalities, the real value of vibration lies in its power to stimulate or soothe the action of the various functions or organs of the body. That is, it will stir up the nerves to renewed activity or quiet them if already too active. It will increase or decrease the blood-supply to a part, thus equalizing the circulation and doing away with congestion and inflammation. It stimulates the lymphatics or natural drainage channels of the system, thus eliminating poisonous or waste products.

### STIMULATION AND INHIBITION

It will be noted that I say it will either stimulate or soothe; in other words it produces two apparently opposite effects, which at first thought sounds ridiculous and impossible, but will be seen to be perfectly simple and reasonable with a word of explanation.

The first effect of vibration is to produce stimulation, that is to stir up the activity of the part to which it is applied or in the case of a nerve center of the part which it controls. If after this has occurred the stimulation is still kept up there comes a period when the nerve or other part becomes tired and relaxes or becomes numb or paralyzed. In other words, over-stimulation brings about a result the opposite of stimulation.

To this effect we give the name of inhibition. Therefore, in vibration we have at our command two remedies, as it were, stimulation and inhibition. The first we use when we wish to increase bodily activities; the second when we wish to relieve irritation or over-activity and produce a sedative or soothing effect.

### HOW OBTAINED

Just as the same-sized dose of medicine may have a somewhat different effect on different people, so it is with vibration. A slight application will produce stimulation in one person, but may be entirely insufficient for another. Or what will be necessary to stimulate one individual may be sufficient to have a sedative effect on another or even the same individual may vary somewhat at different times.

There is no fixed rule to tell us when we have reached the dividing line between stimulation and over-stimulation (inhibition). It is on this account that individual judgment and experience come to count for so much, and this is why some physicians succeed and others fail in the application of vibration.

The greatest danger the beginner has to contend with is the likelihood of producing inhibition when stimulation is his intention. As we have hosts of vibrators on the market, big, little and medium-sized, good, bad and indifferent, it is impossible to state in seconds more than an approximation of the time required to produce stimulation. In general the larger and heavier the machine, and the longer and stronger the stroke and the deeper the pressure, the quicker sufficient stimulation is obtained.

In an average individual with the largest machines stimulation will result in from two to five seconds; with medium sized machines 12 to 20 seconds; and with small vibrators from 40 seconds to two or three minutes.

With the largest machine, 20 to 40 seconds produces inhibition; 40 to 90 seconds with the medium vibrators, and from two or three up to several minutes with the small machines. In producing inhibition, speed counts, and some of the small machines produce it quickly by reason of their very great speed.

### WHERE APPLIED

Vibration may be applied to any part of the body. Ordinarily it is applied along each side of the spinal column to reach the nerve centers, and by influencing them, bring about the desired change in the organ or function controlled by them.

In order to understand this it is necessary to keep in mind the fact that the body contains two great nervous systems, the spinal and the sympathetic. The cerebro-spinal system consists of the brain, the spinal cord and the spinal nerves. This system presides over sensation and motion.

Roughly speaking there is a spinal nerve emerging on each side, between each joint of the spine.

The sympathetic system consists of numerous nerve-centers lying in front of the spine on either side, with their connecting nerves. It also has an especially large nerve center in the chest, abdomen and pelvis and smaller ones connected with the principal abdominal organs. For example, the solar plexus, is the great sympathetic nerve center which lies back of the stomach and which the late Byron Robinson called the "abdominal brain." The sympathetic nerves control secretion, excretion, the muscles surrounding the blood-vessels, digestion, absorption, growth, etc.

The spinal centers and the sympathetic centers in front are connected by communicating branches, (called *rami communicantes*). On this account vibration to a spinal center also penetrates to and affects the corresponding sympathetic center.

### CONTROLLING THE CIRCULATION

The most important centers for our consideration are those known as the vasomotor centers, because they control the muscles surrounding the blood-vessels and through causing the latter to contract or relax as the case may be, we regulate the blood-supply to an organ or part, or, as suggested before, we *equalize the circulation*. The importance of this is not to be under-estimated and if we could do *practically* what we *theoretically* have the means of doing with vibration, it would prove almost a panacea for many ailments. Actually we fail frequently in trying to put our thoery into practice, but not so often that it causes us to lose confidence in vibration. The fault lies with the individual more than with the method.

### SPINAL APPLICATION

When an organ or function is over-sensi-

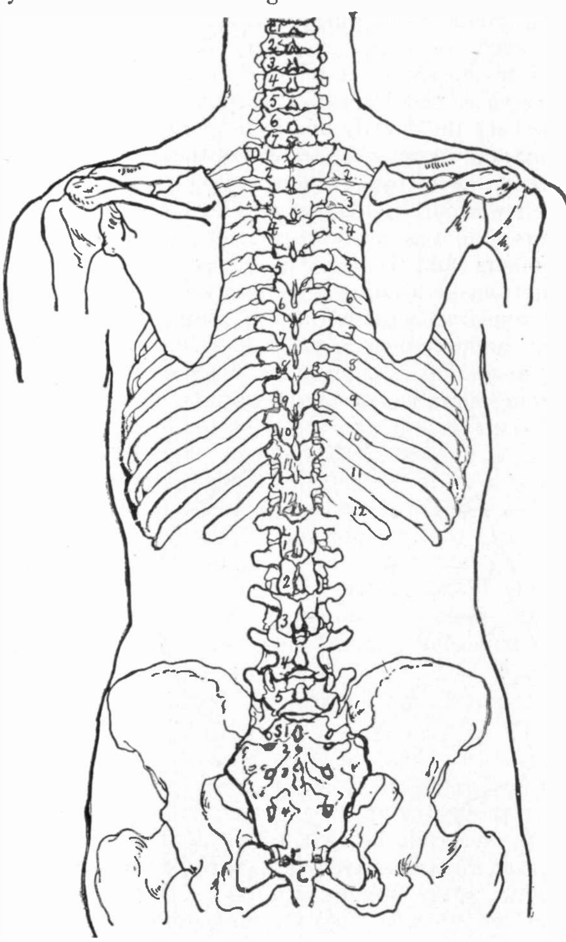


CHART FOR APPLYING VIBRATION

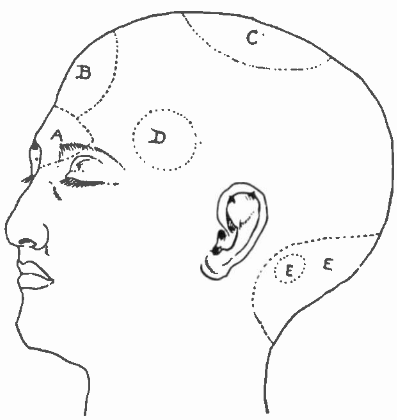
tive or irritated, the condition usually communicates itself to the corresponding nerve-center and on applying the vibrator along the spine in these cases these centers will be found tender and sensitive. When such a condition exists it indicates the need of a long application of vibration to each of these places until the tenderness disappears. In other words we wish to inhibit these centers and thus quiet the part they control.

### VIBRO-MASSAGE

In addition to spinal treatment vibration is applied locally over various areas and organs to produce local stimulation or sedation as required. When vibration is applied with a stroking motion instead of holding steadily over a spot, we call it vibro-massage because it is essentially a combination of vibration and massage.

By referring to the outline drawing, the various joints of the spine are shown. They are called vertebræ (singular, vertebra). Those in the region of the neck are called the cervical vertebræ; in the upper part of the back the dorsal; and in the lower the lumbar and sacral, while the end of the spine is called the coccyx. The seventh cervical at the lower part of the neck has so large a process that it is easily distinguished from the others and is used as a point to count from in locating other centers.

In applying vibration to the spine the thumb or fore-finger is pressed against the bony projection or point on the back of the vertebra known as the spinous process, while




POINTS TO APPLY THE VIBRATOR ON THE SCALP FOR HEADACHES

with the right hand the applicator is pressed down firmly along side of it; first on one side and then on the other.

By means of the figures on the various segments in the illustration it will be easy for the physician to follow the directions given hereafter for vibrating the spine in various diseases.

APPLICATORS

That part of the vibrator which is held against the body is called the applicator. It is also known as the vibratode, a word constructed to show its analogy to the word electrode.

Although there are many types of vibrators on the market, they all employ certain general forms of applicators. Of these we will consider four: the ball, the disk, the brush and the cup.

The ball applicator is used for spinal work. The disk, if small, is sometimes substituted for the ball and if larger is used over the muscles, chest, or abdomen. The brush is of soft rubber having a number of teeth or small points. It is intended for use over various body surfaces. The rubber cup is used in facial massage, over the ear in deafness, and occasionally in place of the brush.

GENERAL TECNINQUE

In order to apply vibration to the spine a sufficient amount of clothing must be removed to give free access to it. In men, this usually means the taking off of coat, vest, collar and suspenders. In women it is frequently necessary to remove the corsets, and a very satisfactory method is to have the patient come to the office wearing a kimono, or have one that she may slip on during the treatment.

The patient is placed face downwards on a narrow table or couch, and if possible the arms should be brought down under the table in order to separate the shoulder-blades as much as possible and thus further facilitate reaching the spinal centers.

It occasionally requires the additional use of a cushion under chest or abdomen to still further relax the spine. The necessary centers are then located with the thumb or forefinger of the left hand and vibration applied as required.

When the object is inhibition the applicator remains for some time over each center, especially until any tenderness present has entirely disappeared.

The approximate time has been suggested previously. In case stimulation is the object the following method will enable the operator to obtain a sufficient amount of stimulation without much risk of producing inhibition.

Suppose the centers to be treated are the second to ninth dorsal. Locate the spinous process of the second dorsal joint of the spine, and press the ball applicator firmly down on the right side of it for the length of time suggested for your particular vibrator. If it is a medium-sized flexible shaft machine the time would be 12 to 20 seconds. I would hold it in place while I slowly counted to myself up to 15, then I would place it on the corresponding location to the left of my thumb and count 15 again. Just before finishing the count I would slide my thumb down to the projecting process of the third dorsal vertebra and be ready to apply the vibratode first on the right and then on the left of it and so on down to and including the ninth dorsal. Then I would go back to the second and repeat the whole process over again, doing this from two or three up to a dozen times according to the amount of stimulation I believed the individual case required. By this method each center receives a sufficient amount of stimulation, but by reason of the period of time intervening between each additional application to the same center we have interrupted stimulation, and so the result is thorough stimulation without inhibition.

If the center received the total application without any intervening period of time, the result would be over-stimulation or inhibition. When treatment is applied to the abdomen, the patient lies on the back with the legs drawn up in order to thoroughly relax the abdominal muscles. In some instances it is unnecessary to have the patient recline and they may be treated while sitting on a stool.

### CAUTIONS

There are some instances where vibration should not be used.

A vigorous treatment should not be given immediately after a hearty meal.

One should not vibrate over a cancer or other malignant growth.

When an abscess exists or any condition where pus is under tension, vibration may rupture the sack or otherwise spread the infection.

If the patient has an advanced case of arterio-sclerosis and the blood-vessels are very brittle vibration if used at all must be employed with great care or arteries may be ruptured by it.

Except for this danger it is useful in arterio-sclerosis because it may be employed to stimulate the peripheral circulation.

### REFERRED PAINS

It has been observed that pains arising from disturbances of various organs are referred to certain centers in the spine. For instance, if from the heart, it will be the first, second and third dorsal centers. Treatment is thereby shown to be necessary over these points in the spine and should be of a prolonged or inhibitory character.

Some organs with the centers where pain is noticed are as follows, the numbers indicate the locations to vibrate as shown in in the first illustration.

Lungs—1, 2, 3, 4, 5, dorsal.

Stomach—6, 7, 8, 9, dorsal.

Spleen—5, 6, 7, 8, 9, dorsal (left side).

Liver—7, 8, 9, 10, dorsal (right side especially).

Kidneys—10, 11, 12, dorsal, and 1 lumbar.

To regulate the circulation in these same organs requires the treatment of additional centers, but space forbids going into this subject.

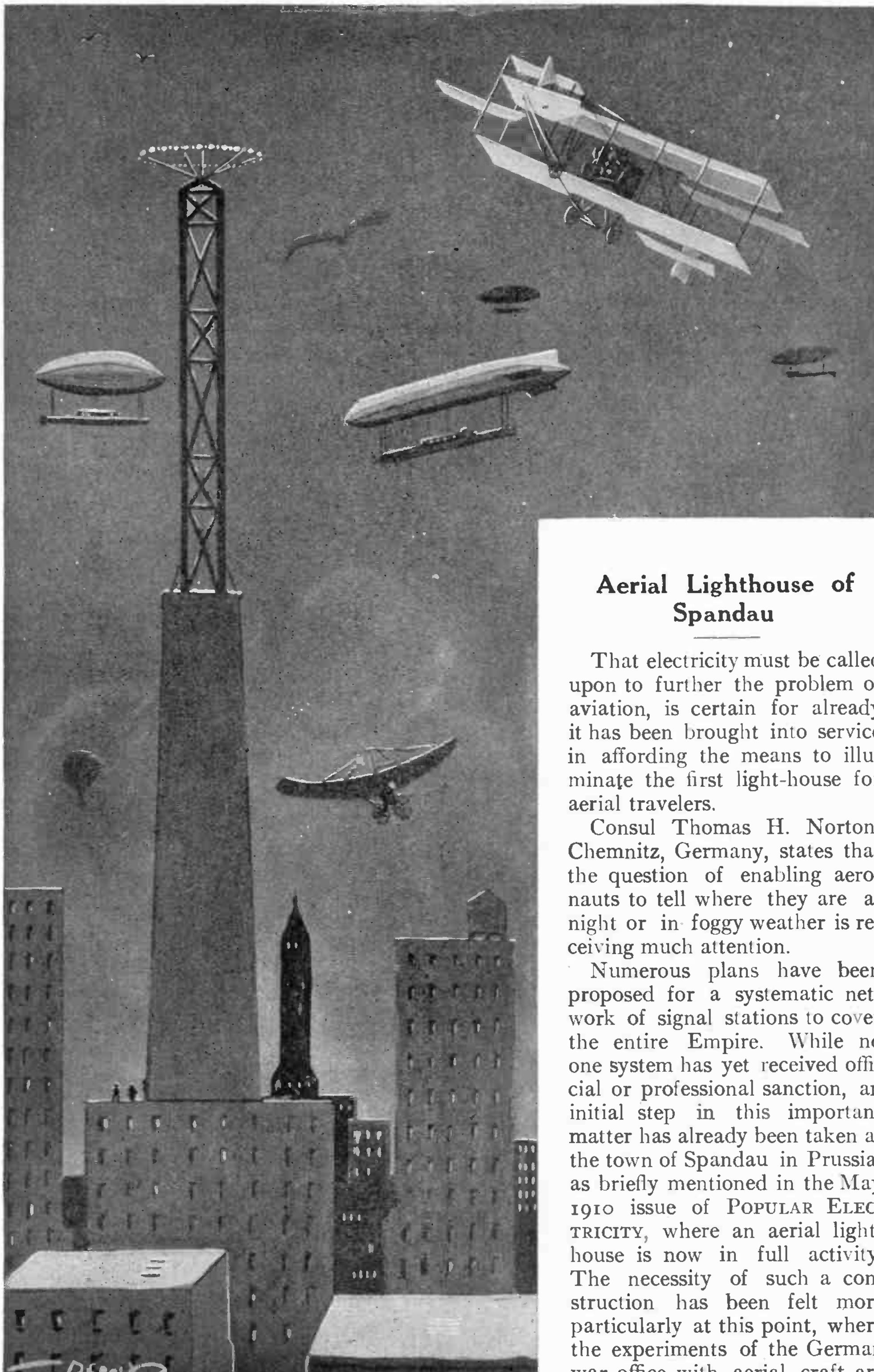
### THE STROKE

If the vibrator delivers a tapping or pounding stroke, it is called percussion. The percussion stroke is always employed in spinal stimulation and inhibition.

The lateral stroke is one from side to side and the rotary or gyrating stroke is one which is of a circular nature. Either of these may be employed over body surfaces or in cavities.

Some vibrators give a rotary stroke as their natural stroke and to obtain percussion with them it is necessary to turn the machine so that the side of the ball gives the stroke.

(To be Continued.)



## Aerial Lighthouse of Spandau

That electricity must be called upon to further the problem of aviation, is certain for already it has been brought into service in affording the means to illuminate the first light-house for aerial travelers.

Consul Thomas H. Norton, Chemnitz, Germany, states that the question of enabling aeronauts to tell where they are at night or in foggy weather is receiving much attention.

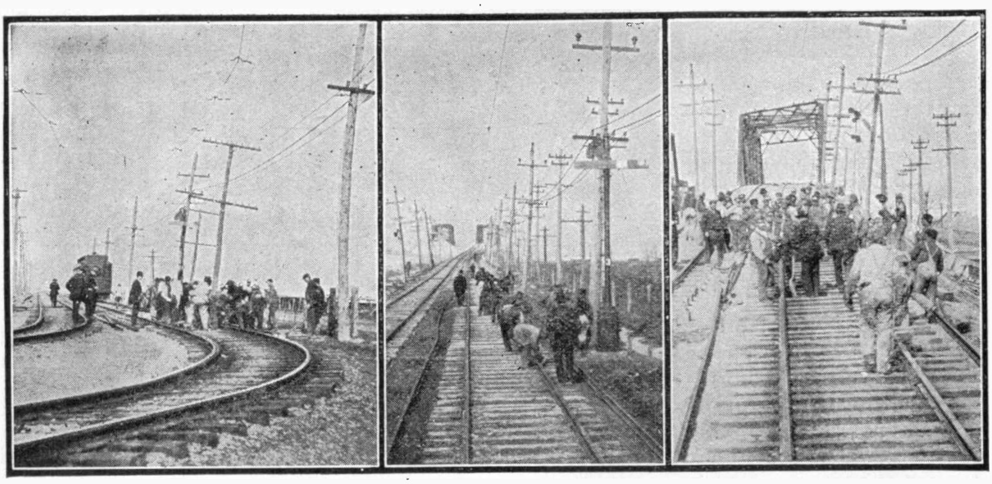
Numerous plans have been proposed for a systematic network of signal stations to cover the entire Empire. While no one system has yet received official or professional sanction, an initial step in this important matter has already been taken at the town of Spandau in Prussia, as briefly mentioned in the May 1910 issue of POPULAR ELECTRICITY, where an aerial lighthouse is now in full activity. The necessity of such a construction has been felt more particularly at this point, where the experiments of the German war office with aerial craft are largely conducted and nocturnal flights are increasingly frequent.

This pioneer beacon for aerial guidance is comparatively simple as shown by the artist's conception of its outlines. It consists of an elevated support on which rests, in a horizontal position, a wooden ring of considerable diameter; 38 powerful incandescent electric lights are placed at equal distances about the circumference, and there is an automatic arrangement for interrupting the current, at regular intervals, for a short period.

The location of Spandau is thus clearly indicated to a traveler passing over the place, by a large luminous circle, alternately disappearing and reappearing. While this device answers admirably for the needs of aeronauts during the night, it is of little or no use when fog prevails at any time. For such contingencies it will be necessary to install a siren or similar apparatus.

## Record in Track Laying

Without delaying the schedule and in just 21 minutes and two seconds 3,720 feet of 56-pound rails weighing 69,440 pounds were replaced by 86,800 pounds of 70-pound rails. This was on the Lake Shore and Northern Railroad in Syracuse, N. Y., near the Syracuse railroad junction bridge, where the interurban also uses the tracks. The rails to be laid were bonded together and placed beside the rails to be removed. The crew began work at 9:13:10 A. M. and finished at 9:34:12 A. M., during which time 78 tons of steel rails were handled and a remarkable record established in track laying.



THE START HALF WAY THE LAST TWO RAILS DOWN
RECORD IN TRACK LAYING

## Telephoning from London to Paris

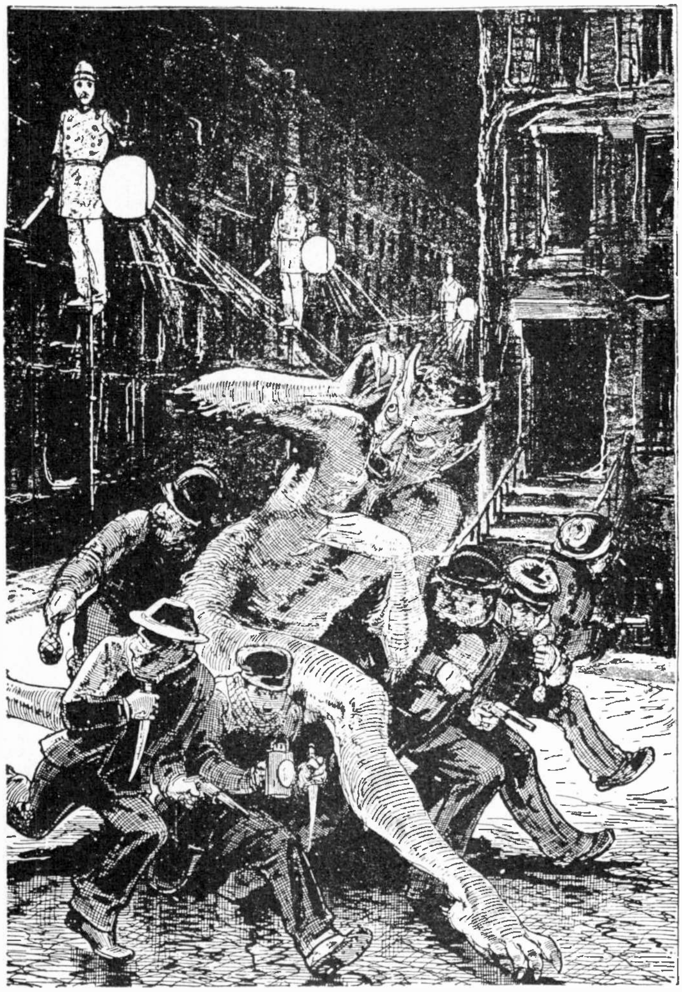
Talking by telephone between Chicago and New York is very common, and in keeping with this, steps are now being taken to establish direct telephone communication between Liverpool and Germany. At the present time, for a fee of $1.95 any one will be given service for three minutes between Liverpool and Paris, Brussels, and many adjacent smaller towns. Reduced rates are allowed for service at night.

## Want Electricity from Sun's Rays

Several persons residing in the Persian Gulf region have requested an American consul to furnish them the names of American concerns manufacturing an apparatus for utilizing the energy of the sun's rays for generating electricity. On account of the great amount and intensity of sunlight in that region such an apparatus would be exceedingly useful. If such a mechanism capable of running an electric fan and of storing up enough power to keep it going at night can be furnished at a moderate cost a great many sales could be effected. Such an apparatus might also be adapted to a variety of uses.

## Light as An Aid to Civilization

Light is the greatest enemy of criminals and evil doers. A city lighted well is a city well policed for it may almost be said that an arc lamp is as good as a policeman any night. That this fact was fully realized in the very beginning of electrical development, as we know it today, is shown by an old woodcut here reproduced from the *Electrical Review* of March 7, 1885. They were just beginning to think about central stations and electric street lighting systems in those days and undoubtedly the argument "light prevents crime" was as effectively used then as now.



ELECTRIC LIGHT AS AN AID TO CIVILIZATION

## Police Tickers in Berlin

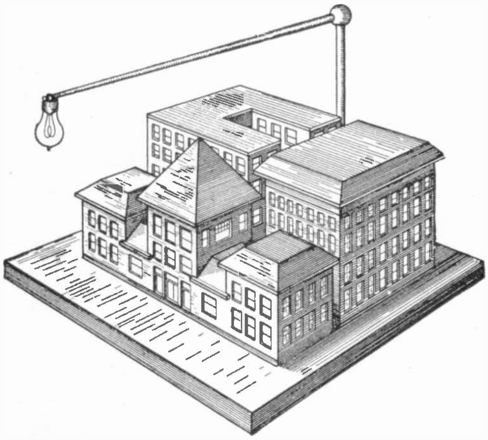
A new use has been found for the telegraphic typewriters or printing telegraphs which have long done service for stock brokers in the larger cities and which we commonly call "stock tickers." The police department of Berlin has recently equipped every police station in both the city and its immediate suburbs with such a ticker for the simultaneous transmission of orders and messages of all kinds from the police headquarters. In this way any important information (as for instance a description of someone who has disappeared with his employer's funds) can readily be transmitted to nearly two hundred points and received at each without requiring some one to answer a telephone call and without the risk of errors in recording the messages. The instruments as installed at Berlin are connected in series on a metallic circuit and record the messages on wide strips which remind one of the column galleys of our newspapers.

## A Safe Explosive

A new explosive which is being tried in connection with the building of the Panama Canal consists chiefly of perchlorate of ammonia, nitrate of soda and paraffine. The latter makes it water-proof and the explosive is said to be nearly 50 per cent stronger in disruptive power than dynamite, although less costly. But the greatest advantage claimed for it lies in its greater safety, as ordinary warming, matches or hammer blows will not set it off. The only way to explode it is by the high heat of a platinum wire connected to a battery; in other words, it is an explosive that can only be fired electrically.

## Lighting Architectural Models

In residence districts where each house has plenty of space on all sides, it is easy enough for the architect to plan each room so that it will receive ample sunlight. The moment we crowd the buildings closer together, this problem grows more difficult, and when we get into congested city districts it is often puzzling to predict just to what extent the sunlight will have access to certain windows at various seasons of the year.



HOW THE ARCHITECT LIGHTS HIS MODEL

To avoid guesswork on so important a theme, Prof. Eugene Hoenig of Munich has started the practice of trying an imitation sun on models of the buildings designed by him, so as to tell at a glance where the light will fall when the sun is in various positions. For this purpose he fastens a small incandescent lamp to the end of an arm which can be swung in an arc above a table, corresponding to the arched path of the sun, the height and swing of the arc being easily varied to match the sun's course at different seasons of the year. On this table he sets a clay or plaster-of-paris model of his building, moulded in 1-500 or 1-1000 of the actual dimensions, sometimes adding such parts of adjoining buildings as might cast shadows on the proposed structure. Then by swinging the model sun through its arc he can see at a glance to what extent the sunlight would enter the courts of the building and what changes, if any, should be made to secure better lighting and ventilation in case the model shows an unintended screening of certain windows from the sun.

## Billions in the Electrical Industry

From the Bureau of the Census comes a very interesting statistical report dealing with the development of electrical properties. The report was prepared under the supervision of Chief Statistician William H. Steuart, assisted by T. Commerford Martin, of New York as consulting expert special agent on the part dealing with the technical features of the electric railway industry. It is not a report of the year 1910 but of 1907, the collection and compilation of the data being such a huge task that it is impossible to keep these reports up to the minute. The figures are, however, none the less interesting.

In the year for which the statistics were gathered there were 30,000 individuals, companies, corporations and municipalities, exclusive of isolated electric plants, which reported the generation or utilization of electric current in what may be called "commercial enterprises."

Statistician Steuart has found that these industries represent the outstanding capitalization of $6,209,746,753, of which amount $1,367,338,836 is credited to central electric stations, $3,774,722,096 to electric railways, $814,616,004 to commercial or mutual telephone companies, and $253,019,817 to telegraph companies, the latter item including $32,726,242, the capital stock of wireless telegraph companies.

It is stated in the government report that the capitalization of the 17,702 independent, rural telephone lines and of the 1,157 electric police patrol and fire alarm systems could not be ascertained. It is set forth as well that there are also excluded a number of companies organized for the purpose of acquiring the capital stock or bonds of electric companies, to hold it for investment purposes, and to some extent supervise the operation of the underlying companies.

There is noted by the government officials an increasing tendency by electric railway companies to sell electricity for general commercial purposes. In 1902 there were 251 railway companies that furnished electricity for light, power and other purposes. These companies reported an aggregate income of $7,703,574 from the sale of current. In 1907 there were 330 railway companies in this class.

In 1902 the annual output of all electric stations and electric railways amounted to

4,768,535,512 kilowatt hours. In 1907 the output of the two classes of stations was 10,621,406,837 kilowatt hours, the increase in that year as compared with 1902 being 5,852,871,325 kilowatt hours, or 122.7 per cent. In 1902 the output by electric roads formed 47.4 percent of the total, and by 1907 proportion for such railways had fallen to 44.9 per cent.

In 1907 the total number of miles of street and interurban railway lines, by which is meant length of first main track or roadbed, was 25,547.19, as compared with 16,645.34 in 1902, the per cent of increase being 53.5. The total number of miles of track, meaning the total length of all trackage, including sidings, was 34,403.56 in 1907, as against 22,576.99 in 1902, the per cent of increase amounting to 52.4. Of the total number of miles of track, those operated by electricity in 1907 numbered 34,059.69 and in 1902, 21,907.59. The per cent of increase was 55.5. The trackage operated by animal power in 1907 was 136.11 and in 1902, 259.10. The per cent of decrease amounted to 47.5. The trackage operated by cable in 1907 was 61.71 and in 1902, 240.69, the per cent of decrease being 74.4. The trackage operated by steam in 1907 was 146.05 and in 1902, 169.61, a decrease of 13.9 per cent.

## Lamps Delivered by Auto

The accompanying illustration shows a unique auto-carrier utilized in London for delivering Ediswan electric lamps. It is of light construction designed so as to have little or no vibration for damaging the lamps having delicate filaments.

This English auto-carrier is provided with a gasoline motor of from five to six horse

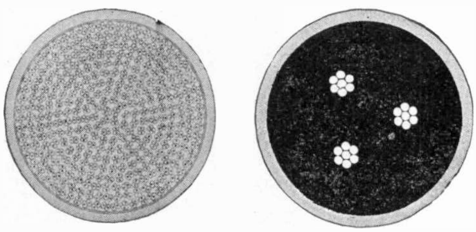

DELIVERING LAMPS IN LONDON

power capacity, having two large external fly-wheels which give great flexibility and steady running.

The fuel tank has a capacity of 2¼ gallons which is sufficient for 75 to 100 miles and is fitted with a special by-pass arrangement for giving due warning when the gasoline is getting low in the tank. It is stated that in actual practice these British vehicles average from 40 to 50 miles per gallon of fuel consumption operating about 100 miles daily, the cost of operation being less than three cents per mile or about $15.00 per week for a distance of 450 to 500 miles.

## How Many Wires in a Cable

If you watch the men drawing a lead covered cable into the conduits which form a network under our city streets, it usually is not long before you hear some one ask:

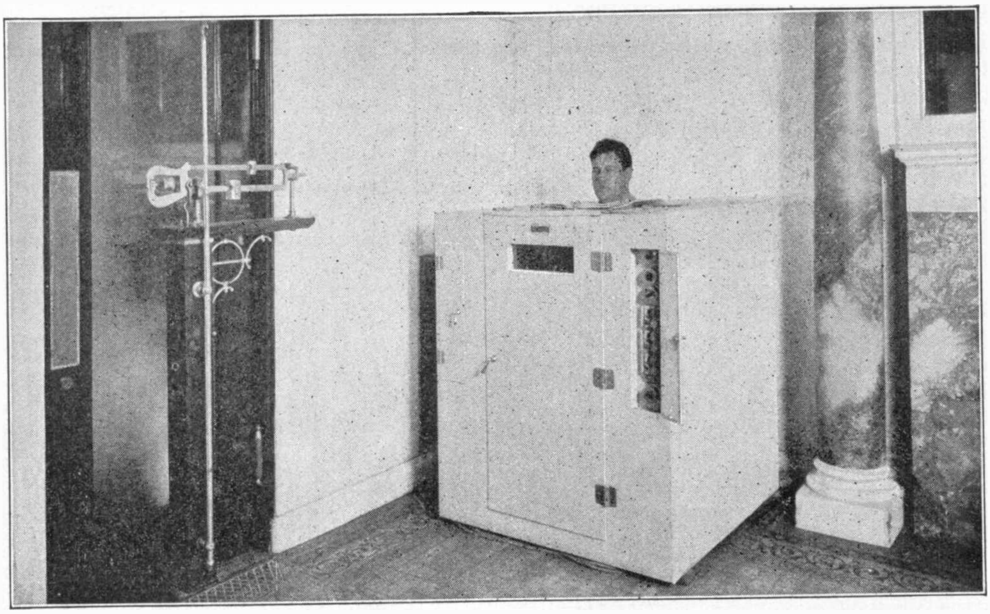


SOME DIFFERENCE IN THE NUMBER OF WIRES

"How many wires are there in the cable?" That there may be some variation in the number of the wires, is easily guessed, but few realize how wide the discrepancy in the number of imbedded wires may be. The two sections shown in our illustrations are by no means the extremes, but give some idea of the range. One is of a telephone cable containing 26 dozen pairs or 624 wires, each pair wrapped with paraffined paper and the whole intertwined in such a way that plenty of air space is left between the wires. The other pictures a 20,000-volt cable for a three-phase power transmission circuit such as is used for conveying power from the central stations to the scattered distributing stations in some of our large cities. This has the copper cables embedded in a solid mass of rubber or gutta percha, with no air spaces whatever, the number of conductors being only three instead of 624.

## A Miniature Hot-room

As an addition to the already complete equipment in the bath department, the Chicago Athletic Association has provided an electric light bath cabinet. This is not to serve as a substitute for the hot-room but is an added feature. While the hot-room, the first process in a Turkish bath, causes the body to perspire freely, the electric bath cabinet accomplishes the same thing besides applying the stimulating and germicidal effect of what physicians acknowledge as next to the sun's rays in beneficial results—the light from electric lamps.



ELECTRIC LIGHT CABINET FOR ATHLETES

The interior of the cabinet is lined with rows of 16-candle-power incandescent lamps, 64 in all, back of which are mirrors for throwing the light upon the bather. In addition to this a portion of the floor is of glass, underneath which are more lamps and reflectors. The cabinet is finished in white enamel and the control switches are located as shown by the open door. Many of our readers will recognize as the bather, Mr. Frank Kehoe, a swimmer of national reputation, holding many records. Through his efforts as coach and captain of the water polo team of the Association the polo championship was recently won from the New York Athletic Club.

## Banquet at Long Beach

Long Beach, Calif., will have a great electric plant, to be built by the California Edison Company, and which will ultimately develop 150,000 to 200,000 horse-power and cost in the neighborhood of $10,000,000. The citizens are highly pleased at the prospect and recently entertained the officials at a banquet. The affair was held in the dining room of the Hotel Virginia and in harmony with the nature of the banquet the room was elaborately decorated with 25,000 small colored electric lights and four electrical fountains. At the entrance to the banquet hall, the guests were confronted with a revolving electric wheel which at ten-minute intervals stopped, all the lights going out but those which spelled the word "Edison."

## Russian Electrical Railway Exposition

Under the auspices of the Imperial Russian Technical Society, an international exhibition having for its object the education of the public to the present state of electricity as applied to railways will be held in St. Petersburg opening Aug. 15 and continuing for three months. Foreign as well as Russian exhibitors will participate.

# Talks With the Judge

## THE TRANSFORMER

"What is a transformer?" asked the Judge. "The electrician was at my place the other day fixing a lamp socket in the bathroom and he said that it wasn't always a good plan to stand in the bath tub and turn on the electric light. In explanation he went on at great length with a strange lot of lingo about how it might be barely possible for some accident to happen to the transformer insulation so that the primary and secondary might come in contact, and how the secondary might not be grounded right, and how it might be possible under those conditions to get the current under the full primary voltage from the lamp through one's body to ground through the water pipes. I didn't understand what he was talking about, but maybe you can explain what this transformer is."

"From what the electrician told you I suppose you have transformers and bath tubs in some way connected in your mind," I replied. "But the little warning which he gave you was only incidental. There is the barest chance in the world that an accident would happen as he explained that it might, but don't let that hinder you from taking your regular baths.

"A transformer is a very simple device for raising or lowering the voltage of an alternating current. You will remember that I told you once that alternating current flows first in one direction and then in the opposite many times per second. Also you understand that voltage in an electrical circuit corresponds to pressure or pounds per square inch in a water pipe system.

"Now I will explain in a very elementary way what a transformer is and why it is used. When electric current is made at a central station it is generated at a high voltage or pressure because then the energy can be transmitted long distances over comparatively small wires, just in the same way that you could send a great many gallons of water per minute through a small pipe if you had sufficient pressure back of it. In this way they save copper, which is very expensive.

"But when the central station company gets the high-voltage current to your door or to a group of houses which it wishes to light it dares not bring the high-voltage inside for it is dangerous—it is liable to puncture ordinary insulation and get away. So transformers are brought into requisition to "step the voltage down" as electricians say, to a low pressure of about 110 volts, which is not dangerous.

Not a Good Plan to Turn on the Light from the Bath Tub.

"In principle, the transformer which does this is very simple. It consists first of a coil of wire of a great many turns wound around a core of iron. This coil is called the primary winding of the transformer. It is very carefully insulated from the core, and the turns of wire in the coil from each other. The two ends of this wire are connected to the two wires of the high-voltage line coming from the distant power distributing point.

"Over the primary coil is wound what is known as the "secondary." The secondary is entirely insulated from the primary and makes no connection with it whatever. To this secondary coil are connected the wires which lead into your house. Now the very peculiar action which takes place is this: When you send an alternating current through the primary of the transformer, and the pulsations of the current and voltage rise and fall, rise and fall in rapidly concurring cycles a current is 'induced' in the secondary although the two windings are not connected. And stranger still, the ratio of the voltage of the current in the secondary and primary is directly proportional to the ratio of the turns of wire in the two coils. That is to say:

suppose the current in the primary (power station current) is at a pressure of 11,000 volts, and the number of turns of wire in the primary winding is 10,000. And suppose the number of turns in the secondary is 100. Then the pressure of the current in the secondary, the pressure at which current will enter your house, is 110 volts. Stated in the form of a proportion. The voltage of the current in the primary is to the voltage of the current in the secondary as the number of turns in the primary is to the number of turns in the secondary.

"A transformer used as just described is known as a 'step-down' transformer with a '100 to 1' ratio. If you were to connect the high tension wires to the coil of the small number of turns and your feed wires to the coil of the high number of turns it would become a 'step-up' transformer and the voltage of the current delivered would be 100 times as high as the voltage impressed or 1,100,000, only of course this wouldn't be practicable with a transformer of ordinary design, as it would burn out.

"When alternating current came into use and the transformer was developed, together they revolutionized the electrical business. Then it became possible to transmit current long distances, hundreds of miles. Big transformers are installed in the water power plants far off in the wilderness. They step the pressure up to enormous voltages—20, 50, 110 thousand volts maybe. Then reasonably small wires of copper or aluminum which will not bankrupt the company to string, can be used to transmit the energy miles and miles away to civilization.

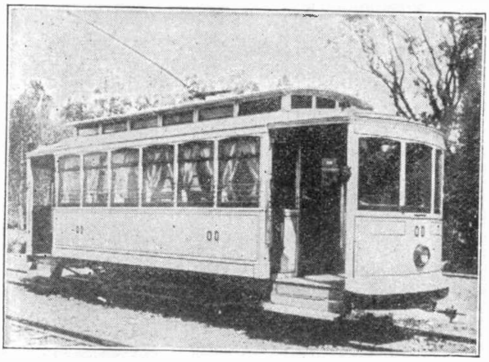
"The transformer has also made practicable the great central power plants in our large cities which generate vast quantities of electricity at from 11,000 to 33,000 volts and transmit it economically to out-lying substations where it is stepped down to an intermediate voltage by special machines, then transmitted to small transformers seen on the poles about the district, where it is finally stepped down to a pressure available for consumption.

"Again transformers have made long interurban electric railways possible.

"The principle of all static transformers is the same, as just described. They are made in a great range of sizes, however, from the tiny ones which ring your door-bell to the gigantic coils in steel cases standing two or three times as high as a man's head."

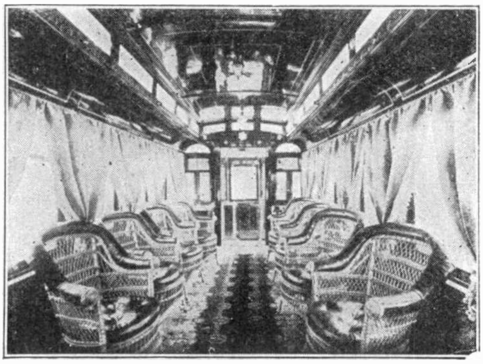
## Private Car of President Diaz

President Porfirio Diaz is provided with a handsome private car by the Mexican Tramways Company which operates an extensive system of electric railway in the City of Mexico and the Federal District. This car was



CAR OF PRESIDENT DIAZ

built specially for the private use of President Diaz and is kept constantly at his command. It is fitted up and furnished in luxuriant style. The president uses the car chiefly when he desires to make a visit to a portion



LUXURIOUS INTERIOR OF THE CAR

of the city or Federal District which is not easily accessible by carriage or automobile. He is a great lover of horses and takes no little pleasure in riding behind his spanking team hitched to the presidential carriage. But of course the use of a carriage in these days is limited. As he has never taken to the automobile as a means of conveyance, although he rides in them frequently when his time demands that a hurried trip be made, the car was provided for the longer journeys.

## Baseball Electric Score Board

Cleopatra dropped her most precious pearl into a bath of grape juice, then drank both, and the history of woman since that day shows her ever ready to pawn her jewels to buy her heart's desire. But to make use of the national "diamond" for any other purpose than to play the national game upon, found its initiative in the construction of the World Advertising Company's electric score board at the Cub National League Ball Park out on the West Side in Chicago. The board is 150 feet in length by 24 feet high, built of angle iron and sheet steel resting on a concrete foundation. As is evident, its primary object is to give information to the 700,000 fans who attend the season's games by placing in the center of the board, as shown, all the data necessary to keep track of the game while it is in progress. Incidentally (?) it carries the short, crisp stories of a great number of national advertisers.

HOW THE SCORE BOARD IS OPERATED

The little section of the board which most interests the fans records the balls, strikes and outs, gives the number of the batter, pitcher, catcher and umpire, and also keeps an accurate record of the games played by clubs on other grounds in their respective leagues. With this valuable addition to the baseball game there will be no further difficulty in understanding the decisions of the umpire which appear on the board the instant

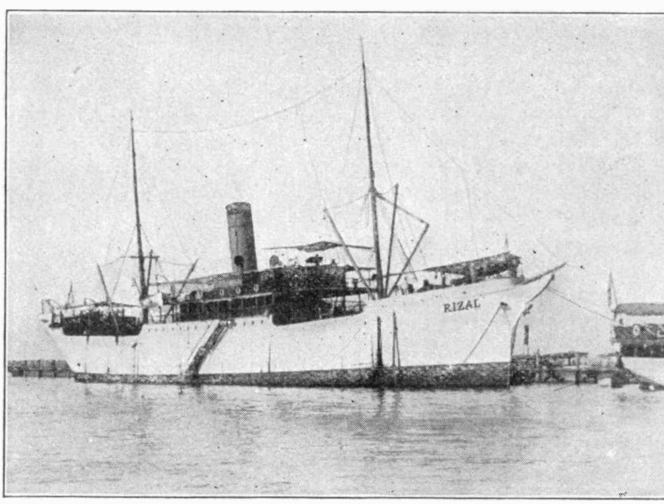

THE ELECTRIC SCORE BOARD

they are given. On the score card all the players' names are placed, and each is given a number ("13" being omitted) beginning with the rotation of the batting order and going down the list, including all the extra batters. To keep informed as to what has taken place at all stages of the game, a score card is of vital importance to the spectator, because the numbers as they appear on the score board correspond to the numbers on the score card, and the score board assists in keeping a correct card.

This is all controlled by the young man you see sitting in front of the desk switchboard in the press box. He is just about to push the button to show on the score board that batter No. 3 is up. As he does this a magnet on the back of the board over yonder is energized, attracting its armature which releases a plate that turns over on a small shaft and shows the number "3" which is painted on one side of the plate. When this number is no longer needed the plate is turned half over again by pushing the button. Each number is controlled by a separate button and circuit from the switchboard and the shaft on which the plate turns is operated by a weight and train of gears on the back of the score board after the manner of the old fashioned clock.

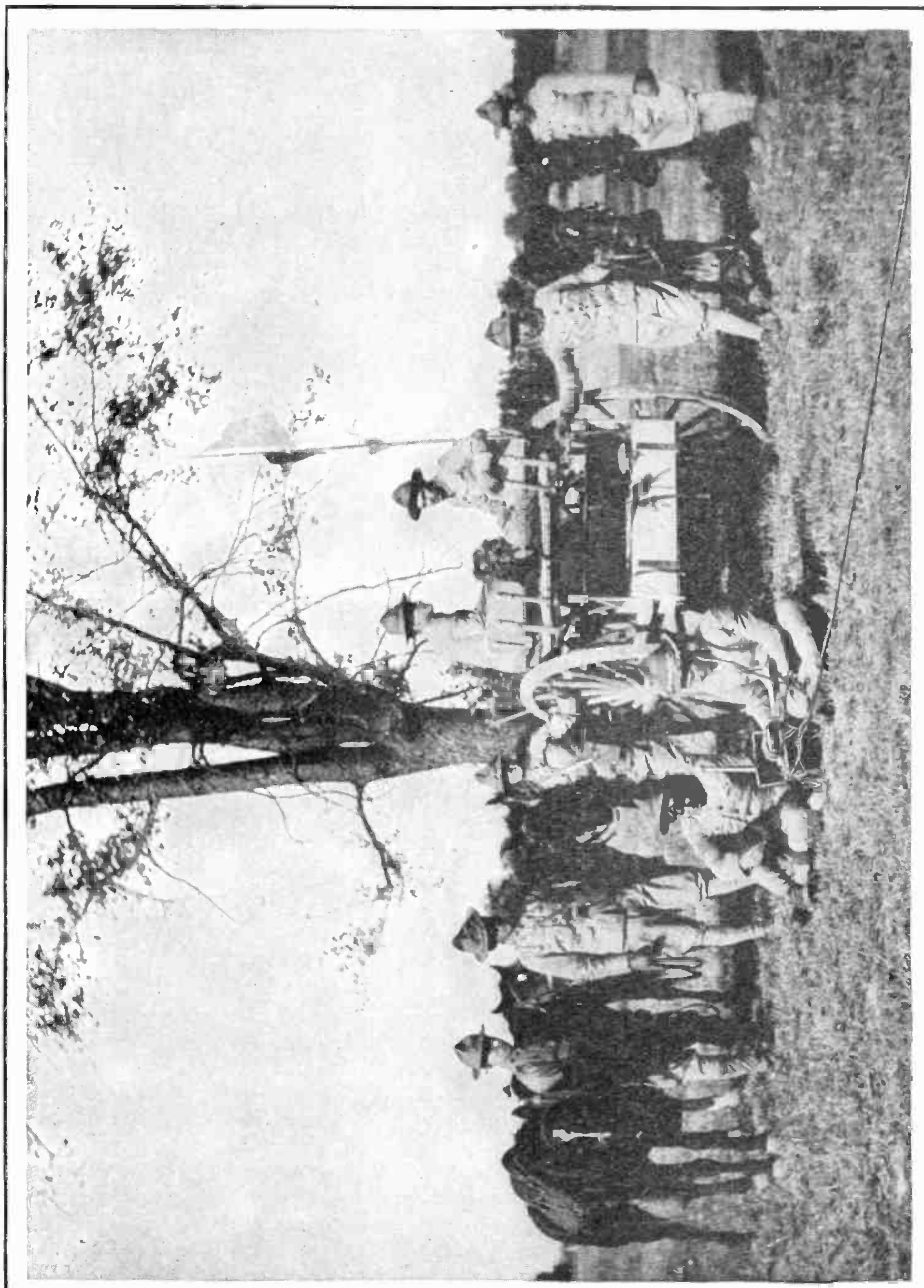
## New Philippine Cable Ships

The telegraph and cable systems of the Philippine archipelago in the days of the Spaniard were not very extensive. The provincial capitals were connected with Manila by wire, but few other, if any, of the outside cities enjoyed the distinction. After American occupation one of the first tasks of the army was to string telegraph wires to every nook and corner of any importance. Thousands of miles were strung into the interior. This vast system about two years ago was turned over to the civil government to become, under the head of communication, a part of the Bureau of Posts, or as we know it, the Post Office Department.



THE CABLE SHIP RIZAL IN PHILIPPINE WATERS

Upon our arrival the only inter-island cable system, connecting the many islands with one another, was that of the Eastern Australasia Telegraph and Cable company. It was over these cables that Dewey sent and received his instructions after the battle of Manila Bay. The cable system was also enlarged and bettered, the army laying many new lines of its own in connection with those of the commercial company, A big army transport, the Burnside, was fitted up as a cable steamer, manned with an expert crew of electricians. Later she was sent to the United States for similar service on the Pacific and Alaskan coasts. The Burnside was replaced in the Philippine work by another army transport, the Liscum. This vessel, after the cable and telegraph systems were turned over to the civil government, continued in the work, being chartered by the Philippine government. But about a year ago the army concluded it could no longer spare the Liscum from her regular work, and the Philippine government was compelled to cast about for other ships. In the end the Basilan, a coast guard cutter, was remodelled and fitted for work as a cable steamer. Later the Rizal, a clipper bowed, yacht-like ship of British registry, was bought at Singapore.



Courtesy of Telephony

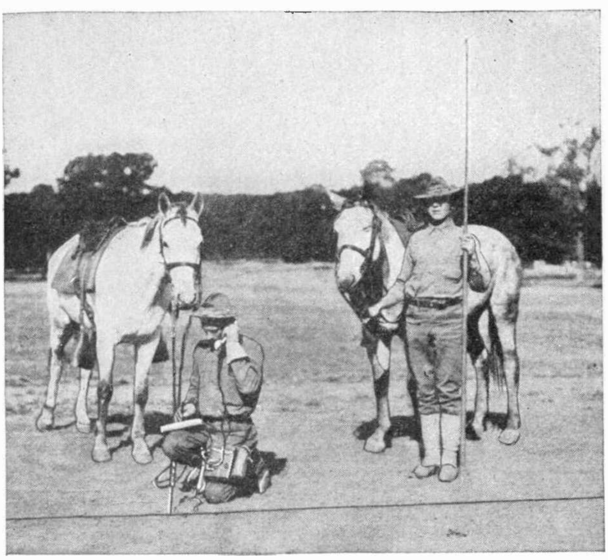
DETACHMENT OF THE ARMY SIGNAL CORPS COMMUNICATING WITH HEADQUARTERS

## Use of Army Telephones

Realizing that efficient telephone communication is as essential in the transaction of military business as in the commercial world, it has been the policy of the United States Army Signal Corps to install modern, underground, common-battery systems at the larger posts as rapidly as funds become available.

Such use of the telephone is more extensive than is generally known. During the last year a large number of camps and posts in the Philippines have had their systems remodeled or new ones installed, and 36 posts in this country have been provided with extended systems.

Rifle ranges at 57 posts have circuits to aid in target practice, and at eight of the largest posts of the army plans have been perfected and materials purchased for the installation of buzzer systems. These systems include a push button at each firing point which will ring a buzzer at the target fired at, additional telephone communication and special arrangements being provided, for sending signals to all targets during rapid fire.



*By Courtesy of Telephony*

TWO MEMBERS OF THE CORPS RECEIVING ORDERS

The large illustration shows a detachment from the Army Signal Corps establishing communication with headquarters by means of a field-telephone, while in the second picture two members of the corps are receiving orders over the field telephone line of special twin conductor seen lying on the ground.

## Shooting Without Ammunition

Ex-president Roosevelt once said "the shots that hit are the shots that count" and this thought is eternally uppermost in the mind of our army and navy. Good records upon the rifle range are much sought after by the men composing the organized teams, and while this target practice is expensive, results have proven it to be a wise expenditure.

To avoid this expense as well as the dangers accompanying target practice the Government has adopted a machine known as the "sub-target gun" which does away with actual firing yet gives the same results.

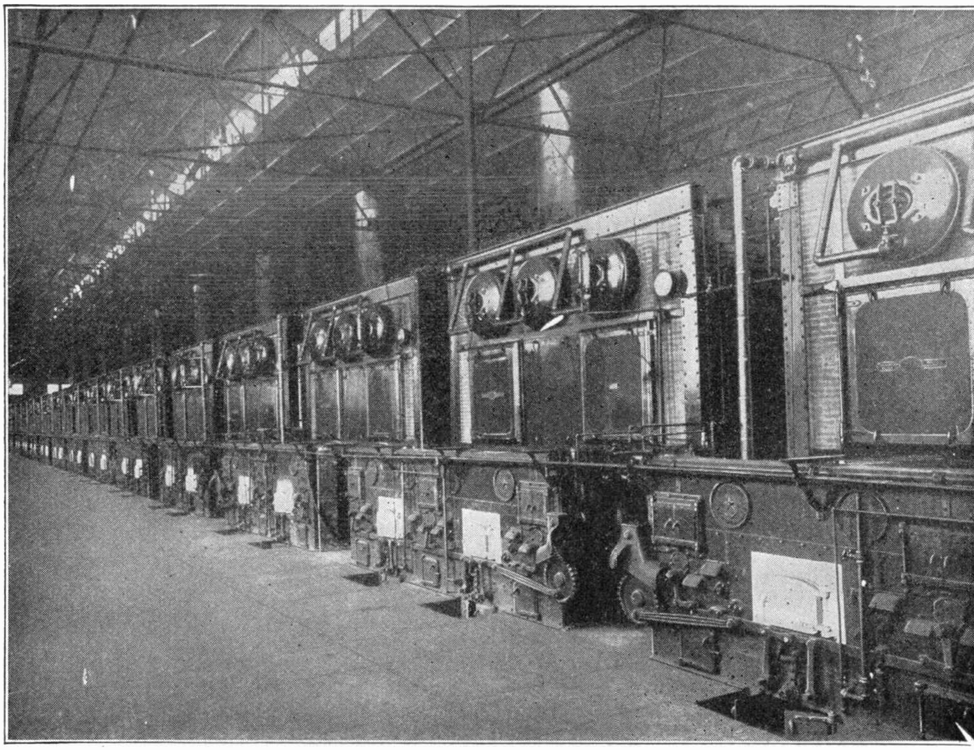
In a sense it is a rifle with a captive bullet the course of which can be followed from gun to target.

A target is placed about sixty feet from the marksman and his aim is taken at this with the weapon in connection with the apparatus upon which the records are made. No support for the gun or assistance is given the marksman by means of the machine, however, but his every movement be it ever so slight while taking aim, as well as the final result of his attempt to hit the bull's eye, are faithfully recorded upon a miniature target located on the machine.

No ammunition is used, the effect being produced by mechanical means. A needle operated by electricity pierces the small target in exactly the spot aimed by the marksman when the trigger is pulled. The apparatus is shown on the front cover of this issue.

The record shown by the small target is of the greatest value to an instructor, as it shows the cause of unsteadiness in taking aim and brings to light faults in manner of holding the weapon and discharging it as well as nervousness due to fear of report or recoil.

The War Department has already invested about $40,000 in the machines.



# A MODERN BOILER ROOM

If we were not told that the boilers in this picture use coal for fuel we would be quite unable to believe it to be the case, as piles of coal upon the floor, firemen busy with shovels heaving it upon the white-hot grates and the attendant dust which are so frequently the accompaniment of boiler rooms are here lacking.

Three plants of the Pittsburg Electric Street Railway Company are so operated that the coal for the 40 boilers in each plant is not handled by manual labor again after leaving the mines.

The coal arrives in freight cars and is dumped directly into the huge bins of the company. A small electric dump car controlled by the engineer from the power house comes down a tram track under one of the huge hoppers and the coal is automatically allowed to fill the car.

The engineer, by a simple movement, then turns the current on the car which starts for the boiler house, at the same time tripping a lever shutting off the flow of coal.

The car when it comes over the boiler supply hopper is automatically dumped on reaching its destination and then goes back for another load.

The coal is next forced into the furnace by automatic stokers and the ashes, shaken down by the automatic grate rockers, fall into another car similar to the first and are carried out to the dump.

In the power house of the company shown in the accompanying illustration only one man is required part of the time to look to the boilers and see that all of the supply hoppers are full. During the night shift however two and sometimes three men are used. It has been estimated that to do the work of the mechanical and electrical contrivances would require the continual services of a force of 38 men, whereas at the present time sometimes one and never more than three are required to operate the plant at its full capacity.

## Six Thousand Turns of a Switch

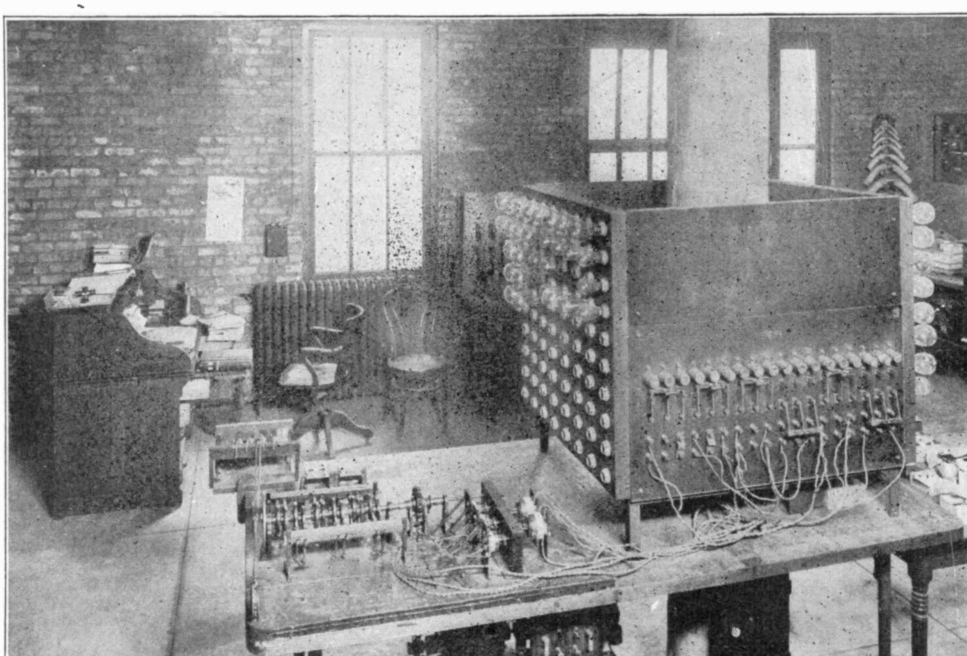
Few devices in the electrical line come more frequently to our notice through use than the ordinary snap switch of either the rotary or push-button type. If you pick up one of these switches today you may find on it a yellow label upon which are the words

*"Underwriters' Laboratories,*
*Inspected Snap Switch"*

and wonder just what it means. A great many devices, like snap switches, are installed in grain elevators, cotton mills, furniture factories, furniture storage, paint factories and numerous other places where a break down in them might start a fire.

Some nine years ago the insurance companies began to realize that electricity was to be the energy of the future, and that standard appliances properly installed make the use of electricity practically safe, and in the matter of light would do away with the open flame. To assist in making and upholding safe standards in the construction of devices the Underwriters' Laboratories were established in 1901 with authority to examine and test appliances and devices and to enter into agreements with owners and makers of these as to the recommendations to be made to insurance organizations. To correct the mistaken impression sometimes found that the Underwriters' Laboratories test only electrical material it should be stated that their field covers all appliances and material which have to do with the fire hazard, such as fire extinguishers, fire doors, gases and oils, fire alarm systems, fire hose, pumps and hydrants, and with the co-operation of the manufacturers and insurance inspectors, many improvements in devices have been made.

But to return to the story of the snap switch. When received at the Laboratories, 207 E. Ohio St., Chicago, the switch is turned over to an engineer who has given this subject special study and attention. After being examined as to mechanical construction the switch in company with others of the same make is placed in a testing machine, which you see on the table in the picture, and so arranged that enough lamps from the lamp bank are connected to give an overload of 50 or 25 per cent according as the switch is rated to carry less or more than ten amperes, respectively. The shaft on the table top is run by a small motor beneath. This shaft



SNAPPING A SWITCH ON AND OFF THOUSANDS OF TIMES operates a train of gears, to each set of which is connected a short projecting clasp which is fastened to the button of the switch, thus turning the switch "on" and "off" from two to three times a minute until a speed counter indicates that the switch has made and broken the circuit 6,000 times without failure. The same machine is arranged to test push-button switches and pull sockets as the case may be.

Formerly re-examinations of appliances were made from time to time, but the newer form of inspection and one which is much more satisfactory to the manufacturer, consists in having the manufacturer test his own devices under the supervision of the Laboratories' engineers, there being 19 branch offices located in various parts of the country. By means of this service the quality of goods in factories where approved articles are made is carefully observed, and the use of labels restricted to such portion of the output as meets in all essentials the standard of efficiency shown by the sample originally tested and on which approval had originally been based.

## Myths of Magnetism

When we consider that the laws of magnetism have been clearly understood only within the last few decades (thanks partly to the master mind of American electrical mathematicians, Steinmetz), it is not surprising that there should have been misconceptions of magnetic phenomena for centuries. Going back a thousand years or more we find an interesting variety of what we may now call "magnetic myths" among the current beliefs, many of them being repeated in various guises almost down to our own time.

Some of these myths seem quite plausible considering the scientific knowledge of the time, while others are so far-fetched that we can hardly conceive of their having been taken seriously by the great thinkers of the day.

For instance, we may very easily excuse the great Greek philosopher Aristotle for believing that submerged magnetic rocks might attract ships loaded with iron nails, even to the point of sinking them. Indeed, this notion was so strongly believed that in certain vessels sailing for Tapiobane the nails were replaced by wooden pegs. But when he also maintains that some lodestones attract gold, silver, copper and tin, we smile at his scientific inaccuracy; and when he says further that there are even lodestones which attract the flesh and bone of man, we must put him down as repeating one of the numerous magnetic myths of his time. Most of these related to supposed magnetic rocks and magnetic mountains, others to magnetic ores which were said to attract human flesh—so-called "flesh magnets."

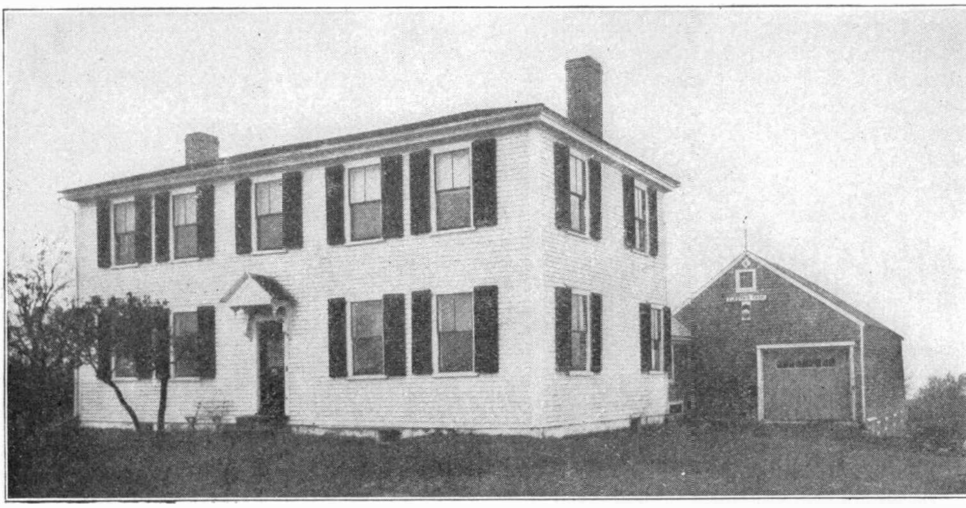
Another and evidently popular myth which we find seriously reported in several books issued as late even as the Sixteenth Century, tells us, with all seriousness, how the ancient temple of Serapis in Alexandria (Egypt) had a lodestone fixed in its roof so that an iron statue was suspended in mid-air, touching neither floor nor ceiling.

Parallel to this is the legend told of Mohammed's being magnetically suspended within his tomb. Another writer of the 16th century contended just as seriously that Venus was magnetic, hence her attracting Mars, the man of iron.

Another series of myths, apparently originating in Sweden, sought to explain the fact that the compass needle does not point to the geographical north pole of the earth by telling of a strongly magnetic island to which it pointed.

Other myths, now equally as funny, with our present day knowledge of these subjects, were the Italian ones about the "Ethiopian magnets" which were said to repel iron; also the French ones about rubbing a diamond to make it attract gold and about the effect of garlic on the magnetic needle. Coming nearer our own time we find one English writer telling of magnetic cures for wounds, while another wrote a whole volume to refute the idea that the earth is a gigantic globular magnet. At Amsterdam one of the Seventeenth Century authors held that everything in the world had the magnetic power of attracting or repelling and that the sun was the most magnetic of all bodies.

Then when in 1677 a German writer worked out a scheme of perpetual motion by means of magnets, we have the connecting link between the myths of the past and of the present. For even to this day there are some in every country unscientific enough to believe perpetual motion possible and imaginative enough to look to magnetic means for realizing this sole survivor of a long series of myths.

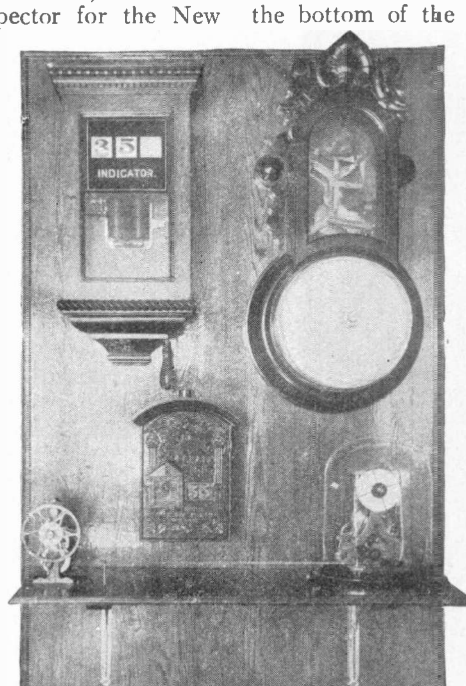


OLD MANSION ON "ELECTRIC FARM"

# "ELECTRIC FARM"

Up in Maine in the town of Minot, Androscoggin county, is a farm which, on account of the numerous electrical devices and the things performed by them, is known as the Electric Farm. The owner, Mr. E. E. Ramsdell, is chief inspector for the New England Telephone Company in that section and is constantly adding to the equipment.

The great number of switches, clocks, bells and telephone sets first attract the attention of the visitor who is still more impressed when he realizes that each device has something to do. Three of the five electric clocks on the place are shown in the picture, on the next page the upper one causing a 15-inch gong on the front of the barn to strike the hours and half-hours. The little clock in the middle of the panel is arranged so that by opening or closing switches, bells are rung in any or all rooms in the house at a stated time. The lower clock gives the horses their breakfast. The grain is placed in a box above the stalls the night before, and when the time arrives a magnet opens the bottom of the box and the grain falls into the feed box below.



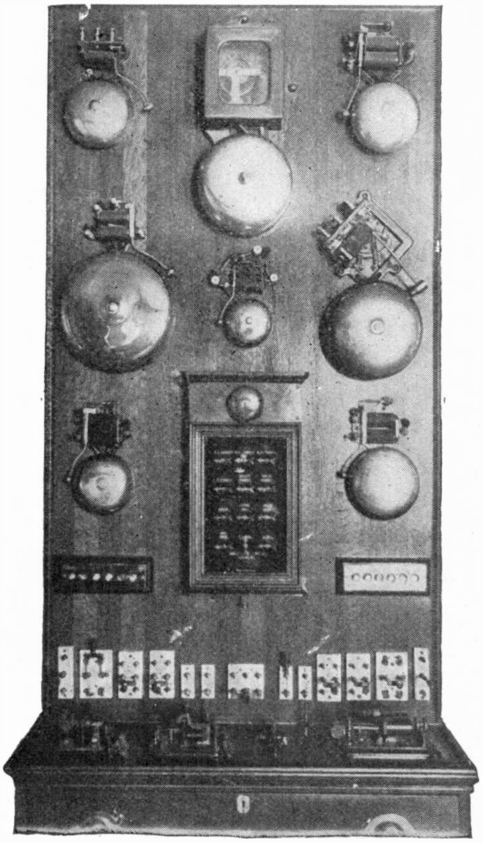

THE FIRE ALARM SYSTEM

Another of the illustrations shows the switching and signal panel which controls all electrical apparatus except the fire alarm and telephones. Running into this board are 194 wires. The annunciator indicates that the rural mail-carrier has just visited the letter-box in front of the house. A burglar alarm system protects the poultry-house and the windows and doors of the dwelling, a bell ringing and an indicator telling where the trouble is in case of an alarm. A new incubator installed in the shop 400 feet from the house is provided with a thermometer so connected that when the temperature rises too high or falls too low a bell in the dining room announces it. In fact this room is the headquarters from which most of the apparatus is controlled.

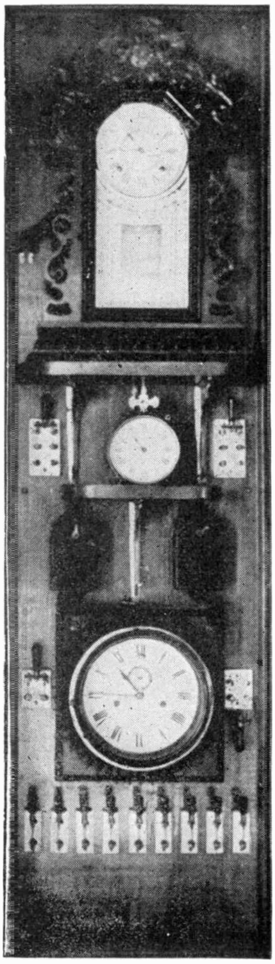
One of the latest improvements is a complete fire alarm system with a 12-inch gong in the house, and an "electric whistle" on the barn. The box which tells the location of the fire is given on the annunciator and recorded on the tape just as in a city fire alarm system.

Not the least interesting also is the portable field telephone equipment. When the men go to the fields to work they take a portable set along. A line of telephone poles provided with jacks into which the connections from a portable telephone may be plugged, runs through the center of the farm and at any time the men may call up the farm house.

Electricity for operating all devices comes from 32 Columbia dry cells, but plans are under way to build a dam across a small stream on the farm and install a water-power plant from which sufficient current may be obtained not only to light the buildings but also to saw wood, to do the churning, run the fanning mill, cornsheller, grindstone, sewing machine, operate electric cooking devices in the kitchen and perform numerous other duties.



SIGNAL AND SWITCHING PANEL



CONTROL CLOCKS

## No "Out of the World" Today

A Frenchman in talking about life today remarked, "The more it changes, the more it remains the same." Wireless telegraphy and long distance telephone communication are tending to make one place just like another so far as getting out of the world, so to speak, is concerned. Steam ships started on their voyage were once a secure refuge from the worries and cares of business, but today equipped with wireless apparatus and a daily paper the broker and business man keep tab on the doings in their respective lines during the trip, while their wives may patronize the dressmaking shop where the latest styles are displayed. Orders are taken for gowns and transmitted ashore by wireless, the garments being ready upon arrival.

# The Lightning Rod

BY BROTHER POTAMIAN, D. SC., LONDON, PROFESSOR OF PHYSICS IN MANHATTAN COLLEGE, NEW YORK

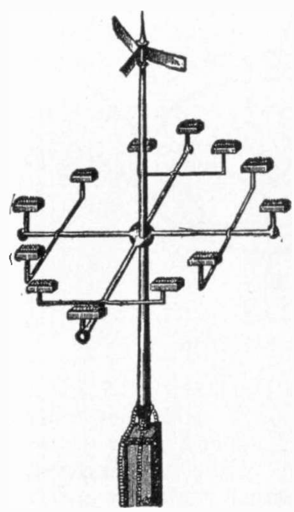
As early as November 7, 1749, Franklin recognized that the "electrical fluid" agreed with lightning in twelve particulars, among which he enumerated its brilliancy, sinuous path, snappish noise, heating power and conduction by metallic rods. Though the resemblances were remarkable, he did not, however—philosopher as he was—feel himself justified in concluding that the two orders of natural phenomena were absolutely identical until he had succeeded in establishing this identity by further experimentation.

By the month of June, 1752, he had matured a plan, very novel in its way, of putting the matter to a crucial test. Accordingly, accompanied by a stalwart son of twenty-two summers, he took with him a queer assortment of electrical appliances, including a silk-covered kite, a Leyden phial, an iron key and a silk handkerchief. With these, he went out into the fields surrounding Philadelphia where, with the expert skill of his son, the kite was raised and an experiment begun, which while dangerous in itself, was fundamental in theoretical importance and pregnant with practical possibilities. With this classical experiment of Franklin all are familiar.

When the cord of the kite was made conducting by the falling rain-drops, sparks were freely taken from the silk-insulated key, the jar charged and discharged and other experiments made by the electricity which was derived from the cloud by the inductive action of the pointed wire fastened to the top of the kite. At the same time, the anger of the cloud was appeased and its striking power enfeebled by the stream of electricity of opposite sign which went up from the pointed conductor. Franklin felt that he had drawn "lightning from the skies" and foresaw the consequences that would follow from his bold experiment with regard to the protection of life and property.

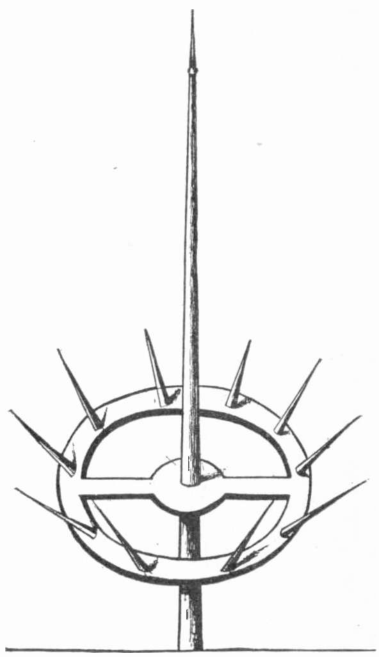
It was not, however, until the month of September, 1752, that Franklin raised a pointed conductor over his own house, which conducter he intended for experimental purposes rather than for the protection of his home. Acting on his published suggestion, pointed rods were erected by French physicists in the month of May of the same year, 1752, when results of a formidable and spectacular character were obtained in Paris and its vicinity.

Off in distant Bohemia, a parish priest, Divisch by name, with a double Doctorate in Philosophy and Theology to his credit, was carrying out at the same time and on a grand scale experiments for the protection of the severely tried villagers of Prenditz who were confided to his pastoral care. His "Meteorological machine," as he called his multiple-point lightning conductor, was erected in the summer of 1754, that is, six years before any building in America and eight before any building in England was protected by a lightning conductor.


AN EARLY LIGHTNING ROD

Franklin's divided rod of 1752 with it pair of Gordon chimes was an experimental rod and not a lightning conductor. Franklin erected a lightning conductor in 1760 over a building in Philadelphia; his friend Watson did the same in England in 1762. It was only in 1769 that conductors were placed on St. Paul's Cathedral, London.

It was early recognized that to be efficient a lightning rod should be continuous throughout; and, at the same time, make good "sky" above and good "earth" below. The good "sky" is secured by making the end terminate in one or more sharp points; and the good "earth" either by connecting the lower extremity to a plate of metal sunk away in moist ground or by making the said extremity send off a number of branches into deep moist soil. The continuity is obtained by means of an uninterrupted rod, round or flat, made of iron or copper and preferably insulated from the building. The reason for the insulation is that a flash of lightning, like the discharge



A GOOD "SKY"

of a Leyden jar, is oscillatory in character, consisting as it usually does of a few violent rushes of electricity up and down the rod until all the energy of the flash has been spent. For the same oscillatory reason these violent surgings in the rod give rise to a tendency to throw off vicious little sparks sideways from the conductor so that its vicinity during an electric storm is decidedly one of danger, and hence to be carefully avoided.

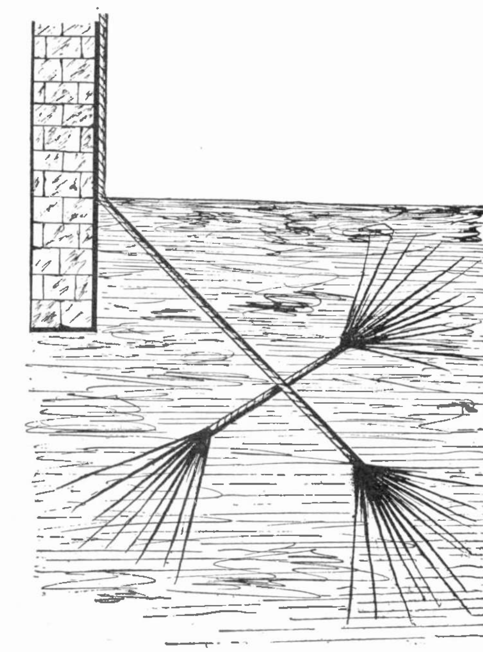
It is not because iron is cheaper than copper and less liable to be stolen that its use is recommended for lightning conductors, but because its higher resistance tends to slow down the discharge and make it less violent and less explosive.

As to the sharp point, which is screwed to the end of the rod, it is sometimes made of platinum, but more frequently of copper. Copper is cheaper and, what is of greater importance, it is less liable to be melted owing to its higher conductivity.

At a time, it was customary to make conductors rise considerably above the building in the belief that their protection extended over a circular area the radius of which was twice the height of the rod. Present practice discards this arbitrary rule and relies for protection on a number of inconspicuous points distributed over the highest parts of the building.

Gas and water-pipes as well as balconies and projecting metallic masses are best separately grounded; or else, they may be well connected together and then grounded. The same holds for gutters, drain-pipes and the like.

Wooden ships need a lightning conductor which may consist of a wire-rope fastened at the top of the main mast to one or more points, the lower part of the metallic-rope being thrown overboard on the approach of a storm. Ships built entirely of iron and steel, such as our merchantmen, ocean grey-



A GOOD "GROUND" OR "EARTH"

hounds and fighting monsters, need no such artificial protection, as their sharp tops make good "sky" and their broad ironsides good "earth."

The functions of a lightning conductor are twofold: (a) *preventive*, by which it gradually reduces the potential of an approaching cloud and prevents the stroke; and (b) *preservative*, by which, if the rod is struck, it will carry the energy of the flash safely to earth. Conditions of impulsive rush may arise, and they are known to electricians, when, however well a building may be protected, it will be struck; hence the necessity of having the conductors examined periodically, say at the beginning of summer, by competent men.

We smile today when we read of the difference of opinion which gave rise in England to the controversy of "Points versus Knobs" in 1772-1777, and which led to the "knobbing" of the rods of St. Paul's Cathedral and of the royal conductors at Kew. Error prevailed, but only for a time. A writer of the day put the matter in epigrammatic form when he wrote:

While you, Great George, for knowledge hunt,
And sharp conductors change to blunt,
The Nation's out of joint;
Franklin a wiser course pursues,
And all your thunder useless views,
By keeping to the *point*.

It is germane to the subject to say that the expression "electric" storm is preferable to "thunderstorm," because electricity is the active agent or principal feature of the impressive phenomenon. No one thinks of calling a hailstorm by the descriptive term of patter storm; yet that would be just as logical and appropriate an appellative in one case as thunderstorm is in the other. The expression "thunder and lightning" is illogical because it puts the effect before the cause.

"Thundertube" is certainly a startling misnomer applied to the long, narrow, glazed tubes formed in siliceous materials by the fervid heat of the flash, but not in any way by the sound-waves produced by the crash. "Thunderbolt" does not mean, despite the common opinion, a white-hot mass that accompanies the discharge; it is purely and simply the flash itself. A glowing mass that comes down in the track of the discharge is a meteorite, a body of cosmic and not terrestrial origin, a visitor from space that chooses the path of the flash, for its descent to earth.

Again, there are no "thunderclouds" in nature, only electric clouds; nor is there ever "thunder in the air" save when the lightning breaks from cloud to cloud or leaps from cloud to earth, or strikes from earth to cloud. But though thunder is only occasionally in the air, electricity always is. We have a normal electrical field in all seasons, times and places.

Though it is the lightning that kills and not the thunder, we would not object to the following inscription found on a tombstone:

"Here lies (so and so), oh! what a wonder,
She was killed outright by a peal of thunder,"

because the suddenness of the peal may have given the aged lady a shock from which her failing heart was unable to recover.

We are well aware that such criticism of technical terms in popular use will have no reform effect; because as long as people will say that "the sun rises" and "the stars set," they will continue to speak of "thunder and lightning," of thunderclouds, thunderstorms and thunderbolts. Though containing an element of error, these expressions have the sanction of centuries; and so they have come to stay.

## Frying Griddle Cakes on a Motor

Of the thousands who daily use the modern electric motors probably few realize how great an advance has been made in certain types within the last few decades. The writer does, for he remembers "carrying the dough" to settle a heated argument about the earliest type of alternating motor (the invention of Nikola Tesla) of which one had been sent to the electrical engineering laboratory at Cornell. While a decidedly practical motor, it wasted a good share of the current in heating both itself and the surrounding room. Indeed it grew so uncomfortably hot during certain experiments with it that one student bet he could fry griddle-cakes on it if he only had the batter.

A few days later the writer procured the latter from his boarding house, but the motor proved to be just a little too efficient for simultaneous use as a stove and the heat was not ample to bake the cakes, so the student who had made the rash prediction paid for a bounteous feast of gas-baked griddle cakes at a hotel on the following Sunday. Since that time one maker after another has learned how to raise the efficiency of his alternating motors, so that no one would now dream of using one simultaneously as a kitchen range, and the student who lost that bet is among those most pleased at the progress, for he is an enthusiastic user of the present highly efficient and cool running types.

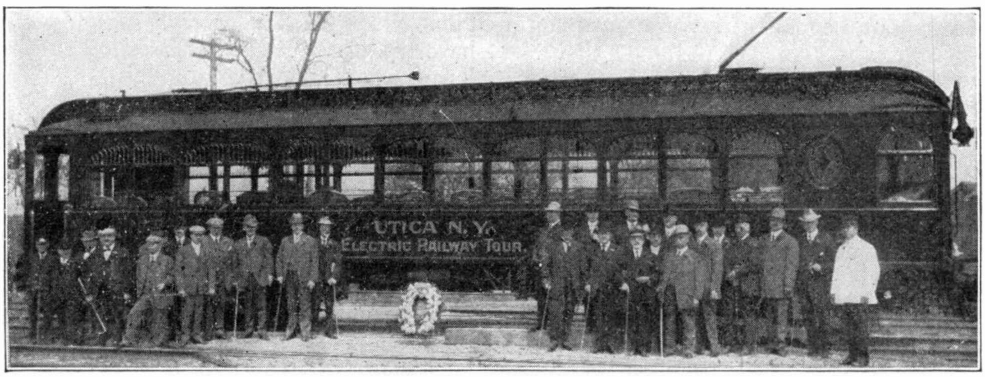
ALBERT SCHEIBLE.

## Two Thousand Miles by Electric Car

The car shown in the photograph is one of the regular cars of the Oneida Railway Company of Utica, which on a continuous trip of 1,994 miles travelled through five states to Louisville, Kentucky, and returned in fourteen days. The actual running time of the car was 75 hours and 56 minutes and the car maintained an average speed of 38 miles an hour which the schedule required. The car kept to its schedule throughout the trip and not a single mishap marred the long journey which officials of the Oneida Railroad and citizens of Utica participated in to learn something of the railway development of the Central States.

The cities of Detroit, Indianapolis, Ft. Wayne, Toledo, Buffalo and Syracuse were all passed through on the long journey, and the lines of 26 distinct electric corporations were passed over in making the trip. At one place where no connection existed it was necessary for one road to lay a temporary track over to the other to allow the car with its passengers to be transferred to the other line. Over all but four miles of track the car travelled under its own power, that distance it was towed owing to a difference in voltage to which the motors of the car were not adapted.

The car was the regular type equipped with four 75-horse motors and the trucks were fitted with three-inch flanges, while the inside of the car was fitted with wicker seats instead of the regular seats used in the ordinary passenger service. The photograph shows the party as it started from Utica May 10, returning May 24.




PARTY AND CAR THAT TRAVELED 2,000 MILES

## Electricity in Coal Mines

Some very interesting facts regarding the use of electricity as to its safety in coal mines have been brought out by experiments made by Professors Thornton and Bowden of Armstrong College, to find out under what conditions coal dust will be ignited by electric flashes.

Coal in bulk or as dust is not a conductor of electricity, but coal dust made into the form of a paste with water, when placed on a marble slab, affords a path sufficient to form a dead short circuit between terminals one inch apart subjected to a pressure of 480 volts. Stones and rocks in the roof and walls of the galleries of the mines were such good insulators that when struck by the ends of live cables one-half an inch apart no flashing occurred. Coal dust deposited on live copper contacts one and one-quarter inches apart did not flash over at 480 volts.

Cartridge fuses are recommended and should never be replaced by a bare wire. Commutators should be kept clean, especially where the gap between live copper and the frame is small.

When an alternating current cable was broken it was found that the voltage necessary to ignite the dust was much higher than on a direct current conductor.

Tests of various kinds to the number of 2,200 were made, and although it is shown that coal dust may be ignited by an electric flash and the probable conditions have been determined, it does not follow that the use of electricity in collieries is dangerous. On the other hand electricity is deemed much safer than gas.

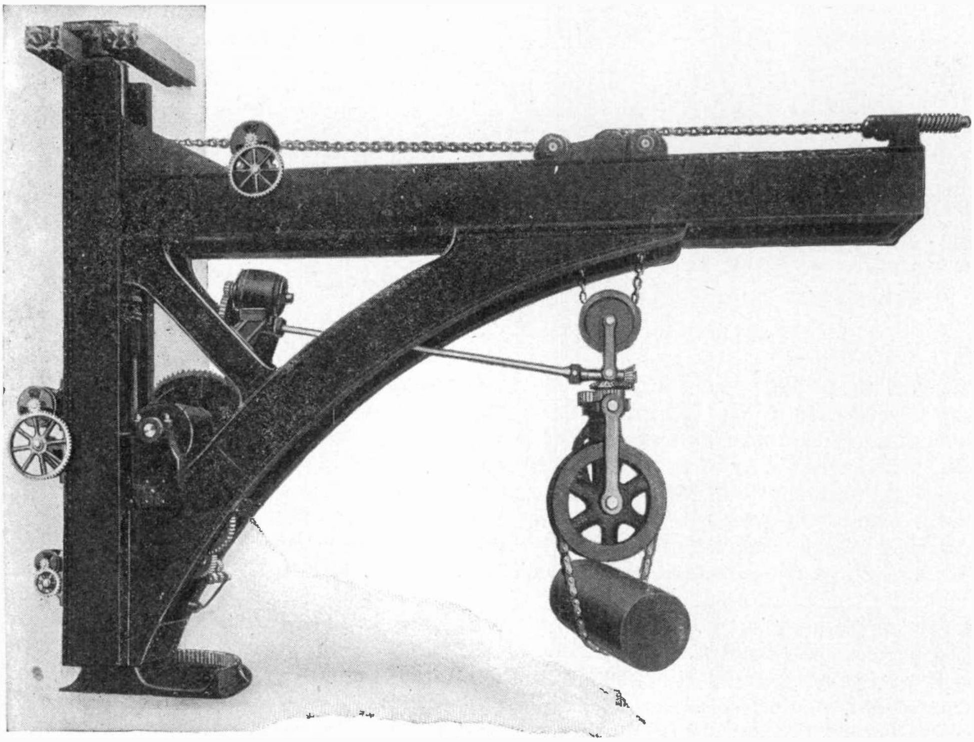
# ELECTRIC CURRENT AT WORK

*NEW DEVICES FOR APPLYING ELECTRICITY*

## Feeding a Trip-hammer

If you ever have visited a steel mill and watched the ponderous power hammer forge a billet of steel weighing, perhaps, 20 or 30 tons, you have thrilled at the sight of the operation. Almost irresistible power seems to be represented in the rapid strokes of the hammer, which itself weighs tons and tons. The billet, white hot and dazzling, is hung by the middle from a crane and is quite deftly rolled by the men so as always to present a new surface to the hammer and eventually secure a nearly round form. But many men are required to perform this job of feeding the hammer, so a way has been devised to do the work electrically and save expense and labor.

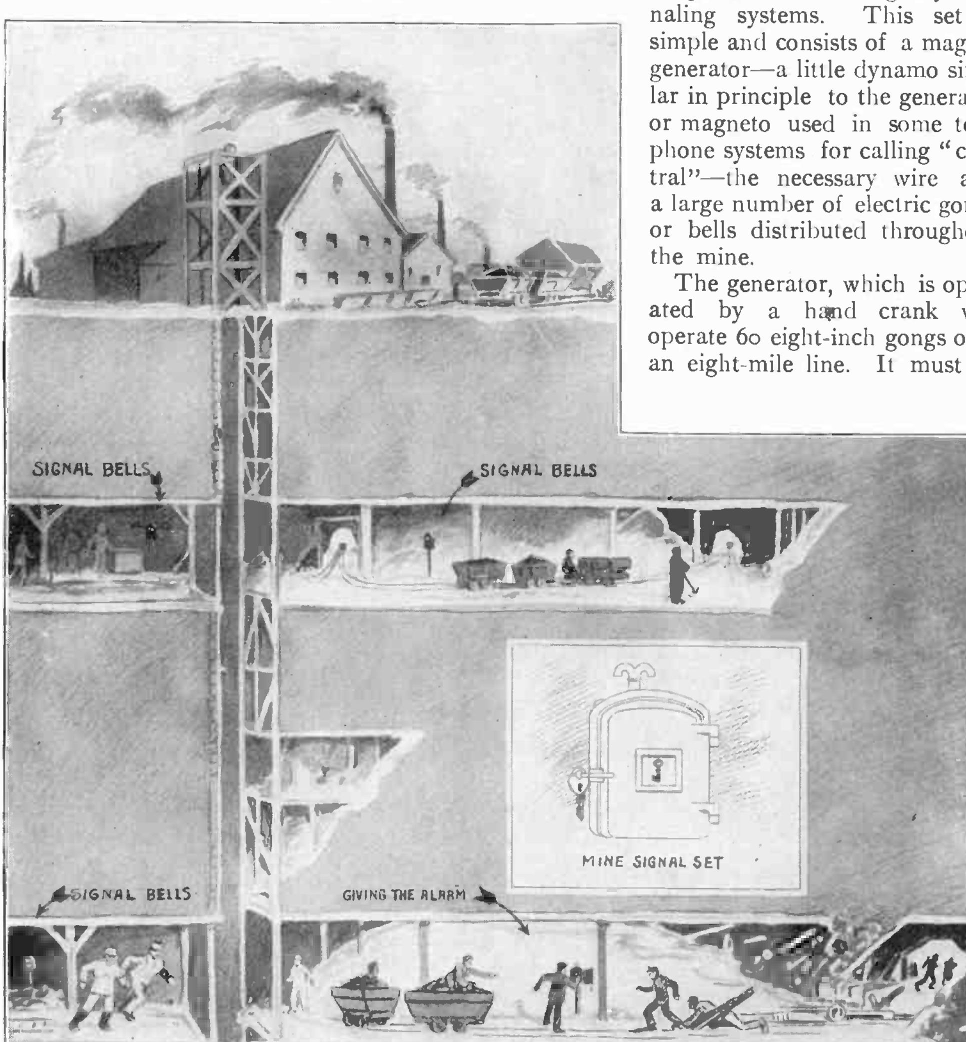
In the picture a 25-ton jib crane is shown with the electric billet-rotating device installed. Only a small section of the billet is shown, as in actual practice it is much longer, and balancing tongs are attached to each end. The wheel and the chain which surrounds the billet may be turned in either direction, thus rotating the mass of steel as you would roll a lead pencil between your fingers. The motive power lies in the little motor shown in the angle of the crane, a long shaft and gearing transmitting the power to the wheel and chain which roll the billet over and over.



HOW THE BILLET OF STEEL IS ROTATED BY MOTOR

## Prevention of Mine Disasters

When fire breaks out in a mine, when an explosion occurs, or any other circumstance arises which may endanger the lives of all of the men in the mine, some way must be provided to warn the miners in all the workings of the danger which is present—some system independent of all others, protected against the elements in every conceivable way and to be used only in cases of emergency. When such a system is not provided and lives are lost there is one more terrible "If" added to the things which, "if they had been done," would have prevented a horror.




ILLUSTRATING THE ADVANTAGES OF THE MINE SIGNAL SYSTEM

A new system of signaling for mines has recently been developed by the Western Electric Company, complying fully with the laws of Illinois and other states regulating the use of telephones and emergency signaling systems. This set is simple and consists of a magnet generator—a little dynamo similar in principle to the generator or magneto used in some telephone systems for calling "central"—the necessary wire and a large number of electric gongs or bells distributed throughout the mine.

The generator, which is operated by a hand crank will operate 60 eight-inch gongs over an eight-mile line. It must be absolutely in working order at all times, so note the precautions taken to protect it.

Each generator is arranged in an iron box provided with a padlock, ordinarily to be kept locked. To protect the generator when the outer door of the box is opened, a steel cover is fastened over the opening of the box and in front of the generator. This cover removes the possibility of any part of the clothing of the party operating the generator being caught in the generator wheels, and also protects the generator from interference by other foreign substances which might collect should it be exposed while the door is open.

A compartment in the front of the door of the box equipped with a glass front is provided for the key to the set. It is the intention that a key to the set shall always be kept in this compartment and that this key will be used only in cases of emergency, when anyone may break the glass front and obtain the key to open the set. This compartment is made air-tight so that it will be impossible for dust to get inside and hide the key from view. The back of this compartment is painted white so as to make the key more noticeable.

It is also intended that the foreman or man in charge of the mine shall be provided with an extra key to enable him to open the box under ordinary conditions in the mine when it is desirable to operate the generator for fire or emergency call drill.

Every precaution against water following the line wires into the case of the signaling set is taken. A curved inlet at the top provides an entrance which removes the possibility of water flowing along the line wires and into the set.

The emergency signal bell used with the generators consists of a non-sparking bell provided with two eight-inch steel gongs mounted upon a wooden or steel backboard and having a protecting canopy. The gongs are hot galvanized and have an especially loud and clear tone. All parts, including the windings, are especially treated to stand conditions of mining atmosphere.

## In the Modern Village Smithy

Many an awkward piece of repair work falls to the lot of the blacksmith, work that requires the tool to be brought to it rather than the work to the tool. Particularly there are a great many holes to be drilled in unmanageable parts which cannot be held on the ordinary drill press. Then it is ordinarily the case for the smith to bring into play the "iron-band" muscles for which he is justly renowned and laboriously drill the holes with a breast drill. But even in

AT WORK IN THE MODERN VILLAGE SMITHY

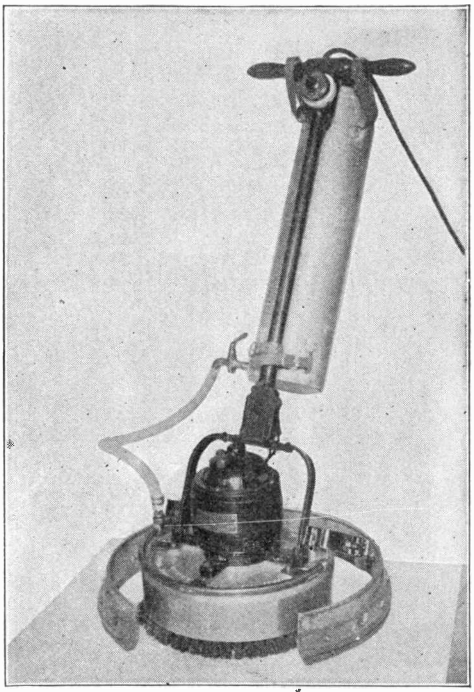
the blacksmith shop electrically driven tools are driving out the old methods wherever day current is available, and one of these tools is the electric drill which runs from a lamp socket.

In the example here illustrated the smith is fitting a steel strap to the under side of a thill. He has probably already drilled one or two holes in the strap, but wants to use it as a pattern to drill the rest through both wood and steel. If he were to do the job on a drill press a helper would be required to hold the awkward thing. With the electric drill it is a simple and quick process.

## Electric Scrubbing Machine

Up-to-date building managers will be interested in the machine here shown for scrubbing floors by electric power. It weighs only 50 pounds and derives the current which propels the brushes from a long flexible cord attached to the nearest lamp socket.

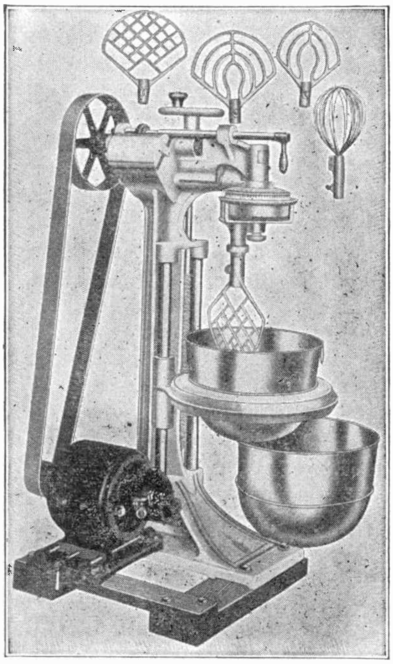
The revolving brushes are driven by a little vertical motor as shown and surrounding them is a ring which carries the water along with the machine, eliminating the necessity of mopping up. Varnish, paint and stains may be removed by the use of a steel brush and chemicals. Then sandpaper surfacers may be attached to the machine in place of the brushes and the floor finished smooth for filling and polishing.



ELECTRIC SCRUBBING MACHINE

## Egg Beater and Cake Machine

Electrical energy transferred to angel cake by means of a motor driven egg beater and cake machine is said to make possible nine cakes where only seven can be made from the same material beaten by hand, such are bakery statistics.

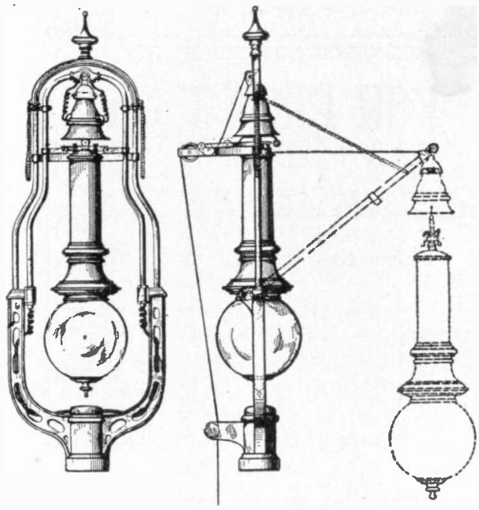


EGG BEATER AND CAKE MACHINE

Material for cream puffs, lady fingers, etc., when electrically prepared results in a greater number of these dainties than when hand beaten. The machine, which is used in bakeries, may be run fast or slow and is provided with several different kinds of beaters shown in the picture. The large bowl holds 50 quarts and the small one 25 quarts. The various kinds of beaters or paddles will serve for almost any kind of dough.

## Ingenious Arc Lamp Pole-top

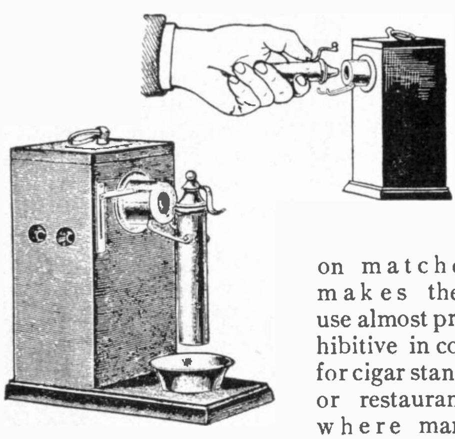
When arc lamps are supported directly over the tops of poles by fixtures known in practice as poletops, it is customary for the trimmer to climb either the pole itself or a ladder leaned against the same when he goes to recarbon the lamp. This is objectionable not only because of the danger in windy weather but also because a man steadying himself on a pole or ladder cannot use his hands to the best advantage. To overcome these drawbacks an ingenious type of poletop is being introduced in England, in which the lamp is hung from an inverted stirrup pivoted within the poletop proper. Paying out a wire rope (which runs down one side of the pole) allows the stirrup to swing the lamp several feet out from the pole and to then lower the lamp so that it can be trimmed by a man standing on the ground. On lowering the lamp it is automatically disconnected from the circuit but is switched into it again when the lamp is returned to its normal position by pulling the rope taut.



ARC LAMP POLE TOP

## Taxes and Cigar Lighters

One of the curious effects of the heavy taxes which Germany must levy to support its enormous army and navy, is shown in the widespread introduction of electric cigar lighters. The recent increase in the tax on matches makes their use almost prohibitive in cost for cigar stands or restaurants where many light their pipes or cigars. Where a lighting circuit is available, the electric cigar lighters of types familiar also in this country serve the purpose admirably. But in the scattered country inns, which the electric current has not yet reached, the problem is more puzzling and a variety of semi-electric types have been evolved.



GERMAN CIGAR LIGHTER

Here is one consisting of a little gasoline torch (or rather benzine torch, that being the liquid preferred on the Continent) hung from a box which contains a battery and an induction coil. The user lifts the torch off the hooks, raises the hinged lid with his thumb and lights the torch with a spark from the coil. According to the manufacturer's estimate, each filling with benzine lasts a week and the battery outlasts the equivalent of over 100,000 matches. To some of us who expect electricity to supplant rather than supplement such dangerous fluids as gasoline or benzine, this combination seems curious.

## An Electric Curfew Wink

According to reports from Cape Town, the electric light company in this important South African city makes a regular evening practice of switching the electric lights off each circuit for an instant and switching them on again, in place of the former ringing of a bell or blowing of a whistle. If this practice extends to other lands will we have to revise the classic recitation which each school class in succession perpetrates upon us, so as to have it read: "Curfew shall not *wink* tonight?"

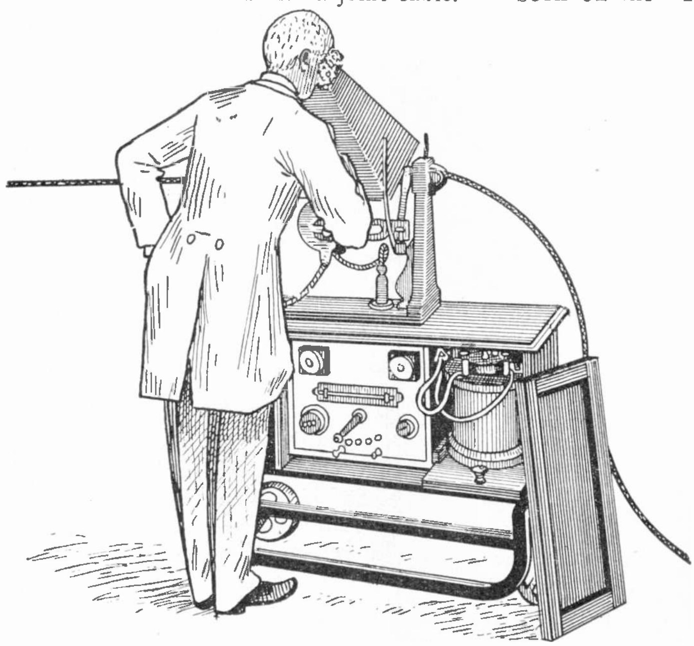
# FOR PRACTICAL ELECTRICAL WORKERS

*HOW TO MAKE AND OPERATE ELECTRICAL DEVICES*

## Locating Flaws in Cables

The tremendously high cost of laying a submarine cable, of repairing it after it has been laid, or indeed of even locating a faulty spot in a finished but unlaid cable, make it essential that every strand comprising the cable should be thoroughly inspected before the assembling. This can be done with fair rapidity by passing each strand (with its gutta-percha covering) between the screen of an X-ray tube and the tube itself.

In the apparatus pictured, the strand to be tested runs over guide wheels on the support for the screen and tube, while the induction coil, rotary interrupter, rheostat, fuses and switch are all contained in the cabinet on which these are mounted. With such an outfit even a rapid inspection of the insulated strand will detect any flaw present in either the copper core or the gutta percha covering, so that any such fault can be remedied before the strands are twisted into a joint cable.



LOCATING FLAWS IN CABLE BY X-RAYS

## Making a Hole in Glass

It is stated that a hole may be made in thin glass by pressing upon the glass a disk of wet clay. Make a hole through this clay the size of the hole desired in the glass, being sure the glass is clean and bare. Now pour molten lead into the hole and the lead and glass will drop through at once. The quick heating of the glass at one point causes a circular crack to form, the outline of which corresponds to the hole made in the clay.

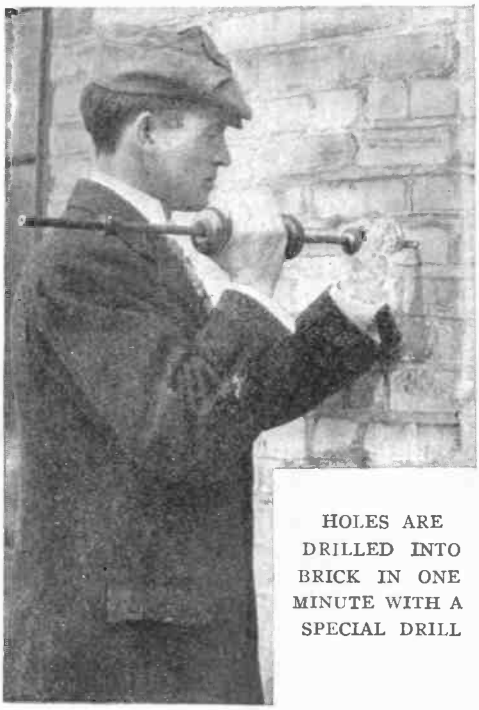
## Plain English or Symbols—Which?

To more clearly realize what it means to have a magazine devoted to as technical a subject as electricity and yet written in "plain English," our readers should turn to the opening pages of one of the standard works on dynamo designing, Wiener's book on the "Practical Calculation of Dynamo Electric Machines." In this volume the author prides himself on adhering strictly to standard notations as adopted by electrical congresses to designate certain common phases of electrical construction and calculation, and prefaces his fine work by giving a list of these symbols—there are 348 of them altogether.

Truly the reader who is not scared out by this list (which occupies 12 whole pages) has the making of an electrical mathematician in him, but most of us will prefer to do our reading on these themes in just plain, unsymbolic, United States English and let it go at that.

## Fastening Up Insulators

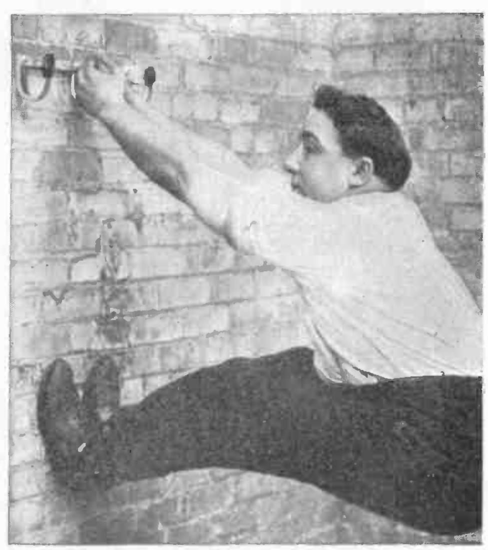
There are various kinds of brackets and supports for fastening insulators to brick walls. Some stay up for a long time, others pull out very readily, some are easily installed and others are put up only after a great deal of labor. How the all-steel bracket of Hubbard and Company is put up and how well it holds is here illustrated in a graphic manner. The bracket itself is made entirely of metal, and a special tool is used for drilling a hole rapidly in brick or mortar and then forcing the expansion bolt in place.



HOLES ARE DRILLED INTO BRICK IN ONE MINUTE WITH A SPECIAL DRILL

THE REVERSE END OF THE HAMMER-DRIVE IS A HOLLOW PUNCH WHICH SLIPS OVER THE BOLT. FIVE BLOWS OF THE SLIDING HAMMER DRIVE IT HOME

THE BOLTS ARE INSERTED HEAD FIRST



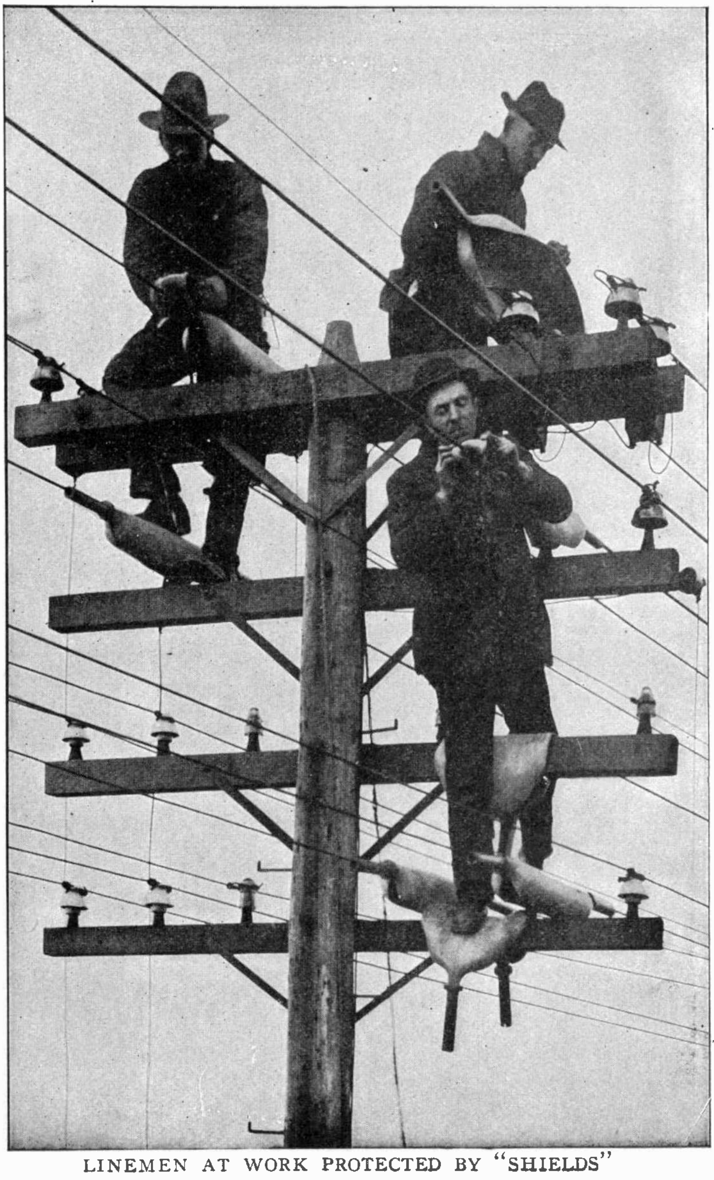
THE BRACKET FASTENED WITH TWO BOLTS IMBEDDED ONE INCH HOLDS A 172-POUND MAN THUS

## Protecting the Lineman

Even if the wires were all "dead," most people would call it a ticklish job to work around among the wires at the top of a pole, which may be anywhere from 30 to 60 feet above the ground. Now multiply the danger fourfold by presuming several of the wires to be carrying high-tension current under a pressure of several thousand volts; you wouldn't care for it, you say. Yet the lineman must frequently encounter this "live" work, as he calls it, and he must be given credit for great precision of movement and no small degree of personal courage when he performs these precarious duties. Touching two wires of widely different potential may cause him to crumple up and go hurtling to the ground, or else he may fall across other high potential wires in the maze which surrounds him.

To protect the lineman against such accidents a device known as the "linemen's shield" is now made, a product of the Linemen Protector Company of Detroit, Mich. It is made of rubber and is about the size of an automobile tire, terminating at each end in two small tubes. It is hollow, of course, and is slit all the way along one side so that it can be opened out and slipped down over a wire. At the shoulder between the small tube and the body tube is a hard rubber ring which fits closely around the small tube and clamps it upon the wire. This ring has a slot so located as to admit the wire.

The rubber is pure Para and varies in thickness from ⅜ inch, where it is subjected to pressure, to 3-16 inch along the flaps. Each shield is subjected, before it leaves the factory, to a pressure of 30,000 volts, so after putting shields over the live wires the lineman need have no fear of accidental shock. He can also throw the shields, spread out, over the cross arms, to sit or stand upon. Then, as he works upon a wire, current can-



LINEMEN AT WORK PROTECTED BY "SHIELDS"

not pass through his body to the ground by way of the pole.

In trimming or repairing arc lamps there is also danger of shock, so the lamp man may take one of the shields along with him on his rounds


USING "SHIELDS" IN TRIMMING ARC LAMP

and stand in it as he would in a snowshoe.

Still another application is in tunnels or subways carrying live conductors. When the lineman is splicing or repairing these cables he makes use of one or more of the shields to sit or stand upon while at his work.

## Doctor Studies Heart by Telephone

The Isle of Wight and London are one hundred miles apart, and over this distance Dr. Milne who lives on the Island recently prescribed for a patient having heart trouble in London after listening to the beating of her heart as heard over the telephone. A stethoscope, an instrument which every physician has for listening to sounds in the lungs and heart, was held over the patients' heart and attached to a specially made telephone which magnifies the sounds in the transmitter.

## Safe Temperatures for Dynamos

The metallic parts of a dynamo can stand a high running temperature without danger, only being limited to the temperature that can affect the insulating materials which are near these parts.

The temperature of the conductors is also limited by the temperature of the insulating material.

It seems reasonable to establish as limit of temperature of the windings for a continuous indefinite run the temperature at which the cotton lining would fail, or about 212° F., but as the exact temperature at any moment cannot be exactly determined it is safe not to exceed 190° F. or 200° F.

For the commutator or collecting rings the temperature limit is fixed more by mechanical than dielectric reason. In order to keep the soldering of the joints in good condition the maximum allowable temperature is about 318° F. But the centrifugal force and the increase in length due to heat may at a temperature above 240° F. produce distortion and loss of alignment of the parts.

Under overload for a very short time an increase over these temperatures of 60° F., viz., 250° F. or 260° F. instead of 190° F. or 200° F. can be allowed.

## Aluminum and Copper Conductors

The use of aluminum wire as a conductor in some cases in place of copper usually brings up the question as to the differences between the two metals for this purpose. The following table, the result of experiments and calculation, gives some interesting comparisons·

| | Aluminium. | Copper. |
|---|---|---|
| Same resistance—Cross section | 100 | 60 |
| Same conductivity—Tensile strength | 100 | 125 to 130 |
| Same diameter—Weight | 100 | 330 |
| Some conductivity—Weight | 100 | 200 |
| Same resistance—Cost (raw material) | 100 | 170 |
| Same resistance—Cost (manufactured) | 100 | 147 |

## An Automatic Electrical Clock

A few weeks ago I was called upon to devise a clock for use in a medical college, notifying the classes at 10 minutes of the hour, and calling them on the hour; the clock was to ring an electric gong for a few seconds each time.

Now this, in itself, was, of course, a simple proposition; but an additional specification that it should be so arranged that any hour could be switched on or off as desired, made the situation more complicated.

I will explain how, by the use of very little material or apparatus, I solved the problem.

I first obtained a large wall clock with a good sized face, some $\frac{1}{8}$-inch hard rubber sheet, German silver strip, wire, screws, etc.

Removing the face and hands I mounted a sheet of hard rubber (A), Fig. 1, upon the frame of the works with screws and washers as shown, so that it was removed from the frame about $\frac{1}{4}$ inch. Circularly disposed about the spindle carrying the hands I placed brass screws (C), Fig. 1, with the heads behind the hard rubber and projecting just through the surface of the front. Attached to the sleeve which carries the hour hand I made an arm of sheet brass (B), Fig. 1 upon which was riveted a thin brush of German silver adjusted to make contact with the screws (C), successively.

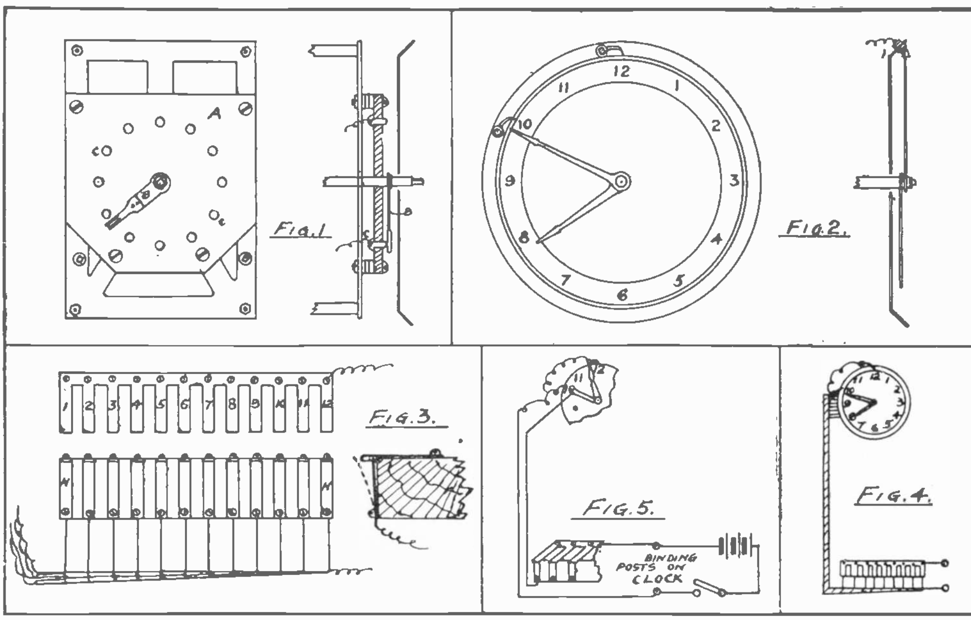
Now upon the outer edge of the face at the hours of ten and twelve, ($D^1$), ($D^2$), Fig. 2, I mounted springs of thin German silver, curved inwardly to make contact with the minute hand at the proper time; these springs were insulated from the face itself.

Next, I took a piece of sheet German silver and cut it like (G), Fig, 3, and screwed it to the bottom projecting shelf over which the door is mounted (although it may be mounted at any other convenient and accessible place); the ends of each of the projecting strips were formed into a hook as shown. Twelve German silver springs (H), Fig. 3, engaged the hooks at right angles; these springs are made to be disengaged at will.

A cable (J) connects the springs (H), Fig. 3, with contacts (C), Fig. 1, better shown in Fig. 4.

Fig. 5 shows a diagram of the circuit of the complete apparatus with the battery and night switch connected to binding posts which are upon the clock.

The arm (B), Fig. 1, must be mounted slightly in advance of the hour hand and in a manner that it may make contact with




DESIGN OF AN ELECTRIC CLOCK

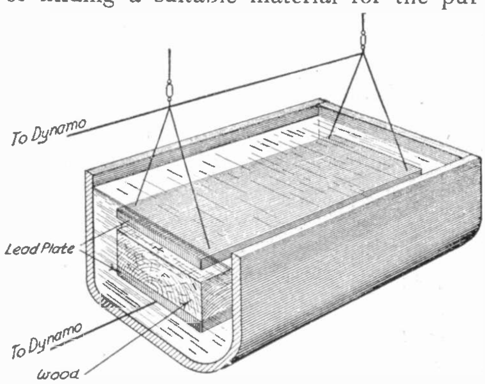
the screws (C), Fig. 1, before the minute hand reaches 10 minutes of the hour, and break contact after the minute hand has passed the hour; also the pressure of the brush upon the contacts must not be enough to retard the movement of the hands.

The springs ($D^1$) and ($D^2$), Fig, 2, should, of course, slant in the direction the hand moves; the length of each call may be governed by the distance the spring projects toward the sweep of the hand; my adjustment was 15 seconds.

When completed, this clock was immediately put in service, and I have yet to hear complaint of it failing to perform the duty assigned it. L. D. SURLES

## Fireproofing Wood Electrically

The general difficulty in fireproofing wood (or for that matter, almost any other combustible material) has not been that of finding a suitable material for the pur-




FIREPROOFING TANK

pose. Quite a variety of mineral salts can be used for this purpose, including some inexpensive ones like alum or borax, but the puzzle has been how to saturate the wood thoroughly with these salts. Painting it with a solution of such chemicals will only fireproof the outer layer, as the sap in the wood will not let any solution penetrate far unless it has first been removed.

This removing of the sap and the replacing of it by a fireproofing solution can be done electrically in a very simple manner as shown in the cut. The wood to be treated is placed on a lead plate connected to the positive pole of an ordinary electroplating dynamo while a similar negative plate is suspended over it, the whole being immersed in a reservoir containing a solution of borax. When the current is turned on, the sap rises towards the negative plate and the fireproofing solution gradually takes its place. A little resin and carbonate of soda are said to make the borax solution more effective, but other solutions can be used in the same way.

## Non-explosive Welders

In trying to develop a new type of electric battery some years ago, one of our regular contributors had the discouraging experience of repeatedly having his experimental battery explode. On counseling with one of the most eminent chemists in the country he was assured that his reasoning out of the chemical reactions was correct and that the mishaps could be explained only by impurities in the chemicals. Unfortunately even the so-called chemically pure chemicals then available on the market had just enough of the obnoxious impurities to cause havoc, and as the proposed battery was to be supplied with lower priced (and hence still less pure) chemicals, its practicability was out of the question.

Very similar to this seems to be the experience of many who have used acetylene gas and its products for the welding and hot cutting of metals. Even in Germany where chemical progress is at its highest, the explosions of acetylene welding devices have been continuing with truly shocking frequency. Recently the causes of these explosions have been discussed in a treatise issued by a prominent acetylene engineer of Vienna, who has analyzed the supposed protective arrangements of the ten different types of acetylene welding apparatus and who frankly reports that not one of the ten can be depended upon to avoid explosions.

If the German and the Austrian mind took less kindly to the complexities of chemical reactions and more so to the simplicities of electrical devices, these costly and sometimes fatal explosions would undoubtedly have been avoided. As it is, continental Europe has merely been showing the rest of the world what not to use in the way of welding devices, while the electrical welders which originated in the United States are steadily finding a wider market even among European manufacturers. For where is the man with keen business judgment who will not appreciate the greater convenience of the electric welding devices as well as their entire freedom from danger.

## Mail Box Alarm

Our mail box is situated almost a city block distant from the house, and this necessitated rigging up some kind of an alarm, or detector, in order that we might be informed when mail was left by the mail carrier. So I made a good-sized wooden mail box, and, through the medium of a cheap electric bell, we are notified when mail is put in the box. The lid of the box is arranged to open as shown in Figs. 1 and 2, opening partly on top and partly on the front. Two pieces (BB), Fig. 2, are attached to the lid to strengthen it, and fit just inside the box when closed (see c, c, Fig. 4.) Fig. 3 shows two pieces of spring brass, attached to a wooden strip, insulated from each other, and this arrangement is screwed inside the mail box so that, when the lid is down, one of the pieces (B) will

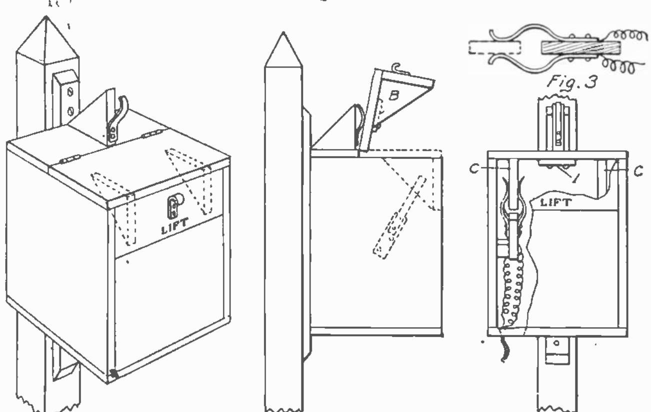



Fig. 1 Fig. 2 Fig. 4

MAIL BOX ALARM

enter between the brass strips, separating them; when the lid is raised ½ inch, the piece (B) rising with the lid, slips from between the strips and allows them to come together, forming a contact.

A piece of incandescent lamp cord is finally run through a hole in the box, and one part is attached to each brass strip; the other end is spliced to two wires leading to the house, where they are attached to the bell and batteries in the same way that any electric bell system is connected for operation.

A stop prevents the lid from opening too far, and a small spring on the stop makes the lid fall down. On the under side of the lid, (I), a weight is fastened to help make the lid close.

Two cells of dry batteries ring the bell loudly when the lid of the box is opened only ½ inch. I placed a switch near the bell to cut it out in case the carrier should put magazines, long papers, etc., in the box, thus holding the lid open far enough to allow the contacts to close the circuit. Other modifications of this arrangement can easily be made.

HERBERT C. SUGG.

## Magnetic Lathe Chucks

Every one familiar with metal working lathes knows that a considerable part of the lathe hand's time is consumed in "setting up," and that the time required to adjust the tool is small as compared with that needed for properly clamping the material which is to be worked. With pieces of some shapes it even takes longer to clamp the piece in the properly central position than it does to take a cut off it afterwards, and if a piece is to be faced off on both ends it often is a hard matter to chuck the piece so that both ends will be exactly parallel. Now in general shop practice probably 95 per cent of the metal pieces that need such turning are of iron or steel, hence it is surprising that magnetic means have not been extensively used for holding these pieces in position.

The principle of a magnetic lathe chuck would seem simple enough, for if we grip a powerful horseshoe magnet in the chuck of a lathe it will hold its armature so firmly that a light cut could no doubt be taken off the latter.

To apply this principle in ordinary shop practice all we need is a strong electromagnet mounted in place of the usual chuck and so designed that the piece to be held will form its armature. This is done quite effectively by making one pole of the magnet in the shape of a star, with the prongs of the star fitted into suitable recesses in the shell which forms the other pole. Then the magnetizing coil or coils can be wound in a groove in this outer shell.

## Insulating Materials

### PAPER

Paper is used very largely in electrical work in the form of common paper and pressed board. To render it impervious to humidity it is very frequently impregnated with paraffine or other hydrocarbons. Its dielectric power decreases with an increase in the pressure to which it is subjected.

The best insulating value is given by good manilla paper disposed in well spread sheets. It must be dried in vacuum before using and the impregnating mixture is to be neither too hard nor too fragile. If too hard the paper would break when first bent—if too fragile it would end by completely pulverizing.

Paper covered cables, lead sheathed, are more homogeneous than those covered by rubber and are more easily manufactured. But the dielectric resistance of India rubber is greater than that of paper, making paper covered cables larger and heavier for the same insulating capacity. The paper insulation, moreover, is destroyed with the lead covering and so paper covered cables cannot be used where there is any electrolytic effect on the line. Their greatest use is in telephone work.

### CELLULOID

This material is made up of a mixture of camphor and gun cotton and is a very good insulator. When they first began making celluloid it would burn very rapidly when its temperature reached 284° F. By means of a process involving the use of alcohol, ether and a ferric salt it has been rendered incombustible. Before the introduction of this process the manufacture of celluloid was very dangerous on account of the explosive character of the gun cotton. The old time celluloid, itself, was a dangerous thing to handle as it would burst into flame with almost explosive violence. It is used especially in the manufacture of storage batteries and dry battery cells.

### RESINS

Different kinds of resins are used in the manufacturing of insulating varnishes for the insulation of spools and wires of electrical apparatus. Their insulating power is quite high, moreover they afford mechanical protection to the inner layers of wires in the spools.

(a) Yellow wax mixed with white wax (in the proportion of 10 to 1) is used for telegraph apparatus spools. The unwound spools are subjected for five hours to a dry temperature of 212° F. and are then dipped in the mixture which is kept at a temperature of 350° to 375° F. The mixture is left to cool gradually and the spool is withdrawn only when the mixture begins to coagulate. After withdrawing the spool is heated up again to eliminate the excess of insulating material, and then wound. After winding the spool the immersion process is repeated at least three times.

(b) To increase the inner insulating resistance of electro-magnets and galvanometer spools a red varnish made up of sealing-wax dissolved in alcohol at 194° F. is used. This varnish is spread on the spool cold. To apply a second layer wait till the first one is dry. In practice it is better to apply several thin layers than few thick ones. Sealing wax is also used in the composition of insulating cements for storage battery and similar work.

### BITUMINOUS SUBSTANCES

Among those the most important bituminous substances are tar, bitumen, and pitch.

(a) Clark's mixture, which is used to insulate underground cables, is made up of 65 parts of mineral pitch, 30 parts of silicon and five parts of tar. This mixture is applied to the cable together with rough hemp in the proportion of one part of hemp to two of the mixture.

(b) The bitumen used in electrical work is largely vulcanized. Used for electrical cables, it contains from five to 20 per cent of sulphur,

For junction boxes and other applications bitumen is mixed with chalk or potter's clay to obtain an economical filling material. Its insulating power is not very high; so it is used for low tension work only.

(c) Dialite is a mixture the basis of which is tar. Cables protected by this insulating material are not subjected to electrolytic effects or to humidity. It does not fuse under overload and can be very easily twisted without cracking. Moreover its cost is very low.

These substances are used principally in connection with the Edison system of underground conduits. In this the cable is drawn into an iron pipe and the space between the cable and the inner surface of the pipe is filled up with tar. When the iron pipe falls away by getting rusty the tar is the only protection left to the cable.

# Electrical Men of the Times

## FRANK J. SPRAGUE

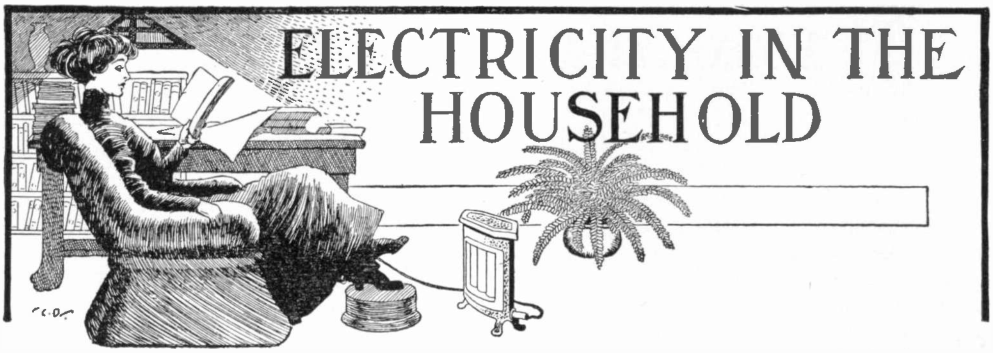
Frank Julian Sprague has been called "the father of the electric railway." As his portrait shows (and it is a recent one), he is still in the prime of vigorous manhood, so that his offspring must be correspondingly youthful. In truth, it is difficult to realize that the great electric-railway industry of the United States, with its 40,000 miles of track and cash investment of over $3,000,000,000, has come into existence within the last twenty-two years.

Mr. Sprague is not to be described as the inventor of the electric railway. Many men, both in this country and Europe, have contributed to the development of this means of transportation as we know it today. Like most great inventions, it is a composite, the first name on the list being Thomas Davenport, a Yankee blacksmith, who exhibited a toy motor, mounted on wheels, operated by a primary battery, in Brandon, Vermont, in 1834. Later Davidson in Scotland, Farmer, Page, Stephen D. Field, Edison, Van Depoele, Daft and Short in the United States, and Siemens in Germany contributed materially to the development of the invention. But it was Sprague, more than any other man, who brought the thing to pass, and by general consent the electric street railway put into operation by him in Richmond, Va., in 1888, stands as the pioneer road of the modern commercial electric-railway industry.

But the merest outline of Mr. Sprague's career can be attempted on this page. He was born in Milford, Conn., July 25, 1857. He graduated from the United States Naval Academy at Annapolis in 1878, and for a few years was a naval officer. He early manifested an interest in electricity and developed strong inventive faculties. He resigned from the navy to become an assistant to Edison, but a year later he, with others, organized the Sprague Electric Railway and Motor Company and began the development of electric motors. In 1882 he applied for his first patent, and it was his company that later took the contract for equipping the Richmond road, which was accomplished, after overcoming extraordinary difficulties, in 1888. Within six years five-sixths of the existing horse-car lines in the country had been converted into electric lines.

Mr. Sprague has been prominent in designing various forms of electric elevators and also large electric locomotives. One of the most important of his inventions is the multiple-unit system of train operation, now in universal use in heavy electric railroading where individually equipped cars are combined into trains.

We also find his name among the members of the commission which carried out the monumental work of electrifying the New York city terminal of the New York Central Railroad. He is a past-president of the American Institute of Electrical Engineers and is a member of several other engineering societies. He has received many medals, and honors have been bestowed upon him in recognition of his work. His home is in New York City.




# Sweets for the Sweet

**By LAURA M. WARREN**

Judith Hamilton had put the finishing touches to her tea table, taking special care to have it look very inviting to the hungry man who would soon be at home. She felt particularly happy this evening, as it was their first wedding anniversary and she wondered if Robert had remembered, for she knew that as a rule men are so forgetful about the little things that mean so much to a woman; but then the thought came to her that Robert was not like other men. She had said nothing about it in the morning as he bade her good-by, but all through the day had gone about her work with a light heart, singing snatches of the opera they had attended the night before. Taking a last survey of the room and giving her maid final directions about serving dinner promptly at 6:30, she ran upstairs to finish dressing. She had just completed her toilet and caught up a few stray locks of her golden hair with the new comb Robert had given her the week before for her birthday, when she heard his latch key and hastened down stairs to greet him as he was hanging up his hat and coat on the rack. She saw a package lying on the hall table, but at the time thought nothing about it.

"How beautiful you look tonight, my darling!" exclaimed Robert as he kissed the smiling face held up to him. "Even more beautiful than you did a year ago."

"Oh, Robert, then you did remember that today is a special one for us!"

"Of course I did, sweetheart, and I have brought you something which I think will be fitting for the occasion, but you are not to open it until after we have had dinner, as I am sure when you find out what it is you will not rest until you have tried it."

"Then, Robert, do let us hurry, for I can hardly wait!"

As soon as they had finished eating the maid brought in the precious bundle and with eager fingers Mrs. Hamilton undid the wrappings, while her husband watched her flushed, happy face with a glad light in his eyes.

At last, his gift—an electric chafing dish—stood before her in all its beauty.

"Oh, Robert!" she cried, jumping up and putting her arms around his neck, "You are the dearest man that ever lived! It was only last week that I was downtown and saw a woman demonstrating this very thing and I wanted one so much."

"And do you know, little woman, I happened into the store just at that time, in search of something that would please you, and when I saw you so interested in what the demonstrator was doing, the thought came to me that an electric chafing dish would be the very thing, so I stepped around to another counter until you had gone, and then went back and bought this."

"I am so glad that you did, Robert, and we will try it this very night, for some of the girls have promised to run in this evening, as they want me to show them how to make some candy to sell at the bazaar they are going to have on Saturday night. I was thinking this afternoon how hot it would be in the kitchen working over the stove, but now we can just attach the plug to the lamp socket above the table here and make our candy where it is comfortable."

Shortly after eight o'clock the bell rang and in came four laughing girls, looking cool and sweet in their light summer frocks. Mrs. Hamilton met them with a cordial smile, telling them how pleased she was to have them come.

"Judith, dear," said Polly, a plump little lassie, the youngest of the four, "We put on the very thinnest dresses we had, for we expect to roast over the hot fire."

"Well, girlie," replied Judith, "I am going to give you a pleasant surprise," and she led the way into the dining room and showed them her new chafing dish.

The girls danced around the table with wild exclamations of delight, eager to try making candy by electricity.

"Let us begin by making molasses candy!" suggested Ruth, "and I think Kathleen should make it as she always has such good luck."

"All right," replied Kathleen, "and while it is getting cool enough to pull get Judith to make some of her maple fudge with the candied cherries."

"Oh goodie!" cried Polly, clapping her hands, "and after that, if it is not too late, we will have Betty make some of those delicious chocolate caramels that she had the last time we were at her house."

**She Saw a Package Lying on the Hall Table**

"Very well," replied Betty, "that will make three kinds, which ought to be enough with what the other girls are going to make."

"Now, Kathleen, it is your turn to begin first with the molasses candy."

"All right," said Kathleen, "I will begin by putting in the chafing dish two cups of molasses, two cups of brown sugar, two tablespoons of vinegar and a piece of butter the size of a large egg; then turn on the current and let the mixture boil (without stirring) until it hardens when dropped into cold water."

When it had boiled sufficiently, Kathleen stirred in a heaping teaspoon of baking soda and poured the candy on buttered tins to cool, and Ruth and Jane began cutting up oiled paper into pieces large enough to wrap the candy in after it was pulled and cut up.

"Don't forget, girls," said Kathleen, "that when you begin to pull the candy you must rub a little butter on your hands to keep it from sticking to them."

After the chafing dish was washed, Judith began to make her fudge.

"I think I will make a large pan of this," she said, "as Robert is very fond of it and is sure to buy some, especially if it is made by electricity, just to see if it hasn't a better flavor."

"Oh Judith!" cried Polly, "you didn't tell us what you put into your fudge."

"Well!" said Judith, "I put in two cups of white sugar, two cups of light brown sugar, a cup and a half of maple syrup and a cup and a half of milk. Let it boil, stirring constantly, until a little dropped into cold water makes a soft ball that you can pick up with your fingers; just before you take it off put in a piece of butter the size of a small egg, and a teaspoon of vanilla. Remove the candy and beat it for two or three minutes, then add one-fourth of a pound of candied cherries that have been cut up in small pieces, and continue to beat until the candy begins to get thick, but not too thick to pour smoothly into buttered tins. Mark in squares."

By the time the fudge was done the molasses candy was ready to pull, and when it was cut and wrapped up, the girls thought it was time to go home.

"But Betty!" cried Ruth, "won't you tell us how to make the caramels?"

"I surely will," replied Betty, "and you may write it down. I was wondering, Judith dear, if it would be asking too much of you to let me come over in the morning and make the caramels in your chafing dish. It is baking day at home and mother does not like me in the kitchen when she is busy. Besides, I want to make the candy in the chafing dish as I intend to ask father to get me one."

"Come by all means, Betty, I should be glad to have you, and you may make the candy here in the dining room where you will not be at all in the way."

"That is so good of you, Judith, I want the caramels to be just right and sometimes when I make them on the stove they burn."

"Well, girls, I see you are waiting for the recipe, so here it is:

"Two cups of white sugar, two cups of Karo syrup, one-half cup of milk, a piece of butter the size of a large egg, one cup of grated chocolate; boil until it stiffens in cold water and pour into buttered tins. Better wrap the caramels in waxed paper as the weather is warm."

The girls then packed their candy into boxes, and telling their hostess how much they had enjoyed themselves and that they had never kept so cool before when making candy, started for their respective homes, singing the praises of the electric chafing dish.

"Oh Robert!" said Judith, as she closed the door after the girls, "I am so delighted with your beautiful gift. I never really liked to make candy before. I am going to cook all kinds of dainty dishes for you this summer."

"I am very glad you like it, dear. It does seem very convenient and makes no dirt at all and is much safer than the chafing dishes with which you have to use the alcohol flame."

## WORK "WELL BEGUN, HALF DONE"

Following the tendency of the business world the housewife of today is seeking as far as possible to eliminate the necessity of labor and the waste of time attendant upon the older-day methods of housekeeping, and in accomplishing this she has no better helper than electricity. Breakfast is usually one of the lightest meals of the day and in having it quickly prepared without unnecessary labor the electric cookers stand first.

Eggs are a common American breakfast dish but require a hot fire in the cookstove. With electricity in the house just push the button and directly the heat is where needed without waiting.

Put up your windows and let in the fresh morning air for there is no flame to blow out. If one of those hot sultry mornings comes along just run the extension cord out the window and have breakfast on the porch, for your cooker is portable. With breakfast over there is little work to cleaning cooking utensils, the kitchen is cool for the day and as a good Irish cook once said "When you smell a stove that doesn't smell, that's electric."

## The Truth About Current Cost

A great many people have been misinformed regarding the cost of current for operating certain household devices. Often the questions are asked: "Why don't you use a vacuum cleaner?" or "Why don't you buy a vibrator?" In many instances the reply is: "Oh, it costs so much for current," or "I've been told they fairly eat up electricity."

Now such answers are wrong. Here are the actual figures. Five manufacturers of vacuum cleaners list the watts consumed by their household machines as follows: 250, 220, 210, 250, 225. The average is 230 watts, or make it 250 watts for good measure. Two hundred and fifty watts equals exactly one-fourth of a kilowatt. When you buy current from the electric company you pay by the kilowatt hour, that is the way your meter measures it. Prices of course vary in different cities, but 12 cents is considered a good average price for a kilowatt hour. Therefore, when any one tries to tell you that current for a vacuum cleaner costs frightfully and that your meter is going to "just whizz around," just remember that it is in reality not going to cost you over three cents an hour—pretty cheap when you consider the nice clean rugs and curtains that result.

It is the same with the vibrator. Two of the best makers list their vibrators as consuming 90 watts and 50 watts respectively. We'll go the highest one 10 watts better and call it an even hundred. That is one-tenth of a kilowatt and if the vibrator were to run an hour it would consume one-tenth of a kilowatt hour or 1.2 cents. Ordinarily you would not care to use a vibrator more than 15 minutes, which means .3 of a cent's worth of current for a nice massage—not so scandalously extravagant.

## The Kitchen Stove

When we buy a ton of coal to supply the kitchen stove, it is quite doubtful if we consider just how much of the heat in the coal is actually used. The best cook stove made cannot keep nine-tenths of the energy from the coal from going up the chimney. Of the one-tenth left, only about one-half is really applied to the cooking, the rest being wasted in making the kitchen uncomfortable, especially in summer.

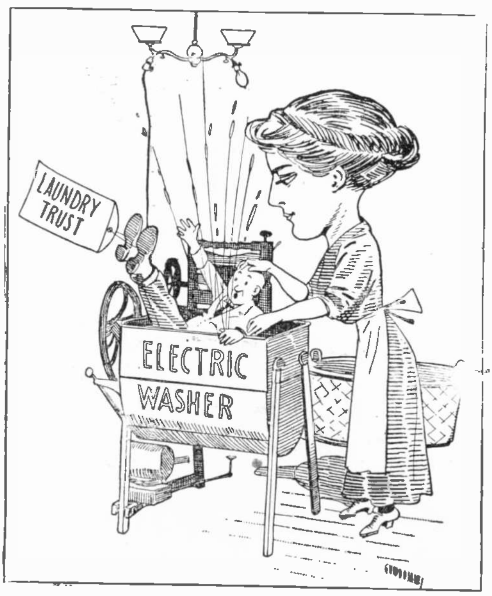
While the electric kitchen in which practically all the heat goes where needed may mean a few cents more a month, no money goes up in smoke.

## Lighting the Home

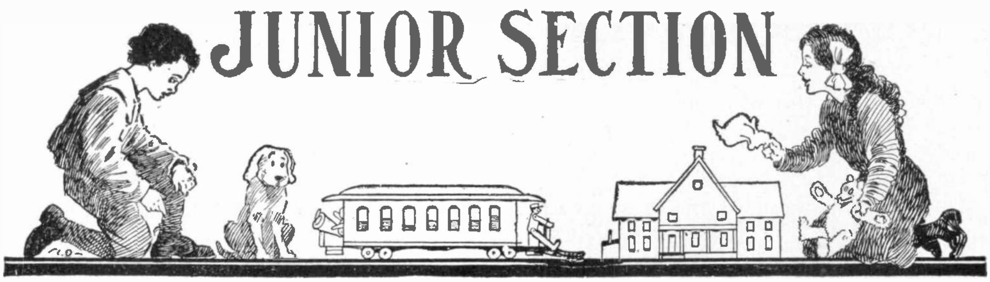
It is not often that in making a comparison between the cost of lighting the home by electricity and lighting it by gas or by the oil lamp the real cost of the latter is considered. The oil lamp and gas light smoke up the paper and ceilings and destroy the paint. Broken globes cost money and are not always promptly attended to which makes matters worse, while the item of oil cost is usually not taken into account.

Every open lamp, gas or oil, is a consumer of oxygen and a producer of poisonous carbonic acid gas, and, no doubt, many doctor bills are traceable to air from which the life-giving oxygen has been taken, especially in winter when lights are most used and windows kept closed.

In the present-day plans for home illumination the tint of the ceilings and walls is made to assist in diffusing the light while the saving brought about by the introduction of the high efficiency lamp and the placing of outlets where a low candle power lamp will take the place of a higher power lamp farther away, makes electricity the cheapest means of lighting where light, convenience, safety and time are considered.



# JUNIOR SECTION



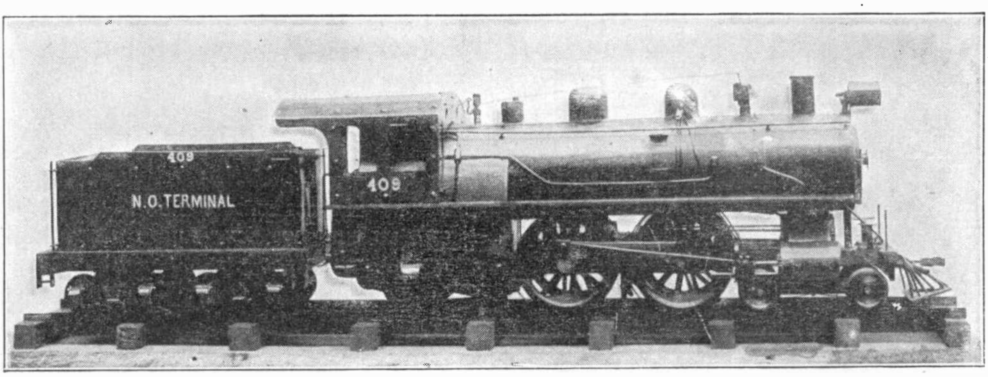
## A Young Experimenter

This is a picture of an electrical experimental table and its owner Harol E. Foley, 42 Plymouth Ave., Buffalo, New York. A miniature electric railway, with semaphores for signalling, an electromagnetic engine, an induction coil, a fan motor and other interesting devices are shown as making up his outfit. Many of the devices are of his own construction and show what a boy can do who really makes up his mind to become an electrical experimenter.

## Model Electric Locomotive

Although appearing to be a steam locomotive the miniature engine and tender in this picture are run by electricity. It took three months to build this outfit, which weighs seven pounds and is 19 inches long. The boiler, cab and tender are made of Russian iron. The frame, wheels, domes, journal boxes, etc., are of brass, and the steam pipes are represented by heavy copper wire. A 10-volt motor is placed in the firebox and geared to the wheels under the cab. A 2½-volt lamp is used for a headlight, the voltage being reduced by a small German silver resistance in series with the light. A lever in the cab reverses, stops, or starts the locomotive. Two wheels on one track are insulated from the axles by hard rubber bushings, these two wheels being each provided with a flat steel brush connected to one side of the motor. When the batteries are connected across the rails the current goes to the engine frame, through the motor to the steel spring brushes and to the wheels and back on the track on that side to the batteries.

J. S. Couret of 830 Canal street, New Orleans, La., had the ingenuity and patience to carry out this novel piece of work.




MODEL ELECTRIC LOCOMOTIVE

# An Electrical Laboratory for Twenty-Five Dollars

By DAVID P. MORRISON

PART VIII

It no doubt would be well for us to pause at this point and see just where we stand financially as we were going to construct an electrical laboratory for $25.00. To make an estimate of the total cost of all the equipment described in the articles up to the present would invoke so many variables that it would not be at all accurate. No doubt a great many of the boys had all the tools required when they started; perhaps some did not have the tools but had wire and other materials that they did not need to purchase so that the cost of different items to different boys will vary through wide limits. The description of the apparatus may have been too crude for some or not fine enough for others, which would result in a wide difference in cost.

Some boys may have preferred to have certain work done by outsiders rather than by themselves, thus adding to the cost considerably. The remaining articles however will describe the construction of small apparatus that will be quite useful about your laboratory and its cost will be very small as compared to the equipment you have been building; and in the majority of cases it will be found that out of the original outlay, after building the essential apparatus that has already been described, there will be quite a few dollars left to spend upon the odds and ends which will go to make up the apparatus now to be described.

## GALVANOMETER CONSTRUCTION

The galvanometer is an instrument for detecting and measuring, relatively, the current in an electrical circuit. Its operation depends upon the simple fact that there is a magnetic field about every conductor carrying a current, due to that current, and the strength of this magnetic field is dependent upon the value of the current in the conductor.

To illustrate this, if you take an ordinary compass and hold it near a wire carrying current the needle will be deflected and tend to set itself in a direction at right angles to the line of the wire. The earth's magnetism will be also pulling it in another direction (except when the wire is in an east and west direction) therefore the needle will point in a direction determined by the resultant or combined action of these two forces. The amount of its deflection will depend on the strength of the current in the wire.

The magnetic field around a current-carrying conductor is supposed to be in the form of little concentric "lines of force" whirling around the conductor. If you look along the wire in the direction in which the current is flowing the unseen rings will be whirling around the wire in the direction in which the hands of the clock move, or clockwise. The tendency of the compass needle is to lie in the plane of these rings. Put the compass above the wire when the current is flowing away from you and its north pole will be deflected toward the right trying to get in the path of the lines of force, and travel with them. Reverse the current and the little whirls will reverse in direction and the north end of your compass needle will be deflected to the left.

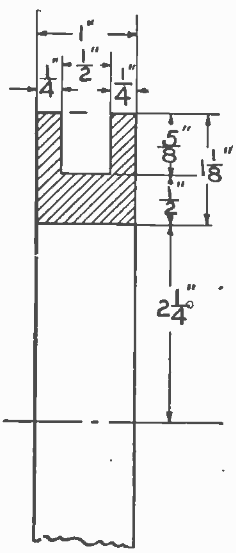


FIG. 79

This principle is applied in the galvanometer; that is, a compass needle, affected by a current flowing in a coil of wire, is made, by the amount and direction of its deflection, to show the course and strength of the current in the coil. A very good one may be made as follows and may be used in a locality where the value of the earth's magnetic field is practically constant.

Turn from some well seasoned close grained wood a ring whose cross section is shown in Fig. 79 and whose internal diameter is 4½ inches. This ring should be thoroughly shellaced to prevent its warping out of shape. Cut from some ⅝-inch hard

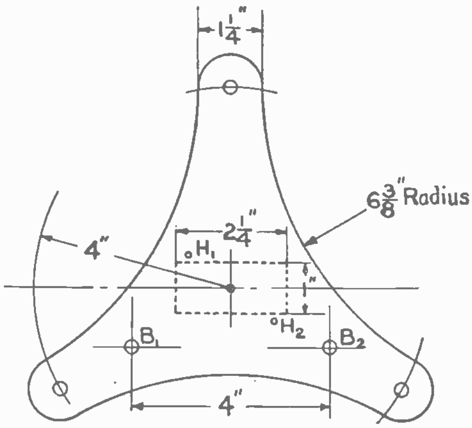



FIG. 80

wood a piece whose dimensions correspond to those given in Fig. 80. Cut a groove in this piece as shown by the dotted lines so that the wooden ring will fit into it. The groove should be ¼ inch deep at its center. Now cut another piece whose dimensions

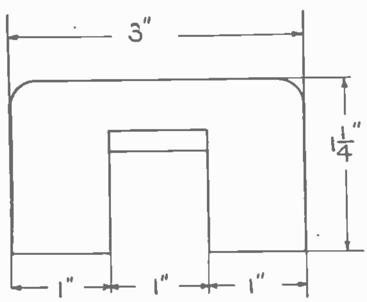



FIG. 81

correspond to those given in Figs. 81 and 82 that is to be used in mounting the ring upon the base. The groove in this piece should fit over the wooden ring and it should be of such a depth that the block will rest almost upon the wooden base when it is fastened down over the ring. This block can be screwed to the base.

Drill three ⅛-inch holes in the base as indicated in Fig. 80. Now obtain a piece of brass rod about six inches long and thread it for its entire length, then cut it into three pieces of equal length. Round off one end of each of these pieces and solder the other end into a hole in a brass washer about ¾ inch in diameter. These three screws can now be forced into the three ⅛-inch holes in the base and are to be used in leveling the instrument. Three ordinary brass screws might be used for this purpose with small pieces of sheet brass soldered in the grooves in their heads and the points rounded off. Two binding posts should be mounted on the base as shown at ($B_1$) and ($B_2$) Fig. 80. Two ⅛-in. holes ($H_1$) and ($H_2$) should also be drilled in the base for the wires to pass through from the coil. There should be grooves cut in the under side of the base connecting these holes with the binding posts to place the wires in, thus providing both electrical and mechanical protection.

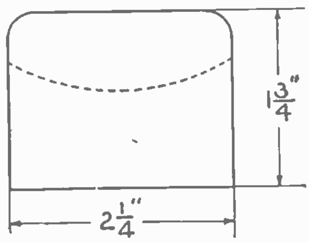



FIG. 82

The compass needle must be mounted in the center of your coil and it must carry a

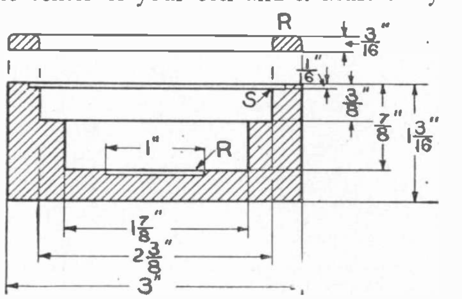



FIG. 83

pointer that moves over a graduated scale. A suitable mounting, containing case, scale and pointer can be made as follows. Turn from some close grained, hard wood a small box whose dimensions correspond to those given in Fig. 83 which shows a cross section of the box. Turn a small wooden ring whose dimensions correspond to those of (R). Drill about eight small holes in this ring and arrange to fasten it to the upper edge of the box. Cut from some thin glass a circular piece 2½ inches in diameter that is to serve as a top for the box. If you are unable to obtain the glass a small piece of clear celluloid will do. It might be well to place a ring of heavy cloth under the glass or celluloid as that will prevent dust and dirt sifting into the box.

Now cut from some heavy cardboard a ring that will fit on the step (S) and project about $\frac{1}{8}$-inch beyond the inner edge. Mark this ring off into equal divisions, each corresponding to a certain number of degrees. Considerable care should be exercised in graduating this scale and the finer the divisions the more accurately the deflection can be measured. Two zero points should be marked on the scale exactly 180 degrees apart and the remainder of the scale lettered 0 to 90 degrees in each direction from these zero points. The scale can be fastened in place with some shellac, or a better way to do this is to cut from some heavy tin a second ring the same size as the one you cut from the cardboard, and shellac the cardboard ring to it. This completed ring can now be fastened in place with three or four small screws.

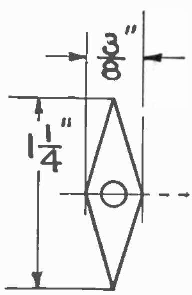



FIG. 84

The magnetic needle should be made from some good quality steel and its dimensions should correspond to those given in Fig. 84. The thickness of the steel should be about 1-16 inch. Drill a 5-32 inch hole through the center of the needle and force a piece of brass rod into it of such a length that it is just flush on one side and projects about 3-16 inch on the other side. Now drill in this piece of brass rod a 3-32 inch hole, with a pointed drill, from the end that is flush with the surface of the needle to a depth 1-16 inch less than the length of the rod. Cut from some very thin spring brass a pointer as shown in Fig. 85. Drill a 3-16 inch hole in the center of this pointer so that it will slip down over the piece of brass rod in the needle. The needle can now be tempered and the pointer soldered in place, making sure you do not overheat the needle when soldering. The pointer and needle should be exactly at right angles with each other. A right angle twist can be placed in each end of the pointer at the points ($P_1$) and ($P_2$) Fig. 86, and the ends then filed to a knife edge thus greatly increasing the ease of reading the deflection, as there will be a fine edge moving along the edge of the scale instead of a blunt point.

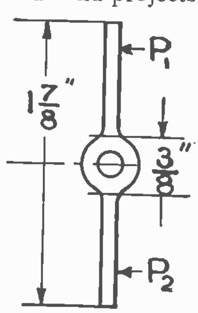



FIG. 85

Obtain a piece of 1-16 steel rod about $\frac{1}{2}$ inch in length and put a sharp point on one end. Drill a 1-16-inch hole in the end of a piece of $\frac{1}{8}$-inch-brass rod, that is threaded its entire length and about $\frac{1}{2}$ inch in length, to a depth of about $\frac{1}{4}$ inch. The steel rod should fit into this hole very tightly without being soldered. Saw a slot in the other end of the brass rod so that it can be turned with an ordinary screw driver. Drill and thread a hole in the center of a circular piece of $\frac{1}{8}$-inch brass one inch in diameter so that the threaded brass rod will turn rather hard in it. Three other holes should be drilled near the outer edge of this piece for small screws to be used in mounting it in the recess (R) in the bottom of the wooden box shown in Fig. 83. Be very careful to see that the pivot is in the exact center of the box, otherwise you will have an error in the indicated deflections on the scale. The position of the pointer can be changed vertically by turning the screw that carries the small steel rod.

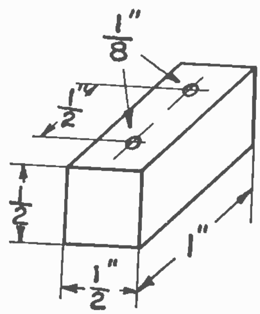



FIG. 86

This part of the instrument is now complete and can be assembled and the box given two or three coats of good shellac. It would add quite a bit to the appearance of your instrument if you would give the inside of the wooden box three or four coats of white paint.

The box containing the needle must now be mounted in the exact center of the wooden ring which can be done as follows:

Cut from some $\frac{1}{4}$-inch hard wood two pieces six inches long and $\frac{3}{4}$ inch wide. Place these two pieces on edge and a distance apart equal to the breadth of the wooden ring and mark out a circle on them as shown in Fig. 87 with a radius equal to that of the outer edge of the wooden box. Cut these pieces out between the dotted lines to a depth of $\frac{1}{4}$ inch. These pieces should now be mounted on opposite sides of the wooden ring with their edges horizontal and at such a height that the needle will be in the center of the coil.

The winding on this galvanometer can be made to correspond to almost any requirements. You no doubt had best first determine experimentally how many ampere turns are required to produce a given deflection. You will find the deflections do not increase directly as the current increases. The number of ampere turns is the product of the current in a coil and the number of turns of wire in the coil. If you know the number of ampere turns required to produce a given deflection, and know the value of current you want to produce that deflection with, you can determine the number of turns required by dividing the ampere turns by the current. Use a size of wire that will carry the current without excessive heating.

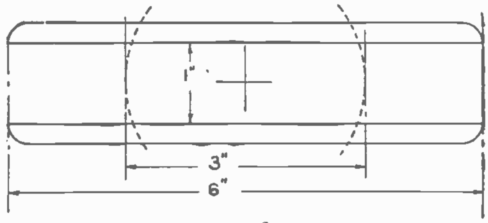



FIG. 87

The terminals of the winding should be brought out in such a way that they will correspond to the holes ($H_1$) and ($H_2$) in the base of the instrument

The wooden containing box should be placed in such a position that a line drawn through the two zero points on the scale will be exactly perpendicular to the plane of the coil. To operate the instrument the coil should always be placed parallel to the magnetic needle, when there is no current in the coil, which can easily be determined by the ends of the pointer being at zero on the scale.

A chart can be made that gives the relation between degrees deflection and current by passing known values of current through the instrument and noting the deflections of the pointer.

All instruments whose operation depends upon a permanent magnet being controlled by the earth's magnetic field, and another magnetic field produced by a current whose value is to be determined, are subject to large errors in indication due to changes in the magnetic field in which the needle operates that may be produced by outside magnets and currents, but so long as the conditions under which the instrument is used remain the same as those under which it was calibrated, there will be no serious trouble.

(To be continued)

## Reversing the Polarity

In reply to frequent inquiries for a convenient means of changing the polarity of a pair of wires two methods are here illustrated. In Fig. 1 the device consists of binding posts mounted on a wooden base and a pair of two point switches so connected by a hard rubber strap as to move the switches at the same time. Connections from the binding posts are made in grooves on the under side of the wooden base.

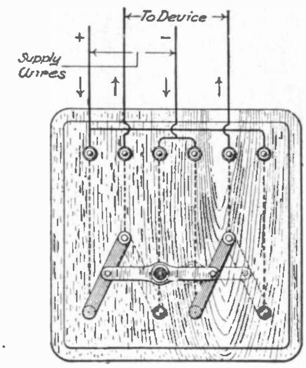



FIG. 1

This device is fitted for use on low voltage circuits.

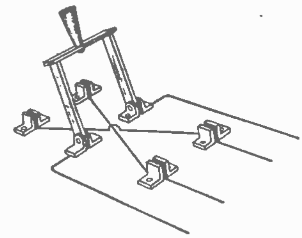


FIG. 2

Fig. 2 represents a standard double-throw, double-pole knife switch suitable, when mounted on slate, marble or porcelain, for use on 110 volt circuits. The wires should be properly bushed where they cross each other in order to prevent any danger of contact between them.

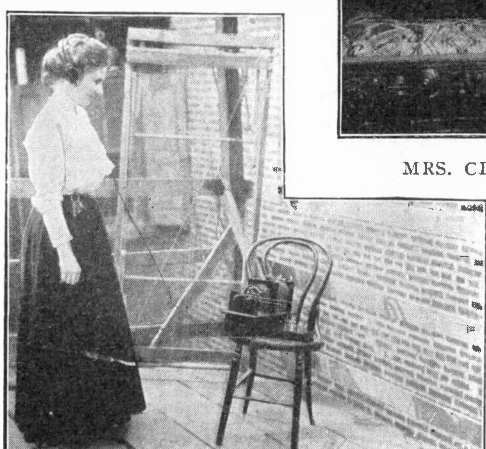
# POPULAR ELECTRICITY WIRELESS CLUB

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

## Wireless in Every Home

That wireless telegraphy, as applied to the home, is not the complicated, expensive science that it generally is believed to be, is proven by F. B. Chambers, of Philadelphia, who, though an amateur in the business, is known among his friends as "The Wizard of North Ninth Street." On the roof of his two-story home he has shown to friends and experts alike that it is possible to receive messages through as simple aerials as three strands of wire clothesline, a wire cot stood on end, an umbrella and even a dishpan. He has not, however, succeeded in sending any messages through the last three.

MRS. CHAMBERS IS A WIRELESS ENTHUSIAST

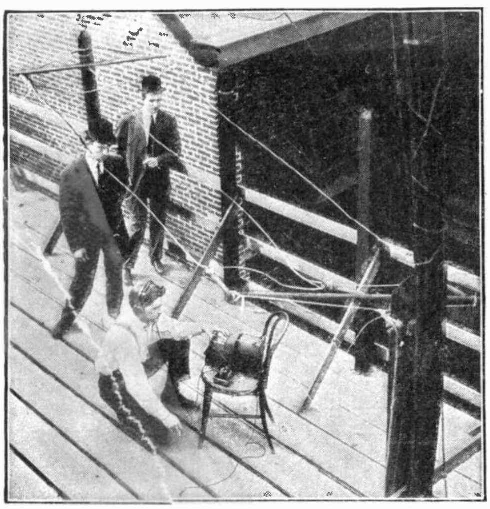


USING A BED-SPRING AERIAL

His wife is almost as great an enthusiast as he is and when he leaves home on a rainy day or evening she frequently talks to him with her key in Morse while he listens through his umbrella, which is connected up to a small portable receiving instrument. To reply, he has to hunt up a wireless station, but there are so many wireless amateurs in Philadelphia and so well known to them is Chambers that he seldom has to search long to attain his purpose. Mrs. Chambers, however, says she has the most fun when she is doing all the talking and he cannot answer back.

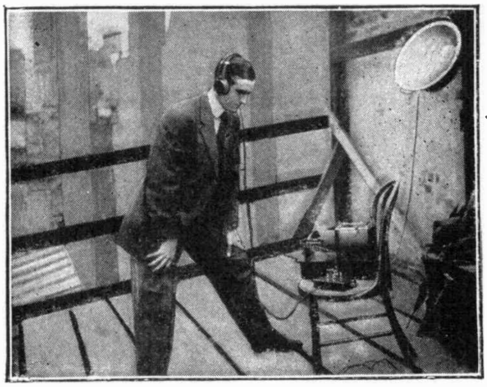
"UMBRELLA" AERIAL

The "wizard" takes great pleasure in aiding and instructing the boys of his acquaintance in the mysterious science and spends many a pleasant evening in talking with them over the housetops. Several of



WORKING THE COIL

his students intend to camp out in the suburbs of Philadelphia this summer to try especially to add to the list of Chambers' makeshift aerials and to see from what long distances they can pick up messages with their crude instruments. The best that Chambers has done so far with his umbrella



DISHPAN FOR AERIAL

and dishpan is to get messages from the League Island navy yard, about three miles from his home.

## Choosing A Pair of Receivers

By C. BRANDES

The beginner, in selecting the parts of his receiving apparatus, very often neglects that most important part, the head receivers. The receivers, as a rule, are taken for granted, not considering the fact that they cannot be adjusted for better results, as can be done with the other wireless apparatus, until the desired results are obtained.

There are three very important points to be remembered, when selecting receivers.

First and foremost sensitiveness, that is, the quality of being able to respond distinctly to the most infinitesimal etheric disturbance.

Second, both receivers must have the same pitch, or, in other words, be tuned alike (in the musical sense).

Third, the entire outfit should weigh as little as possible, so as not to tire the operator when wearing it continually on his head.

In selecting for sensitiveness, care must be taken not to confuse the wireless receiver with the high resistance telephone receiver. The reason for this is plain. The high resistance telephone receiver was originally constructed to respond as loudly as possible, without consideration for the amount of energy required to operate it.

Winding a telephone receiver to a higher resistance, merely improves it slightly on the small amount of energy received, but the diaphragm, size of bobbin, strength of magnetism, all remain unaltered, so that although it responds very loudly on strong signals, it dies out very rapidly on the weaker ones, which are just the ones we are trying the hardest to catch.

The specially constructed wirelesss receiver, with the proper bobbins, diaphragms, magnetism, etc., cannot compete with the high resistance telephone receiver in loudness, as its tone is much softer, but it receives the weaker signals clearly and distinctly, to the very limit of its audibility, which is vastly beyond that of the clumsily built, high-wound telephone receiver.

The second point, in regard to pitch, is very essential to distinctness, both in having them alike and of the proper pitch.

Lastly, the weight. This is decreased by making the receiver as small as possible, and of the lightest material, the case, as a rule, being made of aluminum in the finer grades of receivers. The hard rubber case is also very light in weight, but the drawback is that the rubber case does not keep permanent adjustment, as rubber does not expand in change of temperature at the same rate as the metal parts. There are other bad features connected with it that render it not very serviceable for best results.

In regard to resistance, the question arises, which is best. Experiments have proven that resistance is not the main consideration. The point at issue is sensitiveness, and this is governed by the construction, etc., of the receiver only. Therefore, when purchasing a receiver, sensitiveness is the object, irrespective of the resistance of the receiver, which may be 1,000 to 2,000 ohms, more or less, per receiver.

## Springfield (Mass.) Wireless Association

The Springfield Wireless Association was organized May 14, 1910, starting with a membership of twelve members. The following officers were elected:

A. C. Gravel, president; T. F. Cushing, secretary; Roy Armstrong, treasurer; and Donald W. Martensen, technical adviser. The purpose of the association is to regulate the work among amateurs so as to cause no annoyance between amateurs and commercial companies, or between the amateurs themselves. Also to assist the amateurs in that vicinity in the proper erection of stations, the location of trouble and the selection of the best apparatus for their respective stations. Motto: "No Interference."

Any amateurs wishing to join should write the Secretary of the association, 323 King St., Springfield, Mass.

## Are Wireless Burglar Alarms Possible?

Of burglar alarms which go off when the intruder steps on a contact, breaks a thin metallic film or otherwise touches off a connection, there is seemingly no end. But the shrewd lawbreaker knows these arrangements all too well and too often thwarts their action. The alarm to baffle him would be one that will go off without being touched at all, one that will sense his unwelcome presence much as a watchdog would do. Can this be done by using an alarm device sensitive to the light which he needs in his nightly prowling; that is, by using a concealed wireless coherer so arranged as to close the circuit of an alarm bell when a sudden flash of light strikes it?

A somewhat similar plan has already been tried by placing a box containing a plate of selenium (a rare metal allied to sulphur) where the intruder would be sure to flash his lamp and connecting this both to an electric bell and to a source of current. In the dark, selenium has a high resistance so that with a suitably proportioned circuit it would not pass enough current to ring the bell. But when exposed to bright light, this resistance drops to a hundredth, or even to 1-300 its former value, thus allowing a rush of current which will sound the alarm. The selenium plate might be covered with a thin gauze of cloth or paper so as to hide it from view, thereby making it not only an untouched but also an unseen guardian of the place. Unfortunately the initial resistance of the selenium itself varies greatly from day to day, for reasons not yet understood, hence such a burglar alarm system would need frequent readjusting. With the similarity of the coherer in its action, might it not be more practical to use this in place of the selenium resistance plate as a means of closing the alarm circuit, using a relay if necessary? If so, who will be the first to accomplish it?

# A High-Power Wireless Equipment

By ALFRED P. MORGAN

PART IV.—INDEPENDENT ADJUSTABLE INTERRUPTER

The interrupter plays a more important part in the operation of an induction coil than is generally realized. That the coils commonly designed and employed for wireless telegraph purposes differ from the old-fashioned X-ray coils in having an iron core which is much larger both in cross section and length is perhaps well known. The change has been made necessary through the employment of larger currents. An X-ray coil seldom uses over 100 watts, but a coil used to charge the condenser of a wireless transmitter may use ten times that amount. Just how this concerns the interrupter we will see later.

Electrolytic interrupters are not ordinarily used in commercial wireless telegraph stations for several reasons, among which may be mentioned the facts that the frequency of interruption is considerably too high and that when used for more than short periods, and the electrolyte becomes quickly heated. While it is true that interrupters of this type may be adjusted to operate at a low frequency, the current break will not be sharp and it will require more energy to transmit a given distance.

Mechanical interrupters embody two types, the "hammer break" and the "mercury." The mercury turbine is the only one of the latter group worth more than passing notice. It was the intention of the author to describe one, but upon further consideration he decided that in view of the several special parts required and the increase in cost above that of an interrupter of the "hammer break" type it was advisable to give place to the latter.

In order properly and efficiently to operate an induction coil the interrupter must be adjustable, not only adjustable as regards the frequency and rapidity of interruption but also constructed so that the relation of time between the periods when the current is flowing and when it is broken may be governed. An ideal interrupter would have a much longer period when the current is flowing through the primary coil than that during which the current falls from its maximum to zero. The latter should be as rapid as possible.

The frequency of interruption must accommodate itself both to the requirements of the complete system and to the core of the induction coil alone. The human ear does not hear with equal loudness sounds of the same strength and different pitch. The average ear is the most sensitive to tones of a somewhat higher pitch than those heard in the telephone receivers of the receptor and due to the interruptions or alternations in the primary current at the transmitting station. So in order to make weak signals audible it is desirable that the interrupter at the sending station should have a high speed.

This is a feature realized in Dr. Lee DeForest's new wireless telegraph system. By the use of an arc to generate undamped high frequency oscillations, a clear, high musical note having about 1000 vibrations per second is produced in the phones at the receiving station. Such a tone is very easy to read through severe interference.

The frequency of an oscillatory arc is naturally very high. If it were attempted to obtain such a note by using an extremely rapid interrupter in connection with an induction coil, a new difficulty would be thrown in the way. When the speed of interruption is very high, the current cannot flow through the primary for a sufficient length of time properly to magnetize the core before the break occurs. Also, the rise and fall of the secondary currents will run into each other because the break occurs before the primary current has reached a maximum and the reverse secondary current has died away.

Two other phenomena taking place in the core which deserve attention are known as *hysteresis lag* and *eddy currents.* When a mass of iron is magnetized or demagnetized, momentary currents of electricity are created in the iron itself. These currents are of low voltage but exceedingly large amperage, and as we noted when building the induction coil unless precautions are taken to render them negligible they not only will heat the core considerably but reduce the whole efficiency of the coil. Hysteresis is a peculiar action taking place in the core under the same circumstances, but is of an entirely different nature. When a mass of iron is magnetized is does not immediately lose its magnetism if the inducing field is suddenly removed. Vice versa, it does not always assume the degree of magnetization it should in view of its position in the magnetic field. Hysteresis might be compared to the action of a spring which resists bending but after being compressed or bent does not immediately fly back to its former position.

It is impossible to eliminate these undesirable phenomena altogether, but much may be done to reduce them. They are always directly proportional to the frequency of the interrupter, and since this is a direct argument against high speed the interrupter must be adjusted so that it is a compromise.

All these facts concerning the effects of speed, etc., have been discussed to emphasize the value of experimenting to raise the efficiency of the station. By working with the

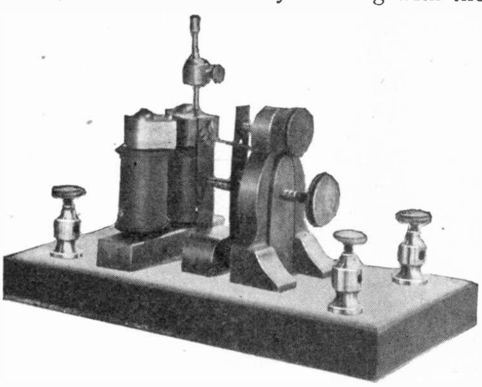


FIG. 34. INTERRUPTER ASSEMBLED

adjustment of some part of an instrument during a spare moment it is possible often considerably to increase the range of the station or decrease the amount of power required to communicate a certain distance under normal conditions. In order to do this to the best advantage, the influence a change in any one part makes upon the others must be fully understood. In the case of an interrupter, one may now readily see why it might be well to call up another operator and ask him how the tone of the spark sounds as well as to watch the hot-wire ammeter when adjusting the springs or screws of the interrupter.

An independent interrupter is one whose armature is operated by a pair of small electromagnets and is therefore independent of the magnetism of the core of the induction coil. These electromagnets are usually supplied with current from the same source as the induction coil but draw only a very small amount. They are connected with the battery and aerial switch so that the armature is set into vibration as soon as the aerial switch is thrown into position for sending.

Fig. 34 illustrates an independent interrupter designed for use with the induction coil described in the preceding chapters and has proven, by considerable service, to be entirely satisfactory.

The electromagnets are illustrated in Fig. 35. Those used on the interrupter from which the photograph was taken once saw

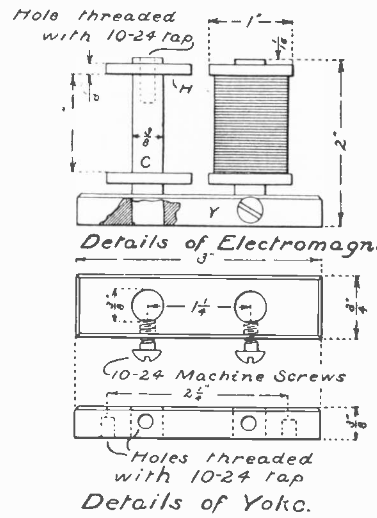



FIG. 35. DETAILS OF MAGNETS

service as such on a magneto telephone bell. The bobbins happened to be just the right size, so after rewinding they were fitted to the interrupter. It is possible for the experimenter to obtain a similar pair from the same source, since they are a standard size, but a set may be easily made to conform with those shown in the drawing. The cores are wrought iron rods two inches long and one inch in diameter. The heads are circular ¾ inch disks of hard rubber one inch in diameter and ⅛ inch thick, having a 5-32-inch hole bored through the center. The holes are enlarged with a rat tail file until the disks can be forced on to the core without danger of splitting. The top of the upper disk should come 1-16 inch below the top of the core, while the lower one should be placed so that the space formed between for winding the wire is one and 3-16 inches wide. A hole ½ inch deep is bored in the center of the top of each core and threaded with a 10-24 tap.

The electromagnets are connected and held upright by a soft iron yoke, three inches long, ¾ inch wide and ⅜ inch thick. The top edges are beveled slightly with a file to better the appearance. Two ⅜-inch holes are bored through the yoke 1¼ inches apart as indicated in the illustration. Two holes are bored at right angles to these and threaded with a 10-24 tap so that a short machine screw having a similar thread may be screwed into each. The lower part of the electromagnet cores fit into the large holes and are clamped by means of the screws. Two holes, 2¼ inches apart, are bored in the under side of the yoke and threaded with a 10-24 tap so that it may be held firmly to the base by two machine screws.

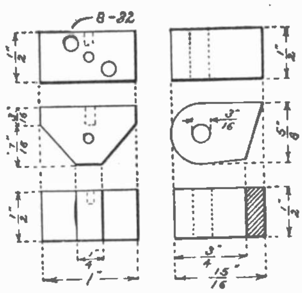


FIG. 36. ARMATURE AND POLE PIECES

The electromagnets are wound full of No. 28 B. & S. gauge magnet wire and connected in series. Two pole pieces are fastened to the upper ends of the magnet cores by means of a screw which threads into a hole. The pole pieces are soft iron blocks which may be cut out with a hack-saw and finished with a file to conform with the shape and dimensions indicated in Fig. 36. One end is cut off at an angle and the other is rounded to coincide with the semi-circumference of a circle having a diameter of ⅝-inch.

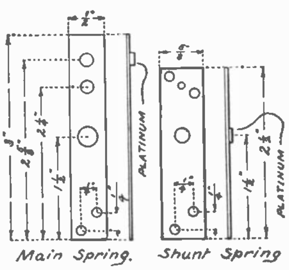



FIG. 37. SPRINGS

The armature is also illustrated in the same figure. This is an irregular piece of soft iron one inch long, ⅝ inch wide and ½ inch thick. Two large holes are bored in the back face and threaded with an 8-32 tap so that it may be fastened to the upper end of the shunt spring. This is a piece of spring steel 2½ inches long, ⅝ inch wide and 1-32 inch thick. A platinum contact is riveted in the center of the spring 1½ inches from the lower end.

The main spring is three inches long, ½ inch wide and 1-32 inch thick. It carries a heavy platinum rivet in the center ⅜ inch from the top. A hole 3-16 inch in diameter is bored along the center line, 2¼ inches from the lower end. A 7-32 hole is bored one inch below. Fig. 37 shows details of the main spring and shunt spring.

The springs are fastened at their lower ends to a brass block shown in detail in Fig. 38. The block is 1½ inches long, ⅝ inch thick and ⅝ inch wide. The corners are rounded so as to present a neat appearance. The holes in the sides are bored on the opposite corners of a ¼-inch square so as to correspond with those on the lower end of the springs. They are tapped to receive an 8-32 machine screw. Two holes are drilled in the bottom of the block and threaded with a 10-24 tap so that it may be held securely to the base by two screws having a similar thread.

A piece of 1-16-inch brass rod two and 3-16 inches long is threaded at the lower end and screwed in the top of the armature. This rod carries a small sliding weight which may be fastened in position by means of a small screw. The higher the weight is on the rod, the slower will be the natural period of vibration of the armature. The weight is most easily made by cutting a small double connector in half with a hack saw and smoothing up the edge with a file.

A hook is made out of 1-16-inch brass rod and threaded at one end. It is then screwed into the back of the armature, a small hole as indicated in Fig. 36 having been bored there to allow of its passage. The hook is passed through the hole below the contact in the main spring and screwed into the armature so that when the armature is drawn forward by the action of the electromagnet the hook will pull the main spring forward, while in swinging back and beyond its normal position it will allow the contact on the main spring to rest against the contact on the end of the adjusting screw. This is the feature of the interrupter which makes the period when the current is flowing through the coil longer than the period in which it is broken. By screwing the hook in so as to shorten it the ratio of time is lowered. Details of block, weight and hook are shown in Fig. 38.

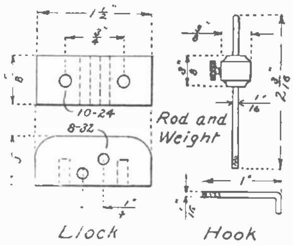


FIG. 38. DETAILS

Two knurled adjusting screws carry the platinum points which make contact with the platinum rivets on the springs. The knurled heads of the screws are ¾ inch in diameter and 3-16 inch thick. The screws are threaded with a 10-24 die. The shunt screw is one and 15-16 inches long and the main screw two and 11-16 inches long. The platinum points, which are 3-32 inch in diameter, are set in a recess bored in the end of the screw and soldered. They should fit tightly before soldering.

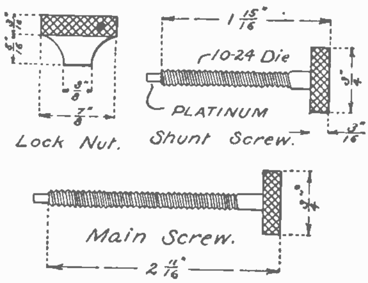


FIG. 39. ADJUSTING SCREWS

After adjustment the screws are locked in position by means of a nut which screws tightly against the standards. The details of the lock nut are shown in Fig. 39.

The standards are cut out of ⅜ brass with a file and hacksaw. The main standard is

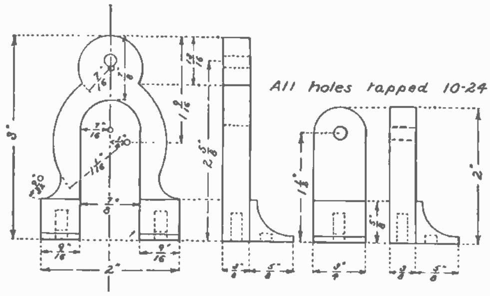


FIG. 40. DETAILS OF STANDARDS

three inches high and two inches wide at the bottom. The middle portion is cut away so that the small standard may fit between the two legs thus formed, but remain insulated from them. The small standard is two inches high and ¾ inch wide. The standards could be made perfectly plain, but in order to please the eye they are shaped as in Fig. 40. The arcs and centers of the circles to which several of the parts conform are shown in the figure. A hole is bored along the center of the main standard 2⅝ inches from the bottom and threaded with a 10-24 tap to take the main adjusting screw. The shunt screw passes through a similarly threaded hole in the main screw 1½ inches from the bottom. The brass feet are soldered to the standards to prevent any

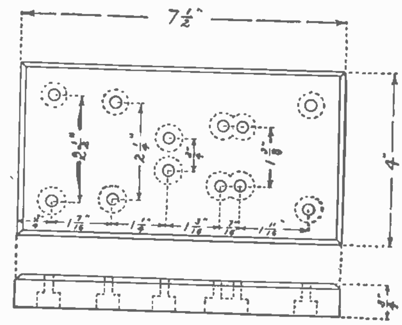


FIG. 41. BASE

rocking motion which otherwise might take place when the interrupter is in operation. These pieces are made by slitting a piece of ⅝-inch square brass rod diagonally across corners with a hack saw and then hollowing out one face with a round file. The standards are each fastened upright by means of two 10-24 machine screws which pass through the base.

The base, Fig. 41, is a piece of black fibre 7½ inches long, four inches wide and ¾ inch thick. Fibre may be rubbed smooth with fine emery cloth and pumice stone and then be polished with tripoli powder. The location of the holes through which the screws must pass to fasten the component parts of the interrupter firmly to the base are illustrated. All holes are 3-16 inch in diameter and are counterbored from the under side to ½ inch in diameter so that a metal washer may be placed under the head of each screw. Otherwise parts of the interrupter are liable to work loose from the hammering of the armature.

Four large binding posts are mounted on the base, one at each corner. Two small holes are bored through the base immediately under the electromagnets so that the wires may be led through. One terminal of the magnets is connected to the brass block. The other leads to the binding post (A) on top of the base, Fig. 42. The small shunt standard is connected to the binding post (B). The large standard and the brass block are connected to (C) and (D).

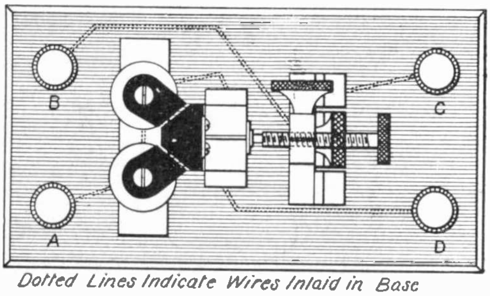



FIG. 42. PLAN VIEW OF COMPLETE INTERRUPTER

(A) and (B) are connected in series with the center knife blade on the aerial switch and a six-volt battery, Fig. 43, so that when the aerial switch is thrown down into position for sending, the circuit is completed and the interrupter is set into operation. A small condenser may be connected across the shunt adjusting screw to reduce the sparking, but in reality the sparking is so small that it is not absolutely necessary. The main standard and the spring are included in the primary circuit of the induction coil by connecting the wires to the binding posts (C) and (D).

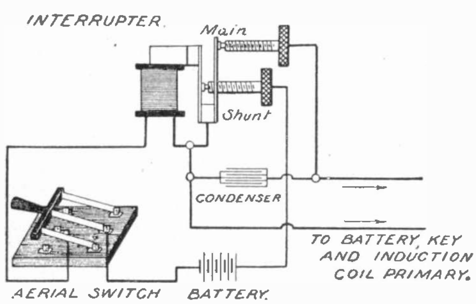



FIG. 43. CIRCUIT

Fig. 44 is a side view of the interrupter.

To obtain the greatest difference of potential from the secondary of the induction coil, a condenser adjusted to stop violent sparking at the break, across the contacts which break the primary current is necessary. When the current is broken under these conditions an oscillating current, the period of which is dependent upon the capacity of the condenser and the inductance of the primary, will be set up in the primary.

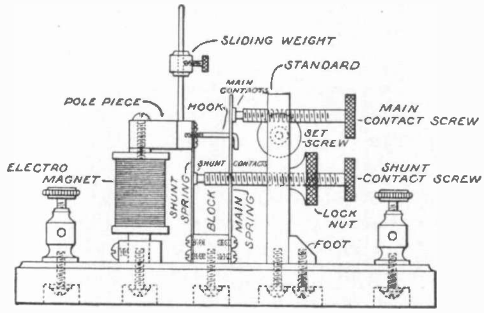



FIG. 44. SIDE VIEW OF COMPLETE INTERRUPTER

The sparking at the contacts is not due to the comparatively small e. m. f. of the battery but to the induced e. m. f. in the primary. When the circuit is made the current increases in strength as shown by the curve (a, b) in Fig. 45. As soon as it is broken the induced current charges the condenser which in turn discharges through the primary producing an oscillatory current as represented by (b, c). These currents induce an e. m. f. in the secondary which is greater than the e. m. f. induced by (a, b), since the rate of change is greater. By adding capacity around the break, the curve (a, b) will be made flatter, but if too much is added the length of the secondary spark will be decreased. The purpose of the condenser therefore is to produce as rapid a fall of current with as little sparking as possible, since the sparking leads to conduction across the break and the current cannot then fall rapidly.

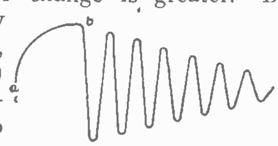



FIG. 45. CURVE OF PRIMARY CURRENT

The capacity of the condenser required to produce this result depends upon the value of the primary current, the inductance of the primary and the resistance of the circuit. The secondary spark length is also somewhat dependent upon several small factors such as magnetic leakage, distributed secondary capacity, etc.

A condenser suitable for the induction coil which has already been described is composed of 200 sheets of tinfoil 15 inches long and 6½

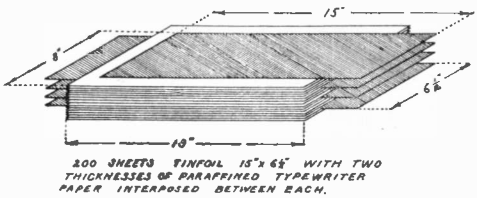



FIG. 46. CONDENSER CONSTRUCTION

inches wide interposed between double thicknesses of paraffined linen typewriter paper 13 inches long and eight inches wide, as shown in Fig. 46. Three inches of each tinfoil sheet is allowed to overlap the paper at the end so that connections may easily

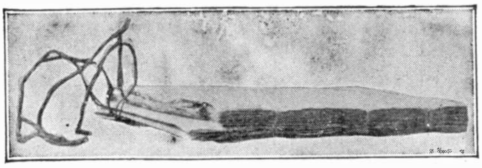


FIG. 47. CONDENSER COMPLETE

be established. This allows a one-inch margin on three sides of each sheet. The condenser is built up in the usual manner, that is by leading the tinfoil sheets out alternately at each end. All of the projecting sheets at one end are bunched together and soldered to a piece of flexible lamp cord.

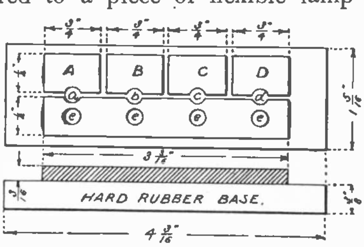



FIG. 48. DETAILS OF PLUG SWITCH

The sheets on the other side are divided into four groups containing respectively 50, 25, 15 and 10 sheets. These sheets are soldered to four different lengths of flexible lamp cord and prevented from coming into contact with one another by sheets of well paraffined paper laid between. Fig. 47 is a view of the condenser complete.

The four wires are connected to the individual members of a plug switch which is illustrated in Fig. 48. Eight holes 3-16 inch in diameter are bored in a piece of brass three and 3-16 inches long, one and 1-16 inch wide and 3-16 inch thick. It is then cut up with a hack saw into five pieces, using care that one cut shall pass exactly through the centers of the holes (a b c d). These five small pieces, Fig. 49, are called plug blocks. The four small pieces are bored from the under side and tapped so that a piece of brass rod 1¼ inches long and having a 10-24 thread may be screwed into the hole. The long plug block is fitted with two such pieces. The blocks are mounted on one end of a rectangular wooden box measuring inside 8¾ by 14¾ by 2½ inches. A piece of ⅜-inch hard rubber four and 3-16 inches long and one and 5-16 inches wide is bored with 14 3-16-inch holes located so that a hole comes immediately under (a b c d e e e e) and the stub pins. The plug blocks should be insulated by a 1-16 inch space.

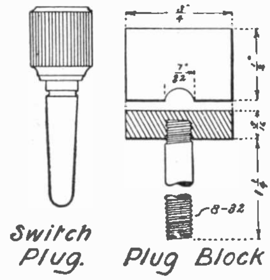



FIG. 49. PLUG SWITCH AND BLOCK

The condenser is placed in a box, Fig. 50, and the interrupter screwed on the center of the top. One terminal of the condenser

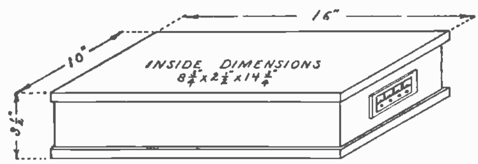



FIG. 50. CONDENSER BOX

is connected to the main spring of the interrupter. The main standard is connected to the long plug block. The four terminals of the condenser connected to the 50, 25, 15 and 10 sheets lead to the small plug blocks which should be marked respectively (50), (25), (15), (10). The brass stubs screwed into the under side of the blocks serve both to hold them in position and to establish connection to, by placing the wires under a small nut screwed on from the interior.

The condenser is adjusted by inserting switch pins into the holes (a b c d). Switch pins having a hard rubber handle may be purchased from almost any electrical supply house. When the pins are not in use they are inserted into the holes (e e e e).

(To be Continued.)

# WIRELESS QUERIES

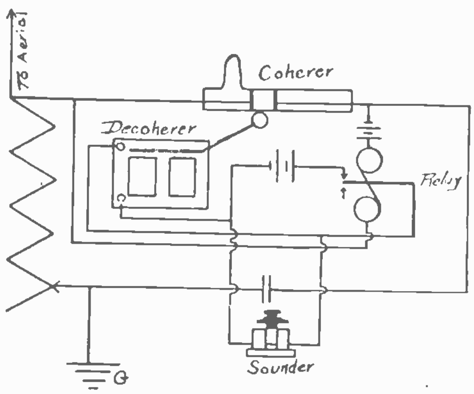
**Answered by A. B. Cole**

*Questions sent in to this department must comply with the same requirements that are specified in the case of the questions and answers on general electrical subjects. See 'Questions and Answers" department.*

### Connections and Sending Radius

*Questions.*—(A) Please give a diagram for connecting up the following instruments: Exhausted coherer, polarized relay, sounder, tuning coil, and condenser. (B) What is the approximate distance that I should be able to receive with above instruments, using either 1000-ohm polarized relay, my aerial being 80 feet high, 30 feet long, 5 wires.—F. S., Baltimore, Md.

*Answers.*—(A) See diagram.




CONNECTIONS OF EXHAUSTED COHERER

(B) You could probably receive from high-power stations over an average distance of 15 miles over water or level land, but you will find that a coherer is not to be depended upon, and, while at some times when it is in adjustment a much greater distance might be covered, you should not expect to receive farther than this ordinarily.

### Condenser and Helix

*Questions.*—(A) How large a plate glass condenser will I need for a one-half kilowatt transformer working on 110 volts alternating current? (B) Would not a heavy aluminum wire helix be better than a brass ribbon one? (C) How much wire and how large shall I use for the helix?—J. S., Wyncote, Pa.

*Answers.*—(A) Fourteen glass plates, each 3-32 inch thick and each having a surface of about 80 square inches. Photographic plates each eight by 10 inches may be used. The plates may be coated with foil to within ¾ inch of the edges. After the foil is secured to the glass, the plates should be given a heavy coat of shellac or other insulating varnish to reduce brush discharge over the surface. It is assumed that the plates are separated by about one inch.

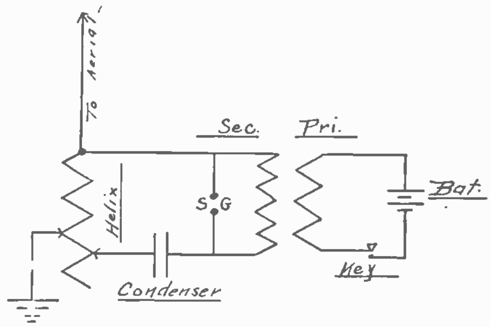
(B) Aluminum wire is easier to work, will make a helix which is stronger mechanically, and will give as good or better results.

(C) The average helix consists of 12 turns of No. 6 B. & S. gauge, wound so that consecutive turns are about one inch apart, and on a drum about ten inches in diameter. About 31 feet, or ¾ pound, will be required.

### Connections for Sending and Receiving

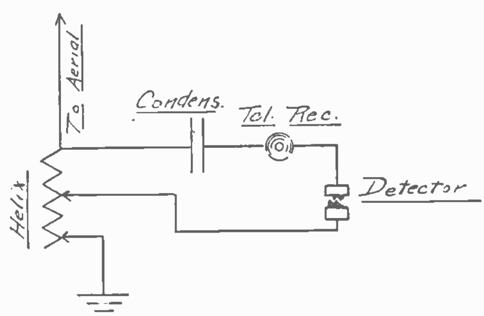
*Questions.*—(A) Please show connections for one-inch spark coil, variable condenser and double slide helix? (B) How do you connect for receiving, using double slide tuning coil, fixed condenser, silicon detector and receiver? (C) What instruments are necessary for a three-mile sending and receiving outfit?—F. G. A., Chicago, Ill.

*Answers.*—(A) and (B) See diagrams.




SENDING

(C) One-inch coil, batteries, key, spark gap, double-pole double-throw porcelain base switch.




RECEIVING

One good 75-ohm receiver, silicon detector and a tuning coil if desired.

### Construction and Connection of Detectors

*Questions.*—(A) How far will a ¼ to ½-inch spark coil send with sensitive receiving set at the other station? (B) In general, how are perikon, carborundum and ferron detectors made? (C) In making a variable condenser could I use a hollow cylinder of wood with tinfoil wound around the outside and a solid cylinder of wood to slide inside the first and covered on the outside with tinfoil? (D) Please give diagram showing connections of variable coupling tuning coil, two variable condensers, electrolytic, silicon, carborundum, perikon and ferron detectors, (with a five-way switch) potentiometer and two, 1000-ohm receivers. (E) Will a Wehnelt interrupter run on a ½-inch spark coil with batteries?—M. H., Ithaca, N. Y.

*Answers.*—(A) A maximum distance of about one mile, with an aerial 50 feet long, consisting of three parallel wires, 50 feet above the earth at the upper end.

(B) A crystal of any of these sensitive substances is generally held in a metal cup by a metal of low melting point. A pointed metallic rod is so arranged that the pressure of the point on the crystal may be varied.

(C) Yes, but if wood is used the walls should be very thin, since the capacity of a condenser varies inversely as the thickness of the wall between the foil surfaces, that is, twice the thickness, one-half the capacity, if all other conditions of length, diameter, etc., are the same.

(D) See diagram in answer to T. C. C. in the July issue, using a variable condenser for the fixed one. Change the switch to a five-point one, and add one more detector.

(E) No, a Wehnelt interrupter does not operate satisfactorily on less than 24 volts. Moreover, it is not well to run coils which are designed for batteries on lighting circuits in connection with electrolytic interrupters. We have known of more secondary windings being damaged in this way than in any other.

### Condenser for One-half Kilowatt Transformer

*Question.*—How many condenser plates will I need to use for a one-half kilowatt transformer, using glass plates 5¼ by 7½ inches and 11½ by 7½ inches covered with tinfoil to within 1½ inches of the top?—S. N., Pacific Grove, Cal.

*Answer.*—If we assume that the condenser is of the most common type in which the plates are separated by about one inch, and that a space ¾ inch wide is left all around the foil, about 35 of the plates 5¼ by 7½ inches or 14 plates 11½ by 7½ inches will give good results with the average aerial system.

### Sparkless System

*Questions.*—(A) What is the difference between the spark system and sparkless system of wireless telegraphy? (B) What instruments are necessary with the latter method? (C) Is the latter system taking the place of the former?—A. T., Thief River Falls, Minn.

*Answers.*—(A) The spark system of wireless telegraphy depends on the production of the oscillations in the aerial system by means of the spark produced by an induction coil, transformer, or other apparatus. The arc, or "sparkless" systems use a singing arc in place of the spark.

(B) Some systems use an outfit somewhat similar to the set described in the April 1910, issue, under "A Simple Wireless Telephone Set," and have a telegraph key in series with the aerial. Other systems have a small step-up transformer connected to a well cooled gap. Although the latter systems use a spark, which is short as compared to those of the "spark" systems, the action is entirely different. The principle may be explained as follows:

If a pendulum is set up, it can be started swinging in at least two ways. The bob may be raised to the side all at once, by expending considerable force, if it is heavy, or it may be struck with a light hammer, which will start it. If when the bob has reached the farthest point to which it will swing, due to the initial stroke of the hammer, and it is just starting back, it be struck another light blow in the opposite direction and the same procedure be continued, the bob will soon be swinging over a long path. The action of raising the bob to the side all at once corresponds to the action of a "spark" system of wireless telegraphy. The other action, of accomplishing the same result by light blows, is analogous to the "sparkless" systems. The circuits in the latter types must all be very well balanced so that the proper action can take place.

(C) We do not believe that the latter systems are entirely replacing the former at the present time.

### Rotating Condenser

*Question.*—How is a rotating condenser made?—W. J. T., Chicago, Ill.

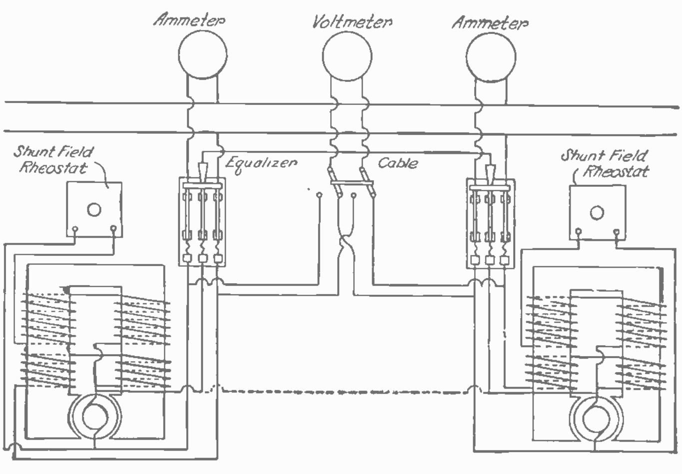
*Answer.*—The design of a rotary plate condenser will require an article of some length, and we hope to publish directions for making such a condenser in an early issue.

# QUESTIONS AND ANSWERS

Use of this department is free to readers of Popular Electricity, but attention will not be given to questions which do not comply with the following rules: All questions must be written in the form of a letter addressed to the Questions and Answers Department and containing nothing for the other departments of the magazine; two-cent stamp must be enclosed for answer by mail, for space will not permit of printing all answers; the full name and address of the writer must be given.

### Sparking Brushes; Paralleling Compound-Wound Generators; Sal Ammonic Cells; Condenser

*Questions.*—(A) What is the cause of the sparking at the brushes of a shunt or compound-wound D. C. motor when it is over-loaded? (B) If the armature does not generate sufficient counter E. M. F., due to the load causing slow speed, why should the motor spark excessively if the brush contact is good. (C) What is the action of the current in the coils at the neutral point in this case? (D) Please explain the path which the current takes when two compound-wound generators are running together on the same bus-bars. (E) How does one machine assist the other if the voltage of one drops? (F) Does the carbon cylinder or electrode of a sal-ammoniac battery become worthless or worn out? (G) How large a current can pass through a condenser? (H) Please give the theory of the condenser.—C. E. H., Philadelphia, Pa.




TWO COMPOUND-WOUND GENERATORS IN PARALLEL

*Answers.*—(A) The brushes of a motor are designed to carry current up to the rating of the motor but usually carry up to as high as 25 per cent over-load for one-half hour without trouble. However a motor which does not run without sparking on a light over-load may have any one or more of the following causes to account for it: (1) Brushes not set at the neutral point. (2) High, low, or loose commutator bar causing poor contact with the brushes. (3) Commutator worn in ridges causing poor brush contact. (4) Improper spacing of brushes. (5) Brushes set with too little pressure against commutator bars. (6) Brushes not set so that their full area is in contact with the commutator. (7) Armature coil short circuited. (8) Excessive over-load on machine. (9) Dirt and grease on the commutator. (10) Commutator bars partially short-circuited by a collection of carbon or copper dust around them.

The Standardization Committee of the A. I. E. E. recommend over-load capacities of 25 per cent for one-half hour, but state that guarantees against sparking should apply to the rated load only of the motor or generator.

(B) The field strength of the motor cannot increase as the over-load comes on because the voltage across the field coils remains the same, consequently the armature falls off in speed which results in a reduction in the counter E. M. F. This counter E. M. F. which acted as a resistance now being less, allows a larger current to flow through the armature and brushes which latter show an undue overload by sparking.

(C) The distortion of the field in a motor increases as the current through the armature coils increases. Hence the brushes would have to be shifted back as the current approaches or exceeds that required for full load, in order to bring the induced current in the coil which the brush is short-circuiting just up to that in the coil just about to be left behind and prevent sparking.

(D) and (E) When two compound-wound machines are running in parallel with the load equalized no current flows in the equalizer cable. However, if the speed of either machine drops off, lowering the voltage, current from the other machine will flow through the equalizer cable and strengthen its series field, thus increasing the voltage. See diagram. The equalizer cable may be run between the brushes as indicated by the broken line if preferred.

(F) The sal-ammoniac solution when low in the cell frequently crystallizes in the pores of the carbon plate but is readily removed by boiling in water for an hour. Practically, the carbon electrode will not wear out.

(G) and (H) Current does not flow through a condenser. Charges are "bound" by attraction on opposite sides of the dielectric, this being under strain during the time the condenser is charged. As soon as a circuit is formed these two charges neutralize each other.

### Roentgen Rays; Crooke's Tube; N-Rays

*Questions.*—(A) What is the Roentgen ray, when discovered and how produced? (B) What is a Crooke's tube? (C) What are N-rays?—D. M., Sawtelle, California.

*Answers.*—(A) The Roentgen or X-ray is a form of luminescence created by the passage of a high potential discharge through a vacuum tube. Roentgen spoke of his discovery made on Nov. 8, 1895, as follows: "I was working with a Crookes tube covered by a shield or screen of black cardboard. A piece of barium platino-cyanide paper lay near by on the table. I had been passing a current through the tube and noticed a peculiar black line across the paper. As this effect could be produced by the passage of light only, and as no light except from the tube could have struck the plate, I made a test at once, and found that some kind of rays actually passed through the black cardboard cover. In a completely darkened room the paper screen washed on one side with barium platino-cyanide lighted up brilliantly, and fluoresced equally well no matter which of its sides was turned towards the tube. The fluorescence was noticeable even at a distance of two meters. The most remarkable thing to me was that this fluorescence passed through the black cardboard cover, which transmits none of the ultra-violet rays of the sun or of the electric arc. I found by experiments that all bodies are transparent to this influence, although in very different degrees." Because opaque bodies throw shadows of different degrees of shade Roentgen called the influence doing this, rays. As their real nature was not known he called them X-rays.

(B) A Crookes tube is a long glass tube exhausted of air to a high degree, and provided with two platinum terminals within, which can be connected on the outside to an electric machine. Named for Sir William Crookes, who first experimented with the tube in the form of an egg-shaped vessel.

(C) N-rays occupy the space between the ultra-violet and the X-rays. Their frequency is about 1-100 of the frequency of ordinary light. They may be observed on a screen of phosphorescent sulphide of calcium. The rays are highly refrangible, highly penetrating and can be reflected and polarized. Dr. Margaret A. Cleaves, of New York City, is an authority on this subject. Of late years there has been some discussion as to whether or not the so-called N-rays are really a separate and distinct form of radiation.

### Carbon Lamp Resistance; Telephone Induction Coil

*Questions.*—(A) What is the resistance of a 16 candle-power, 110-volt carbon filament lamp? (B) What size wires are used on the primary and secondary of a telephone induction coil? (C) What is used for the core of such a coil?—A. W. A., Lowell, Wis.

*Answers.*—(A) The resistance of a 3.5 watt per candle-power, 110-volt carbon filament lamp is 216 ohms.

(B) and (C) Induction coils vary in construction in accordance with the length of the line on which they are used and are made up by experiment to suit the instruments they are to operate. One of the most efficient coils for ordinary service may be made as follows: Provide 500 pieces of No. 24 B. & S. soft iron wire five inches long; allowing one-half inch at each end, this leaves four inches for the bobbin. For the primary wind on 200 turns of No. 20 single silk-covered wire. For the secondary use 1400 double turns (two wires wound side by side) of No. 34 single silk covered wire.

# Notes on the Construction of Patents

By OBED C. BILLMAN, LL. B., M. P. L.

1. **In General.**—The usual rules applicable to the construction and interpretation of written instruments are, in the main, applicable to the construction of letters patent. The construction of a patent, as of other written instruments, is a question of law for the court. The general rule is that the construction put upon it by the patent office is not binding upon the courts.

2. **Construction to Sustain Patent.**—Wherever possible a patent will be given a construction which will sustain it, rather than one which will render it void and of no effect. But where there is no room for construction, the language used must be given its obvious effect even though thereby the patent is rendered void. Claims for a function or result will be construed as claims for the specific device or process described, if possible, in order to sustain a patent. Patents are frequently limited to very narrow claims, often to the specific device described, in order to support them, when to give them a broader construction would render them void for want of novelty in view of the prior state of the art.

3. **Construction in Favor of Patentee.**——Letters patent are to be liberally construed in favor of the patentee. But this rule does not authorize the courts to extend the patent further than the language used in the specifications and claims will fairly and legitimately warrant; the patentee is bound by his claims. The patent must be confined to the actual invention. The patent will, however, be construed to cover the actual invention made and intended to be patented, if its language is fairly susceptible of that construction.

4. **Construction as a Whole.**—The patent must be construed as a whole, and due effect be given to all its parts. The claims define the precise scope of the invention patented, and when unambiguous control the construction of the patent. But where the claims are not clear and precise, they may be interpreted with reference to other parts of the patent, such as the title, description, drawings, and model. It is well settled, however, that while the claims may be limited or illustrated by reference to the descriptive parts of the patent, they cannot be thereby enlarged. Of course, the claims will not be limited by the specifications where there is manifestly no such intention and no necessity for so limiting them. Nothing is covered by the patent which is not fairly stated or implied in the claims. Reference in the claim to the specification makes the latter a part of the claim, and requires the claim and the specification to be construed together.

5. **Prior State of the Art.**—A patent must be construed with reference to the prior state of the art to which the invention belongs, and limited to what is new.

6. **Pioneer and Subsidiary or Secondary Inventions.**—A pioneer invention is one covering a function never before performed, or a wholly novel device, or one of such novelty and importance as to mark a distinct step in the progress of the art, as distinguished from a mere improvement or perfection of what has gone before. A patent for such an invention will be construed as broadly and liberally as its terms will admit, in order fully to protect the actual invention. Subsidiary or secondary inventions which are mere improvements on an existing and well-known state of things are not so broadly or liberally construed, and are often limited to the precise device or arrangement described. Primary and pioneer patents cover a broader range of equivalents than other patents.

7. **Meaning of Words and Phrases.**—Words and phrases used in the patent will be given their ordinary meaning unless the context shows that they are used in a different sense. Technical terms will be given the meaning in which they would be understood by those skilled in the art. The language used must be applied to the subject matter described.

8. **Extrinsic Evidence in General.**—In construing the specifications and claims of a patent, it is the duty of the court to read them in the light of the conditions and usages prevalent at the time they were written in the art to which the invention relates, and extrinsic evidence is admitted for the purpose. Evidence is admissible to show the meaning of terms used in letters patent, as well as the state of the art.

9. **Expert and Opinion Evidence.**—The court cannot be compelled to receive the testimony of experts as to how a patent ought to be construed, but the judge may obtain information from experts, if he desires it, and such testimony is admissible to explain the meaning of technical terms.

10. **Proceedings in Patent Office.**—Where a patentee in the course of the pro ceedings in the patent office, and in cons quence of rulings there made, inserts in his specifications and claims limitations and restrictions for the purpose of obtaining a patent, he cannot, after he has obtained it, insist that it shall be construed as it would have been construed if such limitations and restrictions were not contained in it. The patent must be construed and limited with a view to such amendments. The proceedings in the patent office may be considered as showing the intent in granting and accepting the patent, and the courts should not enlarge claims beyond the patent office construction in allowing them. But mere communications between the patentee or his attorney and the patent office, not carried into the patent as issued, do not control its construction. The language of the patent as finally issued is always the controlling consideration.

11. **Contemporaneous Construction of Inventor.**—The contemporaneous construction put by the patentee upon his own invention is entitled to consideration, but cannot control the plain terms of the patent.


TELEPHONOLOGY. By H. R. Van Deventer, B. S., E. E. New York: McGraw-Hill Book Company. 1910. 586 pages with 682 illustrations. Price, $4.00.

Practical workers will welcome this book as one well adapted to their needs. The subject matter is free from technical terms and phrases and from cover to cover is full of useful up-to-date descriptions and data. The history of telephony is omitted together with obsolete apparatus, the idea being to deal with different types of equipment, its installation and care, as now on the market and in general use. The descriptive matter could hardly be better illustrated, numerous line drawings and excellent cuts of apparatus being provided. If one must confine himself to one book on the subject this work should be considered.

PRACTICAL X-RAY THERAPY (Second Edition). By Noble M. Eberhart, A. M., M. S., M. D., Chicago: New Medicine Publishing Company. 1909. 256 pages with 40 illustrations. Price, $1.50.

The series of articles by Dr. Eberhart which has appeared in Popular Electricity has made him familiar to the readers of this journal. His book on X-rays contains, in a concise form, the essential facts bearing on this subject. It discusses questions that confront the physician in his daily routine and is distinctly a working manual, written to be *used* rather than to be placed on the shelf as a reference work.

The author is a pioneer in X-ray therapy and his opinion, based on long experience, is correspondingly valuable. In the treatment of the various diseases the technique is explicit so that even a beginner may employ the ray properly and intelligently. The book is thoroughly illustrated and with its comprehensive glossary it is intelligible to the layman as well as the physician.

THE INVENTORS' POCKET LIBRARY. Ten Talks to Young Inventors. By an Old One. Washington. D. C.: The Engineer Searching Co. 1910. Price, 3 cents each; 25 cents for the set.

The "Common Sense Series" of "Talks to Young Inventors" by an old one is just what the name implies—good, sensible advice to the inventor who has more brains than money. The series consists of ten leaflets, not bound, they couldn't be at the price, but containing the information just the same. It is dedicated to and approved by the Brotherhood of Inventors, which was incorporated in Washington, D. C., Dec. 20, 1909. Here are the titles of the talks in the first series: (1) The Language of Two Letters (A Straight Line and a Curve); (2) Hints, Tips and Dont's for Inventors; (3) The "Brotherhood" Protective Caveat; (4) Inventors' Catechism; (5) Inventors' Dictionary; (6) American "Wastes" the Inventor's Opportunity; (7) Why Success or Failure in Invention?; (8) The Superstition of Secrecy; (9) Educational and Protective Value of Sketching; (10) Engineer or Lawyer Searching. This is only the first series, others are to follow later, written along similar lines.

# ON POLYPHASE SUBJECTS

**Light Companies Conserve Natural Resources**

Few themes have lent themselves more generously during the last few years to the popular orator or the average newspaper editor than that of conserving our natural resources. Speakers as well as writers on this subject seem to agree that what is everybody's business in this matter is nobody's business; that it will take concerted action by government departments, federal and state legislation, in short, some prodigiously formulated plan which must be developed before we can expect headway along this line. But while those all about us have been crying out against the devastation of our forests and suggesting various kinds of legislation to both stop it and make up for it, one of the far sighted electric light companies over in Michigan has been quietly going ahead and doing its share; yes, and more too.

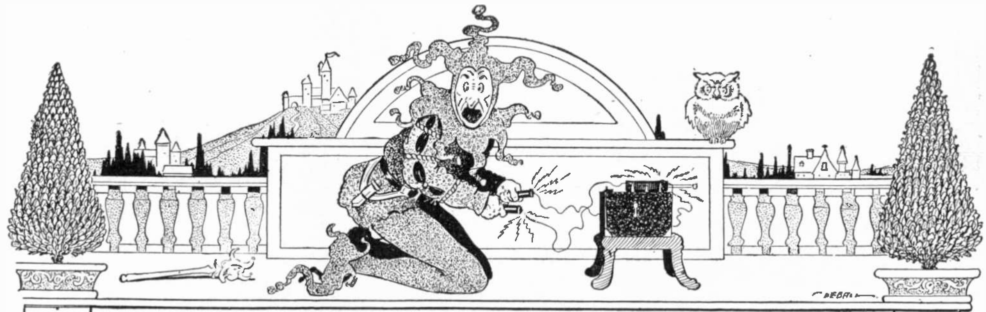
Three years ago the Washtenaw Light & Power Co., of Geddes and Ann Arbor, organized a forestry department with a view to systematically reforesting the district from which its gradually waning water power is drawn. Thanks to the professors of forestry at the University of Michigan, Filibert Roth and Walter Mulford, the work was carefully planned on long lines, and the company's forest nursery is now stocked with half a million young trees. These include twenty different species, ranging from walnut and hickory to some types of the California big trees, although most of the planting so far has been in white pine, Norway spruce and red oak. With the aid of university students who are available during the spring vacations, about a hundred acres have been set with trees each year, the present season's planting comprising over 150,000 trees.

Meanwhile the nursery is kept stocked, so that later on the company will be able to sell young trees at low prices to the farmers in the Huron River Valley, to whom this fine example is set. Even without the aid of the farmers this move of the progressive lighting company will be far-reaching in its effect, for it means restoring the more normal climate, proper rainfall and generally prosperous influence which are bound to affect the whole surrounding community. If such a practice becomes general (and many of our prominent electric utility corporations will try hard to make it so) the electric light and power companies will grow to be among the greatest benefactors of large sections in another and rather novel way. And wisely so, for the general prosperity and welfare of the community reacts on all business and therefore on the market for that greatest boon of modern civilization—the electric current. Meanwhile, all honor to the pioneer electric reforesters of Michigan, Manager Hemphill and his colleagues!

**How About the Fiction Articles?**

The last installment of Edgar Franklin's interesting story, "Current from—Where?" appears in this issue. We hope that our readers have all enjoyed it and not a few have written in to express their satisfaction. In the September issue, to take its place, there will be a story by E. M. Smith—"The Human Heritage"—complete in one number. This is a thrilling account of what we might expect to see if we were to live on earth one hundred years from now, when man has conquered the warring elements and is at last master of the air. It is all visionary but interesting.

There is so much fiction printed now-a-days that in a magazine of the nature of Popular Electricity, which has its own particular field to cover, there is a place for only a limited amount. How much and what kind shall lie with you who read this magazine. We cannot, however, determine your likes and dislikes in this matter unless you write and give us your opinion. Do you prefer a serial story of the order of Mr. Franklin's? Would you rather have short stories complete in one issue or perhaps running into two and bisecting with a bang, as Mr. Franklin once expressed it? Or would you rather have no fiction at all? Let us have your votes.



# SHORT CIRCUITS

"Did you have appendicitis?" said the insurance man.
"Well," answered the skeptic, "I was operated on, but I never felt sure whether it was a case of appendicitis or a case of professional curiosity."

* * *

First Autoist—Is that the same automobile you bought this spring?
Second Autoist—All except the body and three wheels.

* * *

"Do you see that man going along with his head in the air, sniffing with his nose?"
"Yes; I know him."
"I suppose he believes in taking in the good, pure ozone?"
"No; he's hunting for a motor garage, I believe."

* * *

The lecturer raised his voice with emphatic confidence. "I venture to assert," he said, "that there isn't a man in this audience who has ever done anything to prevent the destruction of our forests."
A modest-looking man in the back of the hall stood up.
"I—er—I've shot woodpeckers," he said.

* * *

Robbie ran into the sewing room and cried:
"Oh, mamma! There's a man in the nursery kissing Fraulein."
Mamma dropped her sewing and rushed for the stairway.
"April fool!" said Robbie, gleefully. "It's only papa."

* * *

Mr. Bug—It does beat all how mercenary some fellows are getting these days. Now there's old Firefly letting himself out as a candle on a birthday cake.

* * *

I went to a party with Janet
And met with an awful mishap
For I awkwardly emptied a cupful
Of chocolate into her lap.

But Janet was cool —though I wasn't,
For none is so tactful as she,
And, smiling with perfect composure
Said sweetly ,"The drinks are on me."

* * *

"How can you tell a Yale man from a Harvard man?"
"Well, a Yale man always acts as if he owned the world."
"Yes?"
"And a Harvard man always acts as if he doesn't know what vulgar person owns the world, and, furthermore, he doesn't care to know."

"Some men," said Andrew Carnegie at a dinner "have very queer ideas of honor.
"I was once riding from Pittsburg to Philadelphia in the smoking compartment of a Pullman. There were perhaps six of us in the compartment, smoking and reading. All of a sudden a door banged and the conductor's voice cried:
" 'All tickets, please.'
"Then one of the men in the compartment leaped to his feet, scanned the faces of the rest of us and said slowly and impressively:
" 'Gentlemen, I trust to your honor.'
"And he dived under the seat and remained there in a small silent knot till the conductor was safely gone."

* * *

Simple Simon met a pieman,
Going to the fair,
Said Simple Simon to the pieman,
"Let me taste your ware."
Said the pieman to Simple Simon:
"Young man, my ancestors were the hardy spirits who first blazed a trail through the pathless forest and founded the pioneer settlement in the region which is now Missouri. I myself hail from that glorious commonwealth, and before I can be induced to part with one of the succulent gobs of pastry which I am vending, I must be shown your penny."
Said Simple Simon to the pieman,
"Indeed, I haven't any."

* * *

"Now, Archie," asked a schoolmistress, dilating on the virtue of politeness, "if you were seated in a street car, every seat of which was occupied, and a lady entered, what would you do?"
"Pretend I was asleep!" was the prompt reply.

* * *

"What I want," said the man who was looking for a home, "is a place with a fine view."
"Well," replied the real estate agent, "I've got what you want. But it'll cost you several thousand dollars extra."
"You're sure the view is all right?"
"Couldn't be better. By climbing on the roof you can see the baseball games."

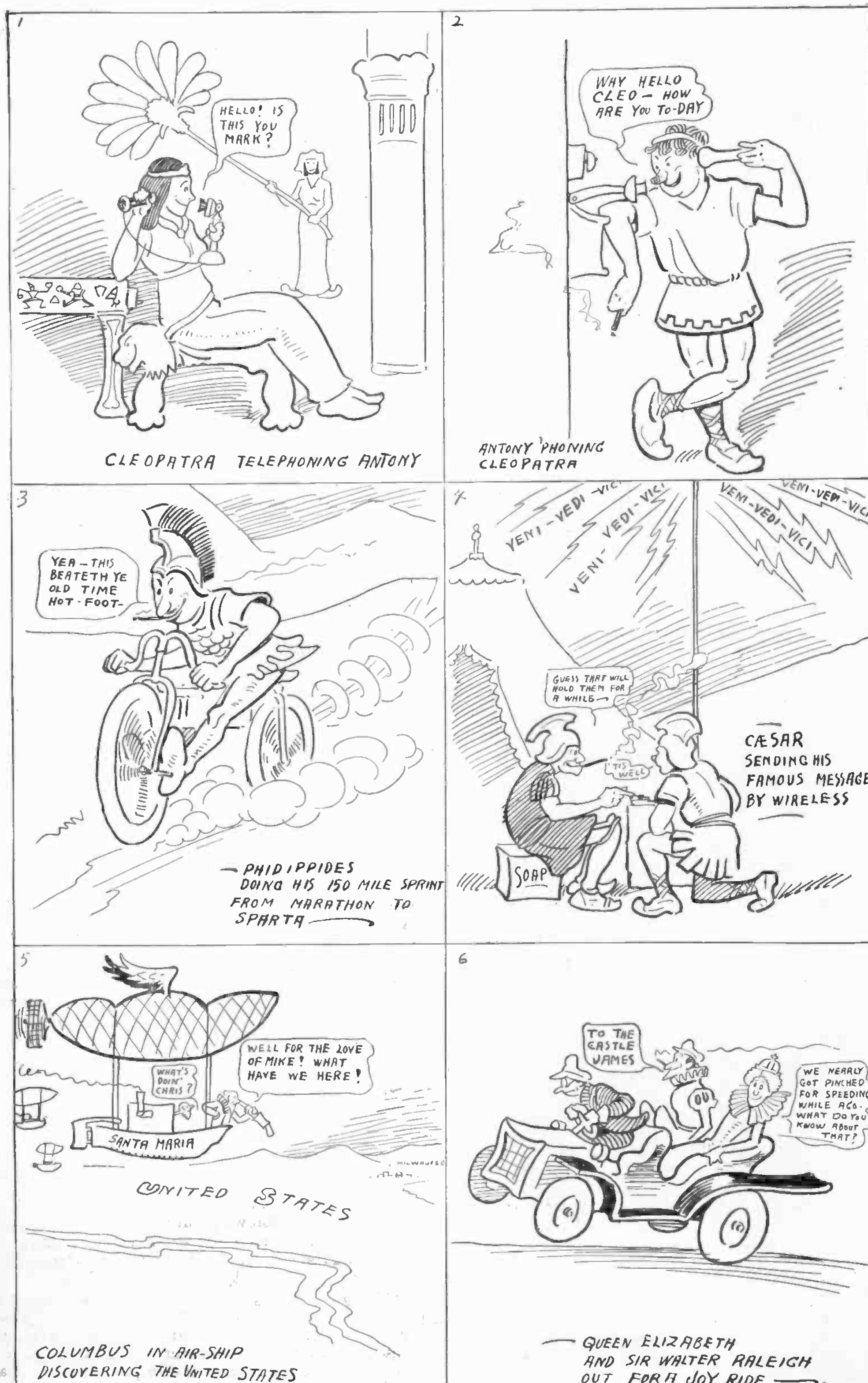
* * *

She laid the still, white form beside those which had gone before; no sob, no sigh forced its way from her heart, throbbing as though it would burst. Suddenly a cry broke the stillness of the place—one single-heart-breaking shriek; then silence; another cry; more silence; then all silence but for a guttural murmur, which seemed to well up from her very soul. She left the place. She would lay another egg to-morrow.

* * *

Dewitt—Does your wife follow the fashions closely?
Jewett—I should say so; she has one of these "standing room only" dresses.

**TOO BAD THESE OLD TIMERS DIDN'T UNDERSTAND THE USE OF ELECTRICITY**



# COMMON ELECTRICAL TERMS DEFINED

**In this age of electricity everyone should be versed in its phraseology. By studying this page from month to month a working knowledge of the most commonly employed electrical terms may be obtained.**

Battery, Gravity.—So named because the two liquids in the jar, copper sulphate and zinc sulphate, remain apart, the latter being at the bottom. A copper plate of almost any shape is placed at the bottom of a glass jar containing a solution of blue vitriol (copper sulphate) and an insulated copper wire connected to it. Water is now poured on very carefully so it will float on top of the sulphate. A zinc in the shape of a crowfoot is then hung over the edge of the jar and in the water. By pouring a few drops of sulphuric acid into the water the cell is ready for work. Electromotive force, 1.07 volts; internal resistance, 2 to 5 ohms; adapted to closed circuit work. Referred to also as blue stone cell and crowfoot battery.

Battery, Grenet.—A bottle-shaped type of the bichromate battery consisting of a zinc plate suspended between two carbon plates in such a manner that the zinc alone is withdrawn from the solution when the cell is not in service. The bichromate solution used is called electropoion. It is made by mixing one gallon of sulphuric acid with three gallons of water (acid poured into water to prevent explosion) in one vessel and in another potassium bichromate and boiling water, six pounds bichromate and two gallons water. Then mix the two solutions. Electromotive force, 1.9 to 2.1 volts; internal resistance, .016 to .08 ohms. For either open or closed circuit work.

Battery, Grove's.—Similar to the Bunsen battery except that Grove used a strip of platinum instead of carbon in his cell.

Battery, Local.—A battery used to operate a relay, transmitter or other device in a building or station, its circuit being closed by a relay located on circuits coming in from the outside or main line.

Battery, Main.—Applied in telegraphy to the battery used to operate the main line relays which in turn actuate the local circuits. Also used in the same manner to distinguish the line from the local batteries in railroad block signalling.

Battery, Open Circuit.—A battery suitable to use on circuits where current is required for very short periods only, and which does not exhaust itself by local action when left on open circuit. The Lechanché is of this type.

Battery, Plunge.—So named because the battery plates are mounted so that they may be lifted out of the solution when the battery is not in use. (See Battery, Bichromate.)

Battery, Primary.—Made up of cells in which the electric current is supplied by the dissolving of one of the plates. Distinguished from the storage or secondary battery by not having to be charged.

Battery, Sal Ammoniac.—Consists of a glass jar which is filled about three-quarters full of water in which a quantity of sal ammoniac is dissolved. In this solution a carbon plate which forms the positive pole of the cell is immersed and also a zinc rod. The carbon and zinc should not touch each other. Current flows from the zinc to the carbon in the cell. Electromotive force, 1.4 volts; internal resistance .3 to .5 ohm. Adapted to open circuit work.

Battery, Secondary.—See Battery, Storage.

Battery Solution.—The liquid or electrolyte in either a primary or secondary cell.

Battery, Smee.—A zinc forms the positive plate and a silver plated copper plate coated with platinum black is used for the negative. Polarization is prevented by the bubbles of hydrogen easily releasing themselves from the numerous small points on the platinum surface. Zinc is used for the positive plate. The electrolyte consists of water, 7 parts; sulphuric acid, 1 part. Electromotive force .47 volt; current falls off rapidly on closed circuit.

Battery, Storage.—A secondary battery. As first brought out by Planté it consisted of two lead plates, or two sets of lead plates either corrugated or perforated, each set fastened together so that the plates of one set fit in between those of the other but do not touch them. All are immersed in dilute sulphuric acid. When current is sent into this cell a chemical action takes place, the plates through which the current enters the cell receiving a coating of lead oxide while the surface of the other plates turns gray and spongy. As soon as the positive plates are covered with the red peroxide of lead the cell is charged. Connect the cell to an outside circuit and the process of charging is reversed. The oxide of lead changes to sulphate of lead and the spongy lead on the other plates also changes to sulphate of lead. The discharge should not continue beyond the point where the voltage goes below 1.75 per cell.

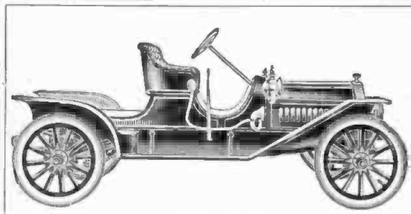
Faure modified this cell by using a paste of red oxide moistened with sulphuric acid to fill the perforations of the positive plates and a paste of yellow lead or litharge to put into the negative plates. Also, both plates may be filled with a paste of sulphate of lead and sulphuric acid. The voltage of one cell when fully charged is about 2.2 volts.

Battery Syringe.—A syringe made of a cylinder of glass within which is a small hydrometer (See Areometer). Some of the electrolyte being drawn into the cylinder its density may be read through the glass. Made especially for testing automobile batteries. Employed also to remove dead liquid from the electrolyte and to replace same with fresh solution.

Battery, Sir William Thompson's.—Similar to the gravity battery in construction. Consists of a number of wooden trays lined with lead. On the bottom of each tray is placed a thin plate of copper and upon this wooden blocks which support a zinc plate, the corners of which are turned up. These corners support the next tray. For directions as to charging see Battery, Gravity. Electromotive force 1.07. Must be kept on closed circuit.

Battery, Volta's.—A simple cell consisting of a plate of zinc and one of copper immersed in a dilute solution of sulphuric acid and water, which Volta devised following his discovery that two unlike metals in contact in air have a difference of potential existing between them. Polarizes quickly.

# SCHACHT



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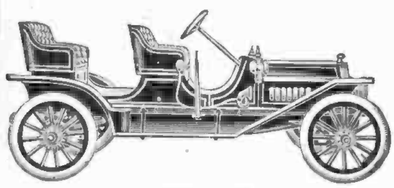

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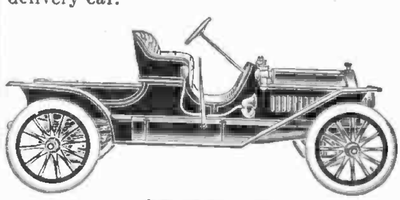

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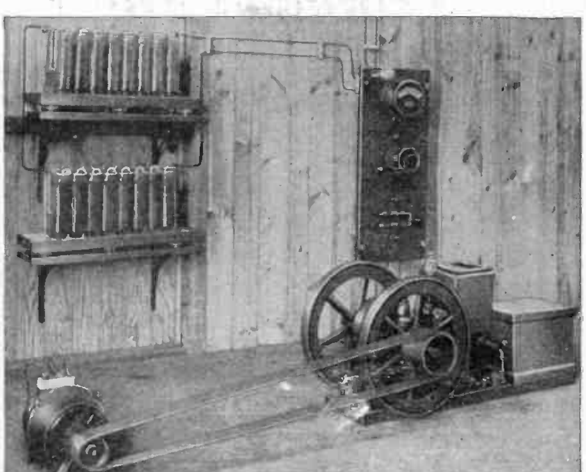
# Electric Lighting No Longer Expensive



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Below is a copy of a bill which HUMAN LIFE—the Magazine About People—has proposed for an endorsement by the public. The bill was drawn by Mr. Charles F. Dutch, of the Harvard Law School. Its purpose is to prevent a monopoly of aerial navigation, to stimulate aviation, and to compensate the Wrights or their company, for their patents. A more detailed statement will appear in HUMAN LIFE for August.

RESOLVED by the SENATE and HOUSE of REPRESENTATIVES of the UNITED STATES of AMERICA, in CONGRESS ASSEMBLED, that the Commissioner of Patents be, and he is hereby authorized and directed to purchase from Wilbur Wright and Orville Wright, of Ohio, their executors, administrators, heirs or assigns, any and all patents, patents pending, and application for patents for inventions or devices claimed by said Wilbur Wright and Orville Wright or by either of them, concerning aeroplanes or flying machines, and to publish or make the same otherwise freely accessible for the promotion and development of the science and art of aerial navigation.

Section 2. That for the purchase of said inventions or devices the sum of one million dollars, or as much thereof as may be necessary, is hereby appropriated out of any money in the Treasury not otherwise appropriated.

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If you can support this bill, tear off this coupon and mail it to

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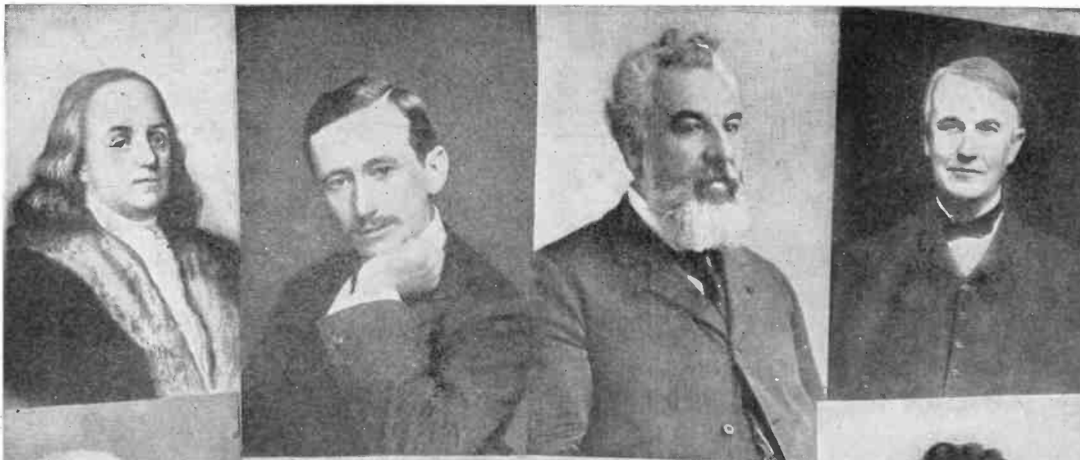



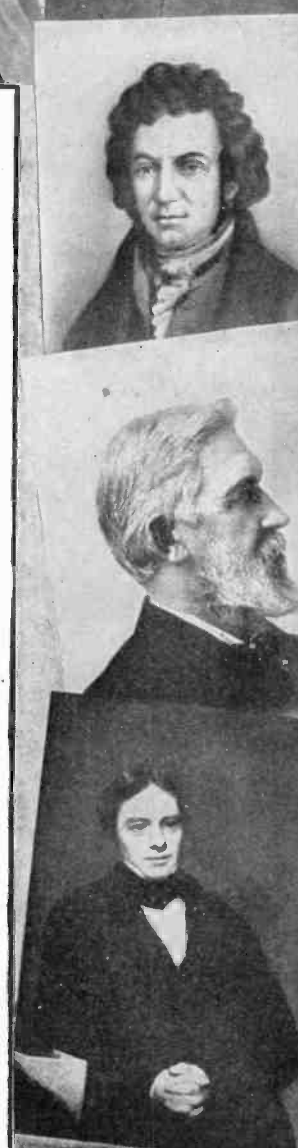

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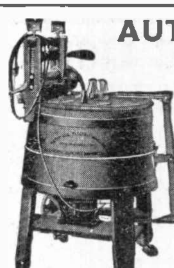

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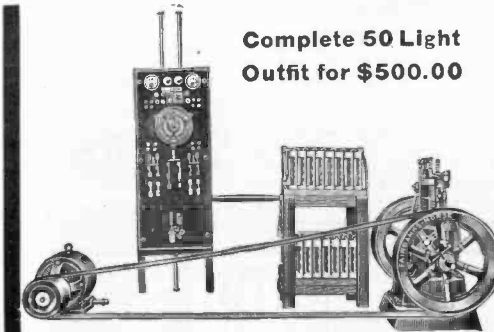

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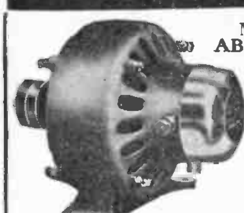

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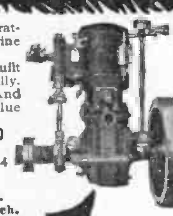

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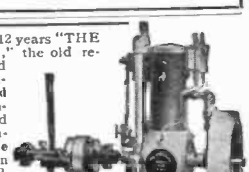

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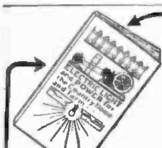

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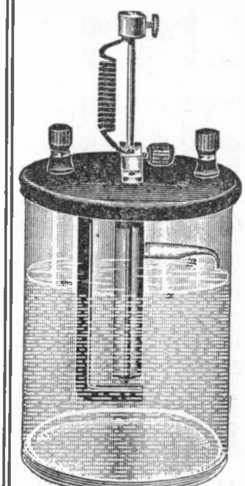

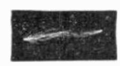

FIG. 2

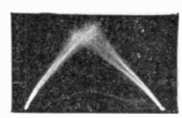

FIG. 3

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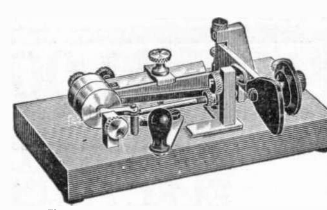

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