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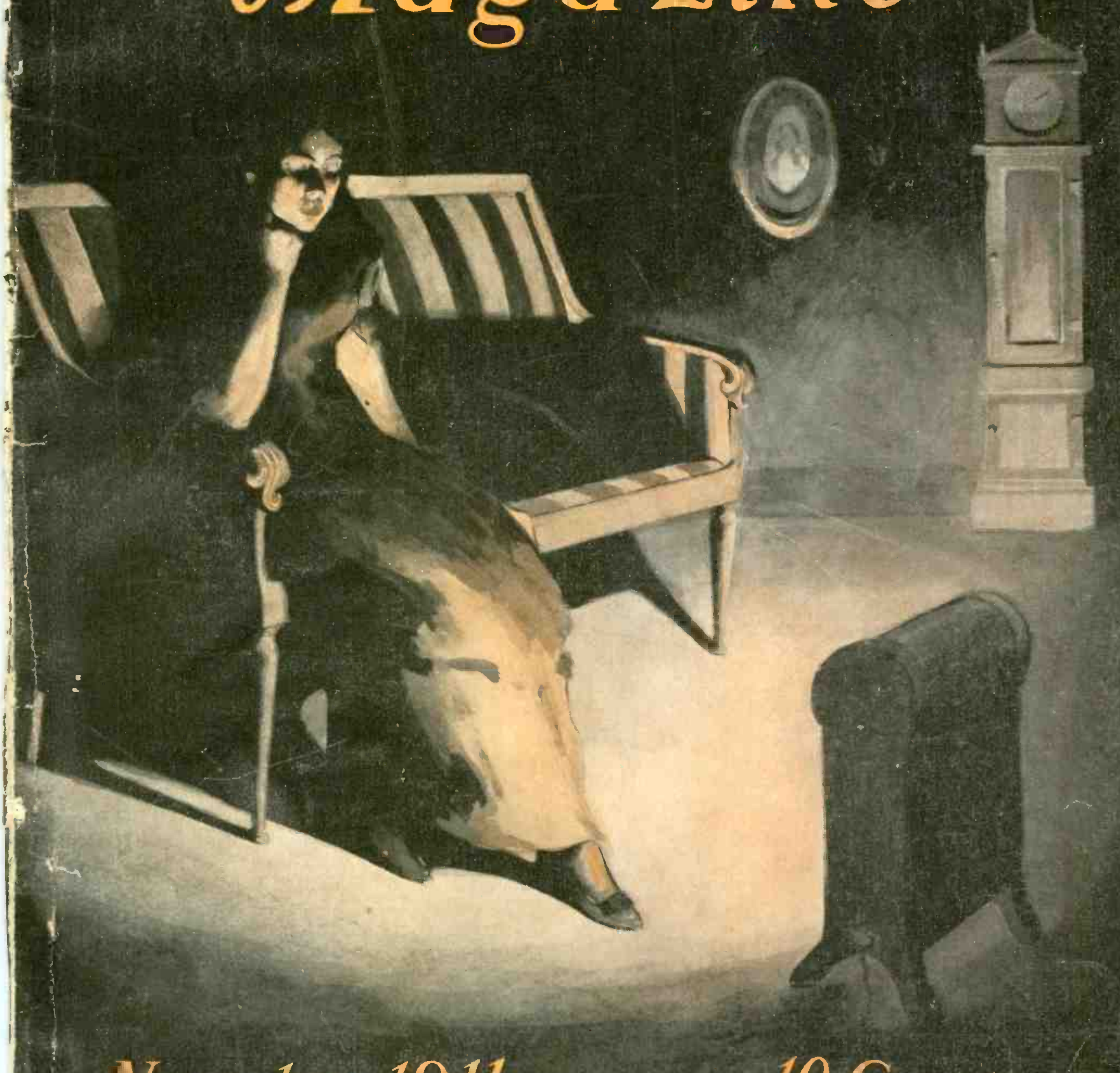

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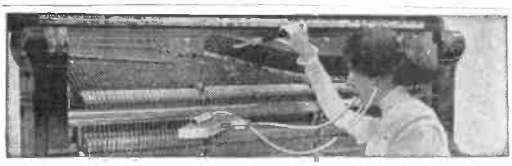

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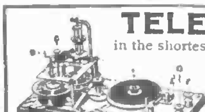

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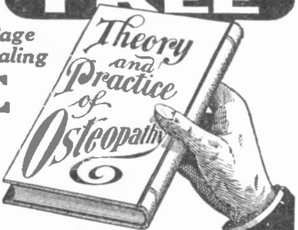

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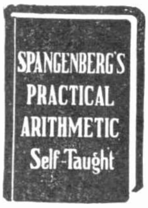

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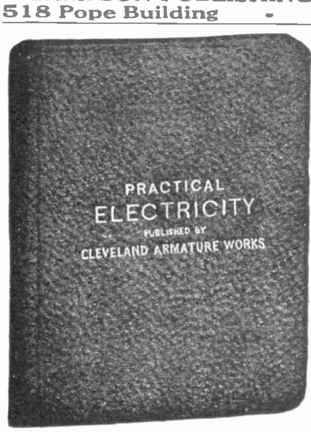

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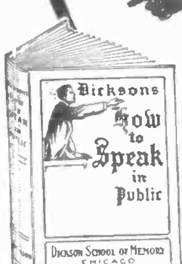

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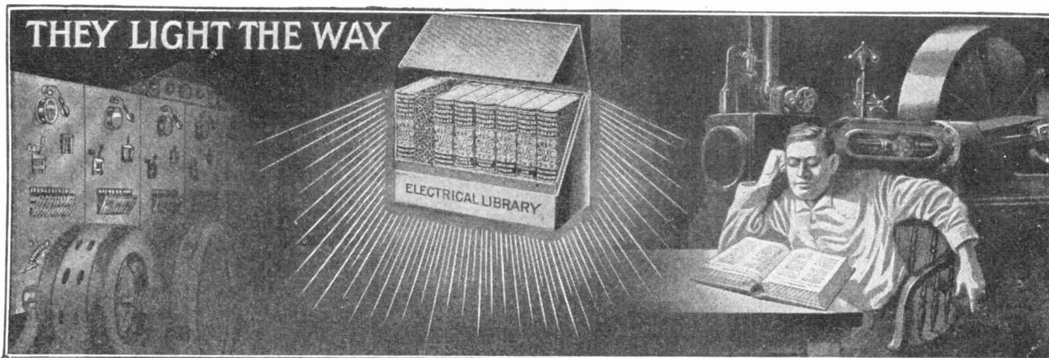

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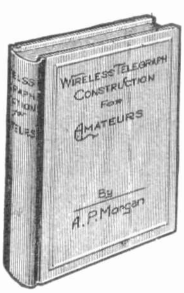

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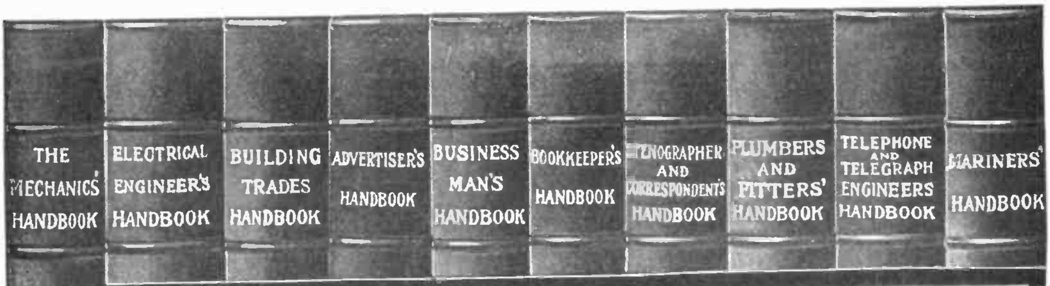

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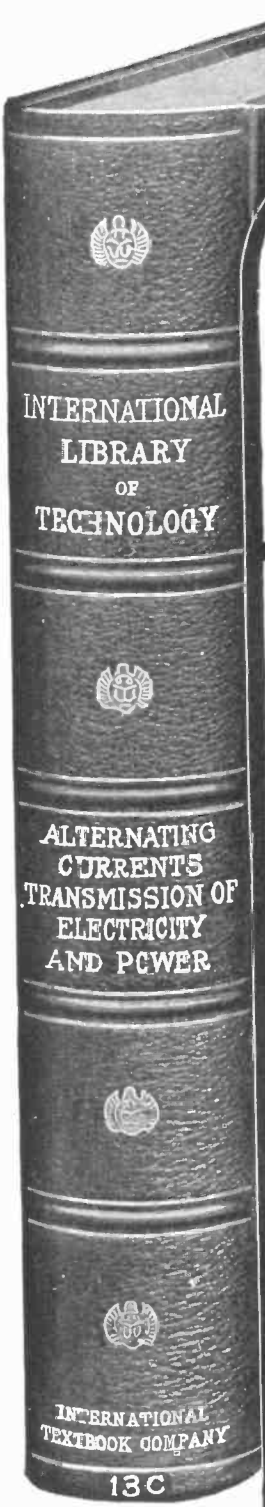

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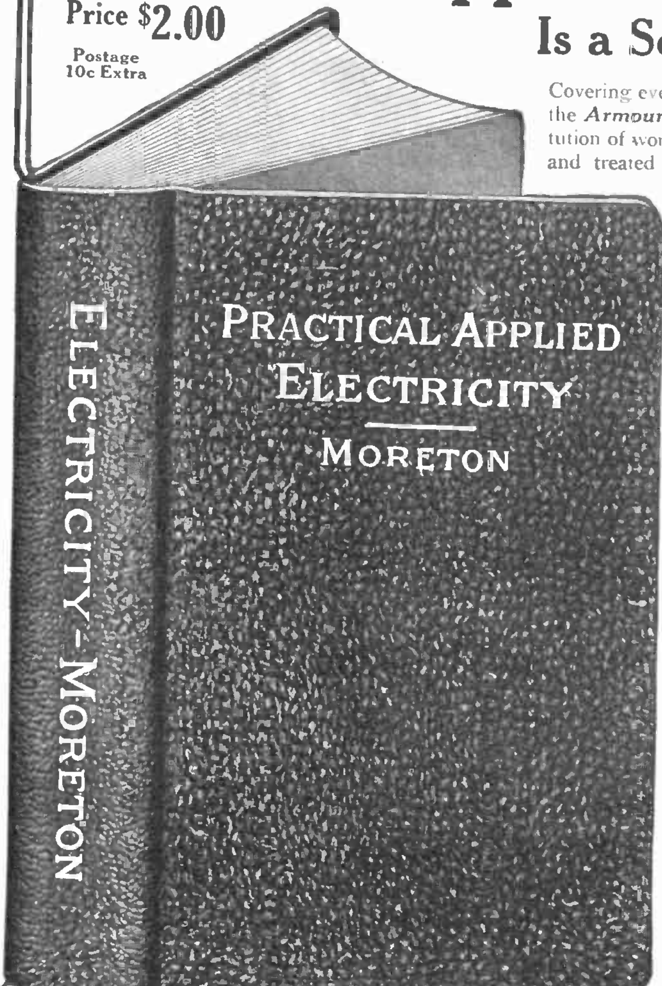

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Popular Electricity In Plain English

Henry Walter Young, Editor

Vol. IV — November, 1911 — No. 7

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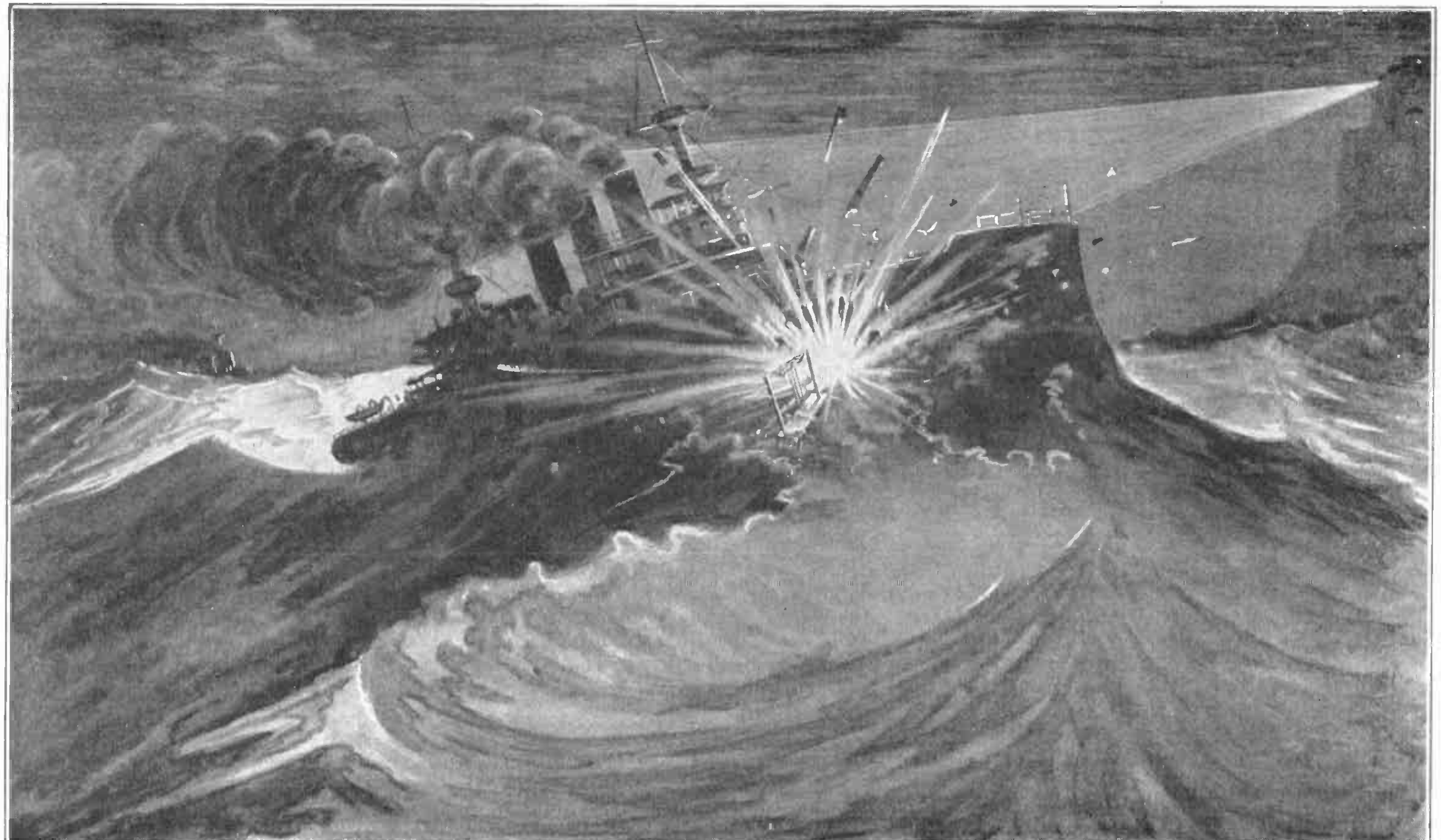


GERMAN WIRELESS CONTROLLED TORPEDO, DESIGNED TO SINK THE MOST POWERFUL BATTLESHIP

Popular Electricity In Plain English

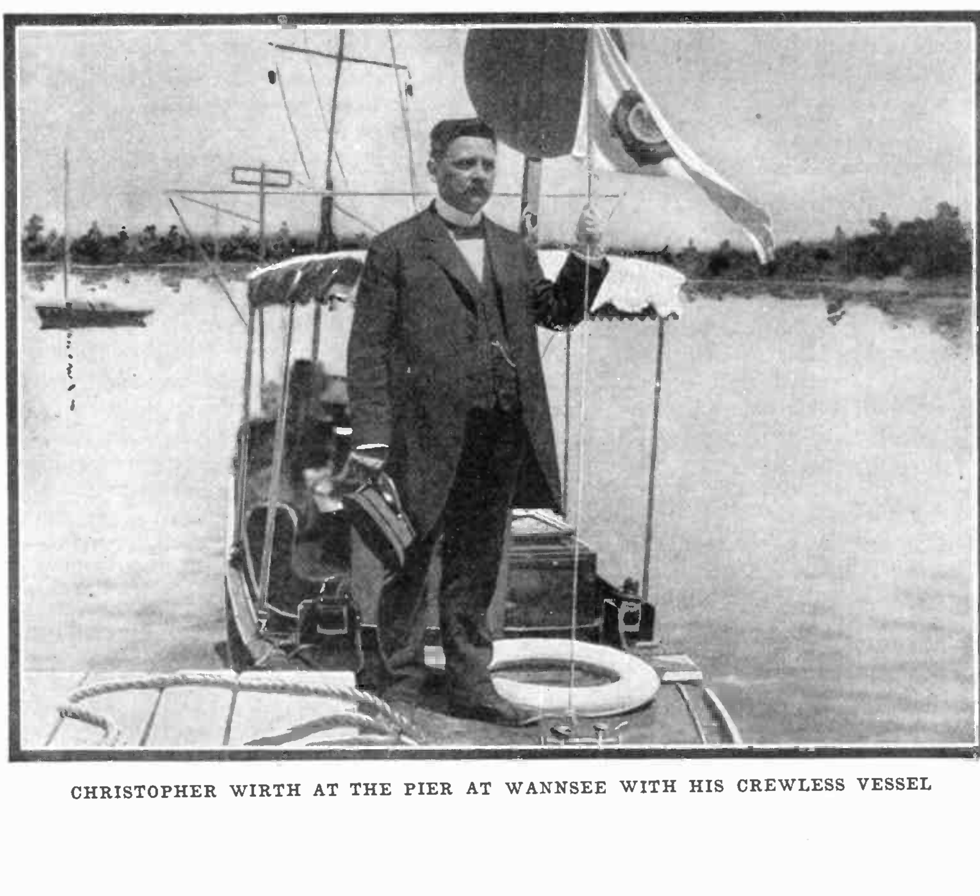
VOL. IV | NOVEMBER 1911 | No. 7

German Experiments with a Crewless Ship

By DR. ALFRED GRADENWITZ

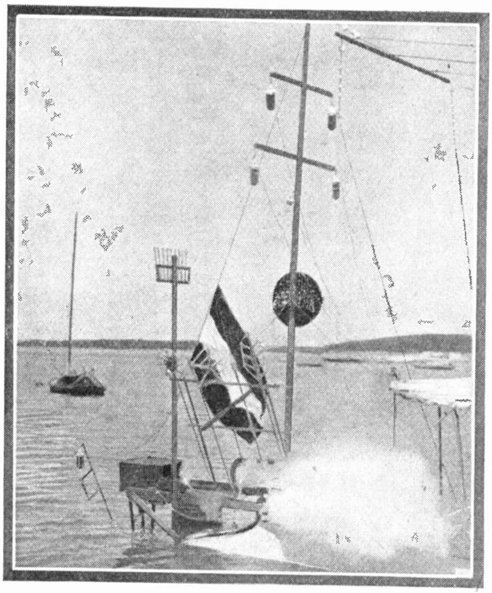
A short time ago a limited circle of navy and army officers as well as representatives of the press had occasion to witness a strange spectacle from the banks of the Wannsee, a lake situated in the environs of Berlin. A Nuremberg inventor, Mr. Christopher Wirth, had in fact been invited by the German Navy League to demonstrate his crewless ship which is finding unusual interest with the Navy Department.

Exactly at the hour fixed for the demonstration the vessel was towed to the center



CHRISTOPHER WIRTH AT THE PIER AT WANNSEE WITH HIS CREWLESS VESSEL of the Wannsee; those that waited on the shore or approached in a motor boat satisfied themselves that nobody was sitting in the ship and the experiment was started.

On the shore had been installed a slender mast for the aerials and the sending apparatus throwing trains of electric waves out to the ship, a perfectly seaworthy vessel. After the apparatus had been set working orders were given out and the ship performed most faithfully any one of them,



GUN SALUTE BEING FIRED BY MEANS OF ELECTRO-MAGNETIC WAVES

turning to the right or left, sailing forward or backward and eventually stopping her course. In fact, an interval of one or two seconds sufficed for the ship to follow any command, while automatic signalling lamps enabled the looker-on accurately to watch the process.

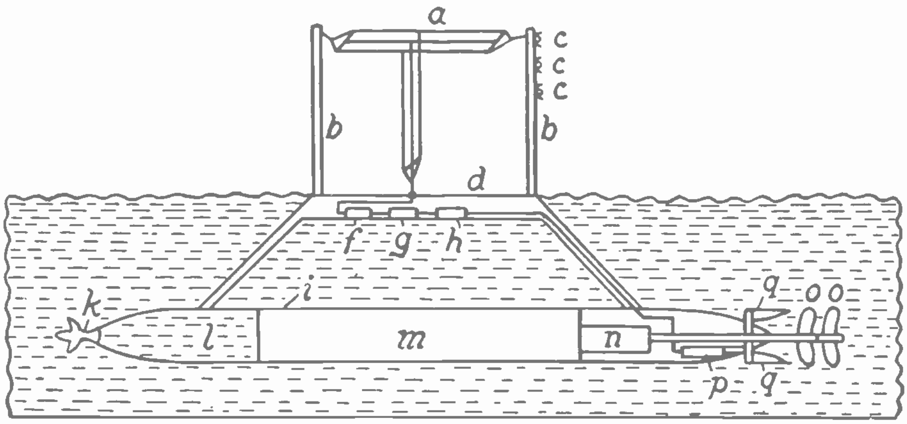
While electrically propelled vessels whose engines were operated from the conning tower—that is, without the aid of a machinist—have been built before, the present invention is a great advance insofar as not only the machinist and stoker but the captain and pilot can be dispensed with. In fact, all mechanisms are operated, not from the ship, but from some point on the shore, out of any material communication with the vessel, which thus is steered by remote control, through the intermediary of the same electro-magnetic waves as used in wireless telegraphy. This, however, does not mean that the boat receives by wireless means the motive force required for its motion; far from this. It has its own source of power in a storage battery while the energy stored therein is merely disengaged by electric waves emanating from the shore and collected by a receiving apparatus installed on board. The sending post is equipped with the tele-mechanic apparatus invented by Mr. Wirth who personally conducted these interesting tests.

From an elevated terrace on the shore, the maneuvers of the boat carrying on two masts the receiving aerials could be readily watched. After firing a signal shot from the crewless boat (likewise through wireless transmission) this would begin its course as if by enchantment, performing several turns to the right and left, describing circles and eights, stopping and returning. While these maneuvers were going on, signalling bells and colored lamps would indicate each operation performed.

This wonderful craft embodies a most momentous invention, the importance of which can hardly be exaggerated. It is a sad symptom of our times that military interests should play such a prominent part in connection with all new inventions, but the unceasing improvements of our war utensils, by making war more and more difficult, will eventually prove the most important factor in the advancement of peace.

As it is, the crewless boat principle will be primarily used for the construction of wireless torpedoes, carrying two short masts for the aerials and which may be steered from a sheltered position in any direction against a ship of the enemy. These torpedoes thus need not be projected from a special tube nor are there any narrow limits in regard to their dimensions as with ordinary torpedoes. In fact, the explosive charge could readily be made so powerful as to destroy even the largest armored vessels. It will be readily understood that these improved torpedoes would afford an absolutely ideal weapon for coast defense.

The schematical view shows the arrangement of such a torpedo steered by wireless; (a) is the aerial (antenna), (b) the signal mast carrying the signal lamps (c), (d) is a float reaching as far as the surface of the water and which contains the wave detector (f), the tuning device (g) and the wave switch (h). The torpedo proper (i), which contains in front the hammer (k) and the explosive (l) comprises in addition to the compressed-air compartment (m) and the motor (n) for driving the propeller screw (o) an electrical controller



DETAILS OF A WIRELESS CONTROLLED TORPEDO

(p), which through the intermediary of electric waves starting from a sending station on the shore or on board ship, will move the rudder (q) to the right or left or to the position of rest.

The possible military uses of the invention are, however, in no way confined to the operation of torpedoes. In fact, it is safe to say that the Japanese, if acquainted with the new scheme, would have been able by its means to steer the numerous blocking steamers against the entrance to Port Arthur, sinking them at the proper place, without even endangering the life of a single man serving as crew for the ship. Furthermore, it allows land and sea mines to be exploded and is likely also to play an important part in connection with the signalling service of warships.

In the same manner as a ship in water, dirigible balloons in midair could obviously be readily steered by electric waves. When the problem of equipping balloons with radio-telegraphic apparatus will have been solved, airships will in their turn be able to control torpedoes, the range of which would thus become practically unlimited. Kites equipped with photographic cameras and steered by electric waves will afford a most welcome arrangement for reconnoitering.

Apart from these military applications, the new invention will, however, prove most useful also for all manner of peaceful pursuits, affording, for example, a welcome means of steering lifeboats from the shore, that is, without an danger to human life. Railway trains could in case of emergency be stopped by its means on the open track, while a number of other applications will doubtless turn up as soon as the invention will have been more generally adopted.

It may be said that an ingenious scheme eliminates any risk of interference due to extraneous waves, such as those emanating from a wireless telegraph station, by automatic tuning between the sending and receiving stations.

Electricity

Mysterious power, fluid of the air,
That men have conjured from the azure sky,
Extracting from thy hidden alchemy
Heat, light and force—thy secrets weird and rare.
Make miracles seem possible—the glare
Of light that makes Night's sable mystery
As Day—the force like some strange witchery
That moves the cars along the thoroughfare.

And that occult, swift current that conveys
Upon the wires the spoken word afar,
That writes the written word across the sea.
These miracles wrought in thy wondrous ways
Speak dimly of thy future, as each star
Speaks dimly of the skies' far mystery.

FREDERIC BURTON EDDY.

An Electric Automaton

THE LATEST FRENCH MARVEL

By BERNARD ST. LAWRENCE

ILLUSTRATED WITH PHOTOGRAPHS BY LAURENCE & CO., PARIS.

"I'm not going to tell you how it's done, so don't ask any indiscreet questions," said the inventor when we had seated ourselves under the shady *pergola* in his beautiful little garden at Cros-de-Cagnes, near Nice. "When a man has worked at an electric problem for fifteen years and has at last solved it, is it likely he is going to give his secret away to a newspaper man—and to the whole world? No, of course not. It was with the object of making money that I invented, and now that I am well within sight of the goal I shall take jolly good care not to let anybody know how my *petit bonhomme* is worked. But I don't mind telling you the story of how he came into being, and you shall see my automaton at work. That will supply you with material for a first-rate yarn."

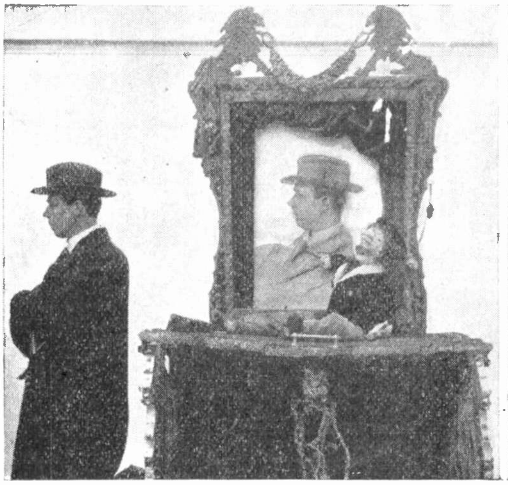
Monsieur Pierre Gill'o, who thus excited my curiosity, is the inventor of a wonderful automaton which he calls "The Artificial Man." I had heard of him from a fellow passenger whilst travelling on the railroad towards Nice, and on reaching my destination I made a point of finding out where he lived and calling upon him. There was no difficulty in running him to earth, for I found that all Nice knew Pierre Gill'o and his automaton. I must confess that my desire was to know everything about the mechanism of his marvellous machine. I had pictured myself as handling all the pieces—as examining all the joints and connections. But, as you see, I had to be content with the details which the inventor cared to give me. However, I must not complain. Truth to tell, his story was, as he himself said, "staggering."

"Fifteen years hard labour!" said M. Pierre Gill'o, musingly and with a faint smile on his round ruddy face. "Sounds bad, doesn't it? But, as in the case of the convict, the day of liberation came at last, and here I am, with my *homme artificiel* in perfect working order, ready to show it to all the world, provided you go round to the box-office. I made my *debut* the other day with the perfected automaton at a Nice music hall and I'm keen on business. I've engagements booked already for Berlin, Paris, London, and other great continental cities. When I'm through with them I'll take a trip to Chicago and New York, just to see if your American public has still a love for mechanics and the marvels of science."

"I'm a Lyonnais, bred and born. Do you know what that implies? A man with ambition, courage, inventiveness and a love of marionnettes. I've got all these good qualities. A love of the marionnette theatre came to me when, as a boy, my mother used to take me to the famous puppet show at Lyons; inventiveness was stimulated when she apprenticed me to an electrical engineer; courage and ambition came when I started to try to make an artificial man. As long as ever I can remember it was my desire to produce something better than the marionnettes of the Lyons puppet show. I used to work at the problem—without the faintest success—when I was a kid. When I grew to be a man I found myself irresistibly drawn towards the same idea. How could I produce a thing of wood and canvas and steel and wires, worked by an electric current, that would have something of the appearance of a man and, as regards certain given actions, conduct himself like a human being? The idea of solving the problem haunted me day and night. It still stuck to me when I got married, much to my wife's dismay. She must indeed have thought, as people said, that I was crazy. However, despite my wife's anxious looks and the remarks of the neighbours, I stuck to my plans and models and at last succeeded in producing something which wasn't at all bad. Certain rudimentary movements of the head and hands of my artificial man bore a very fair resemblance to those of a human being. This was my first model, which dates back to 1904. Model No. 2, a much more perfected automaton, came the year afterwards, and it was then, while my wife and I happened to be in Buenos Aires, that I was persuaded to make my appearance on the stage.

"My duties as an electrical engineer had taken me to that city, and while in a club one evening, telling a group of friends of the automaton I had invented and brought with me (for I never travelled without it), one of them suggested that he introduce me to the manager of a music hall who was a friend of his. At first I looked upon the suggestion as a joke, but finally, seeing that he was serious, I accepted, with the result that I obtained a short engagement at the Cirque Argentino. Nervous on my first appearance, was I? I should think so. But one thing made me determined to do my best. Just as my turn came the manager rushed into my room to say that the great Coquelin *ainé* was in the audience. Playing at a Buenos Aires theatre, he had seen the announcement of my 'Artificial Artist: the Great Parisian Attraction,' so had taken a box, where, on peeping through the hole in the drop curtain, I could see him sitting in his characteristic attitude—his chin resting on his hand. 'We must play exclusively for Coquelin,' said I to my wife, who was to present the automaton to the public whilst I saw to the working of the electrical apparatus. 'If we can make a good impression on the greatest of French actors we have won the day. Who is a better judge of a performance than the great Coquelin *ainé*?'

THE ARTIFICIAL MAN STEPPING OUT OF HIS BOX



ARTIFICIAL MAN DRAWS A PORTRAIT FROM LIFE

ARTIFICIAL MAN CONDUCTING AN ORCHESTRA

"Well, now, let me describe that first performance, just as though you were there yourself. Mme. Gill'o first of all carries on to the stage a long box in which the artificial man usually lives; she opens the lid, whereupon the occupant slowly rises, as though he were getting out of bed, rubs

PEEPING THROUGH THE HOLE IN THE CURTAIN I COULD SEE HIM SITTING IN HIS CHARACTERISTIC ATTITUDE

his eyes, looks round in astonishment, and, generally speaking, conducts himself like a person who is waking up from a profound slumber. Just as he is about to step out of the box, Mme. Gill'o takes him in her arms, carries him towards a little platform, on which an easel is standing, and instructs him to draw the portrait of some celebrity: Emperor, King, Prince or other personage. Immediately the artificial artist, who is dressed like a Montmartre student, seizes a crayon from a box of pencils which lies before him and writes on the sheet of paper on the easel the name President Loubet. Then he proceeds to draw from memory the portrait of the chief magistrate of France. When he has finished, in five or six minutes at the most, he tears off the sheet of paper, throws it to the ground, and sets to work to draw the likeness of the Kaiser. Then, glancing in the direction of the box where Coquelin is sitting, he suddenly recognizes the great actor and in large letters writes the name COQUELIN AINE. Great surprise on the part of the celebrated actor; dead silence and intense interest amongst the audience! The artificial artist, with many a glance towards his model, produces a striking likeness in six minutes,—a likeness in colours which is taken round to Coquelin to admire and preserve.

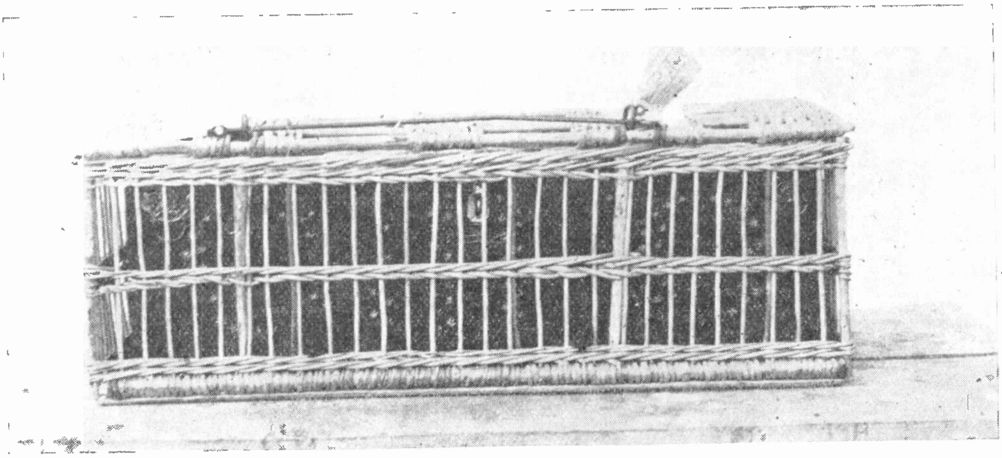
"From my post of observation in the wings I notice, with delight, that an admirable impression has been produced. Coquelin's face is a study, so I make a hasty sketch of his face, to serve as a memento of that memorable matinee. Then while the applause is still sounding in my ears and Mme. Gill'o is gracefully bowing her acknowledgments to the public. I give a signal to the orchestra to strike up a tune, and the second part of the performance of the artificial man begins.

"The *petit bonhomme* seizes, this time, a conductor's baton and proceeds, almost with Sousa's skill, to conduct the orchestra. One of the musicians makes a mistake (intentionally, of course), whereupon the artificial man suddenly drops his stick and looks severely in the direction of the erring instrumentalist. Another mistake causes him to thrust his fingers into his hair, to show all sorts of signs of distress, exactly like an irritable conductor of a band. The

LAUGHING AT THE PUBLIC

CONDUCTING AN ORCHESTRA

EXPRESSING SORROW



HOW THE ARTIFICIAL MAN IS PACKED FOR HIS JOURNEY AROUND THE WORLD

audience is thus kept continually in a roar—and so the performance continues until the end.

"There, now, I have given you a brief outline of my first appearance in public," said M. Gill'o after a pause. "But I have yet to tell you of the sequel. Judge of my delight the next morning when the postman brought me the following letter of thanks from M. Coquelin;—a precious document this which I ever carry with me, as you may well imagine:

"Royal Hotel,
"Buenos Aires.

"To Monsieur Gill'o.

"Sir,—Your little artificial man is wonderful, so amusing and so full of mystery he is. I have not attempted to discover the means by which you work him. In the pretty Argentine Circus where I spent a most agreeable matinee, I was entirely absorbed in the pleasure of seeing him arrive on the stage, bowing to the public, sitting down in front of his easel, drawing portraits, conducting the orchestra,—in a word, providing the charming entertainment which you gave everybody and particularly yours very cordially,

"C. Coquelin."

"Could any man desire a better testimonial? With this letter in my pocket I was back at Lyons in the following month and at once I set to work to still further perfect my artificial artist. And many are the improvements which I have made. It was back at Lyons in the following month had on show the other day in Nice and which I am going to take round the world on a tour. My next performance is at the Kursaal, on Friday next. Here is a ticket for the performance. Go yourself and judge of the merits of the 'Homme Artificiel.'"

Needless to say I accepted M. Gill'o's invitation and on the day in question found myself assisting at one of the most delightful entertainments it has ever been my pleasure to see. This artificial artist is, indeed, a wonderful piece of mechanism. How it is worked I know not, for, like the great Coquelin, I have not sought to find out; I was wholly absorbed, from the beginning to the end, in the *petit bonhomme's* wonderful mimicry, which the Nice representative of a Parisian firm of photographers has kindly consented to attempt to represent—and not unsuccessfully—in the accompanying series of photographs.

Gold as an Adulterant

Alloying baser metals to resemble gold, or adulterating gold with other metals to cheapen the product, has been a common practice for centuries. But that gold itself should be used as the adulterant for cheapening another metal, is a new development and one for which the electrical industry is largely responsible. The use of platinum for electrical contacts, for wires leading into X-ray tubes and the like has increased the demand for it so that instead of being nearly as costly as gold, it is now considerably above the latter in price. Consequently a German firm (at Hanan) has begun making articles of platinum adulterated with gold.

The Founders of the Electrical Industry

By GEORGE FREDERIC STRATTON

This is the story of the men who have developed the mysterious power of electricity; the power that glides—silent and unseen—over a tiny wire for a hundred feet, or a hundred miles, impelling powerful locomotives, operating gigantic machinery, and lighting outdoors, indoors and the bowels of the earth. The exploitation of the telegraph and the telephone is another story, and has been told before.

The year 1877 is written with red ink in the chronicles of electrical history. In that year four men, in different quarters of the country, were sifting out from the mass of impracticable experiments and inventions, the germs of the commercial availability of electrical light and power.

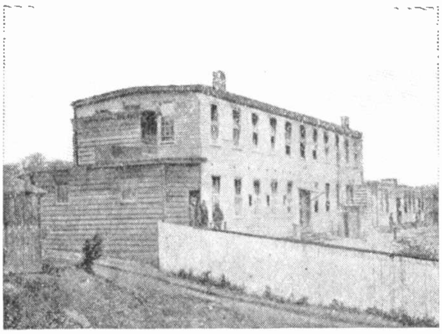
Edison, at Menlo Park, was plunging into exhaustive investigation of the possibilities of incandescent lighting. Brush, in Cleveland, was doing the same on the possibilities of arc-lighting for public service. Thomson, in Philadelphia, was experimenting with a simplified and improved dynamo. Westinghouse, in Pittsburg, was planning to add the manufacture of electrical machinery to his already great and diverse industries.

In that year not a single arc lamp was to be found in the streets of any city of America. The first serviceable incandescent lamp had not been produced. No man had seen a fare collected on an electric street car. Within two years, each of these four men had established small factories, and commenced the manufacture of the different apparatus they had invented; and those four business ventures are combined, today, into the two gigantic manufacturing corporations which dominate the industry in this country, and largely influence it in other countries.

Courtesy of the Cassier Co.

THE EDISON LABORATORY AT MENLO PARK IN 1879, SHOWING OUTDOOR POLE CIRCUITS ERECTED FOR THE FIRST PUBLIC EXHIBITION OF INCANDESCENT LAMPS

From those small beginnings in 1877 have developed an industry which absorbs the business ability and inventive genius of nearly 200 companies, firms and individuals with a capitalization of over $200,000,000; in addition to which—and as a consequent result of the utilization of the apparatus so invented and manufactured—are the street railways, and the power and



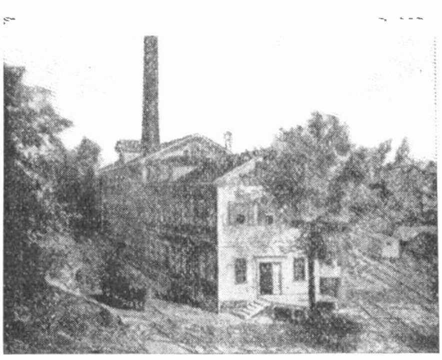
THE FIRST INCANDESCENT LAMP FACTORY AT MENLO PARK, 1880

lighting industries, which at the present time are capitalized at three billions and a half, with annual earnings amounting to $340,000,000 and affording employment to nearly 200,000 persons.

In 1877 Edison commenced his experiments on incandescent lamps. In '79 he had attained success with them, and was making them at Menlo Park at the rate of 100 a month. In 1882 the output was 1,000 per day, and at this time it is over 100,000 per day.

In 1877 Brush exhibited his first arc-light dynamo. In 1879 he installed the first arc-lamp street lighting system in the United States. In that year he was poor, but ten years later he sold his plant and his patents, and retired with an ample fortune.

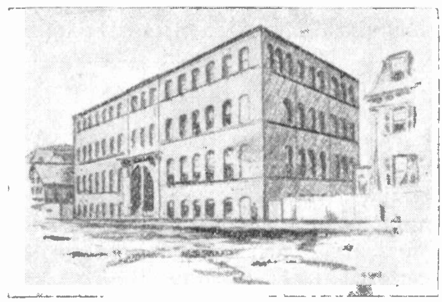
In 1877-8 Professor Thomson was experimenting in Philadelphia with arc-light



BUILDING AT NEW BRITAIN, CONN., USED AS A FACTORY BY THE AMERICAN ELECTRIC COMPANY, ORGANIZED BY THOMSON AND HOUSTON IN 1880

dynamos and lamps. He formed a partnership with Professor Houston, and they started a small shop where they manufactured lighting apparatus very successfully. In 1888 they became interested in electric traction, exhibiting their first car at Crescent Beach, Mass.

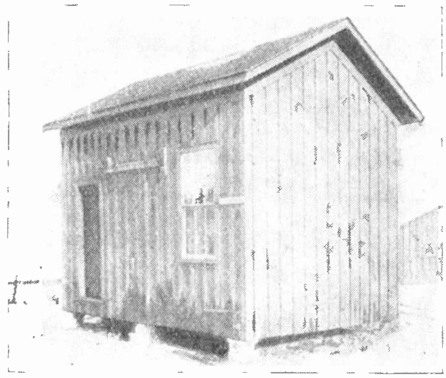
In 1880 Edison had a short track at Menlo Park, upon which he exhibited an electric locomotive which hauled cars. A little later, Stephen D. Field built an electric locomotive which was exhibited at Chicago. In 1883 Daft showed an experimental car at Mt. McGregor, near Saratoga. In the same year, Van Depoele showed an electric car of his own invention, at Chicago, and immediately after formed the first company for manufacturing such cars. Three years later he had greatly improved the equipment, and converted fourteen horse railroads into electric railways. In 1884 Bently and Knight electrically equipped a mile of the track of the East Cleveland Street Railway, and operated an old horse-car converted into an electric. In 1887 Sprague equipped a road at Richmond, Va., which gave promise of successful operation.



THE FIRST FACTORY OF THE THOMSON-HOUSTON CO. AT LYNN, MASS., 1884

Each of these was claimed, by its inventor to be the first successful electric car—the claims being based upon the different conditions under which the cars were operated.

Over in Pittsburgh, in 1877, the irrepressible Westinghouse, of car-brake fame, made plans for entering the electric field. He soon secured ample capital, and with it, threw into the new enterprise all of his characteristic energy and wonderful inventive genius, with the result that, in a



FIRST PUBLIC LIGHTING STATION IN AMERICA—APPLETON, WISCONSIN

short time, he was running neck and neck with the Thomson-Houston Company.

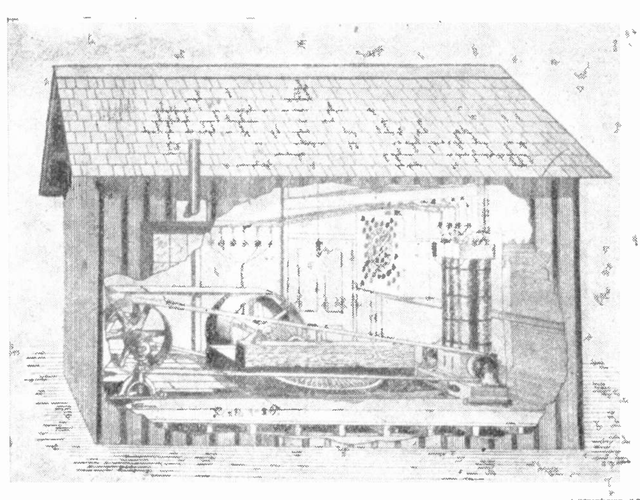
Among all these pioneers the names of Edison, Brush, Thomson and Westinghouse soon began to stand out with peculiar distinctness. The four original companies organized by these men have long since been merged into two—the General Electric Company of Schenectady, N. Y., and the Westinghouse Electric and Manufacturing Company of Pittsburg, Pa., and it is a very remarkable fact that although each of those four founders was an inventor, each has received great recognition of, and reward for his genius. All are, today, hale and hearty, with unimpaired faculties, and, excepting Mr. Brush, are actively interested in the gigantic output of the two great companies of which they were the founders—an output which reached, last year, including that of the European plants, a total of $200,000,000, and required the employment of nearly 60,000 hands.

EARLY EXPERIENCES AND TROUBLES.

Those early days of the industry were marked by an overwhelming scramble of cities for electric lighting, and of street railway companies for electrification, resulting in a flood of orders which amazed the manufacturers. Plants were doubled, yearly, in capacity. During the years 1889-90 the Thomson-Houston Company installed $100,000 worth of machine tools every month for fifteen months. At the Menlo Park workshops the doors were never closed, the wheels never ceased turning—day or night—but the output of 1,000 incandescent lamps every 24 hours was but a drop in the bucket to the demand. Brush, at Cleveland, was running crews day and night on arc lamps and generators.

And with it all came the most stupendous confusion of litigation and quarreling that has ever assailed any industry. At a recent reunion of old officials and foremen of the Thomson-Houston Company one of the speakers said:

"It was Donnybrook Fair in those days, all right! Every head which showed with a patent mark on it was struck with some interference cudgel. If a man wasn't being clubbed himself, he was clubbing someone else; but it was generally both ways.



INTERIOR OF THE APPLETON STATION. EDISON APPARATUS OPERATED BY WATER POWER, CAPACITY 250 LAMPS

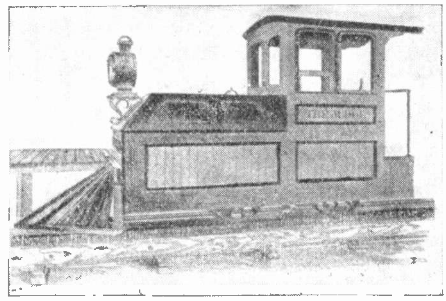
No one knew what he had a right to make, or who was trying to beat him. Our company spent over $100,000 yearly, for several years, in law costs. Edison got mixed up in a fierce squabble with Field and others, and, disgusted with the whole affair, allowed his electric locomotive to rust out on its tracks."

Mr. Edison thus lost the leadership of electric car exploitation which would have undoubtedly been his. His car had repeatedly hauled six loaded freight cars at over 40 miles an hour. Afterwards, in speaking of this, he said: "I could not go on with it because I had too many things to attend to, especially in connection with electric lighting." But no one who knows Mr. Edison's splendid industry and application will understand this as being the whole reason. He would undoubtedly have found time to develop his car, but he did not care to give time and thought to developing lawsuits.

As a few years passed, much of the litigation and confusion was settled by combinations between the contesting parties. Thus the smaller men were gradually eliminated, and their patents and claims purchased by the four leading companies. Daft, Field, Van Depoele, Bently and Knight, and others, dropped out as individual manufacturers, although their services as inventors were usually retained by the large companies.

On the financial end of the developing industries the excitement was as intense as in some great mining boom. When Edison gave his first public exhibition of incandescent lamps, the stock of the company—which had already been formed—jumped to 3,000. Stock of the Thomson-Houston Company sold at par in 1887, went to 380 in 1890. The demand for apparatus of every kind was so great that competition in prices was practically unknown, the struggle between the various manufacturers being altogether confined to a speed contest in filling orders. The profits were great, and capital was generally secured without difficulty, although many of the well known, heavy capitalists held distinctly aloof. One of them said: "We have had such a shower of patents during the past five years, such a multiplicity of claims, counter claims, and interferences, such a jumble of litigation, that no man can tell whether, or not, what he thinks belongs to him is his own. I intend to sit quietly on the fence and watch the procession!"

And the procession went on all right. If the big money did not come in, the big brains did. Probably—Yes, undoubtedly—no new industry ever so quickly assembled such a marvelous combination of scientific skill and business ability as the new electrical field. No salary was considered too



STEPHEN D. FIELD'S ELECTRIC LOCOMOTIVE, 1880

great for securing such men, with the result that, today, the companies can point to an organization, an output and a development that has known nothing but success and increase from the earliest days to the present time.

There were strange views and opinions about electricity in those early days, often reflected in suits for damages brought against the operating companies. In one such suit, entered against the Jamaica (Long Island) Street Railway Company by a woman, the declaration stated that she was injured "by receiving a charge of electricity; a ball of electricity having passed into her, and the doctor stated that it was in her, yet."

In another suit, a truck gardener asserted that the electric cars emitted a stream of electricity as they passed his grounds, "blackening and damaging certain crops, to wit—one-half acre of cabbages and one-half acre of potatoes."

London Engineering, in 1884, in a somewhat derogatory review of electric street lighting by arc lamps, stated that, in Edinburgh, four men were kept going the rounds at night, armed with long poles, with which they jabbed the lamps whenever the carbons refused to feed together. "It is well known," it added, "that the best friends of the system are the street arabs who, having become initiated into the mystery, make it their sport to climb the lamp posts and give a friendly shake whenever one is seen to go a 'swooning.'"

The sociological aspect of the new industry also received due attention. In a contribution by Professor Tice to the *Electrical Review* of April, 1884, he says:

"Electricity will prove itself a boon to the poor by breaking up aggregated industries. This, I believe, will be its *greatest mission.* It will subdivide power so that each operator can have his own, at a trifling cost."

A hopeful outlook, but one which is still only "outlook."

In the *Scientific American* of June 12, 1880, the editor said: "We have already experienced, in the telegraph and the telephone, the advantages of electricity as a carrier of thoughts and sounds. Who can tell but that, when its capacities as a carrier of men and things have been fully developed, the electric telegraph and telephone will be eclipsed, in scope and utility, by the electric railroad?"

How that question, and the implied hope, have been answered will be told in a future article.

(The Second Article of this Series Will Tell of the Three Great Inventors Whose Names Stand Out so Prominently and in Many Cases Dramatically in the History of the Electrical Industry; Namely, Edison, Brush and Thomson.—*Editorial Note.*)

Trains Controlled by Wireless

By CHARLTON LAWRENCE EDHOLM

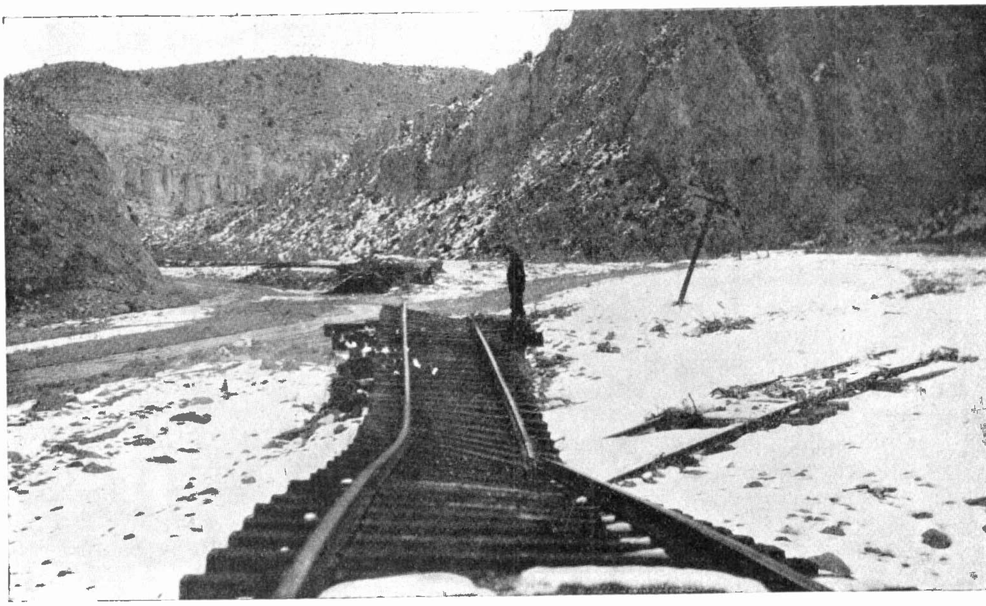
Not long ago a train of twelve cars was rushing along the Canadian Pacific tracks near Toronto, behind a powerful engine at the rate of 45 miles an hour, the throttle wide open, and the engineer standing as a mere spectator, prepared at any time to assume control of his engine, but in the meantime allowing it to run wild. Suddenly a whistle in the cab blew a warning note, the brakes were thrown on by some unseen agency and the huge mass of steel with its dozen cars was brought to a standstill without the engineer or anyone else on the train having raised a finger.

FRANK W. PRENTICE, INVENTOR OF WIRELESS TRAIN CONTROL

It was weird, it was uncanny. Any demonstration of power equivalent to this would in other times have been characterized as "black magic," but this marvelous new use of the Hertzian wave might more appropriately be termed "white magic," a force not for evil, but for good, the preserver of countless human lives. It is one of the latest triumphs of modern science, and is designed to eliminate the horrible annual slaughter of those who travel by rail, and of numberless thousands of railroad men all over the world who daily face more dreadful perils than did the soldiers of Gettysburg or Waterloo.

The system whereby a train or engine, despite the mistakes of despatchers, operators, conductors or engineers will not only be warned of danger, but actually brought to a standstill, is the life work of a Canadian railroad man and inventor, Frank W. Prentice, and the successful test of his device near Toronto some months ago is the culmination of fourteen years of hard work, struggle against financial difficulties and brave overcoming of obstacles, above all, a persistent renewing of the fight after crushing disappointments such as defeat the average man, but serve only to strengthen the heart of a genius.

In this instance the task was well worth while. No recital of statistics is necessary to convince the casual newspaper reader of the appalling loss of life from railroad accidents, one wreck following another with its long list of mangled victims, which equals or surpasses in its yearly aggregate the returns from a battlefield. But it is not until some such report contains the name of a



A WASHOUT LIKE THIS WOULD BREAK THE WAVE WIRE AND BRING ALL TRAINS IN THE BLOCK TO A HALT

friend or loved one among those crushed and torn in a collision that the horror of this barbarous waste of human life strikes home.

If there is any person who feels this horror more keenly than the survivor of such a catastrophe, it is the train despatcher whose efforts in this instance have proven unavailing and who must bear the responsibility before the public and his own conscience.

It was with one of this class that the bold idea originated of eliminating the control of despatcher, operator or other human agent in the handling of a train, and substituting therefor the mysterious Hertzian wave, which is the basis of wireless telegraphy. The circumstances were dramatic. In 1898, Mr. Prentice held a position in the office of the chief train despatcher of the B. & O. at Pittsburg. A recent reorganization of that system had apparently demoralized the operating force and, as he expresses it, "For three months collisions head-on and rear-end were of daily, and I was about to say, hourly occurrence."

The climax was reached on August 12th in a terrific collision between a passenger and freight train with a sickening story of mangled limbs and lives crushed out, told with a realism familiar to the railroad men, but suppressed as too strong for publication in the newspapers.

This particular catastrophe affected Mr. Prentice the more deeply because a dear friend of his, a train despatcher, was involved. His life-saving invention was conceived in the excitement following that calamity. He had studied the theory of wireless when Marconi's first triumphs were given to the world, to pass away the long tedious winter nights when he was on duty at a small telegraph station in northern Canada. Thus the call found him prepared. As he tells it in his own words: "That night on retiring at one a. m. I fell into a light sleep. I dreamed that I was placing a wireless generator on the rear end of a van to prevent rear-end collisions. I awoke and slept no more that night. With drawing board on my knees, the first plan for train control by wireless was evolved and finished as the sun's first rays penetrated the cloud of smoke arising from Carnegie's numerous furnaces at Braddock (a suburb of Pittsburgh) on August 13th."

"My superior officials became interested, as has every one else who has come in contact with "the wave." The lurid fascination of this mysterious agent that knows no barriers seems to be irresistible. Had I known the many years of toil, hardship and poverty this will-o'-the-wisp was to lead me through, I imagine my inclination would have been to seek to escape by plunging beneath the turbid waters of the Monongahela."

The system which Mr. Prentice evolved at that time was based on the use of "coherers," using two metal lugs inserted in a glass tube, the lugs being one-fourth of an inch apart and the aperture filled with filings of iron and German silver. Under normal conditions a current would not flow through the filings, but should the Hertzian waves be emitted in the zone of the coherer from a "wave wire" following the track, the filings would become conductive and the control apparatus would become effective. It was supposed at first that these filings became magnetized and cohered, hence the apparatus for detecting waves was styled a "coherer." Years later it was found that the filings were not magnetized, but that a high resistance was set up on the outsides of the particles of metal that resisted the flow of current through them; the emission of waves breaking down the resistance, allowing the current to flow and close the relay circuit. In the first wireless apparatus made by Mr. Prentice successful tests were made at a distance of one thousand feet.

For two and a half years Mr. Prentice was engaged in the work of installing his system on a ten-mile stretch of the B. & O. near Baltimore. The device was still in its infancy, and the inventor's perseverance in developing it may be shown by the fact that not less than 3,000 different coherers were made and tested on the various types of locomotives before one was perfected which would render service in spite of racking and jarring of hard-running engines.

Fifteen thousand dollars was spent in this time, but finally the installation was complete, and here again the inventor tells of his effort in such a picturesque way that his own words are most appropriate.

"On the 13th of May all was complete for the official approval. A train of seven officials' cars left Baltimore early in the morning and passed into the installed zone at a speed of 100 miles per hour. In the second block, the gong on the engine and in each of the cars was sounded vigorously, and the train brought to a standstill. My hour of triumph seemed at hand. But lo, a pair of pliers in the hands of an engineer clipped the wave wire beside the track, and the sentence he uttered seemed my death knell, 'Now ring your gong on the engine.' The point he made was that an accident like a washout or the burning of a bridge would sever the wire as his pliers had done.

"The General Manager, standing by my side, tried to comfort me, saying: 'Cheer up, Prentice, you will win out, because precedent is in your favor.' 'How do you make that out?' I asked. He replied, 'On those poles the first message transmitted by telegraph was sent. It read, *What wonders God hath wrought.* On this roadbed where we now stand the first locomotive was successfully run by steam. Right here the Hertzian wave was first used for train control, and will win out, as the other two did.' "

These were encouraging words, but the fact remained that the problem was unsolved. For two years the inventor wandered from one place to another, often in desperate financial straits, and finally drifted into Cincinnati, where a trivial incident gave him the idea which resulted in the final success of his system. The proprietor of a drug store in that city had placed a little advertising device in his window designed to attract attention by means of a moving object. It was a small fountain which threw a jet into the air and kept a glass ball suspended and dancing up and down by the force of the water. It is a common enough device; you can find one in almost any shooting gallery, the dancing ball being used as a target, but common as it is it suggested the idea, which was this: Use the Hertzian wave to keep some object suspended in space. When the wave stops, this object would fall by its own weight and the train would be brought to a halt.

The principle was just the reverse of the first, which was to send messages in case of danger. The present system sends a continual message when all is well, and when the wave ceases then the danger signal follows, and after that the clamping on of the air brakes. A basic patent was secured for Mr. Prentice on this idea: "In a railroad signal system a generator of Hertzian waves for each block indicating safety, and the absence thereof danger."

Then followed months of persistent struggle to develop the idea on eighteen roads in the city of Chicago, but one rebuff succeeded another and, finally, driven to desperation by the indifference of the railroad magnates, the inventor wrote to the President of the United States, explaining the device. That was in the last three months of 1906, and in that time there was a disastrous series of railroad wrecks, killing 347 and injuring more than 4,000 people. It was a condition similar to that which prevailed when Mr. Prentice's first drawing was made, after the big wreck on the B. & O.

No doubt these reports had their influence on President Roosevelt, who, to the great surprise of Mr. Prentice, responded favorably to his letter and secured action by Congress. The result was an appropriation of $50,000 to enable the Interstate Commerce Commission to conduct an investigation regarding various safety appliances.

The board of experts which considered Mr. Prentice's device, among the 345 submitted, stated that wireless was too young to be given serious consideration. The only dissenting voice was that of the chairman, Prof. M. E. Cooley, of Ann Arbor, who expressed the opinion that wireless would eventually solve the problem.

The following year, however, the board reported more favorably on the device, it having been tried out on a suburban electric road running out of Chicago. Although the report of that board was favorable, in May, 1909, the inventor realized that he could not get the necessary financial assistance in this country, so he appealed to the General Manager of the Canadian Pacific Railway, Mr. J. W. Leonard, and an investigation by experts of that line led to a favorable outcome. In September of that year a stretch of track in West Toronto was assigned to Mr. Prentice for the installation of his system.

In order to take advantage of the liberal offer of the Canadian Pacific Railway the inventor was forced to face the financial problem once more. He met it by appealing to his comrades in the ranks, the engineers, firemen, conductors and train despatchers, who (together with some business men of Toronto) raised the sum of $15,000, and also aided in solving some of the mechanical problems. On the other hand, the general superintendent, Mr. James Oborne, was generous in placing engines, material and laborers at the inventor's disposal, and so, in less than a year from the time actual operations began, the installation at Toronto was complete. It was on this track that the test was made of stopping a train of twelve cars and an engine while it was running at the rate of 45 miles an hour.

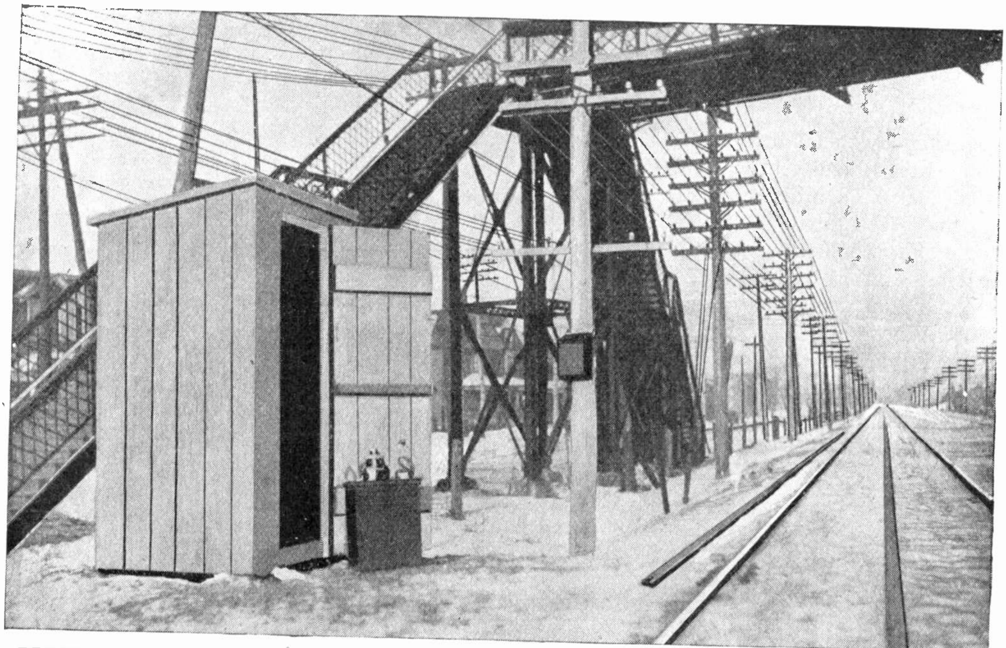
The track installation on the C. P. R. consists of eight blocks, from 2,000 feet to 4,500 feet each, four blocks on the west bound and four on the east bound track, beginning at Queen Street subway and ending at Royce Avenue, a distance of two miles, generators being located at Noble Street, Lansdowne, Golden, Wallace and Royce Avenues. These have been in constant service since March 25th, 1910, without interruption. The expense for current for this period has been two cents per day per block—about 90 per cent less expensive than visual signal systems. There being no batteries in the track installation, the cost of maintenance is cut to 50 per cent.

An aluminum wire enclosed in a trunking runs between the rails. This is known as the "wave wire." A generator of the wave, consisting of the transformer, the condenser and the discharge points (known as oscillators) and connected with a feed wire, is placed at the end of each block, and a wave wire is extended for a block-length in the rear. The generator is controlled by the track circuits of the block in advance. The wire is charged with the wave producing current only when the block in advance is clear, or, in other words, there is a continuous "go ahead" message, the absence of which indicates danger. The maximum length of the wire which can be charged with one oscillator, is measured by miles, so it is plain that the length of the block is governed only by the requirements of traffic.

Such is the briefest possible description of the track installation, avoiding technical terms.

The corresponding part of the system which is carried upon the engine is described by the inventor as follows:

"It comprises, first of all, the main antenna, nineteen feet long, suspended from the boiler braces by three hangers, the antenna consisting of an aluminum plate four inches wide, and hanging directly over the wave wire, two inches above the level of the



BLOCK STATION ON THE WIRELESS-PROTECTED LINE. BETWEEN THE TRACK RAILS IS THE TROUGH OF THE MAIN WAVE WIRE; AT THE LEFT THE PICK-UP WAVE WIRE

pilot, or seven inches from the indurated trunking.

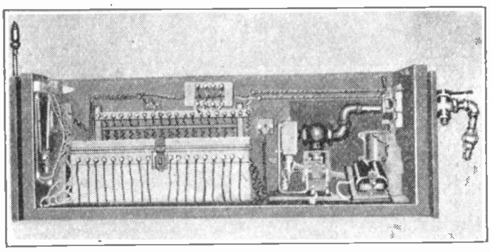
"Second: A pick-up antenna supported in a like manner on the right hand side, suspended beneath the cylinder cocks thirteen inches outside of the rail and directly over the pick-up wave wire at the end of each block.

"Third: A Pyle turbine generator giving six volts and 20 amperes of current for supplying the working force of the wave responsive apparatus.

"Fourth: The train control mechanism, the salient feature of which is the coherer, consisting of a wood fibre receptacle having a hole in the center, and two lugs inserted in its bottom one quarter of an inch apart. Placed in the coherer are the wave responsive filings, sufficient to fill in the aperture between the lugs. The coherer is rotated upon an axle through 90 degrees of space by a solenoid rack and pinion, being held in the upright position two seconds by means of two hold relays, the filings during that time resting between the lugs. Normally these filings are a non-conductor of current, but when the Hertzian wave is emanated in their zone the resistance on their outer surface is broken down and a current flows through them, closing the master relay. Once these filings are cohered they will retain such cohesion until they are jarred to restore their non-resisting qualities, hence the rotating coherer to drop them out by gravity to perform this function. The coherer is in operation constantly as long as the engine is in service. The master relay opens and closes every three seconds when the wave is being received. Connected to the master relay is a series of ten hold relays, three to twelve inclusive. These relays will hold their magnetism one second each after the current is broken, and being in parallel series relay No. 12 releases its contact ten seconds after the master relay ceases to be operated by the wave controlling influence."

Various relays operate with the cessation of the wave, blowing the whistle as a danger signal and stopping the train, although the engineer by simply pressing a push button can prevent the brakes being applied and proceed under a caution signal. Tests have been made for such a length of time that the absolute reliability of the system has been demonstrated. One engine, No. 147, covered 500 miles with the apparatus intact. Engine No. 798 has made a continuous run of 104 hours using this equipment, and is at present in regular operation, handling from 20 to 60 cars a trip. The feat of bringing a train to a standstill with the throttle wide open is performed daily.

This system has been so far perfected that it is not possible for signals meant for one train to be taken up by another, also

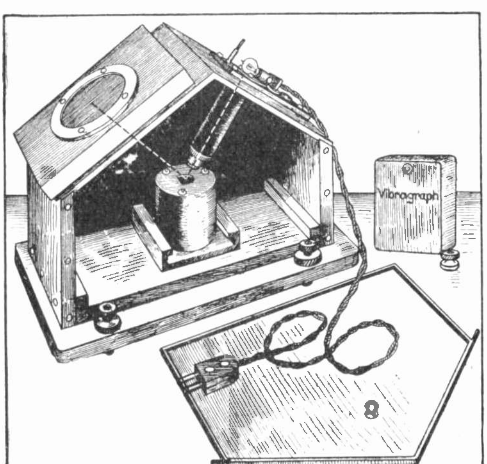


INTERIOR OF THE ENGINE DEVICE WHICH CONTAINS THE HOLD RELAYS, MASTER RELAY AND COHERER

the action of the wave is not influenced by the presence of metal, such as steel bridges, nor by nearby power lines, nor does it in any way interfere with the operation of other electric signals already installed.

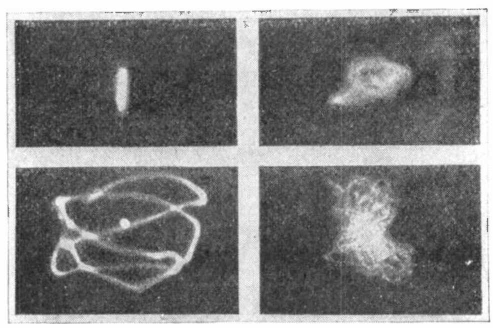
Measuring Vibration

The influence of vibration on machines and structures is receiving the attention of the present day engineer. It is only necessary to recall the problems of accurate balance connected with high rotative speed, such as have arisen in the use of the steam turbine in buildings and ships; the problems of moving loads on bridges and the tremors



DEVICE FOR MEASURING MACHINE VIBRATION

produced by tramways and railways, says the *London Electrical Review*. In all such cases the actual vibration has been a vague quantity and definite measurement has been a matter of difficulty. Just what kind of vibrating motion a structure or machine is subjected to or causes of itself, seems to be now open to discovery by the use of the vibragraph, an instrument made by a London firm and arranged to magnify vibrations 100 times. In the device is a mercury cup provided with a floating mirror, so pivoted as to avoid lateral movement, and the mercury ripples caused by vibration result in an angular movement of the mirror. The beam of light thrown by the small electric lamp and reflected by the mirror, will, therefore, record on photographic paper a straight line if the vibration is in one plane only, or a complex figure if the vibration be in many different



"VIBRAGRAMS"

Steam Turbine — Two-crank Engine
Crank Casing of an Engine at 188 r. p. m. — 4-Cylinder Motor Car

directions, as is nearly always the case in actual practice. When no records are required the photographic paper can be replaced by a screen, thus permitting of direct observations. Three different mercury cups are usually supplied with the instrument so as to make the vibragraph suitable for recording strong, medium and small vibrations. Data are supplied with each cup, which permit of the determination from the photographic record of the actual movement of the vibrating body in fractions of inches or millimeters.

The apparatus has been under practical test for eighteen months and the accompanying "vibragrams" show some of the results.

The FIREFLY as a LIGHTING PLANT

Nature holds her secrets well, but by the persistent efforts of scientists they are gradually being wrested from her. The wonderfully efficient light of the firefly has attracted the attention of thinkers for many centuries. Probably none of us has not admired this interesting insect, but the privilege of studying it is reserved for the few. Writers as far back as Aristotle and Pliny, make mention of this phenomenon, but not until a score of years ago were there any real scientific investigations made.

Prof. S. P. Langley, one of the greatest men of science that this country ever produced, published the first noteworthy paper on the subject. To him the light of the firefly was "the cheapest form of light." His investigations were not conclusive, however, as will be brought out later.

In order better to understand what is meant by an efficient light source and what conditions it must fulfill it will be necessary to take up a few physical phenomena, for many readers may not be acquainted with the nomenclature that inevitably must be used in discussing a problem of this sort. Heat, light, and photo-chemical radiations are the same phenomena. They are transmitted through space as vibrations or pulses in that all-pervading medium known as the ether, and differ only in regard to the frequency of these vibrations. To make it more clear suppose middle C on a piano keyboard be struck. A note of a definite pitch is emitted. Strike the C an octave above and a note of higher pitch is heard. Both these sounds are conveyed to the ear by actual vibrations in the surrounding air. The latter note is of higher pitch and the vibrations of the air are likewise of higher frequency. In fact the latter note is due to a vibrating string which is sending out vibrations at twice the frequency of those in the first case. When the vibrations are less than ten per second or more than 30,000 per second, the ear drum no longer responds and no sound is heard.

Somewhat analogous is the phenomenon of radiation through the ether. The heat radiations are of low frequency, and one of our special senses responds to those vibrations. Light consists of ether pulses of higher frequency, and the retina of the eye responds only to frequencies of from 400 million millions per second to 770 million millions vibrations per second. When the frequency of ether pulses becomes greater than the latter figure the human eye no longer perceives the sensation of light. These pulses of higher frequency are called photo-chemical or ultraviolet radiations. These affect the photographic plate. The two figures given above as the limiting frequencies to which the retina responds represent respectively what is termed deep red and deep violet. Intermediate frequencies are seen by the eye as blue, green, orange, etc.

Any body radiating energy due to its temperature being higher than its surroundings will give off heat, heat and light, or heat, light and photo-chemical rays, depending on its temperature. This is at once evident if we heat an iron rod. At first heat is emitted, then heat and light, etc., as its temperature is raised.

The reader can now understand what constitutes an efficient light and why our modern light sources are very inefficient. If light is desired why pay for heat? The reason is that light sources as transformers of energy are radiating nearly all their energy as heat instead of light. This is not true of the firefly. All the energy radiated by it (excepting body heat) is radiated in the visible spectrum or in other words as light. Hence the radiant efficiency is 100 per cent.

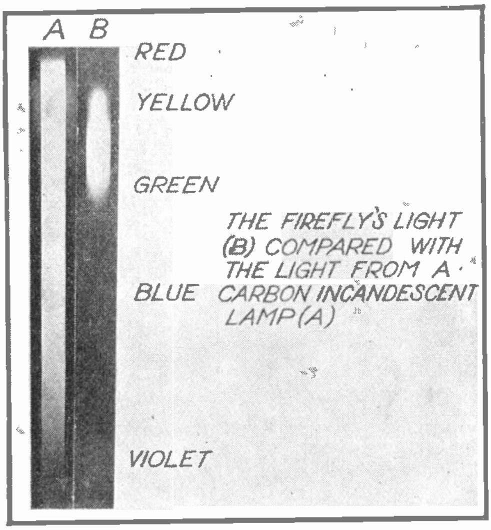
Although it has been stated that the firefly radiates rays other than light, the latest and best investigations find this to be untrue. There are other reasons which indicate the unlikelihood of other rays than light being emitted.

This, then, is the ideal toward which to strive in producing light sources. It might well be stated here that by radiant efficiency is meant the ratio of the energy radiated as light to the total energy radiated. This ratio or radiant efficiency of the tungsten lamp is less than five per cent. The radiant efficiency is, however, not the efficiency which interests users of light. Much more energy must be radiated at a frequency which gives the sensation of red light than at a frequency which produces the sensation of yellow-green light in order to give equal sensations of brightness. The same is true of blue and yellow light. In other words, a certain amount of energy radiated as yellow-green light will give a greater sensation of brightness than in any other part of the visible spectrum. The firefly's light is yellowish green and therefore nearly all its energy is radiated at the most efficient point — at the point of maximum brightness production.

As a luminous source its "luminous efficiency" is 96 per cent as determined by the latest investigations. The tungsten light is not confined to this point of maximum brightness per unit of radiated energy, and as a consequence its luminous efficiency is barely *one* per cent. On the same basis the "luminous efficiency" of sunlight is fifteen per cent, yellow flame arc and carbon arc, six per cent, and the mercury vapor lamp about five per cent. It is thus seen that the energy radiated by the firefly is not only all radiated as light, but of a color to give a maximum amount of light for a certain amount of radiant energy.

The actual method of production of light by the firefly is yet practically unknown. The luminous organ consists of two layers of material under the outer transparent chitin. The inner layer consists of guanin and is a reflector. Both layers contain an elaborate network of tubes, which are filled with air. Ordinarily the light consists of a faint glow, which at periods of a few seconds, flashes out with greatly increased intensity.

Under the microscope the luminous portion, when merely glowing, appears to be made up of numerous scintillating points. Some species found in Cuba emit a continuous bright glow. Many long investigations have been undertaken to learn more of the light-producing process, and it is quite well established that water and oxygen are required to produce the light. Carbonic acid and many other substances extinguish or



THE FIREFLY'S LIGHT (B) COMPARED WITH THE LIGHT FROM A CARBON INCANDESCENT LAMP (A)

diminish the light. Irritation, mechanical or electrical, stimulate the process.

It was thought for some time that the luminosity was due to free phosphorus, but latest chemical analyses show that there is not present sufficient (if any) free phosphorus to produce the light. The luminous tissue, when dried carefully in an atmosphere of hydrogen, retains for over a year its power to glow when moistened with water in the presence of oxygen.

The light may be due to chemical action or may be a phosphorescence phenomenon. Certain chemical compounds have the ability to store up energy and radiate it, at their leisure, as light. This phenomenon is called phosphorescence. In this manner the firefly might store up the sun's energy and emit it during darkness as light. This theory seems to be substantiated by the fact that the firefly more actively emits light just after dusk. However, fireflies which have been kept in the dark for 24 hours showed the same activity as those which were kept in the sunlight. The luminous tissue does not obey any of the well-known laws of phosphorescence.

Something of the methods of measuring the light of the firefly may prove of interest. The first instrument used was the bolometer, which consists of a very thin blackened strip of platinum. When energy falls on it the energy is absorbed. This raises the temperature of the strip and likewise the electrical resistance, which can be easily measured. This instrument under best conditions can detect a change in temperature of one-millionth degree. This method, however, is not sensitive enough to obtain quantitative results. This also illustrates the very small amount of energy which is radiated by the firefly.

Another available instrument is the spectrophotometer. The light is dispersed by a glass prism into its component parts and the actual amount of light in different parts of the spectrum is compared visually with known amounts. The intermittent character and low intensity of the light makes this method unsatisfactory.

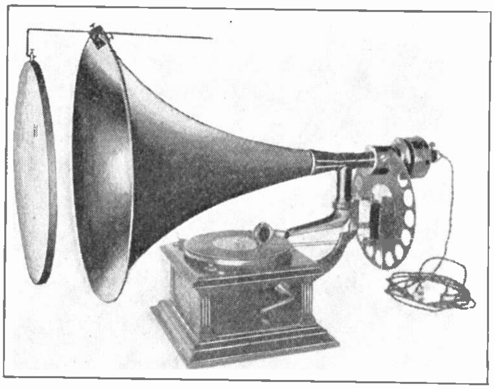
The best results have been obtained by photographing the spectrum. Plates can be obtained which are sensitive in the ultra-violet and throughout the visible spectrum. Several hours' exposure is necessary and the fireflies must be held before the instrument. Besides the long tedious work of obtaining the exposure the photographic method is replete with many other difficulties in interpreting the results because the plates are not equally sensitive to all frequencies of light.

A phosphorescence method has been used to study the radiation, if any, beyond the visible region on the lower frequency side. This method depends for its success upon the action of heat rays on a phorescent substance. The difficulties of the methods are too intricate to more than touch upon them here.

There has been a great amount of work done and money spent on this interesting problem; however, there is much to learn in regard to the actual light production. The high radiant and luminous efficiency are quite firmly established; however, the efficiency of the light-producing process is as yet unknown. The problem is one worthy of solution because of its economic importance. If ninety-nine times more light could be obtained from light sources for the expenditure of a certain amount of fuel what an aid to the conservation of our fuel supply the complete revelation of the firefly's secret would be!

Pictures Projected Through Phonograph Horn

Double pleasure may be obtained from your phonograph by the use of a new device known as the picture disk. An attachment which can be fitted to any straight horn has been invented recently, which consists of an electric light placed behind the small opening of the horn, lenses for focusing, a screen to hang in front of the mouth of the horn and finally, a twelve-inch disk with a

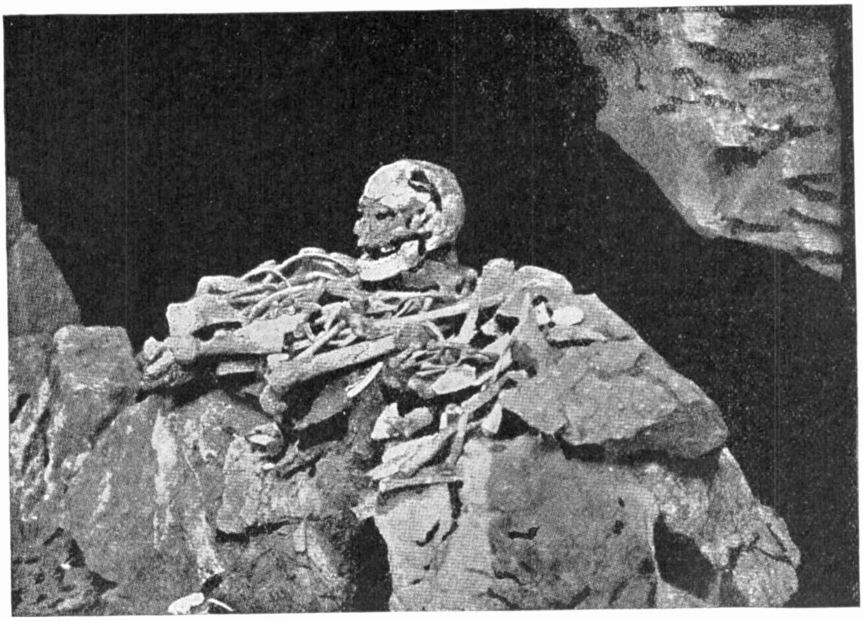


ELECTRIC PICTURE PROJECTOR ON A PHONOGRAPH HORN

set of illustrations for any suitable song or other selection such as monologues, etc. The disk revolves at regular intervals before the light, stopping long enough for each view to be appreciated as it is projected upon the screen, then moving enough to allow the next view to appear, and so on. The motor of the talking machine operates the disk, through a shaft and gear.

Of course, the electric light attachment is available in most modern homes, so that one of the pleasures of the popular stage, the song with illustrations, is brought into the household for the amusement of the family and guests. The new invention is inexpensive, and when picture disks and records are sold in sets, as planned by the inventor, it undoubtedly will gain rapid popularity.

Lighting the Caves of Prehistoric Man



REMAINS OF A PREHISTORIC MAN SAID TO BE 40,000 TO 60,000 YEARS OLD

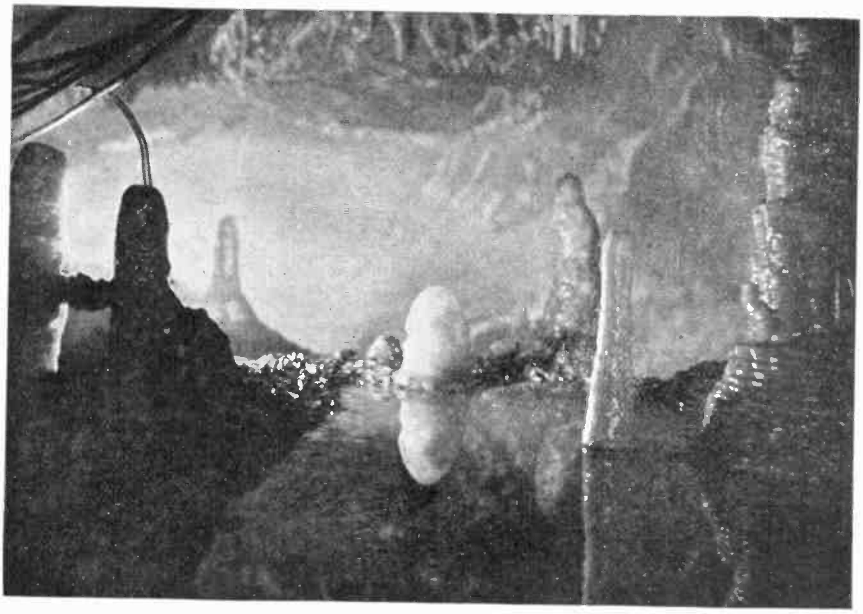
In the time of the Saxon kings, Cheddar was a royal demesne and chase. King Athelstan and his brother, King Edmund, hunted there. The outward and visible signs of antiquity are apparent to the visitor. It is obvious from the derivation of the place-name—*Ced*, signifying eminence, and *dwr*, rock water—that here was an early British settlement. In Druidic days, those days of childlike and increasing wonder at natural manifestations, it may be assumed that there dwelt in this place a comparatively large community, for the wild and impressive beauty of the spot would make it impossible for neglect.

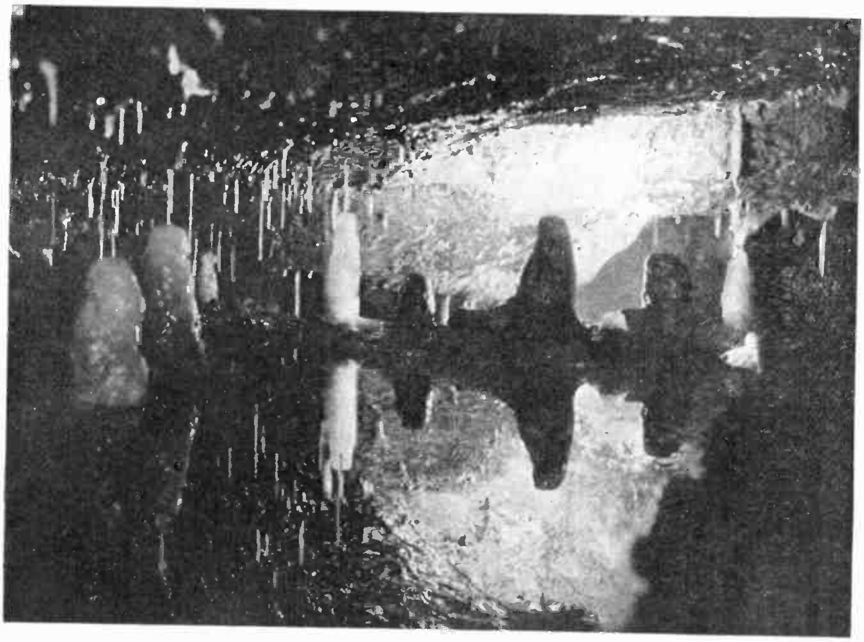
The majestic cliffs, known as Cheddar Cliffs, are among the most beautiful pieces of cliff scenery in all the British Isles and hidden away in them are the wonderful stalactite caverns known as Gough's Caves, discovered by the late R. C. Gough in 1877.

The first object to attract the attention of a visitor at the entrance to the caves is a glass case in which are exposed to view the remains of a prehistoric man. Savants from all over the globe have seen this unique find, and declare it to be from 40,000 to 80,000 years old. The skull has projections at the back of the temple bones, which is not the case with other specimens; and the tibia, flat and pointed as it is, has no parallel in the world's museums of anatomy. The brows protrude and the forehead recedes much more than is the case nowadays. The frontal bone of the skull measures nine millimeters. The jaw is very powerfully formed, and its width is obviously in excess of that of any modern man.

This, the most ancient skeleton in public existence, was found in December, 1903, to the left of the passage leading to the cave discovered in that year. It was surrounded by palæolithic flints and its great age was thus placed beyond all question. It was found nine feet below the surface and under eighteen inches of stalagmite.

Years after the discovery of the entrance to the cave, blasting operations were begun, in 1893. After digging through twenty-





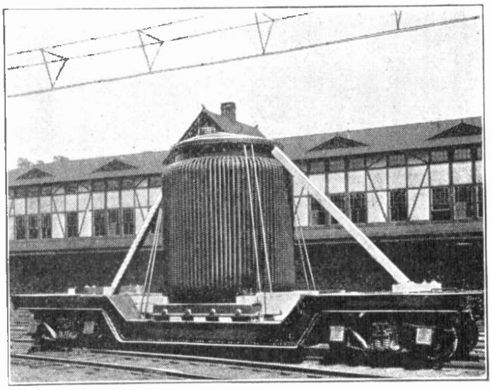
TWO VIEWS OF GOUGH'S NEW CAVES, CHEDDAR. BEAUTIFUL EFFECTS PRODUCED BY CONCEALED ELECTRIC LIGHTS seven feet of solid rock, access was given to a series of magnificent caves and grottos extending in all directions.

The fairy-like tracery of the stalactite and stalagmite formation could scarcely be brought out by candles and lanterns, so an electric lighting plant has been established at the cave and many of the most famous grottos lighted by metallic filament lamps, cunningly arranged behind the rocks. Besides the wonderful effect of the play of light on the shining surface of these curious stalactites, the lamps serve to bring out the transparency of many of these delicate traceries: the light is allowed to pass through the translucent material and the colors are beautifully displayed by this means. At certain points in the cave, when, for example, the roof of "Solomon's Temple" or "The Diamond Stream" are reached, the visitors are electrified by the sudden switching on of the light. In several cases alternative lighting effects can be produced by a throw-over switch, so as to put into circuit different groups of lamps.

Two pictures of Gough's "New Caves," secured through the courtesy of the *Illuminating Engineer* of London, are presented herewith and show the marvelous effect that has been produced with the aid of electrical illumination.

Transformer and Its Special Car

Transformers, which are used for raising the voltage of electric current, are now made of such large dimensions that special cars are built to transport them to their destination which is some light or power company hundreds of miles away. It is essential that they be sent already assembled and ready for operation for the manufacturing company must put them together and test them in the plant and it would be a waste of time to take them apart again.



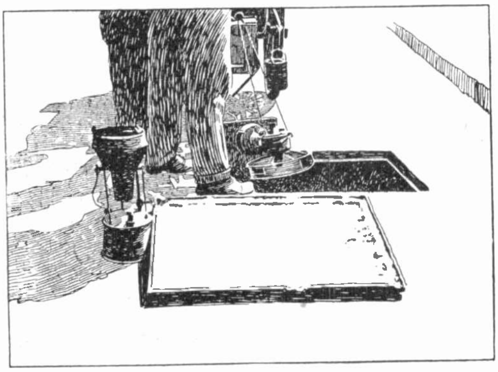
TRANSFORMER READY TO SHIP ON SPECIAL CAR

The picture shows a great transformer built by the Westinghouse Company and loaded on a special type of "cut-out" steel car.

This car has a capacity of 75 tons in the well and the entire platform has a capacity of over 100 tons. The transformer when loaded stands at a height of sixteen feet above the rails, giving the necessary clearance for bridges, etc.

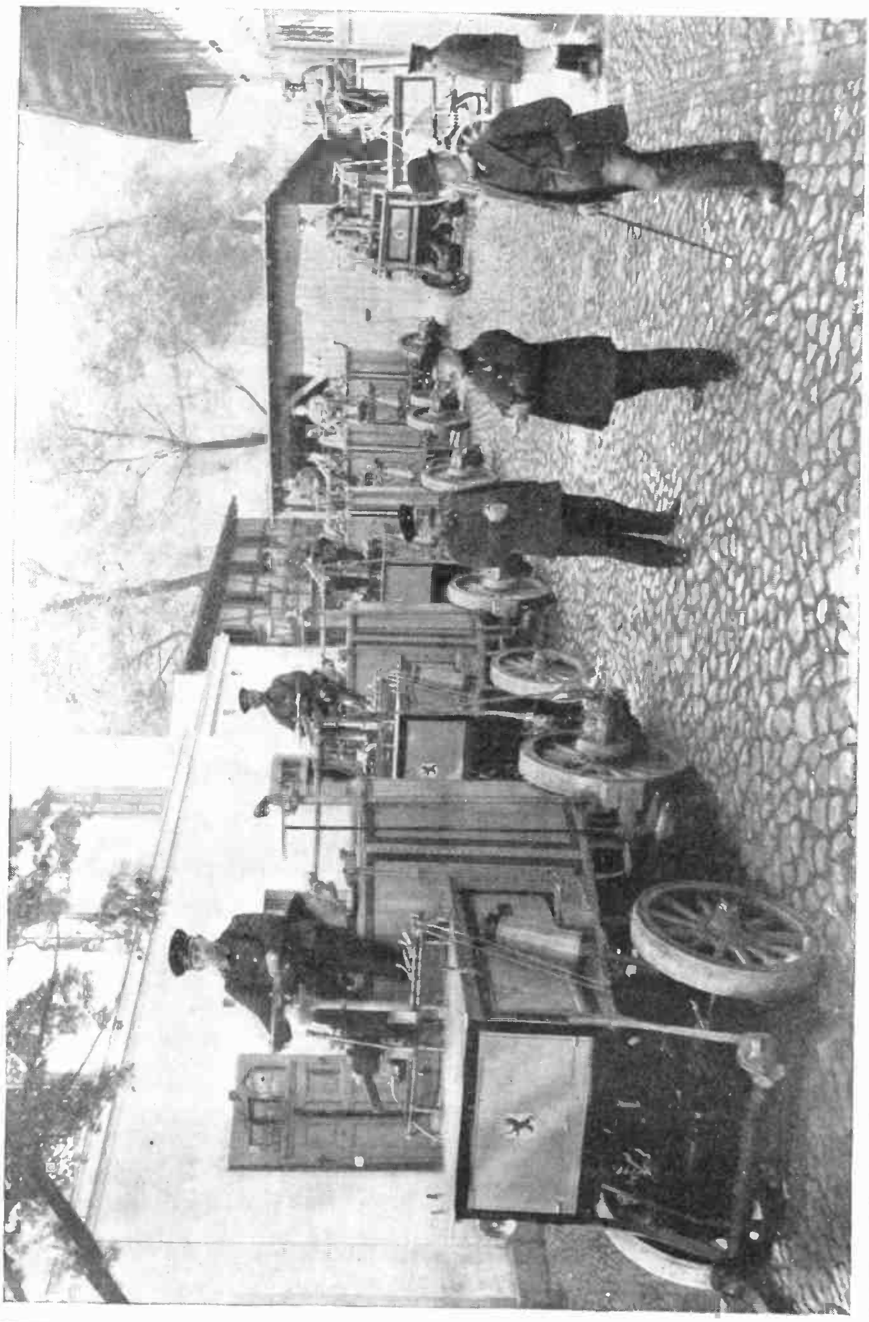
Electric Fan for the Manhole

Workers in the manholes must stand unusual heat in the summer months as there is no circulation of air underground, and to provide for their comfort and add to their efficiency the plan of setting an electric fan at the edge of the hole has been tried out with success by a Los Angeles corporation. The fan, as the photograph shows, is set at an angle so that a current of cool air is directed upon the laborer below.



VENTILATING A MANHOLE WITH AN ELECTRIC FAN

Two English experts have recently visited Iceland in order to survey the large Dettifoss Fall, on the River Iokulsa, which is calculated to have a capacity of 60,000 horsepower. Another less known fall, the Vigaberg Fall is estimated to have a capacity of 50,000 horsepower.



ELECTRIC STREET SCRUBBING MACHINES USED IN BERLIN

Electric Street Scrubbing Machine

In many respects Berlin sets the pace for the large cities of the world as far as municipal undertakings are concerned. Especially in her beautifully kept streets and thoroughfares she sets an example which cities of every nation have tried to follow.

One of the most carefully organized departments of the city government is occupied with the cleaning and sprinkling of the streets and boulevards. In this work literally hundreds of electrically operated street washing machines are employed, each of which is capable of flushing thousands of square meters of street surface each day. The machines are housed in huge garages located at various advantageous points about the city, with large buildings devoted to work shops for keeping the machines in repair.

Each machine is driven by a motor and storage battery. The water is also forced out through the nozzles under pressure developed by the motor. In addition, the motor drives a revolving brush or scrubber which follows the machine.

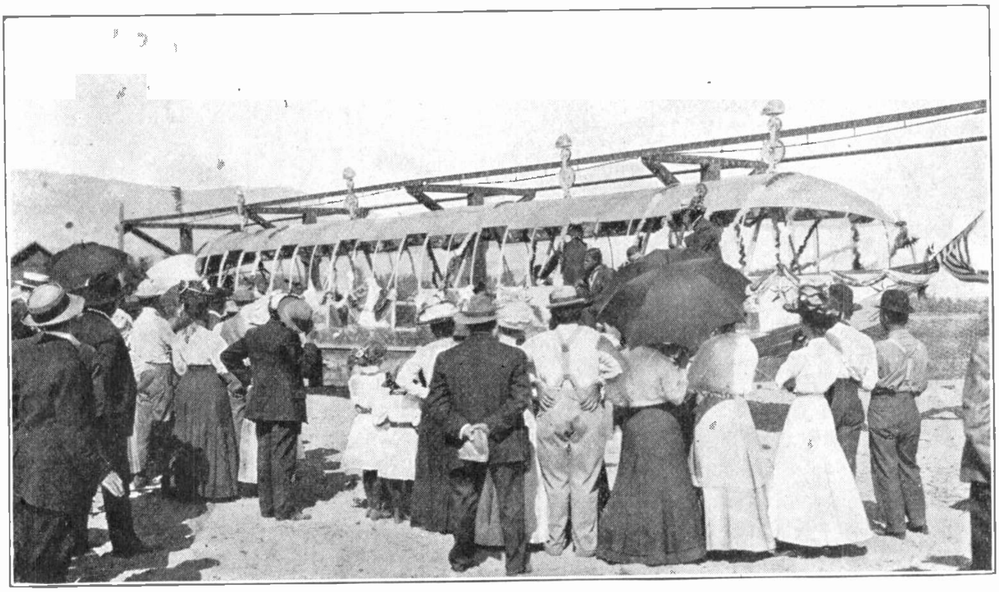
Although strictly a German innovation these machines are now presented in this country by a Milwaukee concern, the Kindling Machinery Company.

An Aerial Trolley Car

Resembling a huge torpedo and constructed of steel rods with bottom, sides and top covered with aluminum, the aerial trolley car "Swallow" was christened on July Fourth. It is maintained that there is no swing to the car while in motion and running at a speed of 25 miles or more an hour, the bottom of the car being so shaped, that it breasts the air, as a sailing ship rides the waves, thus taking a great deal of the weight off the rail, hence the aerial idea. Moreover, one can rest and even read in it with as much comfort as if sitting in an easy chair.

It flies or glides simply by means of an air propellor as in the ordinary aeroplane. This propellor is driven either by an engine or an electric motor. If the scheme proves a practical success, undoubtedly the latter form of motive power will be used exclusively, with conducting wire and trolley wheel to feed the motor.

It will be seen that the weight of the car is suspended from the rail, on grooved wheels with ball bearings running on top and underneath the rail, making it impossible for the car to "jump the track," if the expression may be permitted. The cars are provided with an emergency brake, which is applied underneath the rail, and



AN AERIAL TROLLEY CAR

is capable of bringing the car to a dead stop when the power is shut off.

The car itself, which was built for demonstration purposes, and run on a track 840 feet long, has a length of 50 feet and a width of six feet. It weighs a ton and has a seating capacity of 56 passengers.

Portable Telephones for the Automobile

If your car breaks down while touring in Southern California, you need not worry; a repair car can be secured in short order by the use of the roadside telephone system recently installed in that section. Subscribers to the emergency service carry small portable telephone outfits of light weight in their cars, and stations where they can "plug in" are located two miles apart on the principal motor highways.

THE PORTABLE AUTOMOBILE TELEPHONE AS USED IN SOUTHERN CALIFORNIA

The system is being rapidly extended outward from Los Angeles, until within a short time the entire southern part of the state will be covered by the system, operating in connection with the Bell Telephone Company.

A bell shaped container for the apparatus is attached to poles beside the road, at a convenient height, so that a driver who wants to call up central can drive up and telephone while seated in his car. Even if the emergency should be so serious that he could not drive to the nearest station, he would not have to carry his portable outfit farther than one mile, and frequent signposts along the route indicate the direction to the nearest station.

Plans are now being made to install this system on the Santa Monica course, for use during the road race in October, when stations half a mile apart will be set up for the benefit of the racers.

Only subscribers can use this telephone, as the box must be unlocked with a special key, and then the subscriber's identification number must be given to central to get the right connection. Repair cars are in readiness to answer such calls from various official garages, and will deliver supplies and mechanics, or if necessary will tow the injured machine to the repair shop. Calls can be made to any desired number, so that the motorist is always in touch with home or business.

On the cars of the Denver City Tramway Company the air gage is illuminated and a stand is placed in front of the motorman with a receptacle for holding his watch so that the watch is also illuminated.

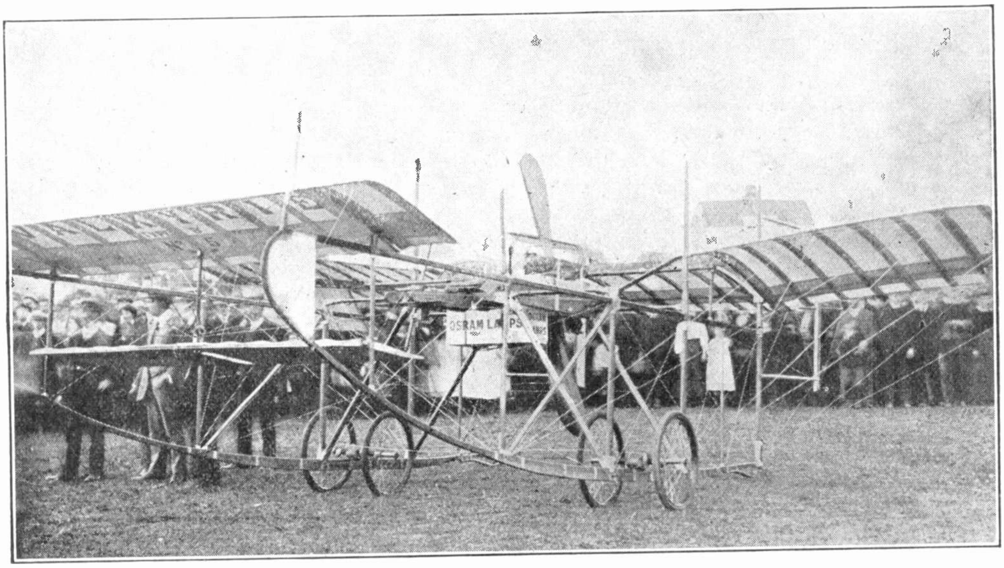
Delivering Lamps by Aeroplanes

"For I dipped into the future
Far as human eye could see;
Saw the vision of the world
And all the wonder that should be.

Saw the heavens fill with commerce,
Argosies of magic sails,
Pilots of the purple twilight,
Dropping down with costly bales."

Imaginative as he undoubtedly was, the former Poet Laureate little dreamt that he would almost live to see his prophetic lines turned into reality right on his own shores, for it was there that the first of the costly bales handled as aerial commerce were both loaded and delivered. And to make Tennyson's prophecy all the more fitting, the magic sails with their cargo arrived at their destination in what the poet termed the purple twilight.

It was on July Fourth that H. Barber, an English aviator, sailed forth from the beach at Brighton with a cargo of tungsten lamps (or, as the makers, the British General Electric Company, call them, "osram lamps") secured under the seat of his monoplane "Valkyrie." Speeding across the country over the roofs of Shoreham, he made a fine descent at the Hove Marine Park, where some five thousand people had gathered to watch the arrival of the first commercial cargo ever carried by an aeroplane. After delivering the batch of lamps, all of which arrived intact, Mr. Barber turned the money paid to him for this record-making flight into a prize fund for the encouragement of aerial navigation.



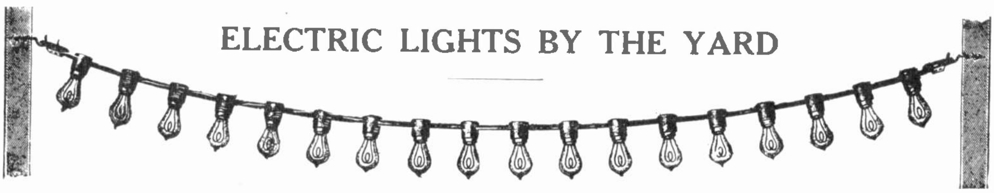
FIRST AEROPLANE TO DELIVER A CARGO OF MERCHANDISE—A BOX OF OSRAM LAMPS

Turning on the Light

When you turn the electric switch and get a flood of light, you may infer that the light comes instantly. While this in a sense is true, many things really happen before you have light. The light was not instantaneous. The first thing accomplished in turning the switch is to close the circuit so that current can flow on the wires. The electrical energy rushes along the wires at a speed of 186,000 miles a second. When this energy going at such a swift pace reaches the electric lamp, it passes readily through the small copper and platinum wires into the bulb, where it meets with decided resistance. In its paths stand tiny loops of a fine wire. With all the pressure behind it the electric energy pushes and forces its way through the obstruction and this requires a certain amount of work, just as it would require work for a man to climb the face of a cliff. This work consumes the electrical energy, just as work consumes mechanical energy, or human energy, and the energy thus consumed is not really destroyed—for Nature never destroys anything—but is changed into heat.

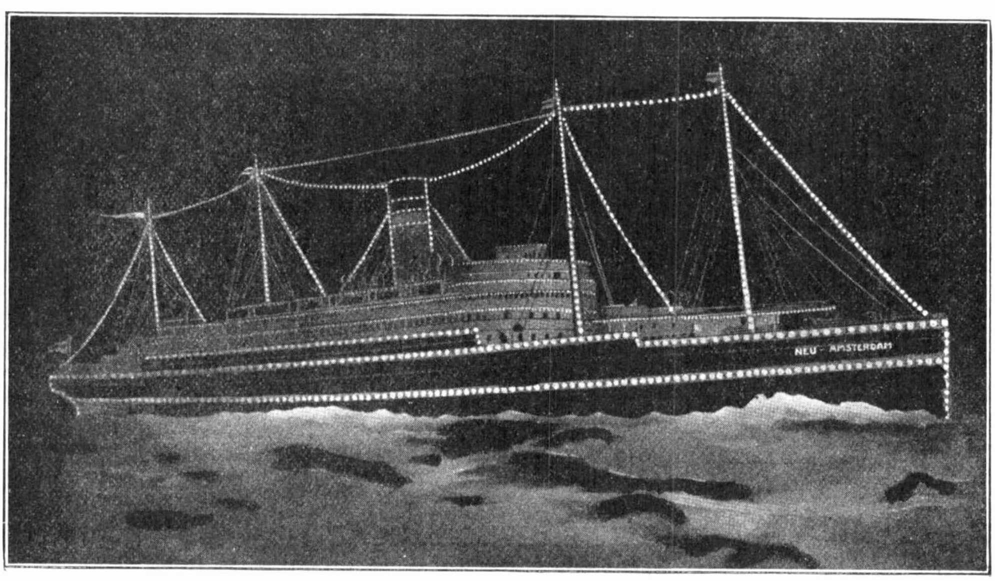
As the current forces its way through the fine wire, the electrical energy is rapidly changed into heat and this heat quickly brings the wire to a white glow. While the light seems instantaneous, it is only because it is too quick for the eye. In reality, the filament first gets warm, then hot, then a dull cherry red and finally this red fades as it gets hotter, to a white hot glow which is maintained as long as the current is turned on. The heat resultant from this process is rapidly dissipated into the air.

ELECTRIC LIGHTS BY THE YARD



Every holiday season brings more of the so-called Christmas tree outfits, consisting of miniature lamps spaced along flexible cords, each cord being provided with suitable terminals, so that trees large or small can be festively decorated with lights in five or ten minutes. Lately, some manufacturers have put out similar strings of larger and more closely spaced lamps for use in decorative lighting at carnivals, street fairs, lawn parties and other special occasions.

The rapidity with which such luminous ribbons or strings of light can be fastened in place and connected to the circuit is surprising. Thus when Queen Wilhelmina, of the Netherlands, gave birth to the Princess Juliana, the Holland-American Line ordered 1,200 yards of "Illufix" (a lamp-string made in Europe) for trimming its ship, "New Amsterdam," which was then at anchor in Holland. The whole 1,200 yards of light was installed and connected up in twelve hours' time, decorating the entire vessel from bow to stern and from the mastheads to the water line. Of course, the electrical decorations were removed in even less time after the vessel left its port, and they can be used again in all sorts of ways.



THE NEW AMSTERDAM TRIMMED WITH 1,200 YARDS OF LIGHTS

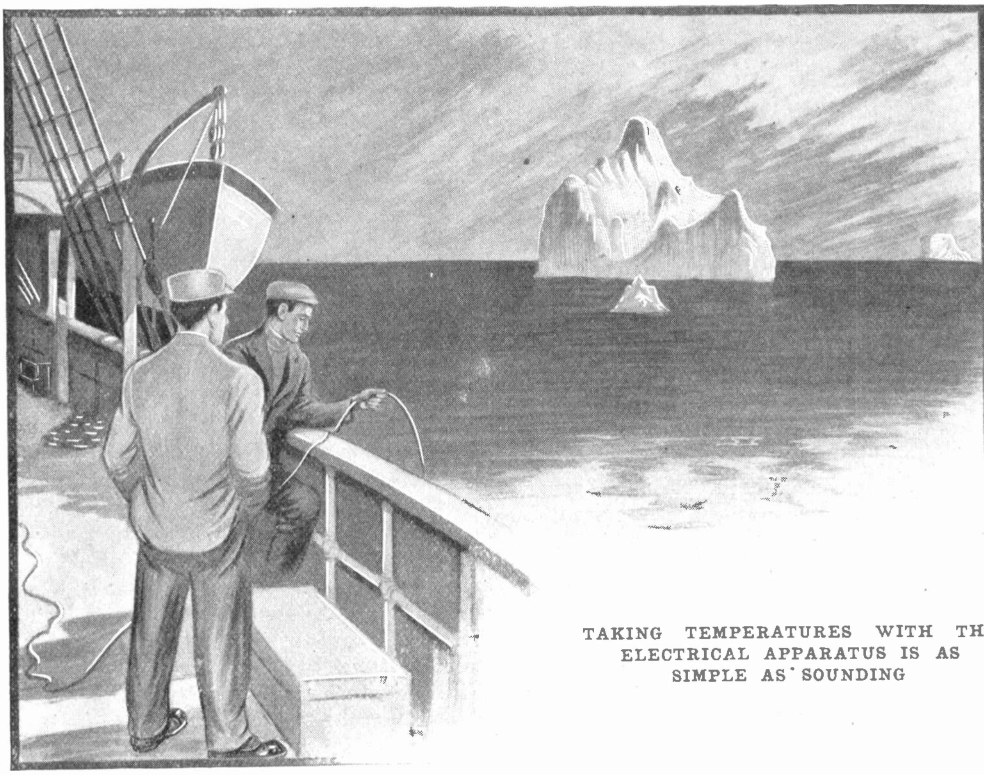
Locating the Vicinity of Icebergs

FELIX J. KOCH

Recently, according to official reports, experiments have been made in the northern portion of the Gulf of St. Lawrence with a new type of marine thermometer, the results of which seem to promise much in aiding to detect icebergs in fog and at night, and hence to lessen danger from these ever troublesome sources. By means of this new type of thermometer, it is stated, it is possible now to record accurately and continuously sea temperatures down to one one-thousandth of a degree, Centigrade.

The micro-thermometer, as it is called, is of the electrical resistance type, which embodies a coil of very fine resistance wire to be suspended in the water. It is well known that the resistance of a metal varies with its temperature, and by connecting this coil in an electrical circuit together with instruments for measuring and recording the amount of current flowing through the circuit, the whole becomes a thermometer of extreme sensitiveness, any particular current value representing a certain temperature as ascertained by previous calibration with the coil suspended in waters of known temperatures.

The coil, it seems, is made with a resistance of 125 ohms, and consists of 200 feet of pure iron wire, silk covered, and bound on a copper cylinder about four inches in diameter and six inches long. The cylinder is fitted accurately inside a second copper cylinder.



TAKING TEMPERATURES WITH THE ELECTRICAL APPARATUS IS AS SIMPLE AS SOUNDING

The ends of the cylinders are carefully soldered and rendered water-tight, while the connecting wires pass out through the middle of the outer cylinder. A stout copper tube is riveted on to the outer cylinder, to which other copper tubes can be fastened. These wires then pass though a lead cable to the chart-room where they are connected to the instruments.

It is thus possible to record automatically the temperature to one one-thousandth of a degree. Readings can be taken every half minute, and curves are plotted, showing the variations of water temperatures.

An interesting detail of the instrument is given by Mr. Deedmeyer, one thoroughly familiar with its operation. It is supported over the side of the ship, about five feet under the surface of the water, he tells us, for it has been found that the exposure of the bulb of the thermometer to the air, by the action of the waves, produces no irregularities, as the temperature of air in direct contact with the sea does not differ from that of water.

"Hitherto," he adds, "the proximity of icebergs has been determined by means of the bridge thermometer, and by immersing a mercury or alcohol ship thermometer in buckets of water drawn up from varying depths. These instruments, as a rule, are not graduated to less than a single degree, which represents an interval, on the stem, of only one-eighth of an inch. Temperatures taken in this manner, even as often as four times in an hour, in a ship going at eight knots, give temperatures only every two miles. The temperatures of the sea change rapidly in the immediate vicinity of an iceberg; hence observations taken at intervals of even one mile are of no value in determining their presence.

"The oscillations can really only be observed on a continuous record. On the scale of the new electrical thermometer a single degree of temperature is represented by an interval of two feet, so that variations which would be imperceptible on an ordinary thermometer have a great effect on this sensitive instrument."

A scientist is quoted as showing that in the neighborhood of ice, melting in salt water, three different currents are discernible. One on the surface being produced by the cold and light fresh water running down the icebergs, another current at intermediate depths, which runs straight toward the ice, while a third current, consisting of water, cooled by ice, sinks to lower depths.

Numerous tests, it seems, were made with the new micro-thermometer in the vicinity of icebergs near the coast of Labrador. The result of these tests serve to show that the temperature variations are *nil* at a distance of more than one mile from the berg; that, going toward the berg there is at first a rapid rise of temperature, followed by a sudden drop. The sharp rise before the sudden fall can be taken to indicate the entrance of the ship into the surface current of the berg, and furnishes an indication of the close proximity of ice. If the rise is followed by a rapid fall below the mean temperature of the water, the presence of ice may be taken as fairly assured.

Dangerous, however, as are the bergs, travelers on the high seas are ever eager to meet them, for your genuine iceberg is a thing of beauty if not a joy forever. To see the iceberg at its best one must go to the coasts of Labrador, up beyond Battle Harbour. There they are always resting. They lie always in what seem perfect lines, off on the horizon. They are of many shapes, but somehow, at a distance these shapes assume harmony.

In Philadelphia 36 Years Ago

In a letter recently received from F. O. Culin, electrical contractor, Fourth and Chestnut streets, Philadelphia, he says that 36 years ago there were only three electrical contractors in all Philadelphia—the firm now known as Partrick, Carter, Wilkins Company, the Holmes Burglar Alarm Telegraph Company, now out of business, and himself. He has kept shop during most of these 36 years at Fourth and Chestnut streets. Prices were higher then than now. Wire that we buy at 22 cents per pound at present was $1.25 per pound then. Bells that now cost 35 cents each were $2.50. Batteries that are now 20 cents each used to cost $2.25. Push buttons that are now five cents were then 55 cents. Bell switches that are now seven cents, were selling for 90 cents. Annunciators that are now $12.00 were then $40.00. These prices are from a circular list issued in 1875 by the Champion Electric Burglar Alarm & Annunciator Company, L. G. Tillotson, president, and Cornelius Roosevelt, secretary and treasurer. There were no electric lights and no electric gas lighting in those days.

—*Electrical Record.*

Los Angeles Telephone Men Use Mortar

A small mortar, used for shooting a life line to a wrecked vessel, was utilized by a telephone repair crew at Los Angeles to dragged across by men on the opposite side and service was resumed in short order. A mortar of similar design, mounted on an automobile, is to be used as part of the repair outfit in the future, according to the foreman who carried out the unique plan.

GETTING READY TO FIRE THE LINE ACROSS THE RIVER

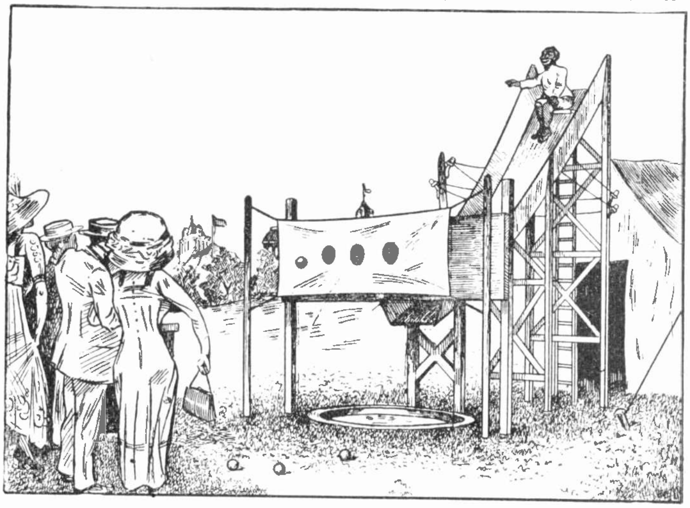
get the broken wire across a river. The stream was one of the sort which is very common in dry countries, a bed of sand through the summer and a raging torrent after a heavy rain. During the last rainy season it washed away the long distance telephone line and there was no way to cross the swollen stream to repair it. No boat could live in such a current, while quicksand and rolling boulders made it hazardous for a horseman to attempt to ford it. The problem was ingeniously solved by a message to the nearest beach, where a life-saving station was located. The small cannon, life-line and a can of black powder were sent to the river bank, where the gun was charged and aimed across the stream. The result of the explosion was successful, for the projectile carried one end of the coil of rope more than a thousand feet to the other bank; the telephone cable was attached to the other end of the rope and

Flashlight Signals at Sea

An Australian inventor, Mr. Victor Nightingall, has designed a simple apparatus by which any one can send searchlight signals at sea, even though he knows nothing of telegraphy. To accomplish this, he equips each vessel with a wheel into which a series of metal plates can be slipped. These plates are lettered according to the alphabet and perforated to match the Morse code, so that they will close the circuit to exposed lights and signal according to this code when the wheel is rotated. The sailor wishing to send the message consults the international signal book, picks out the needed letters slips them consecutively into the wheel and throws a switch. The latter turns on the current for the lamp and also for a motor which slowly rotates the wheel so that it repeats its message without further attention until it is stopped.

Give Him a Bath

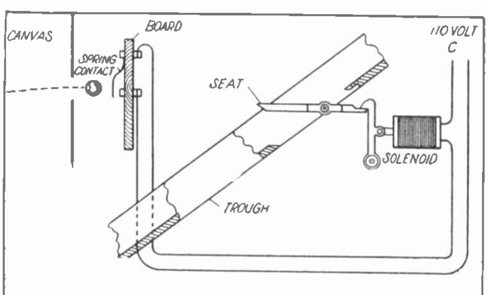
The ruins of Dreamland amusement park at Coney Island, New York, had not yet cooled from the terrific fire which swept it before they were occupied by a great array of fortune tellers, souvenir dealers, etc., in-



A LUCKY THROW WILL GIVE HIM A BATH

stalled in tents ready to profit by the great crowds of curiosity seekers who came to view the havoc wrought.

Prominent among the money seekers were two lusty voiced barkers shouting, "Give him a bath, boys. Give him a bath. He needs it. Seven for a dime. Give him



THE ELECTRICAL ARRANGEMENT WHICH SPRINGS THE TRAP

a bath!" Their paraphernalia consisted of an ordinary wooden counter covered with baseballs. In the background hung a large sheet of canvas in which were three holes a little larger than a baseball. Extending above this for ten or twelve feet was an inclined wooden trough lined with galvanized iron. The lower end of the trough terminated over a tank of water. At the top of the trough upon a small seat sat a negro clad in sweater and overalls. He amused himself by jeering and making faces at the crowd who were engaged in throwing their arms off in trying to place a ball in one of the three holes in the canvas. The canvas was very deceptive. A ball striking the edge of the hole would be thrown back, but if one landed squarely, passing through the hole, there was a click, Mr. Sambo's seat collapsed and he started on a journey which ended with a splash in the tank of water. His place was immediately taken by another, ready to "shoot the chutes."

The device coined money for its owners. The mechanism was simple. Back of each hole in the canvas was a spring contact which when struck by a ball completed an electric circuit. The folding seat was held open by a catch. This catch was released by a solenoid when the ball closed the contact behind the hole in the canvas.

Dunkards Finally Allow Telephones

The old order of Dunkards have concluded a five days' session, near Delphi, Indiana, and the much discussed question as to whether or not the church members shall be allowed to have telephones has been decided in the affirmative. Five members of the church, who had been expelled for having telephones, were reinstated at this meeting.

Electric Lamps per Capita

There are in Boston the equivalent of 1,232 sixteen-candlepower electric lamps per 1,000 of population, in New York 850, in Chicago 730, and in San Francisco 660. European cities show much smaller figures, St. Petersburg having 440; Vienna, 246; Paris, 185, and London, 184.

Some Unexplored Fields in Electrical Engineering

By DR. CHARLES PROTEUS STEINMETZ

In discussing the subject of the unexplored fields of electrical engineering, we must consider as belonging to the realm of the electrical engineer, all those phenomena of electricity that are of importance to man; those which are beneficial and useful, and utilized in doing the work of the world, and also those phenomena which are harmful and destructive, and therefore to be guarded against.

In some fields of electrical engineering or of electrical science we might almost say that we know less now than we knew, or rather believed we knew, a quarter of a century ago. There are things which had been investigated a quarter of a century ago and which were explained in a satisfactory manner to our limited knowledge in the early days, but this explanation does not seem satisfactory now with our greater knowledge.

A curious example we might cite from the textbooks on natural history, for instance. There are supposed to be some fishes which are capable of giving electric shocks. There are some species of gymnotus in the South American mud creeks capable of imparting electric shocks, which have been described a number of times, fishes which have an organ which generates electricity. It has been described as being constituted like a Volta-pile, of a number of successive cells. That theory was quite acceptable 25 years ago, but is not satisfactory now. To give a severe shock would require about 500 to 1000 volts, and it is not intelligible how such voltage could be generated in the conducting animal tissue without being short circuited. Furthermore, the fish is immersed in water, which is a fair conductor, especially sea water, and 500 volts or more would produce hundreds of amperes in the surrounding water, representing hundreds of kilowatts, and it is not intelligible how such a large power could be generated even momentarily. Thus here we have a mystery, because, after all, the descriptions have been so concise that it is difficult to doubt that there are fishes which can give electric shocks. Just why that phenomena has not been investigated by electrical engineers, we do not know, especially when considering that one of the electric fishes, raja torpedo, lives in the Mediterranean and is frequently caught on the Italian shores, as claimed, thus being within easy reach of engineers.

But we do not need to go so far from home; right at hand we have some of the most important uninvestigated phenomena of electricity. The thunderstorm, the lightning, and so forth. In the early days lightning was explained as the discharge of the clouds. The clouds are positively charged, and the ground is negatively charged, and the spark jumps from the cloud to the ground. Speculations were made as to how the clouds became charged, and as then the only method of producing electricity was by friction, it was said it might be the friction of the vapor through the air, or the rain drops through the air, or some other form of friction. That explanation used to appear satisfactory, but with our present knowledge of dielectric phenomena, it is not satisfactory any more.

It was thought that lightning was the discharge from the cloud to the ground. That means that the electric field between the cloud and the ground must be beyond the breakdown strength of air. In a uniform field the breakdown strength of air is about 75,000 volts per inch, or nearly a million volts per foot. Even if the cloud is only 1000 feet above ground, this would require a thousand million volts. If there were an electrostatic field between the cloud and the ground of a thousand million volts extending over the whole area of the thunder cloud, this would represent such an immense amount of electric energy that it is inconceivable how any reasonable source of energy can produce it; how it can exist

[1]Abstract of paper presented at a joint meeting of the Electrical Section of the Franklin Institute, Philadelphia, and the Philadelphia Section of the American Institute of Electrical Engineers.

without having a destructive effect far beyond anything known of lightning. Furthermore, a uniform field cannot well exist between clouds and ground, on account of the unevenness of the ground surface.

We cannot consider the lightning discharge as a simple electric rupture in the same way that an overloaded beam may break mechanically, but as an equalization of internal stresses, about as a piece of hot glass that is rapidly chilled, and thereby full of internal compression and tension strains may suddenly break all over by the internal stresses. So with our present knowledge we must consider as the most probable explanation—although not certain by any means—that the lightning discharge is the phenomenon of the equalization of internal electric stresses in the cloud, and is analagous to the splintering or breaking of an unevenly stressed brittle material, like glass.

Lightning discharges are the result of the voltage inequalities produced in the clouds by the unequal rate of conglomeration of rain particles due to the unequal cloud density.

In agreement with this is that heavy lightning strokes are usually followed by a heavy downpour of rain; in reality they are preceded and caused by it, but it takes time for the rain drops to come down.

The lightning rod is a great protection, and I would not like to be in an exposed place without such protection. But you must not expect that one rod on one end of the building will completely protect the other end a hundred or more feet away. There must be sufficient rods to extend their protective zone over the entire area; the apex of the roof, and other projecting edges must be protected by connecting wires, etc. That is, like any other apparatus, the lightning rod protection must be installed intelligently and properly to be effective. But the general principle is correct, only it must be rationally applied.

PICTURESQUE TELEPHONE EXCHANGE

This telephone exchange at Riverside is the most picturesque in Illinois. The building is rented from the village of Riverside, and is the well house built over an artesian well. Covered with vines and with a background of trees and shrubbery, it is an attractive spot.

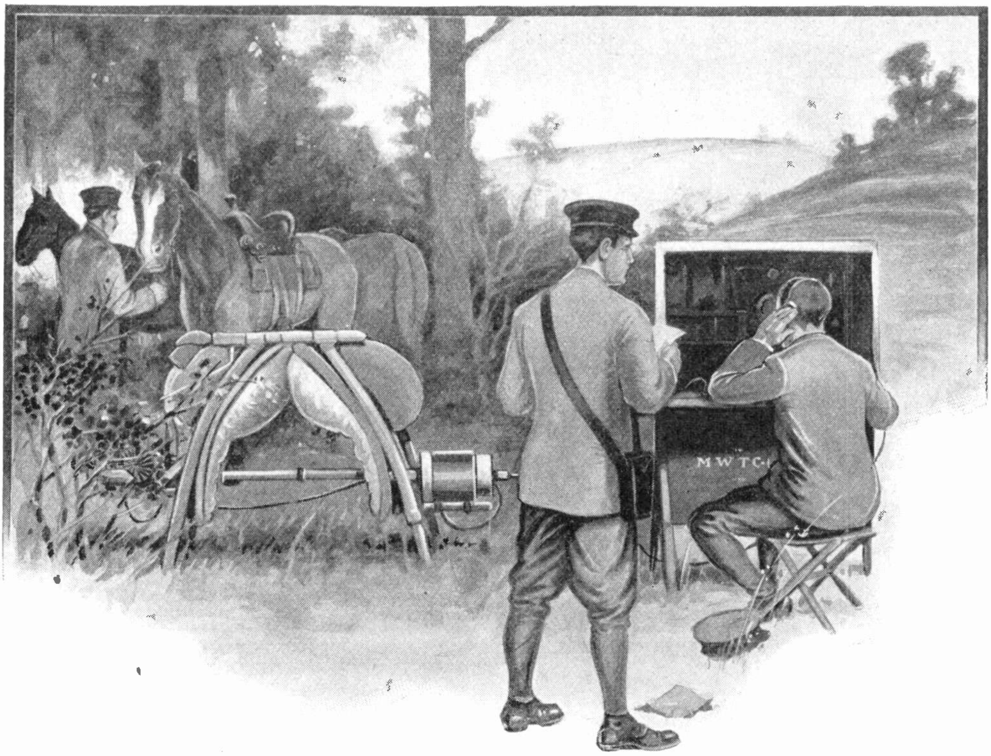
A Cavalry Wireless Set

At the recent Investiture at Carnarvon of His Royal Highness the Prince of Wales two Marconi portable wireless sets were used. These are the English standard cavalry type and are the property of the Westmoreland and Cumberland Yeomanry.

The stations have been specially designed by the Marconi Company to be capable of easy and rapid transport and to afford a means of communication between cavalry or other mounted units and the main body. Owing to the rapidity with which these portable sets can be erected and dismantled, the whole process lasts only a few minutes, and they are consequently of the greatest value from the military point of view.

One of the stations was erected in the neighborhood of Carnarvon Castle itself, the second being situated in the vicinity of the headquarters' camp, and by means of these two installations, constant communication was established between the Royal yacht and the units of the fleet and the shore. Communication from the Carnarvon Castle installation was also established with the Government station at Liverpool and with the headquarters camp.

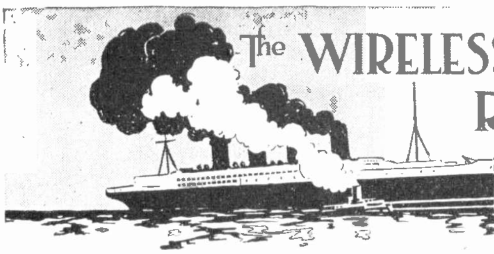
As will be noted in the picture the equipment is designed to be carried on the back of a horse or mule. The saddle-like affair is quickly removed from the animal's back; a shaft run through carrying on one end a small gasoline engine and on the other a dynamo for generating the current.



CAVALRY WIRELESS SET IN THE FIELD

Prize for Miners' Electric Lamp

A prize of £1,000 ($4,866.65) is offered by the British government for the best electric lamp or lamps for the use of miners. The competition is open to persons of all nationalities. Lamps submitted must be addressed to C. Rhodes, Esq., Home Office Testing Station, Rotherham, England, and must reach there not later than December 31, 1911. Requirements which should be fulfilled by any lamps submitted have been issued by the United States Bureau of Mines and also by the British ambassador at Washington.



The WIRELESS OPERATOR REMINISCES

By J. M. Baskerville

Recognized by Wireless

Every telegraph operator, wire or wireless, has what is called a personal "sign" by which he is known to his brother operators. This sign usually consists of one or two letters, and is booked at headquarters in an official list of signs. For instance I sign "BO." When I send a message I put "BO" immediately after starting, and by that sign the receiving operator knows me. Every ship or wireless station ashore also has a call letter by which it is known, apart from that of the operator. Some operators, indeed most of them, inject some of their personality into the dots and dashes while handling the key. You can often tell who is sending by knowing his peculiar style, even though he fails to use his personal sign.

Operator King, of the old Finance was a boy who thought he could recognize anyone just by hearing their "fist" (handling of the key). I once met him down at Colon. His ship lay at the dock, and he had worked me from her as I neared harbor on the incoming ship of the same line.

He invited me aboard for dinner, and as we sat there with the officers all at one table, talking and joking, King said to me:

"I can tell you anywhere by your fist. You don't need a sign. You could change it, or send with your left mitt, but I would know that it was you at the key."

"King, I would just like to bet you the smokes that I can fool you so badly you will believe it. I will show you at an early date."

Three weeks later my ship neared Colon. We were only about 65 miles out when King "picked me up." I began to use my left hand, and gave him our position and docking time, after which I signed "X" instead of "BO."

Instantly King came back with the query "Where's 'BO'?".

I decided to be dead so I said sadly:

"BO got killed in the subway last week."

"How did it happen" he flashed, "Give me the details quick."

I decided to die a hero.

"He died trying to save the life of a little child. Will give the sad details when we get to dock."

"BK min," (Break, wait a minute) he snapped and disappeared. It appeared to me that the news had somewhat stunned him. I sat for a few minutes waiting, but he failed to show up. Then I began to think the thing over. As I began to think I began to call; and the more I thought the more insistent became the calls. But King didn't return. Then I thought soberly of the friends I had aboard the ship, and in the town. How this news would grieve them! You see, I had sailed King's ship at one time for three months, and knew every man on her, and they were friends. The freight clerk, Thompson, big, fat, was like a brother. Monroe, second officer, thought I was just about right. The doctor, known fondly as "Pills," would miss me, for I used to pour water in his wine, and hide his shoes.

"I can tell you anywhere by your fist"

Three hours later we were alongside the dock. I deemed it advisable to view the scenery through a small port hole. Before landing I wished to get some idea of the reception which would likely be accorded me when I was resurrected. Through the port I saw the captain of King's ship. He gazed up at my ship, and appeared sad. With him was a big blonde man named Bird. He was a model of neatness and looked as if he had come out of a fashion shop. Bird had been a passenger on my ship about a month before, and I knew him well.

In another direction was Thompson and a few officers of the Finance. All were soberly listening to Thompson who jotted something down in a note book from time to time. Pills was there chewing the nail off his long finger. King stood near, but was not in the conversation.

In my heart I felt sorry that I had played such a joke on such good friends. I was contemplating this, and trying to reckon how pleased and surprised they would be to see me alive again. They would appreciate me the more on account of my death. As I cherished this thought, Bird perished it. I had gotten too close to the port hole and had been discovered by this blonde gentleman. He rose on his tiptoes for height effect, pointed a manicured finger at me and shouted: "You are not dead yet, but you *are going to be* very shortly!"

The friendly spirit was not manifest

I now concluded that I had no business ashore that morning. I preferred the ship, and I suddenly remembered that I had forgotten something in the wireless room. I immediately started there, but the jam of passengers on the deck was so bad that I couldn't get through. After a struggle for several minutes, I thought the best thing to do would be to go down to the main deck, back aft, and then up on the port side on the promenade deck, up a short flight of stairs to the upper deck, and into the wireless room.

I got as far as the promenade deck, when around the base of the stairs came Bird and Thompson, heading the loyal band of friends. By Bird's look and Thompson's actions, and the undue haste of the whole party I knew at once that they were coming to kill me.

They had beaten me to the stairs, so I started forward for the parlor companionway. The matter in the wireless room seemed very urgent to me. But they beat me to it. They overhauled me, and the friendly spirit was not manifest. They caught every available point of clothes and limb. The action was too much for for words. My friends tried to sit me on their toes. They thought I looked tired. I looked anxiously for Bird to produce a death dealing instrument, but he had lost it. After this friendly manifestation had lasted for a few minutes, I asked Bird to kindly hold me on my feet as I couldn't sit down. Then I got a moment's respite, and said:

"Gentlemen, before you kill me, listen to my story. This morning when I went to breakfast I left a ham operator in the wireless room. He had belonged to the Signal Corps and during the trip was so anxious about the wireless set, I let him work it several times. He was such a wireless enthusiast that he insisted on coming up and relieving me at meal times. He appeared to be a nice man. But I remarked this morning when I came from breakfast that he had on a smile that wouldn't come off. I am sure that this is his work. Find that man. Gee I am sore!" They did look for him, but he had vanished.

Eight bells in the evening, on the after deck of the Finance, King, Thompson, Pills and I smoked it over. King began to tell how it affected him. He reiterated that he would have known my fist if I had been sending, right mitt or left. He said that when he got the news from that ham that morning, he really felt badly. He ran to the Captain's room with the distressing news. It got all over the ship in a jiffy.

Finally I asked King why he didn't do his work in a conscientious manner and give me a chance to get him that morning by wireless after he had gotten the terrible news. He said his heart wasn't in his work that morning. Said he knew I was going to play a joke on him, but after he had heard from the signal corps ham that I had passed away, he felt sorry that it wasn't really and truly "BO" at the key, really and truly putting one over on him.

Then I waded in: "King, your ears need medical attention. You couldn't detect it if some one hit you in the ear with a brick. You belong to the awkward squad. You learned wireless by correspondence. You are a regular human blotter, taking in all and believing all everyone tells you. Get out your personal feelings and sacrifice them, for it was I who did the work on the Colon this morning. I used my left hand and signed "X" instead of "BO"—and you fell for it. There was no other operator and I can prove it. You are easy. Now, gentlemen, who are the smokes on?"

Gauss and Weber

While Americans have been slow in honoring the perfecter of the commercial telegraph, S. F. B. Morse, Germany has just added another proof of its appreciation for the two physicists who are popularly credited in Europe with having invented the

GAUSS AND WEBER

electric telegraph. That Gauss and Weber did send messages by means of an electromagnetic apparatus in 1833, fully a dozen years before Morse made his memorable public demonstrations, is a matter of history. But the tediousness of reading the signals from the needle telegraph of the two German professors kept this from becoming a commercial success and the practical uses of telegraphy had to wait for the American inventor.

However, the Germans still take great pride in this pioneer work of both Gauss and Weber and have recently honored the former by erecting a monumental observation tower at the point in the mountains near Dransfeld where Gauss conducted his experiments 80 years ago.

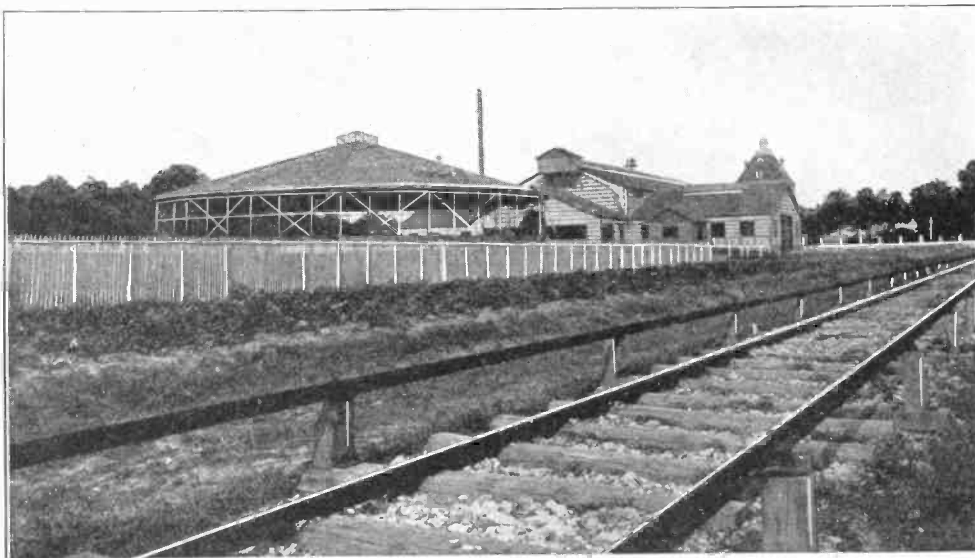
It has been decided to erect a wireless station in Spitzbergen, within the Arctic Circle, in addition to the one to be set up near Hammerfest, in Norway.

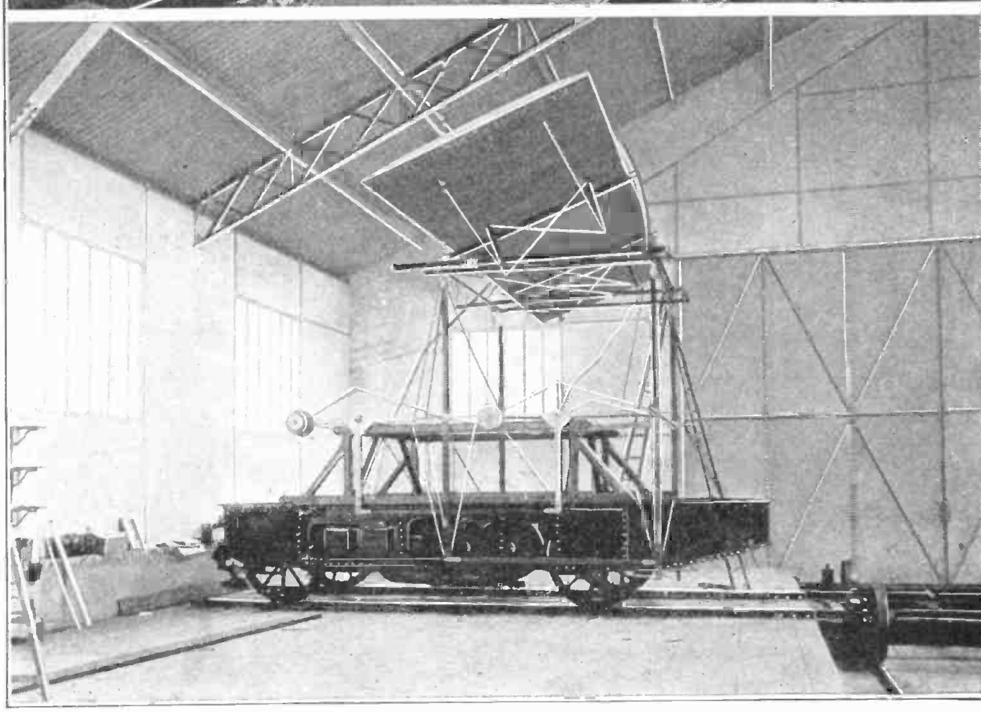
Electricity in Designing Aeroplanes

Electricity is now being brought into service so as to aid in designing aeroplanes. The latest idea of the kind is in the new aeronautic establishment near Paris, which is about finished now, and was founded by Senator Henri Deutsch at an expense of $1,000,000. All kinds of useful information about aeroplanes, propellers and the like will be secured by Professor Maurin and his corps of engineers.

A special electric car has been built in order to test aeroplane surfaces and thus spare the builders much time and trouble, not to speak of accidents or even loss of life. The car is driven by a powerful motor, and it runs over a 4,500-foot track upon the grounds at very high speeds. Instruments on the car register the force of the wind when the aeroplane surface is tipped more or less. The pilot does not mount the car himself, but operates it from a distance. He stands at a high observation post on the roof of the building and works his controller so as to send more or less current into the motor. Starting off at slow speed, the car is soon brought up to high speed, and this may be as much as 100 feet a second. At such a rapid run, the wind has a great pressure on the aeroplane surface, and the instruments record this at each instant as well as the amount of power which it takes to run the car. When the trip is over, all that remains is to compare the results and find out just how the given surface has acted.

Other cars will soon be built, and some of them will be used for testing propellers. This is an easier matter than the first, as all that is needed is an electric motor to drive the propeller and a few instruments for taking the wind pressure and speed. In most cases the propeller itself will propel the car along the track. A round building is to be used for making somewhat the same tests, but in another way. The building is quite a large one, being 130 feet across. Pivoted at the center is an arm which moves around a circular track, and on it are mounted aeroplane surfaces or propellers. When different surfaces or planes are being tested, the arm is driven around by an electric motor placed at the center, but for propellers the arm itself carries a 30-horsepower motor coupled to the propeller, so





NEW AEROPLANE TESTING ESTABLISHMENT AND THE TESTING TRACK NEAR PARIS
SPECIAL ELECTRIC CAR TO TEST AEROPLANE SURFACES

that this is enough to take the arm around the track, and as before, the instruments show the force of the air at different speeds. The buildings and large grounds are located near Versailles, and are quite in the aeroplane region. Besides a great central hall for mounting air blast apparatus and testing propellers, there is a well-fitted electric plant, a machine shop and many laboratories.

A considerable increase was made during 1910 in the amount of water power utilized for the generation of electricity; 21 new power stations, representing an aggregate of 103,530 horsepower, were completed.

STURDY AS THE WASHINGTON FIR ITSELF—THREE GENERATIONS OF THE LEWIS FAMILY

Where Cross-Arms Come From

Standing at the corner of the Masonic Temple in Chicago and gazing up along its 21 stories, one is inclined to respect human engineering. Yet Nature in the western fir forests of the United States has outdone this by sending giant firs up 33 stories or 400 feet towards the sky on a base fourteen feet in diameter.

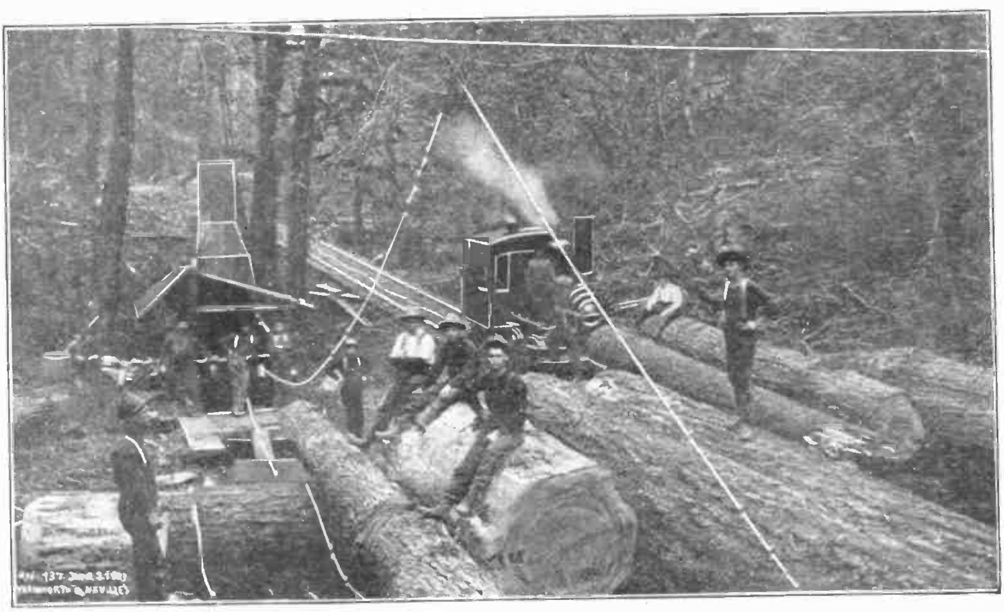
These big trees, especially in the State of Washington, are being made into cross arms for electric light and telephone poles. After a sleet storm in the fall or winter your attention has been called to the electric light and telephone wires loaded with ice until they appeared to be long cylindrical sagging icicles extending from pole to pole. This condition is a good test for the cross-arm which must support this load, but should the wind blow upon this added ice surface the tugging and straining of the wires will severely test or perhaps break the cross-arm.

This has meant that manufacturers of cross-arms are always on the lookout for good timber for their product, and as a result mills like those of the American Cross-Arms Company have been built in the fir forests of Washington and the big trees felled and cut into cross-arm timber.

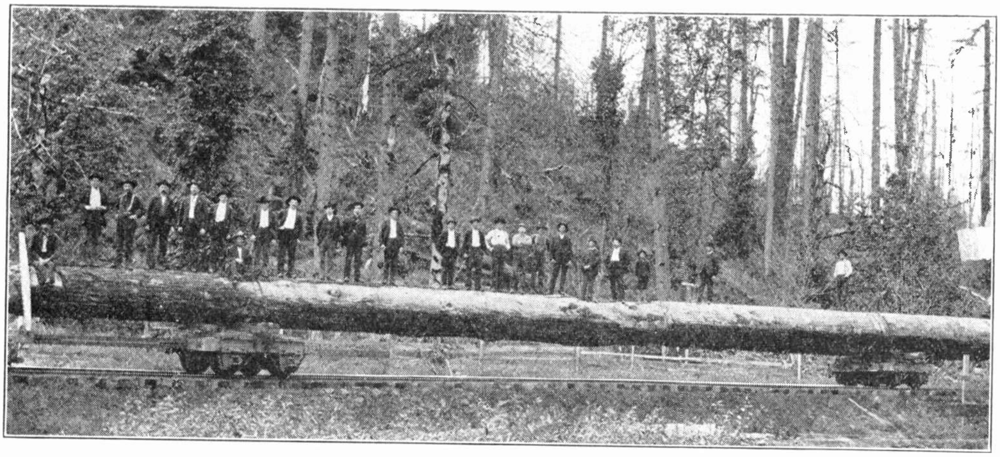
The quality which makes the Washington fir sought is the close grain of the wood. As we know, each year a tree forms around its trunk a layer of new wood. These layers may be counted on the end of a log, each layer indicating a year in the life of the tree. In the Washington firs there are near the center of the log from twelve to eighteen of these rings to the inch. This means that the wood is close grained, strong and less liable to allow moisture to enter and cause rot after the wood is seasoned. Because of these qualities more than 60 per cent of the cross-arms used in 1910 were made from fir.

SAW MILL IN THE GREAT WASHINGTON WOODS. HERE IS PRODUCED THE MOST SELECT AND LASTING WOOD FOR CROSS-ARMS

With a mill located in the midst of a tract of fir and surrounded by rough board houses in which the loggers and mill workers may eat and sleep, the work of converting the big tree into cross-arms is carried on. Narrow gauge railway tracks are laid to points where cutting is done. By hand labor the trees are felled and the logs cut into proper lengths for loading upon four-wheeled trucks which are then drawn over the track to the mill by donkey engines. The coarse-grained part is now cut off the



IN THE HEART OF THE FIR COUNTRY—LOGS READY TO BE DRAWN OUT ON THE MINIATURE RAILROAD



A GREAT WASHINGTON FIR ON THE TRUCKS—LENGTH 105 FEET, LUMBER SCALE 10,400 FEET

outer part of the logs and sawed into slabs and lumber, while the inner close-grained portion is made into cross-arm timber. Such cross-arms properly painted when put up have stood service for 30 years.

Many Indians occupied some parts of the fir country before the white man's arrival, and we find many of them now employed in and about the mills.

Whether the climate exercises the same effect upon human beings as upon these centuries-old trees is open to consideration, but that it is invigorating and healthful is vouched for by the accompanying picture of three generations of an Indian family of the fir forests.

Have We a Magnetic Sense?

Inferior as the lower animals may be in most respects, some of them have certain of their senses much more strongly developed than has yet been found possible in man. The distance at which a pointer can scent game, or at which eagles and hawks can see their prospective prey, the extremely low intensity of lighting which is ample for cats or owls at night, the keen sense of hearing developed by so many animals, the readiness with which a cat tastes poison in its food — all of these are instances with which we have long been familiar. But they all refer to an intense development of some one of the five senses on which every sane man prides himself to a considerable degree, and due allowance for them still leaves some characteristics of animal life unexplained. Most notable among these has been the method by which bees, carrier pigeons and even ants find their way as if they possessed an added sense, which some speculatively inclined naturalists have called a sense of direction. The common theory that a pigeon has an unusually retentive memory for the places passed by it does not explain how it finds its way home from distant points to which it has been transported in the dark, nor how it can choose an air-line for its return from places to which it has been taken by roundabout roads. Nor does it explain how cats and dogs do the same, even when they are soundly asleep during the outgoing trip. Indeed, there have been cases where dogs were kept numb by an anæsthetic while being taken to strange places and still returned by short routes — a feat not explainable by any overtraining of sight, memory, hearing, touch or smell. How did they do it?

Having long sought the answer, a French fancier of carrier pigeons, A. Thauzies, has recently reported the results of nearly two dozen years of observations which lead him to believe that the pigeons have a special sensitiveness to the terrestrial magnetic currents, the same currents to which our compasses respond. The fact that they can easily be trained to fly in certain directions, speaks for this theory, as also their persisting in the direction of their goal even on total stretches of over 60 miles, and their steadily maintaining the same height above the varying contour of the earth (usually about 400 feet). But the strongest confirmation was found by Mons. Thauzies in the regularity with which they missed their directions at times of magnetic storms. At first it seemed as if fogs and rain might explain their being misled, but careful records showed the same occurrences on clear days or nights, when meteorologists observed unusual earth currents. What is more, the spread of wireless telegraphy was found to have decreased the dependability of the carrier pigeons considerably.

As a check on the new theory that the directional sense of animals may be due to earth currents, experiments were made with white rats which had learnt how to find their way out of a portable labyrinth. If this was moved from place to place without changing its direction in regard to the compass, they continued to find their way out; but whenever it was turned to face another direction, they were perfectly bewildered. Similar tests with Japanese whirling or dancing mice showed the same results. Whether such a "magnetic" sense can also be trained in human beings, remains to be seen, but if the theory advanced by Mons. Thauzies is a correct explanation of the accuracy and ease with which various animals find their directions, it is quite possible that another generation will find us speaking in all seriousness of a sixth sense as common to (or at least possible for) all men.

CUTTING INTO THE HEART OF A FIR—THE FIRST STEP IN CROSS-ARM PRODUCTION

Queer Freaks of Lightning

Electricity in the form of lightning accomplishes so many queer feats that it keeps us thinking to explain or try to explain them. In the Ozark Mountains of Arkansas and Missouri there is hardly a rain that is not accompanied with electricity. This is perhaps due to the large deposits of ores found here. Almost every storm has its electrical freak. One occurred near Witt Springs, Ark., recently which is worth notice. Lightning struck the top of a tree and ran down the body, bursting it, till it came to where a nail had been driven; here it left about six inches apparently unharmed. The remainder of the tree was bursted on into the ground.

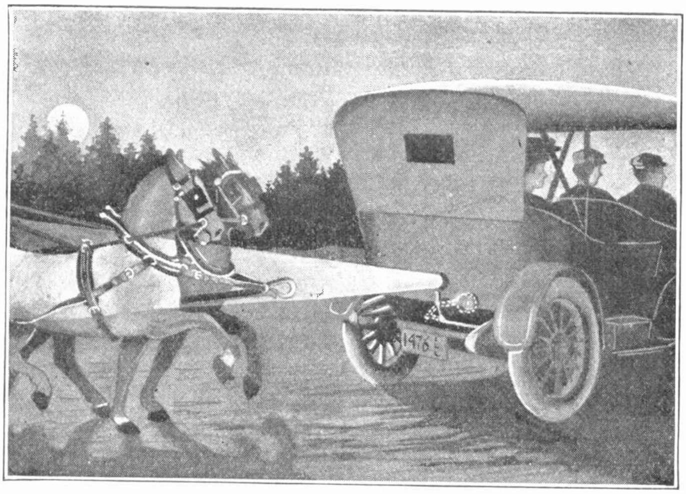
In what way did the nail affect the power of the current or change its course, so that the tree was left unmolested at that point?

Some one has said that the exploding of trees is caused by the heat of lightning coming in contact with the water contained in them, and if this is true, it explains the above freak perhaps, as the nail had probably poisoned the wood surrounding it and either caused it to die and dry so that there was no water to convert into steam, or rendered it spongy so that the explosion had no effect.

I suppose the readers of this magazine remember the freak which happened near Ben Hur, Arkansas, some time ago, when the lightning shattered a telephone post down to the wire and then followed it (the wire) nearly to the next post, vaporizing it.

EDWARD H. JOHNSON.

"Going to Stop" Signal



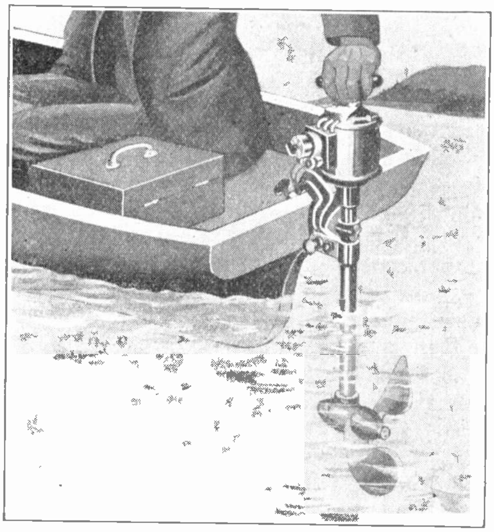
SIGNAL LIGHT FOR AUTOMOBILES

A signal light which may be lifted to an upright position from behind an opaque shield and by its sudden appearance warn the vehicle behind that the one ahead is about to stop is the subject of a patent issued to Lee O'Brien, Montclair, N. J. The movement of the lamp is controlled from a foot lever operated by the driver. Because of its necessary motion the semaphore-like signal will be equipped with an incandescent lamp fed by flexible conductors from a battery.

Propel Your Rowboat by Electricity

Owners of rowboats and those who would own them were there some simple, clean means provided for propelling them besides the oars, will find a solution in the electric propeller here shown.

The propeller is a detachable and portable one. It may be attached to a boat with straight or slanting stern or to one of the sides if so desired, and is also adjustable to either a high or a low boat.


ROW BOAT WITH PROPELLER ATTACHMENT

With it the boat may be operated at three different speeds and is easily controlled by one hand, the device not only propelling the boat but steering it as well. The motor mounted in a vertical position is connected to the propeller shaft by a worm gear and is arranged for speed control without the usual resistance and controller. A reverse switch is used for reversing the direction of rotation of the propeller.

It is claimed that two portable storage cells of six volts each will drive a three-passenger boat five miles per hour for six hours. For greater speed and for larger boats the number of cells in the battery must be increased accordingly. The propeller weighs 35 pounds and each battery of two cells about 40 pounds.

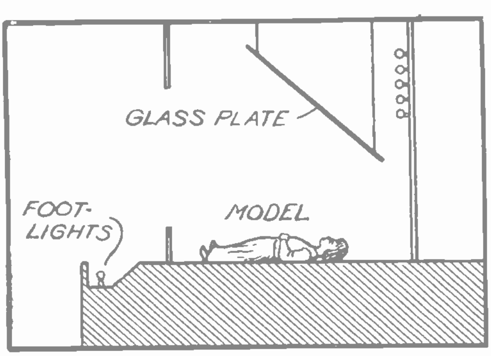
Seasoning Wood by Electrical Process

Seasoning wood is chiefly a matter of the evaporation of the moisture, or sap. This ordinarily takes considerable time, especially with dense hard woods. A process of artificial seasoning has been devised in France which greatly shortens the time required for the work and, it is claimed, does a more thorough job. A tank is filled with a solution containing ten per cent of borax and five per cent of rosin. The timber to be seasoned is placed in the tank between two lead plates. Electric current is then allowed to flow between the plates, driving out the sap and depositing the borax and rosin in its place.

Aerial Living Pictures

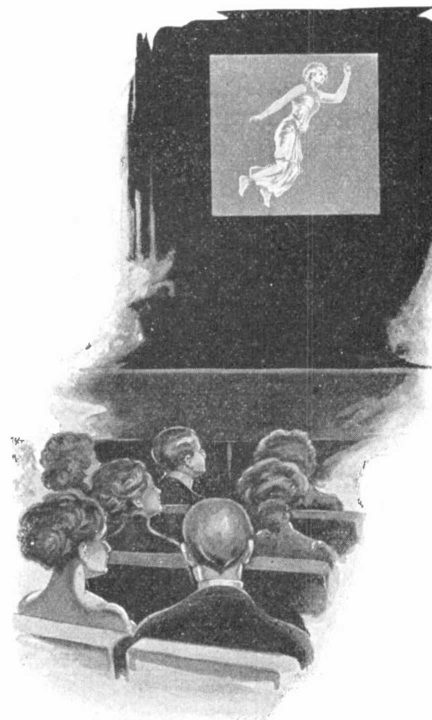
No matter how old some of them are in their conception, the tableaux, or "living pictures," as the Europeans have always called them, never seem to lose their charm. Every one who has an eye for the beautiful enjoys the thrill of a handsome picture posed by beautiful and appropriately costumed models. Some of the same statuesque posings that delighted our grandparents are still offered occasionally, for the changes since their day have been confined almost wholly to the methods of lighting the tableaux. The old Bengal light or "red fire" with its air-vitiating fumes and smoke, yielded several decades ago to the calcium light, which in turn gave way before the safer electric lamps.

Having thus attained the really artistic lighting effects for which our grandfathers groped in vain, the presenters of tableaux are now trying to overcome the other limitations which handicapped their predecessors. Chief among these is the fact that living pictures have always meant poses on a pedestal or support of some kind, a limitation not felt by the artists whose masterpieces have included many fine pictures of both angels and mortals floating through the aerial realms. To produce the same effect in a tableau, to show the fair figures floating high above the floor without any supports for them, would mean a novel departure from the range of pictures to which our forefathers had to confine themselves, and one that would be appreciated by the novelty-loving public.



METHOD OF PROJECTING LIVING PICTURES

Such is the "latest Parisian sensation" now making the round of the vaudeville stages. The curtain rises on a dimly lit sky framed in black in which the stars can be seen softly blinking. For a moment these stars grow brighter. Then they fade away as a beautiful figure appears in their stead, apparently floating in the air and yet showing by the free motion of its limbs that it is not holding itself up by hidden supports. After a minute or two the vision fades away and the stars again twinkle brightly, only to turn into another and equally charming picture, each successive art gem being the more remarkable because the model presenting it seems to be suspended in mid-air.



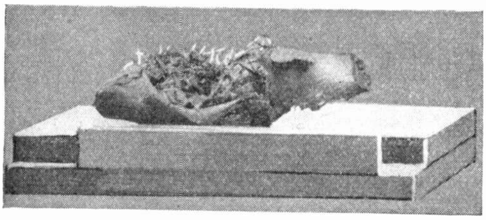
AERIAL LIVING PICTURE

With the first picture a chorus of whispers pervaded the audience: "It is only a painting." But when the supposed painting smiles and moves in ways that show her independent of any support, the impression changes, and as the last picture fades away there is a general questioning of "how did they do it?" The answer is simple enough, for instead of being in the vertical position in which they were seen by the audience the models were reclining on the floor of the stage. A huge plate of glass, placed diagonally just back of the drop, acted as a reflector whenever the lights were turned brightly on the models and settings placed below the glass. When these lights were turned off, the automatically flashed miniature lamps in the background were seen right through the glass; but when the spot lights were turned on the horizontal picture, this was mirrored in the glass so that the twinkling stars would show only as a faint setting for the suspended figure. In changing from one picture to another, the settings were arranged on the stage floor beforehand and slid into place under the glass plate, thus permitting the quick changes which add to the charm of such a gallery of living pictures.

THE TELEPHONE IS IMPORTANT TO THE SUBMARINE DIVER'S EQUIPMENT. BY ITS AID HE IS IN CONSTANT COMMUNICATION WITH THE MEN IN THE BOAT ABOVE WHO REGULATE THE PRECIOUS AIR SUPPLY

Bullet-Pierced Cable from Mexican Battlefield

In the battle of Juarez, Mexico, May 9, 10 and 11 of this year both General Madero and his opponent, General Navarro made use of the telephone in directing



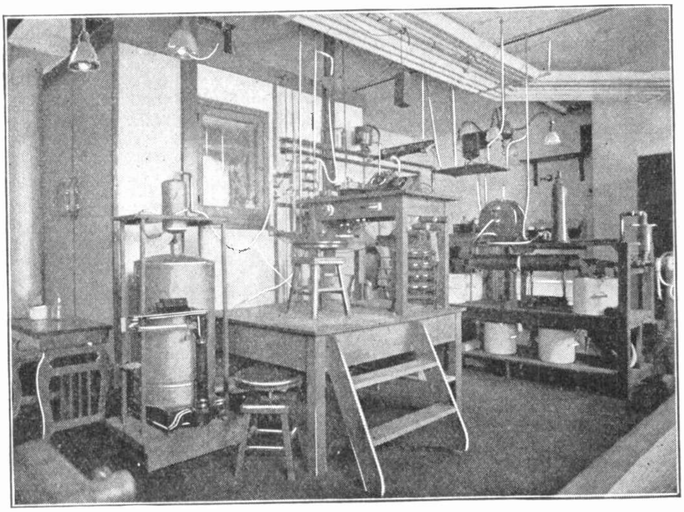
EFFECT OF A RIFLE BALL ON A CABLE

their troops, cables being laid for the purpose. During the engagement Madero sent 116 messages and Navarro 74. As in every day business, success was with the side making the greater use of modern devices. During this engagement a shot pierced one of the telephone cables the picture showing the damage done, nearly every one of the 50 pairs of wires being severed.

The Respiration Calorimeter

Electricity is relied upon to do much of the work in the experimental laboratories of the United States Department of Agriculture, and special forms of apparatus are constantly being invented to explore new fields which might have remained closed to science but for the aid of the magic current. One of the latest and most interesting of the investigating apparatus, dependent upon electricity is the lately perfected respiration calorimeter. This apparatus was devised by Uncle Sam's experts in nutrition investigations and its purpose is the accurate measurement of the in-come and out-go of matter and energy in the body of man and animals.

The respiration calorimeter is an instrument of precision. It is an air-tight and heat-tight chamber in which the subject remains during the experiment, with accessory apparatus for measuring and recording the expenditure of energy and otherwise obtaining the desired data. This complicated apparatus is also equipped with devices for maintaining a ventilating air current; for removing and determining the amount of the products of respiration; for supplying oxygen to the air current to replace that withdrawn by the subject; and for carrying from the chamber and measuring the amount of heat liberated by the subject as a result of muscular work, either internal or external, which has been performed.



THE RESPIRATION CALORIMETER

The calorimeter evolved by the experts of the Department of Agriculture and lately installed in the Department's new building at Washington is of a size suitable for experiments with man under a variety of conditions. The respiration chamber in which a subject may be called upon to remain several days is 6½ feet high and 6½ feet long by four feet wide. It is metal-walled, having double walls, the inner one of copper and the outer one of zinc. An opening in the side, closed by plate glass that is sealed in place during an experiment serves as door and window. This window is shown in the rear in the picture. The man making the test sits on the stool on the elevated platform. A telephone is provided for communication between the subject inside and the investigator outside the apparatus. The air in the air-tight chamber is continually changed by means of an electrically driven blower.

To determine the temperature of the air in the chamber electric resistance thermometers are used, six resistance coils joined in series being distributed on the walls of the chamber.

Between the inner or copper wall of the chamber and the outer or zinc wall beyond which is a layer of cork board is the temperature-controlling apparatus. Here again electricity is largely depended upon. Resistance wire, which, when a current of electricity is passed through it, heats the air in the confined space, is carried on insulators attached to the zinc. To detect temperature differences use is made of thermo-electric elements attached between the two metal walls in such a way that one end of the element lies close to the copper wall and the other lies in the plane of the zinc wall. There are 95 such thermo-electric elements scattered about the walls, connected in series with each other and with a delicate galvanometer. Electric resistance thermometers are employed to ascertain the body temperature of the subject in the calorimeter, one being attached to the surface of the body and another introduced into the large intestine.

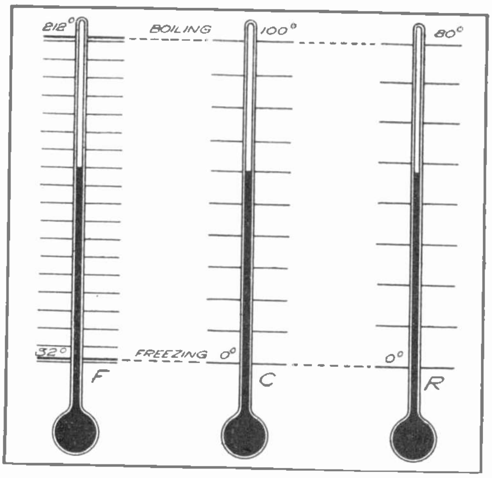
Telegraphing Round the World

The *New York Times* recently dispatched a telegram of nine words round the world to itself, a route of 28,613 miles; the circuit was completed in 16½ minutes, and the message passed through sixteen relays. The record is held by a message sent round the globe on the opening of the Pacific Cable eleven years ago in 9½ minutes, but on that occasion the route was cleared in advance and all the operators were standing by in readiness for the dispatch. The *Times* message, on the other hand, was handled as a purely commercial message. The route was everywhere north of the equator, passing through Honolulu, Manila, Hong Kong, Singapore, Bombay, Suez, Gibraltar and Fayal.

There is no other city with so many miles of distributing street mains for central-station electric service for light, heat and power as Chicago, Illinois.

Comparison of Thermometer Scales

In reading books of science or in taking temperature measurements one may meet with three different thermometer scales, the Fahrenheit, the Centigrade and the Reaumur, each of which is abbreviated in print by the first letter of the name, as F., C., and R. The Fahrenheit scale is used



COMPARISON OF THERMOMETER SCALES

largely in engineering practice, the Centigrade in scientific works and by European engineers, while the Reaumur thermometer is common in Russia and in distilleries and breweries.

To change a reading on one thermometer to degrees of another scale is often confusing. The accompanying comparison of the three scales without going into mathematics may make the relations clearer. Choosing the two common points, the freezing and boiling points, on all three scales the illustration shows 180 scale divisions on the Fahrenheit thermometer, 100 on the Centigrade and 80 on the Reaumur between these points, each division representing a degree. The ratio of 180 to 100 (Fahrenheit to Centigrade) is that of nine to five, or 1 degree C in scale space equals 9-5 degree F., hence to reduce Centigrade readings to Fahrenheit use the formula:

$$F=\frac{9}{5}C+32$$

In a similar manner

$$C=\frac{5}{4}R$$

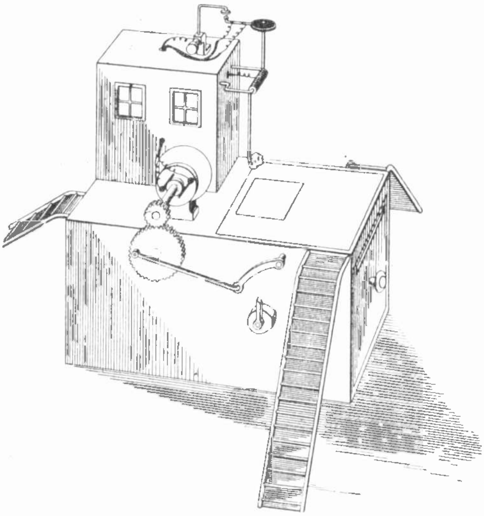
and

$$R=\frac{4}{9}(F-32)$$

the letters at the right in each formula representing the reading in degrees that is to be found in terms of the thermometer scale indicated by the letter on the left.

Electrocutes Then Drowns Rodents

The extent to which inventors go to place something new upon the market is well shown in the accompanying illustration. This is not a model of a grain elevator, nor a doll house nor yet an amusement device for a summer park. It is designed to exterminate the species *Mus* by that quick and painless method, electrocution. The common mouse and long tailed rat are supposed to take pleasure in climbing the little stairways, without a thought that they are climbing the golden stairs to the rat heaven. Once at the top, a tiny nibble and a big jolt does the rest, for at that moment a sort of trap door

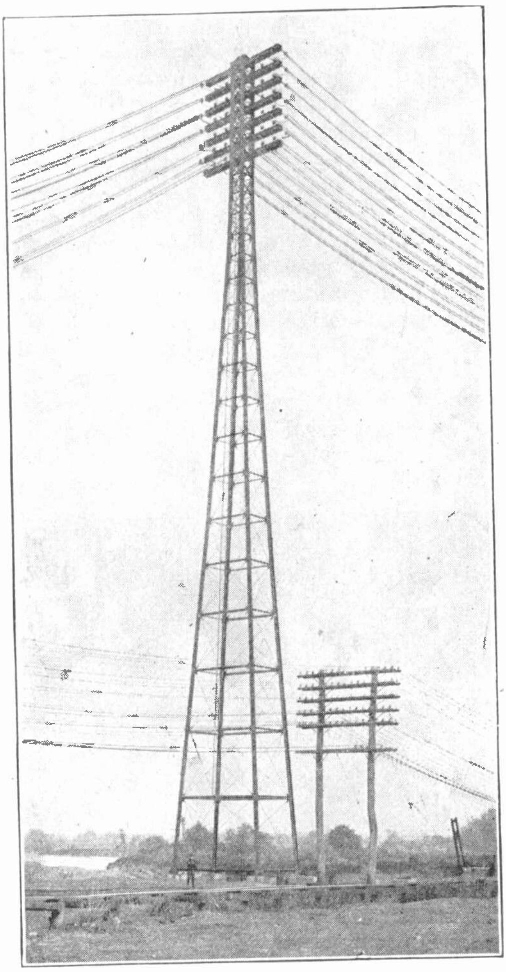


FOR THE RAT WITH SUICIDAL INTENT. HE REGISTERS HIS OWN DEATH

gives way and there is a splash, the lower part of the trap containing water. If Mr. Mouse comes from a family of sailors, a pinch of salt added to the water will materially assist his shocked imagination in believing that he is being swallowed up by a briny wave. Every intelligent mouse who travels to this undiscovered place from whose bourne no mouse returns, may know how many have gone before, for a tiny register clicks off and numbers in a soulless way the drop of each unsuspecting victim.

High Transmission Towers

The accompanying illustration shows the construction of the Public Service Electric Company's power transmission towers at Coopers Creek, Camden, N. J. These towers have a height of 156 feet and a span of 270 feet. The voltage of the current



GIANT TRANSMISSION TOWER AT CAMDEN, N. J.

carried on these lines is 13,000 and the number of wires 36.

The concrete foundations are placed on timber piles and as Coopers Creek is a navigable stream the War Department clearance required is 130 feet above high water. The crossing, showing in the illustration was designed by Robert Duncan Coombs, consulting engineer for the Public Service Company.

Earthlight

Sunlight, moonlight and starlight are familiar to every one, but earthlight, on the other hand, is perhaps known only to the scientists.

If the laymen be of an observant turn, he may notice that after the sun is eighteen or 20 degrees below the horizon, so that twilight is no longer possible and the stars are not especially bright and clear, there will be a peculiarly greenish glow about the whole circle of the horizon, gradually falling off to absolute darkness at the zenith.

This is earthlight. The observatory of Groningen, in Holland, has made a report on this light. According to the measurements taken on luminous nights, using the light of a star of the first magnitude as a unit, the sky about the zenith has an illumination in a square degree varying from .08 to .16 of whic . only .02 is starlight, the rest being earthlight—one of the most mysterious of all electrical phenomena.

On the cloudiest nights, with no star visible, this earthlight will make an appreciable impression on a photographic plate and at certain times it is as intense as twilight.

The explanation is that it is a permanent aurora not confined to any one section of the heavens, but evenly diffused. In the familiar aurora the green line of the spectrum is always present and the same characteristic is to be found in the earthlight phenomenon.

Economy Bureau for Customers

The New York Edison Company has established a new bureau to supervise the use of electricity in large buildings with the purpose of watching for and stopping all wasteful use of current. The "economy men," as they are called, will see among other things that lamps are not left burning except when needed, that carbon lamps do not replace broken tungstens, will make recommendations to a customer as to the kind of lamp to use for his particular need and will advise him how, if possible, to reduce his light bills. Like all far-sighted public service corporations this one believes that what is best for the customer in the long run is best for itself.

Electric Current at Work

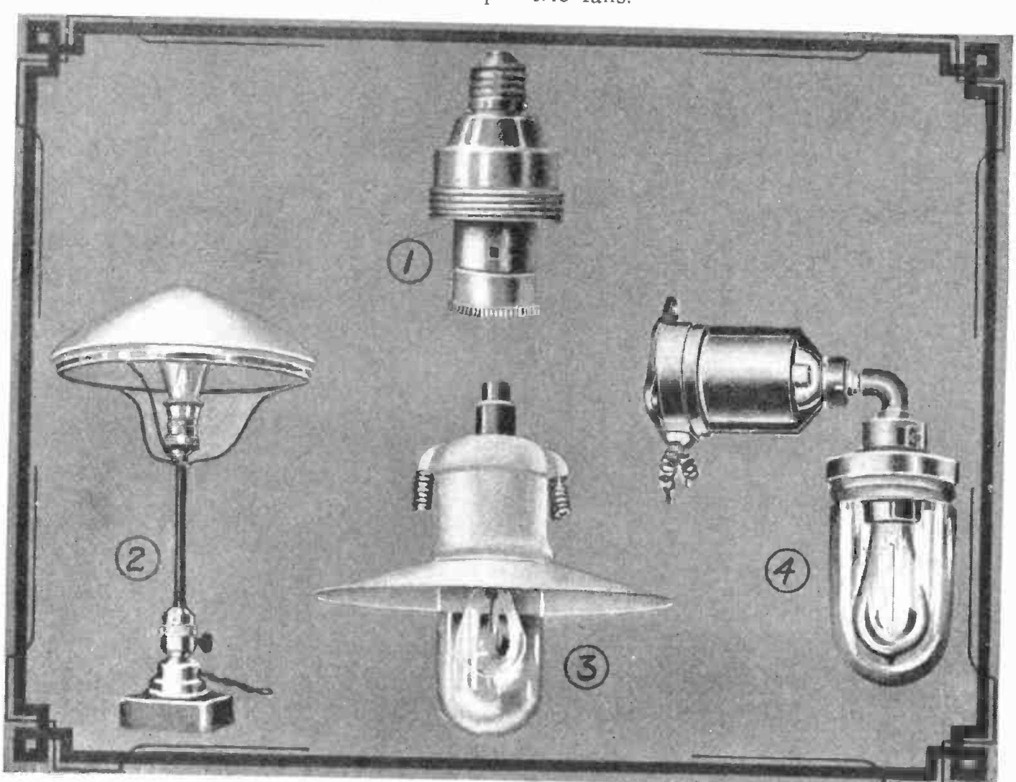
Little Transformers for Low Voltage Lights

It is possible with a low tension or pressure of say fourteen volts to employ cheap and very durable metal filament lamps for almost every purpose. Lamps of five candle power and upwards may be employed with economy, since the filaments of such low-voltage lamps are thick and short and being more heavily charged their light is intensely white.

With a view to making possible the wider application of such lamps a German firm has designed a complete line of tiny transformers, "reductors" they call them over there, which are cheap enough so that one may be used with each individual lamp to reduce the ordinary line voltage to the low-voltage needed for the operation of the light. They are very compact and neat in appearance and when screwed into the socket just ahead of the lamp they appear to be nothing more than a slight enlargement of the lamp base.

Each little transformer is provided with a switch and when the light is snapped out the transformer is also disconnected from the circuit and there is consequently no waste of current when the light is not burning.

In addition to the types made for individual house lamps these transformers are built in larger sizes for electroliers, portable lamps, street lamps and even electric fans.



A NEW LINE OF LIGHTING FIXTURES WITH TRANSFORMERS ATTACHED

Ice Cream Made by Factory Methods

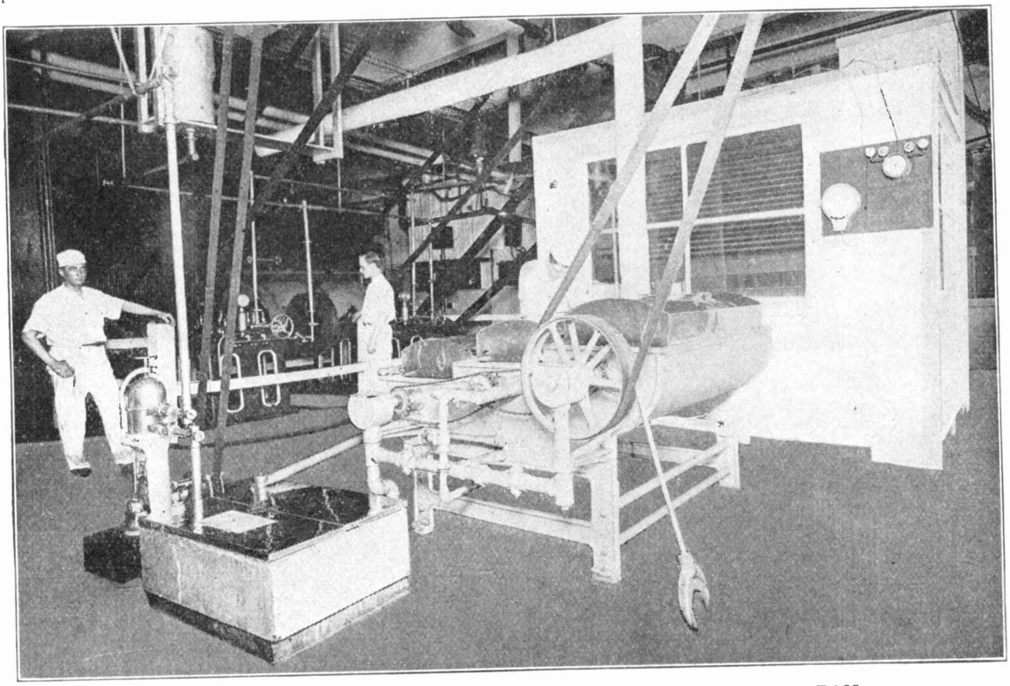
In large cities ice cream is made on a large scale in factories devoted entirely to this industry. To make and keep this food wholesome and pure is a problem that has taxed manufacturers and health officials alike. With the installation of modern equipment electricity as a motive power has become one of the improving factors.

In a trip through a modern ice cream plant like that of Collins Brothers, Chicago, we may follow the manufacturing process from the time the sweet milk in ordinary cans is deposited upon a concrete receiving platform until it emerges as brick or bulk ice cream ready for delivery.

From the can the milk is emptied into a tank upon an upper floor and thereafter handled entirely by piping and electrically driven pumps.

Butter fat is first added to the milk. To mix thoroughly the butter fat and milk, special machines are employed which bring the two together and force them under pressure through very small openings. This mixture then goes through a pasteurizing machine which heats and then cools it. The cleanliness and whiteness of things even to the men who care for the apparatus reminds one of the operating room in a hospital.

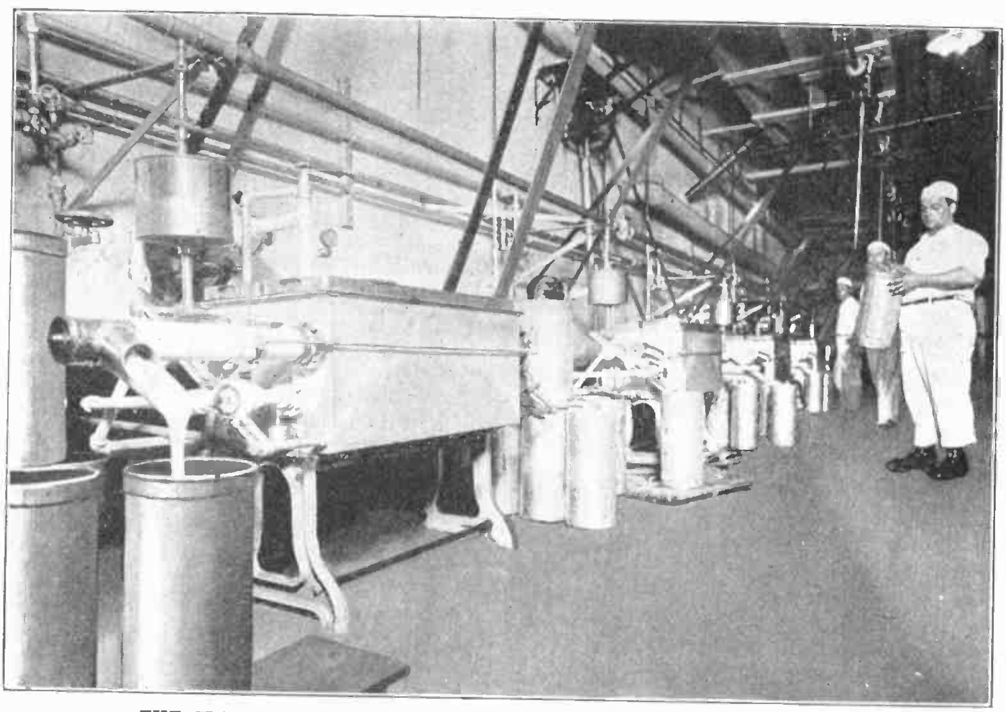
The cream is now pumped into huge metal tanks in a storage room so chilled by artificial refrigeration that the piping is heavily covered with a white frost. Upon the inside of each tank is a mixer or "agitator." A motor-driven shaft running the length of the room operates the agitators and keeps the cream in motion, thus aiding in the cooling process. Each tank in the storage room is connected by pipes and pumps to the mixing room. Here granulated sugar, and proper seasoning and coloring are added to make the different flavors. The cream is thoroughly stirred all the time, and when the added ingredients are well worked into it the cream is let out through pipes to the floor below where you see it running out of a box-shaped metal tank through a spout and into cylindrical cans.



MIXING AND PASTEURIZING THE INGREDIENTS FOR ICE CREAM

The box-shaped tank contains pipes through which cold brine circulates, thus chilling the cream, which is further cooled when these cans are placed in the freezing room to await delivery by the familiar ice cream wagon, to drug stores and ice cream parlors. Ice cream for bricks is run into pans the width and thickness of a brick.

MAKING ICE CREAM CONES



THE CREAM IS DRAWN FROM THE TANKS INTO CYLINDRICAL CANS

Water tight covers are then placed over the pans which are now put on racks in a room made freezing cold by dripping brine which soon chills the bricks to a solid condition. The pans are then removed from the racks, lowered for a moment into hot water when the brick of cream comes out readily and is cut into proper lengths.

Deft fingered girls immediately wrap these bricks in wax paper and enclose them in neat pasteboard boxes labeled with the flavor, after which they are placed in a dry chill room to await delivery.

A later idea but one now a part of the ice cream manufacturer's business is the making of ice cream cones. One might infer from much that has been said and written that the ice cream cone was absolutely without cleanliness. But like all other baked foods, the place where it is made, the method of handling and the care in packing are some of the things that make it wholesome or otherwise.

The ice cream cone has come to stay and is made in some factories with extreme attention to purity and cleanliness and by electrically driven machines that turn out the cones without the touch of human hand from dough to finished product. The accompanying picture shows a cone baking department where 500 cones per hour are turned out by each machine.

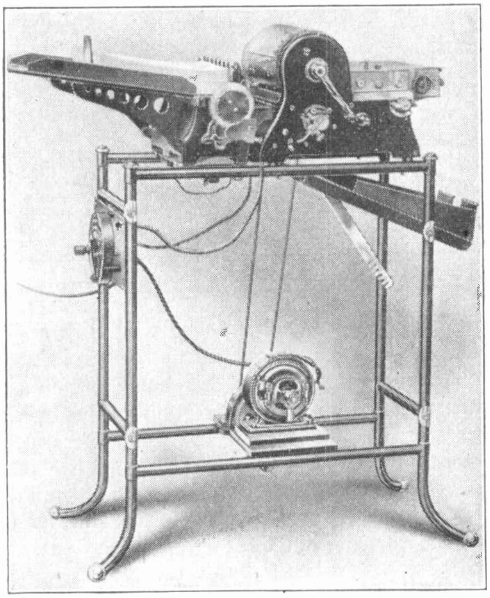
The prepared dough made thin enough to run is placed in the covered tank at the left of each machine. A circular plate made up of several waffle grids revolves carrying the grids about in a circle. As each grid reaches the side next to the dough tank, the cover automatically lifts, a stopcock opens for an instant and just enough liquid dough drops upon the grid to make a cone. Then the cover drops slowly and the next grid comes under the spout. Meanwhile the grids already supplied with dough pass on around the circle and through a gas-heated oven.

By the time the cones reach the attendant who is standing at the machine, they are baked to a nice brown, the cover lifts, and the attendant with a small pick removes the cone and at the same time rolls it into shape. The girls at the tables then wrap each cone in paper ready to be packed in pasteboard boxes for delivery, not again to be handled until filled and placed in the consumer's hands.

The Motor-Driven Flexotype

This office appliance, known as the Flexotype, is a machine for printing fac-simile letters. When the motor is speeded up to the fullest extent as many as 8,000 letters may be run through in an hour.

A gravity typesetter enables a beginner to compose or distribute the type in record time. Flexible type forms instantly attached to either the typesetter or the print-



THE FLEXOTYPE

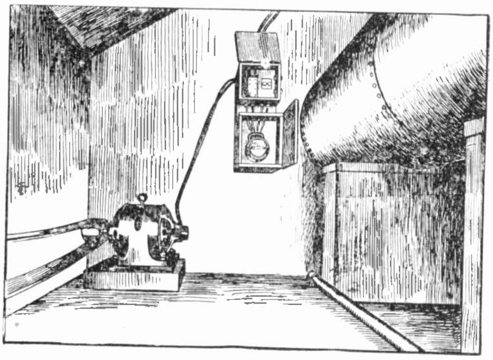
ing machine provide a permanent and portable medium for carrying as many letters as may be desired, available for immediate duplication in any quantity.

The printing machine, which is of the rotary type and prints from a short immovable inked ribbon, is automatically re-inked at each impression, with practically no supply cost.

For duplicating typewriting the machine prints through a ribbon sixteen inches long, which is fastened immovably over the type, and is automatically re-inked at each impression, resulting in a large number of impressions from a comparatively small and inexpensive ribbon. Special advantages are claimed for this plan in the reduction of the cost of supplies, obtaining uniform color through the longest letters and on long and short lines, or throughout a long run.

Farmer Solves a Pumping Problem

A farmer started to build some expensive farm buildings for his home, and after the foundations were in he tried to sink a well but was not successful in securing water which was suitable for domestic use. In a field about one-fourth of a mile from his



FARM MOTOR WHICH DOES THE PUMPING

new home was an abandoned well with good water. He found out that he either had to change the location of his home which he did not like to do as his foundations were in, or put in a pump with some arrangements for getting the water from the old well to his new place. He decided on the latter plan, and as a transmission line from which he could get electric service passed within 100 yards of the old well, he at once decided to install a motor for power.

He had a small concrete building erected and installed a two horse-power motor belted to a single plunger geared power pump. This pumps the water into a steel tank, against air, up to a pressure of 70 pounds per square inch. The tank is connected to his buildings through a 1½-inch pipe.

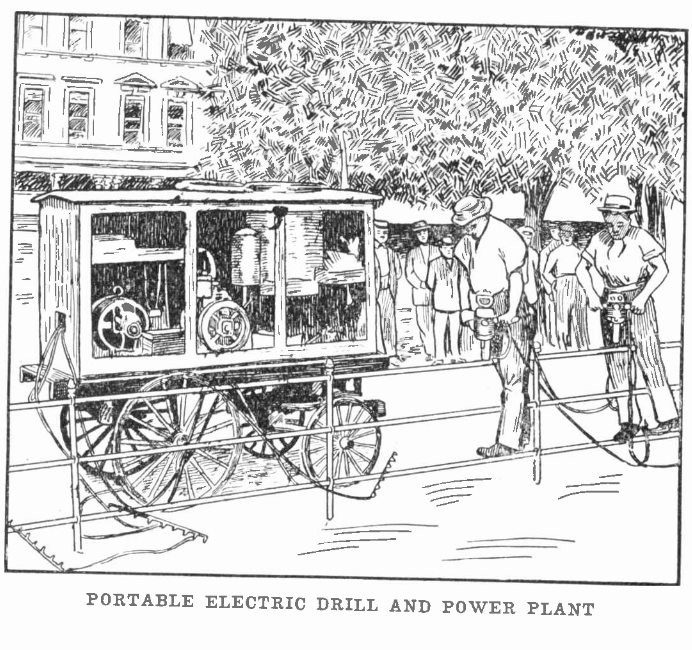
The pump is arranged with an automatically controlled device so made that it will close the circuit and start the motor when the water drops to a certain predetermined pressure in the tank, and stop the motor when the pressure becomes normal. The tank has a capacity of 2,500 gallons of water and requires about two hours pumping per day to keep it full. This installation is giving entire satisfaction and requires practicaly no attention for its successful operation.

Bringing the Tool to the Work

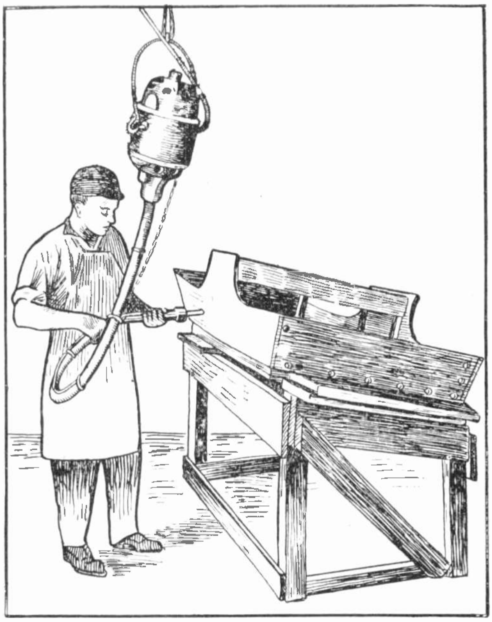
To bring the tool to the work rather than the work to the tool has become common practice. This is almost wholly due to the utilization of electric power with the flexibility of operation which it permits. Drilling is an operation once so laboriously performed with a hand ratchet, or else the work had to be taken to a drill press. Now the workman takes an aluminum encased motor with drill attachment, and wherever a lamp socket is available does the work of five men with the old fashioned tools.

In one of the drawings is shown what is called a portable electric shaft of the "United States" type, for drilling. The motor is hung up by a rope or iron rod and drives a flexible shaft to which the drill is attached. The switch for starting the motor is on the shaft right at the operator's hand.

Sometimes, however, work is to be done at a place where electric service is not available. For such work manufacturers



PORTABLE ELECTRIC DRILL AND POWER PLANT

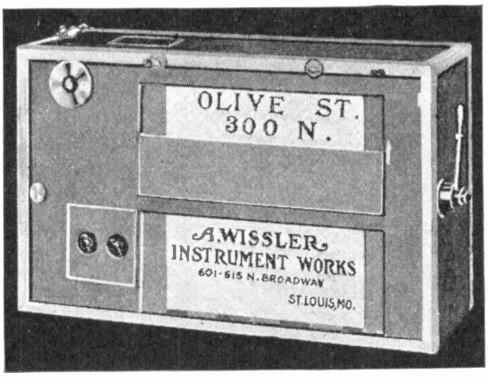


PORTABLE ELECTRIC SHAFT WITH DRILLING ATTACHMENT

have even gone so far as to design small portable power plants on wheels, consisting of a gasoline engine driving a dynamo which latter furnishes current for the motor of the drill.

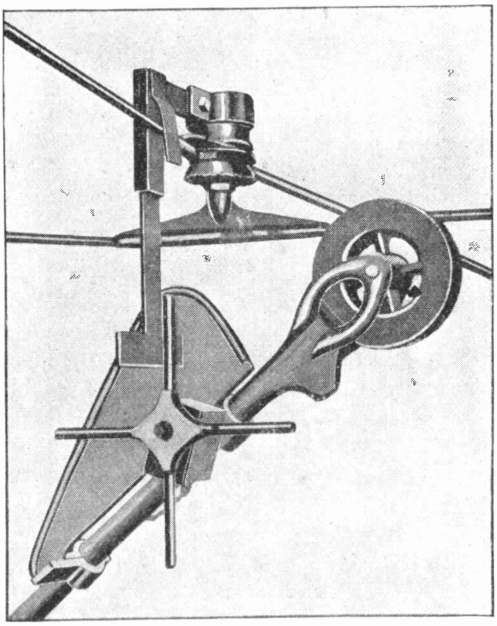
Street Indicator for Electric Cars

At the recent International Exposition of Inventions held in St. Louis there was exhibted a device known as the Cosmopolitan Multiplex Signograph invented by H. Alweis of St. Louis. It embodies a modern system of automatic street and station indication also a new system of street



STREET ANNOUNCER

car advertising. The names of streets and the advertisements are put on a web, the ends of which are fastened to opposite rollers, this web to be unwound from one roller and wound upon the other. As the car is advancing upon its route, the circuit closing device on the trolley pole will strike its counterpart, which is put on the first cross wire supporting the trolley wire that is met after the crossing is passed, thereby closing momentarily an electric circuit coming from the wire that supplies cur-



CIRCUIT CLOSING DEVICE FOR STREET ANNOUNCER JUST BEFORE BEING OPERATED

rent to light the car. This current in passing through the circuit into the signograph, energizes an electric magnet and passes out through the ground wire. The duty of this magnet is to release an automatic switch, which turns on a separate electric current into a small electric motor. The motor is connected by suitable gearing to the two web-carrying rollers each of which can, by means of a lever, be thrown in gear with the motor, or cut out, as very naturally, when one roller is in gear with the motor, the other must be running loose. The further rotation of the motor due to its attained momentum and its consequent pull on the tape is taken care of by an ingenious automatic brake, which forms part of the motor.

Thus it is that as the trolley pole, or rather the circuit closer thereon, momentarily closes the circuit from the power wire with each contact with its counterpart along the line, the magnet is energized, thereby releasing the automatic switch, which in turn works the motor, releasing the automatic switch, which in turn shuts off the current of the motor, thereby stopping the movement of the web.

Electric Rail Grinder

An electric rail grinder of unique design is being utilized by Mr. John Kerwin, superintendent of tracks of the Detroit United Railways for grinding rough track due to the use of the cast weld. It was held that the process of welding had softened the ends of the rails and that the "cupping" which took place was due to this condition. To overcome this, a water jacket was placed on the head of the rail during the process of welding but even with the use of the water-jacket the rails continued to "cup" at the joints. It was finally decided that the welding caused a ridge to form on the working surface of the rail and that it was the dropping of the cars off of the ridge which caused the "cupping."

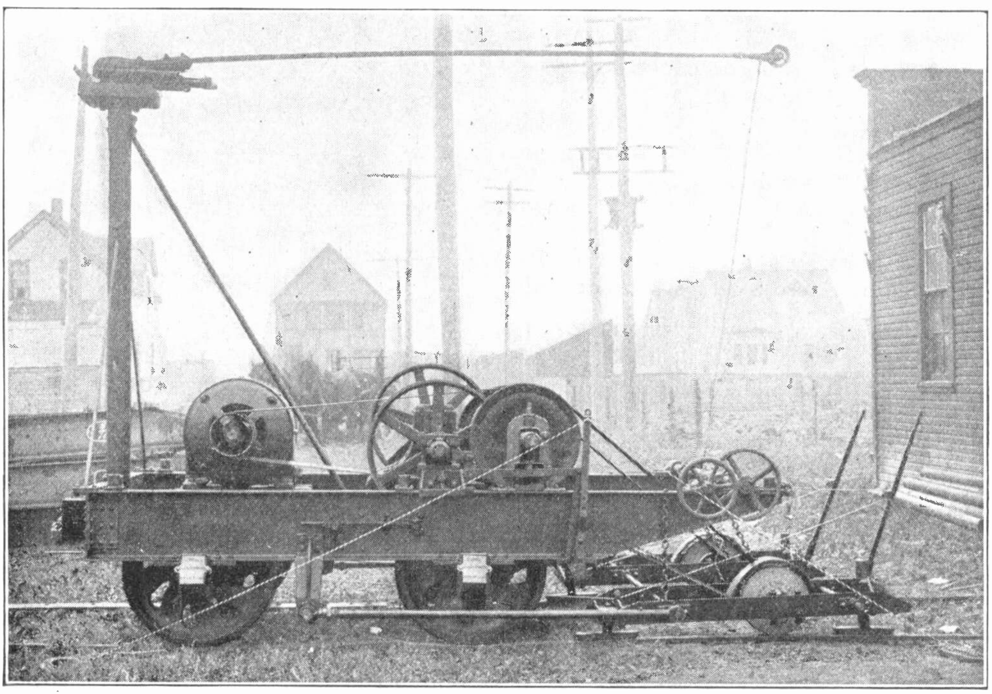
For grinding the rails, this electrically operated rail grinder was designed, and consists of a portable, self-propelled car which operates emery grinders, mounted on a sliding carriage. This carriage may be adjusted automatically or by hand to control the position of the emery wheels so they will take from the head of the rail cuts of required length and depth for the purpose of obtaining a perfectly smooth tractive surface.

The grinder is entirely automatic in its action, requiring the services of but one man to operate it.

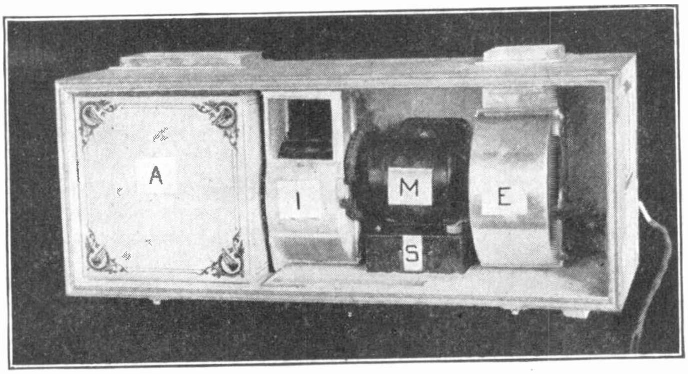
Warm or Cold Air From the Window

There is always a wide difference as to comfort between the ordinary ventilation provided by opening doors and windows and the comparatively inexpensive means provided by the electric fan.

Quite out of the ordinary for a small equipment, the ventilator here illustrated is arranged to heat or cool, as desired, the fresh air supply. The ventilator is placed on the window ledge on the interior of the building, the only necessary change being



ELECTRIC RAIL GRINDER



WINDOW VENTILATOR

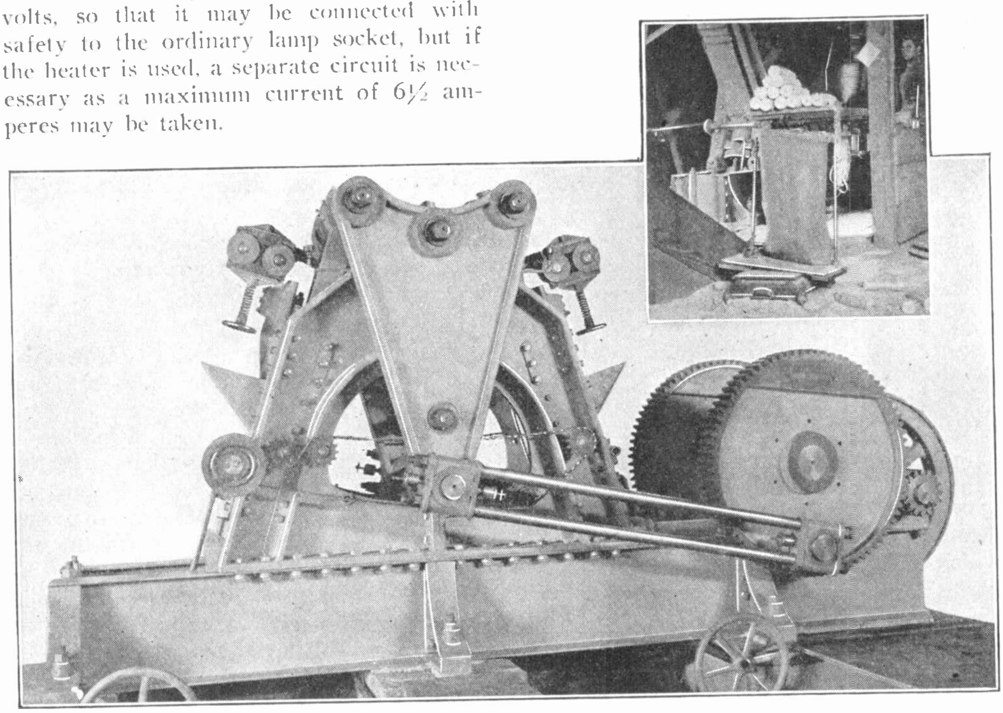
that a ventilator board is placed in the window frame with holes cut to correspond with the inlet and outlet holes in the cabinet of the ventilator.

The device consists of a neat enclosing case containing an intake fan (I) for pure air, an exhaust fan (E) for the removal of impure air, both fans being enclosed in aluminum cases and direct-connected to the shaft of the motor (M). The entering pure air may be either heated or cooled by simply placing ice or an electrical heating element in the compartment (A), which consists of ducts through which the entering air passes. Moist warm air may also be obtained by placing the "heater," which is provided for that purpose in compartment (A), in a pan filled with water. Different degrees of temperature may be given the air by closing or opening switches connected with the heating element and placed conveniently upon the outside of the case.

The motor requires one ampere at 125 volts, so that it may be connected with safety to the ordinary lamp socket, but if the heater is used, a separate circuit is necessary as a maximum current of 6½ amperes may be taken.

Converting Waste Into Fuel

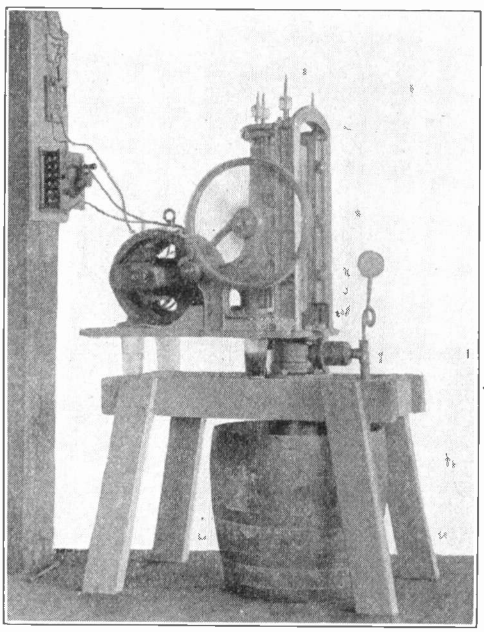
Sawdust, shavings and the fibrous waste from cane-sugar manufacturing are converted into firewood by the machine shown in this photograph. The power is an electric motor. The fuel is in the shape of stove-wood when it emerges from the machine, being cylindrical and three inches in diameter. It is exceedingly hard, as it is compressed with a force of from 30 to 80 tons, the pressure varying according to the material used. No oil or sticky material is used to hold the particles together,



FUEL BRIQUETTING MACHINE AND SOME OF ITS PRODUCT although the ends are dipped in rosin when finished to prevent flaking. The secret of the cohesion, a cord of hemp which runs through the center of the cylinder, is an original idea. This machine has a capacity of five tons a day, and the cost of operation is slight, while the profits are great, as it makes a valuable by-product from the refuse of saw mills, woodworking establishments and cane-sugar factories. It is in successful operation in Los Angeles, Cal.

High Power Pump Runs on Four Tumblers

An electrically operated pump, running under a pressure of 40 pounds and with a speed of 45 revolutions per minute of the cam shaft, is in daily operation while supported by four tumblers, which in turn rest

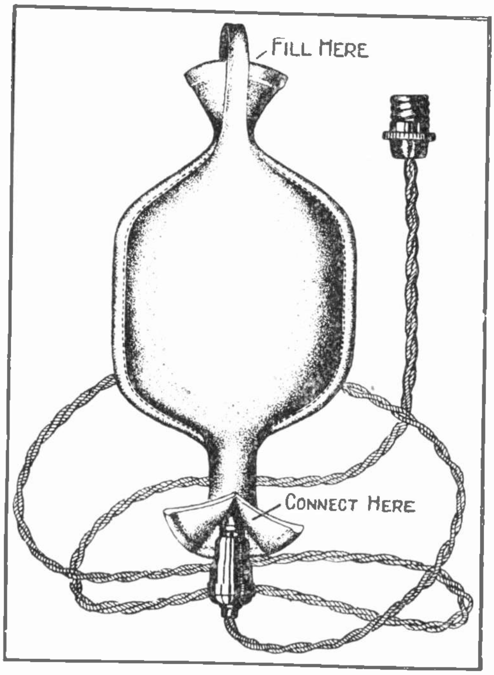


PUMP RUNNING ON FOUR TUMBLERS

upon a wooden trestle. This is a practical demonstration of the steadiness of a pump which is perfectly balanced and non-pulsating. There is no movement perceptible in the water in the drinking glasses, although during the eight minute exposure of the photographic plate, the pump was delivering water at the rate of 75 gallons per minute.

Water Bottle Heated by an Incandescent Lamp

The ordinary hot water bottle is a nuisance. When first applied it is too hot, five minutes afterwards it is too cold. To be able to apply heat to the water after the bottle is in position and to regulate the temperature to any degree desired would be an ideal condition. The Kunz electric self-heating water bottle permits of just such regulation.



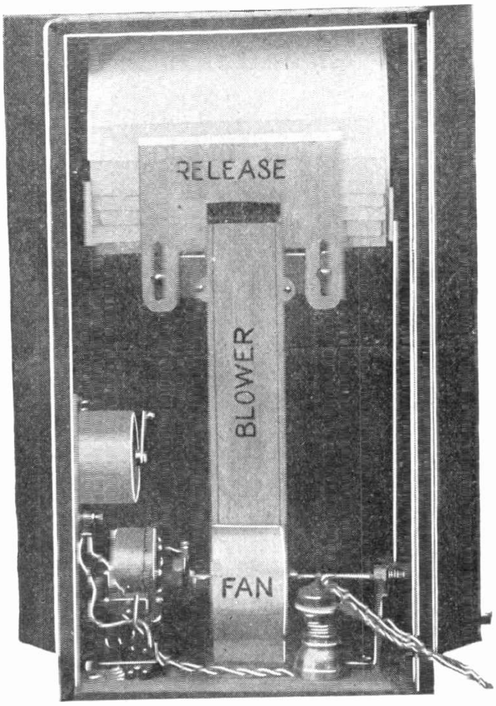
WATER BOTTLE HEATED BY A LAMP

The odd thing about this device is that the heat is developed by an incandescent lamp within a tube inserted in the bottle through a water-tight collar. A lamp is popularly supposed to give light only, but in reality most of the energy put into a lamp gets away as heat. An incandescent lamp may not get very hot when exposed to the air, but confine it so that the heat cannot be radiated and it gets intensely hot. So in the case of this bottle almost all of the energy liberated in the lamp passes directly into the water as heat and this heat may be readily regulated by turning the lamp on and off.

Poster Display Machine

One of the new devices for advertising is a machine which displays behind the glass front of a cabinet, sheets or posters upon which advertisements or pictures are printed. The sheets are mounted upon a revolving cylinder run by an electric motor. From 20 to 120 sheets, according to the size of the machine, may be attached to the cylinder which slowly turns, releasing one sheet after another while a fan blows just enough air against each sheet to turn it over to the front of the case.

The machine illustrated holds 50 sheets 10 by 16 inches. The device is suitable for windows and is lighted for night service and can be used wherever electricity is available.

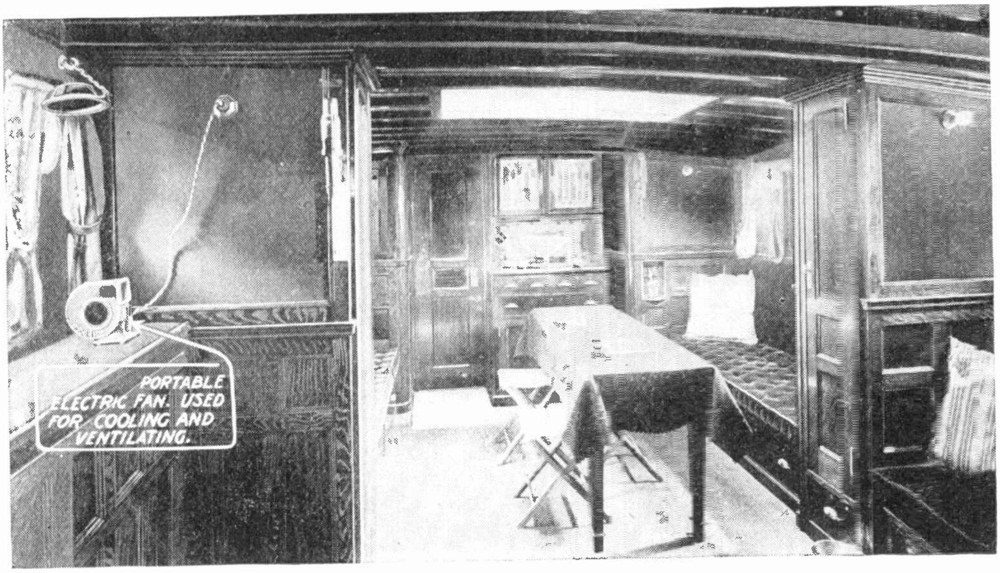


BACK VIEW OF POSTER DISPLAY MACHINE

Ventilating a Yacht

William G. Coxe, Wilmington, Del., owns a splendidly equipped private yacht. The quarters in any yacht, however, are necessarily somewhat narrow and it is not always easy to ventilate them. Mr. Coxe was able to overcome this difficulty by using a portable electric fan blower as shown in the cut.

The distinguishing feature of this particular electric fan resides in its blast wheel or runner. This is of drum form, with a large inlet chamber, enclosed by numerous blades, which are very long, but narrow, and are curved forward. It is a kinetic fan and a characteristic feature is that the air leaves the blades at a higher velocity than the top speed of the fan wheel.



INTERIOR OF A YACHT WITH PORTABLE VENTILATING FAN

Electrical Men of the Times

WILLIAM H. MERRILL

William H. Merrill, the popular manager of the Underwriters' Laboratories and president of the National Fire Protection Association, has acquired international prominence by reason of his valuable service in behalf of up-to-date fire protection engineering.

He was born in New York in December, 1868, and graduated from the Massachusetts Institute of Technology in 1889. At the conclusion of his institute course he entered the service of the Boston Board of Fire Underwriters in the capacity of chief electrical inspector, and came to Chicago in 1893, joining the staff of the Chicago Underwriters' Association in the capacity of electrician and without severing this connection, he entered the service of The (Western Insurance) Union in 1894, organizing the old Underwriting Bureau of Fire Protection Engineering.

Mr. Merrill assisted in the organization of the Electrical Committee of the Underwriters' National Electric Association and participated in the conference which created the National Electrical Code.

His efficient service as secretary and treasurer of the National Fire Protection Association was an epoch making period in the history of that organization.

His wonderful executive ability and genius for organization began to display itself immediately upon his arrival in Chicago. The problems confronting him may well be appreciated when it is known that the standard for wiring, which prevailed in the West at that time, permitted the use of all sorts of defective material and devices which were common in those days. Mr. Merrill seemed to know intuitively what to do and at once devoted his attention to the bringing of the Municipal Department of Chicago up to standard and eventually secured the promise of its co-operation in the work of establishing a reasonably safe standard for electrical wiring and apparatus. As might be expected, the new wiring rules met with considerable opposition on the part of local electricians, some of the old time electrical inspectors and a number of insurance agents, especially those having in charge the insurance on buildings defectively wired, which necessitated the expenditure of considerable money to make the electrical equipment safe. The owners of these buildings scouted the idea that danger existed because no trouble had developed from defective wiring in their immediate property.

In order to meet this opposition squarely and effectively Mr. Merrill conceived the idea of gathering from all parts of the country accounts of fires of electrical origin. These he published at his own expense. Bureaus desiring copies for use in the field outside of Chicago were charged a nominal sum to cover cost of printing. Later the cost of publication was defrayed by The (Western Insurance) Union and still later by the National Board of Fire Underwriters. These reports proved to be the most powerful of campaign documents and greatly assisted the crusade against the electrical hazard.

Among the early undertakings of importance requiring Mr. Merrill's attention upon his arrival in Chicago was the electrical hazard in the buildings comprising the World's Columbian Exposition and his work in this connection probably saved many lives and large property values.

The phenomenal record Chicago has made in the work of reducing its electrical fire loss makes the origin of the work of considerable interest. Mr. Merrill early appreciated that one man could not expect to make reasonably good progress in handling the problems which confronted the electrical department covering such a large field as Chicago and Cook County and the regular building inspectors of the Chicago Underwriters' Association were detailed to assist him and were instructed by him in the art of electrical inspection insofar as it related to the serious electrical hazards. The training of these men consisted of lectures with practical demonstrations covering the detection of dangerous wiring and apparatus, together with the application of the proper safeguards.

In 1894 while the work was at its height, Mr. Merrill organized a laboratory under the joint auspices of The (Western Insurance) Union and the Chicago Underwriters' Association. Originally the work of this laboratory was limited to the investigation of the hazards contained in electrical material and fittings, and was a distinct success from the first, being speedily recognized by all departments in the United States. While carrying on this work Mr. Merrill prepared and circulated a number of highly prized pamphlets covering important phases of the electrical hazards.

The laboratory equipment in these days was of the most meager character, and consisted largely of a work bench, two electrical instruments, a comparatively small amount of apparatus which was built by laboratory employees, together with a three-wire service composed of No. 6 B. & S. gauge conductors bringing current from the Chicago Edison Company's street main to the test rack. It is almost impossible to believe that the well equipped buildings now occupied by the Laboratories could possibly have sprung from such modest beginnings within so short a period of time, and it is especially remarkable that its work should be extended to cover such a large variety of subjects.

The laboratory had scarcely been organized when Mr. Merrill conceived the idea of bringing to the attention of the municipalities in the central western district of the United States the necessity for, and value of, municipal control of the electrical hazards. We are all familiar with the tremendous success of this movement, and are surprised that this service did not from the first appeal to the citizenship in general as a natural municipal function instead of being looked upon with suspicion and reluctantly adopted.

Mr. Merrill's service in behalf of the reduction of the fire waste has always been characterized by rare initiative, a great capacity for hard work and a special genius for organization. His management of the laboratories has been exceedingly wise and the work of enlarging its scope has been carried on with wonderful foresight. The prudence with which he has always used the great power, which has from the first been placed in his hands and which has been constantly increased, distinguishes him as one of the great leaders of men.

It will be at once apparent that this tremendous work would be too much for one man to attempt single handed, and as the demands upon his time increased it became necessary for him to delegate the detailed execution of his plans to others, and in the matter of selecting these men he has displayed a wonderful sagacity and is seldom deceived. A prominent engineer, familiar with these undertakings, once remarked, "Merrill has the faculty of surrounding himself with good men." He possesses the rare faculty of inspiring his associates with his own enthusiasm for the work he has entrusted to them and has seldom been disappointed by results. The wisdom with which he has handled men both in his employ and those with whom he has had business relations has characterized him as a natural leader.

Mr. Merrill possesses an unusual sense of proportion and avoids trifles. He is thoroughly impartial and he has the faculty of promptly relinquishing views which are not borne out by facts. He is extremely thorough and exhaustive in the handling of problems and strives to keep prominently in view the practical features. In spite of the engrossing character of his work he has a neverfailing sense of humor which has served him well in many a crisis. The early newspaper experience gained during his college days has made him master of the art of expression and his letters are brilliant examples of the direct, lucid, comprehensive and graceful style he possesses.

Electricity in the Household

Mrs. Fitzgerrell Organizes the Elektron

By GRACE T. HADLEY

"I declare it is perfectly dreadful the way the modern woman is being talked about and written about," remarked Mrs. Fitzgerrell, laying aside a copy of Any-body's Magazine.

"What's the matter now?" inquired Mr. Fitzgerrell, looking from the pages of a golf magazine, which he was perusing.

"Well, here's an article criticising the sweet woman of today who drops a plugged, non-negotiable nickel into the slot machine of life and draws out an automobile and many other good things without working for them."

"H-m-m-m," said Mr. Fitzgerrell, his eyes upon the golf book.

"Then there was Philip Gilbert Hamerton who criticised women for their 'total lack of accuracy in their mental habits' and who declared that this was and is still proving to the immense majority of women an unsurmountable impediment to culture—are you listening, darl?" Mr. Fitzgerrell laid down his book.

"I'm all attention, Marian," he said.

"Well," continued Mrs. Fitzgerrell, "Hamerton said that it is the absence of intellectual initiative which causes the great ignorance of women. What they have been well taught—that they know—but they will not increase their stores of knowledge."

"What's the matter now?" inquired Mr. Fitzgerrell

"What else did he say?" asked Mr. Fitzgerrell, with interest.

"He said what they will not do is to hunt up matter unaided and get an accurate answer by dint of an independent investigation."

"Well, they don't," commented Mr. Fitzgerrell.

"There is Madame Curie who has made some wonderful experiments with radium," said Mrs. Fitzgerrell, severely. "Besides the help she gave her husband, she is a fine chemist herself."

"Oh, I beg your pardon," said Mr. Fitzgerrell, properly subdued.

"The worst thing Hamerton said about women was this," continued Mrs. Fitzgerrell. "They are like perfect billiard balls upon a perfect table, which stop when no longer impelled, wherever they may be."

"Now if he had only said golf balls!" exclaimed Mr. Fitzgerrell.

"You are positively frivolous, Francis, and I won't say anything more," declared Mrs. Fitzgerrell.

"Please continue, Marian," urged Mr. Fitzgerrell. "I assure you I am deeply interested, only don't get beyond my depth."

"Well," remarked his wife somewhat mollified. "I thought I would undertake to disprove some of Mr. Hamerton's statements."

"My goodness, Marian," exclaimed Mr. Fitzgerrell, "don't do anything rash!"

"Hamerton said that the absence of investigating and discovering tendencies in women confirmed by the extreme rarity of inventions due to women, even in the things which interest and concern them, was evidenced by the invention of the stocking loom and sewing machine by men and brought to practical efficiency by masculine energy and perseverance."

"What do you propose to do about it?"

"I propose to organize a club to be known as the Elektron, which is the Greek word for amber, and the word from which electricity is derived."

"Fine idea," commented Mr. Fitzgerrell. "Electricity is a great subject. Now let me see—what is electricity any way? Would you mind defining it?" he asked with a twinkle in his eye.

"Electricity is a disturbance of the ether," responded Mrs. Fitzgerrell, promptly.

"Why, yes, of course—I should have known that. It is so simple. And ether is —let me think—I read something very profound in regard to ether, only the other day. Oh, yes, I recall it now. It is this, 'Light travels 186,000 miles per second through the ether, but gossip can give it a handicap and then beat it."

"You may jest as much as you like, but I am perfectly serious," announced Mrs. Fitzgerrell, with dignity, "and I shall go ahead and organize The Elektron, a club for original research."

"My dear, you are at liberty to do whatever you wish," said Mr. Fitzgerrell, earnestly, "and I am sure it will prove to be at least an interesting experiment."

The next day Mrs. Fitzgerrell sent out cards to about 25 women of her acquaintance inviting them to meet in her library the following Thursday afternoon. The cards stated that the object of the meeting was the organization of The Elektron, a club for original and experimental research.

Among those who received cards were Mesdames McGinnis, Flannerty and Watson. Mrs. Fitzgerrell hesitated at first about sending them cards, but upon reflection she wisely concluded that before they made bridge a life calling, it might be well to interest them in The Elektron. On Thursday afternoon about 20 ladies gathered about the table in Mrs. Fitzgerrell's library. They were all interested to know what their hostess had in store for them in the way of a novel entertainment. The table was littered with silk remnants, threads and yarn ravellings, cotton batting, leaf foil, a tumbler, a glass tube and rod.

Mrs. Fitzgerrell seated herself at the head of the table and after calling the meeting to order, remarked:

"You have been asked to gather here to consider something of importance, namely, the organization of a club for original research. You are well aware of a few everyday happenings. You have doubtless noticed when combing your hair on a cold morning how it snaps and sparkles. You have, I daresay, been much annoyed by lint sticking persistently to one's dress, when one has tried just as persistently to brush it off. You will remember how, as children, we slipped the cat into a dark closet and stroked her back vigorously to see the tiny flashes of fire. These are natural phenomena. All objects behave in a certain way under certain circumstances. This behavior is the result of law. There are several ways in which we can find out why they behave in this manner. For instance, I drop this ball to the floor. It falls. I have performed an experiment. I have asked a question of Nature—and it has been answered by the law of gravity.

"I have asked a question of Nature—it has been answered by the law of gravity."

"How very interesting!" exclaimed the ladies.

"Now," continued Mrs. Fitzgerrell, "on this table I have a number of objects. They lie here quietly. Nothing happens. We do not notice any kind of phenomena, but I rub this glass tube with this little silk pad. On the reversed tumbler I place some

"Oh, may we play?" she besought.

threads, leaving the ends dangling. Now I rub the glass tube briskly again, then hold it near the threads and now tell me what happens!"

"The threads are attracted," cried the ladies.

"Just so," said Mrs. Fitzgerrell, elated with her success. "Similar experiments were performed for ages without any definite result. It was noticed long ago that if a substance like amber was rubbed, it would attract light bodies to it. But no one could explain why. The phenomena is due to what we call electricity. These experiments were first performed with yellow amber or electron, hence the origin of our word electricity."

"Oh," exclaimed Mrs. McGinnis, "I have a beautiful amber necklace. Mr. McGinnis gave me for Christmas, but I never wear it. You know I wanted pearls and I was so disappointed when——"

"We have in our homes," ran on Mrs. Fitzgerrell, "many conveniences which we accept as a matter of fact, when in truth we know little or nothing of their operation. There is the telephone for instance——"

"Oh," cried Mrs. Flannerty, "I don't know as I thoroughly understand the telephone, but I think I can explain it. You see it is something like this. If I were to take Spitfire and stretch her out until she reached to Mrs. McGinnis' house and then if I stepped on one end, she would meow at the other end."

There was a sudden outburst of laughter. Mrs. Flannerty looked surprised and then puzzled, then she flushed a rosy red. Mrs. Fitzgerrell tactfully touched a bell and instantly several maids entered with tea tables. The ladies arose as if by magic and grouped themselves about the tables. They were soon sipping fragrant tea and nibbling Mosaic sandwiches and every woman present was asking for the recipe. Mrs. Fitzgerrell in looking for a pencil and notebook in which to jot down instructions, opened a drawer of the library table and accidentally disclosed to view several decks of cards. Instantly Mrs. McGinnis pounced upon them.

"Oh, may we play?" she besought Mrs. Fitzgerrell with appealing eyes. Mrs. Fitzgerrell glanced about at the other guests. All the faces held a similar appeal. She could not refuse. The scientific ground under Mrs. Fitzgerrell's feet gave signs of unsteadiness.

"But," she protested, "I thought this was to be a club for scientific research——"

"There's a lot of scientific work in bridge," remarked Mrs. Norman Van Ess, "if you play it right." There was a chorus of approval on all sides. The different decks were being rapidly passed from hand to hand. Mrs. Fitzgerrell made a last desperate effort to save The Elektron.

"At the next meeting of The Elektron," she said, lifting her voice above the swish of the cards and the hum of other voices, "the luminous efficiency of the incandescent lamp will be considered." Mrs. Norman Van Ess reached forth a jeweled hand and pulled Mrs. Fitzgerrell into a chair beside the table but the hostess still had a trump card to play.

"The new illuminating engineer of the Consolidated Light & Power Co. will deliver the address. I understand he is handsome and eligible——"

"In that case I make it hearts," said Mrs. Van Ess gathering up her cards with a graceful sweep.

"Partner," enquired Miss Lindsey, the heiress, "may I play to a heart?"

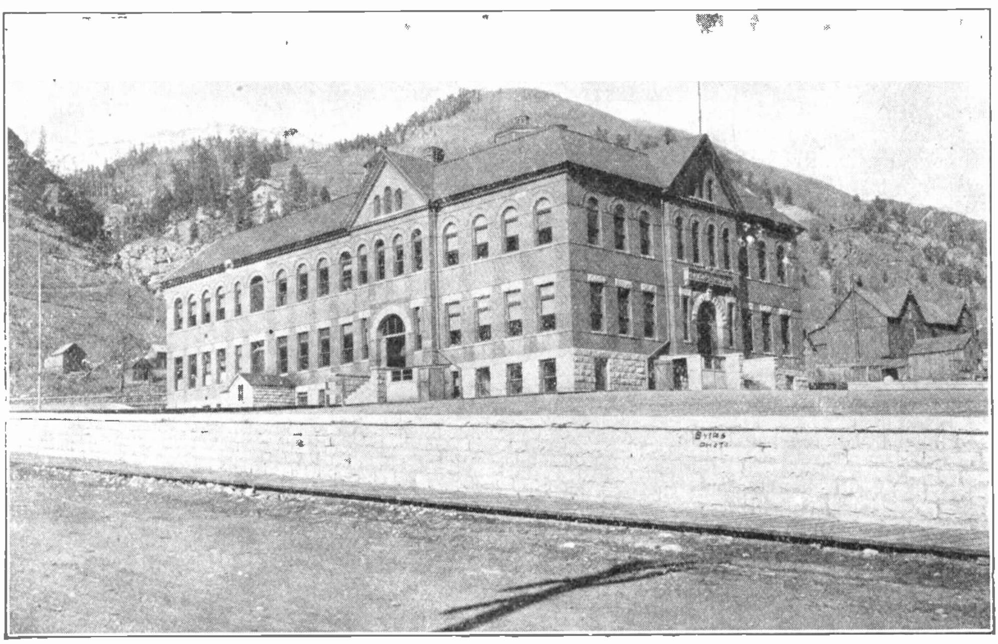
"Pray do!" said Mrs. Fitzgerrell.

Teaching Electric Cookery in Public Schools

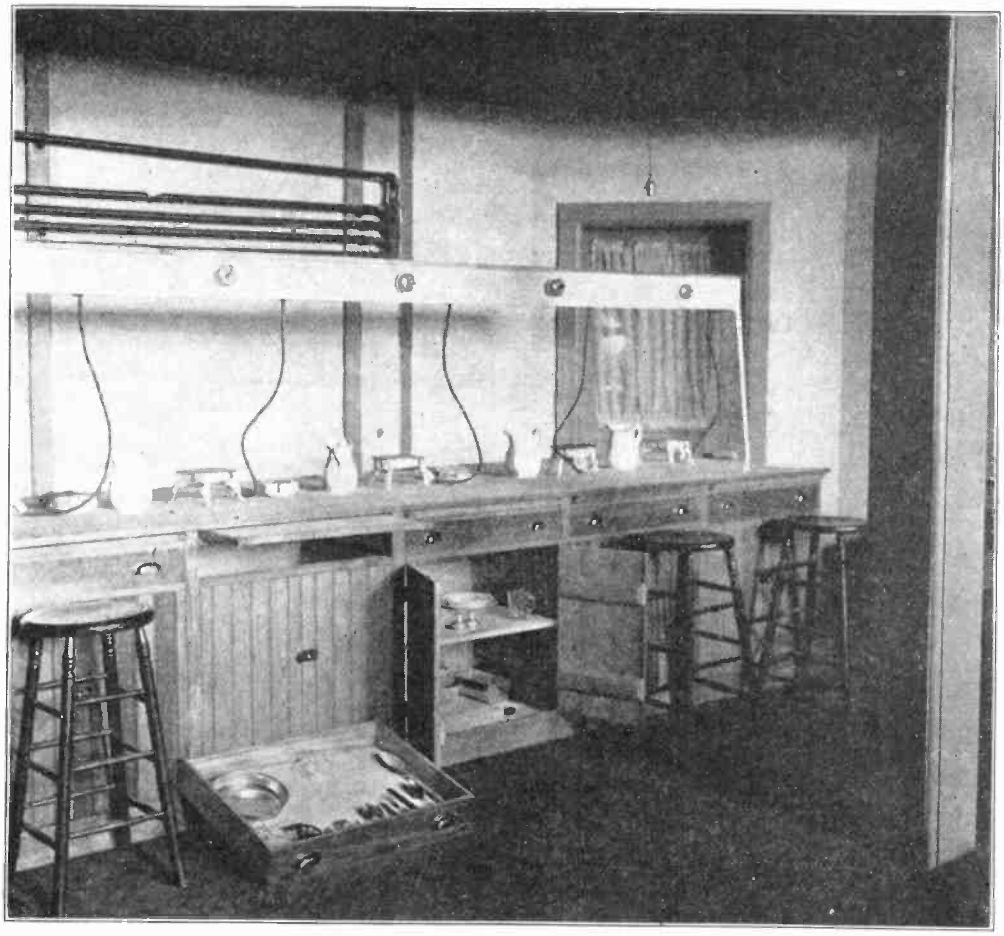
By ALBERT SCHEIBLE

Those who have never had the good fortune to visit some of the thriving mining towns of the West are apt to think of such places as rather primitive in their civic and educational development, as cities in which the picturesque crudeness of frontier life must be strongly in evidence. They forget that the very progressiveness which has led some of the best young blood of the East to pioneering in the mineral districts will also show itself in the readiness with which the communities are led by these same men to take up the most advanced ideas in the various lines of civic activity. Indeed, thanks to this freedom from the conventional methods which are still handicapping most of the older communities, many a western city is able to show a standard of progress for which the older towns may well envy it.

For instance, among the gold mining centers of southwestern Colorado is Telluride, a city barely 30 years old and yet one in which the local superintendent of schools publicly asserts that "while the district would not be classed as rich, still funds



THE HIGH SCHOOL BUILDING AT TELLURIDE, COLO.



DOMESTIC SCIENCE LABORATORY

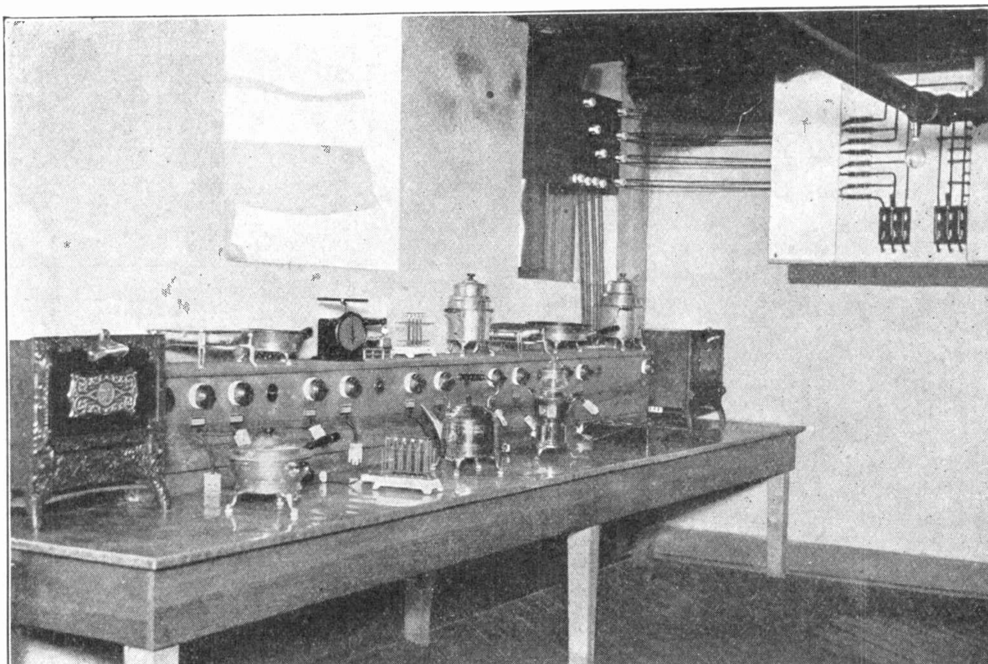
for the spread and maintenance of the schools are available at all times and adequate for all needs." To have ample funds available not only for the maintaining of existing schools, but also for taking care of their growth in a thriving city is a situation of which too few American cities can boast.

But Telluride does even more. It not only commands funds which are adequate when carefully used by a businesslike school board, but also has educational leaders who are fully abreast of the times and ready to undertake any forward step that promises to bring good returns, even if precedents for the same are not to be found among the older cities.

Yet this progressiveness is not a rash one, and when the Telluride Board of Education voted 2½ years ago to equip its schools for the teaching of domestic science, this was done only after a careful study of its constituency. There, as in many other cities of both the East and the West, the pupils are largely the children of immigrants, who themselves are unfamiliar with the American standards of living and housekeeping. The records showed that a large share of the girls are compelled to leave school before completing the High School or even the Grammar School. Unless their previous school training included cooking, sewing and the household arts, they would be forced into active life without the most important preparation needed for their future welfare. To meet this lack, instruction in the needed branches was introduced into both the elementary and the High Schools, cooking being taught in the sixth and eighth grades of the Grammar School and in two grades of the High School.

When it came to equipping the domestic science rooms, the choice lay between the familiar coal ranges and the comparatively untried electric stoves, for no gas was available and gasoline was promptly barred as too dangerous. In spite of misgivings on the part of some, the electric equipment was adopted, and during the past two years it has pleasantly surprised even those who had questioned the wisdom of introducing it. Instead of obliging the pupils to crowd around hot ranges in which the rate of heating depended to a large extent on the wind and weather, the use of electric devices left the girls plenty of room for their work, as enhanced by the electric range at one end of the room, which provides the ovens, grids, broilers, double boilers, toasters, frying pans, coffee percolator, chafing dish, waffle iron, flat iron and a ten-gallon water heater. All of these are arranged so that they can be instantly connected to the circuits when needed, and as none are heated when not in service, their use has shown a decided saving in cost over that of similar cooking on coal ranges.

But aside from the saving in fuel, the adoption of electricity has been most im-



ELECTRIC RANGE AT THE TELLURIDE HIGH SCHOOL

each one could attach her cooking utensils separately and regulate the heat to suit her particular need. Most of the practice in cookery is gotten by the girls at long tables, having drawers and cupboards for five on each side. Switches and plugs on an elevated shelf allow for attaching the eight-inch electric disk stoves, each of which serves for two girls working on opposite sides of the table. A heat regulating switch at each stove makes it easy to control the heat to the exact amount needed for the purpose in hand, and the general attractiveness of the whole outfit makes an appeal which could never come from any coal or gas-heated equipment. This charm is further

portant in making the cookery lessons so pleasant and the kitchen practice so congenial as to dispel the common impression that cooking means disagreeable drudgery. The cool, cleanly and always attractive electric equipment has entirely changed the attitude of the girls towards kitchen work and has led them to take a keen interest in what they would otherwise have grown to despise. Even if gas had been available, there would have been vitiated and usually overheated air, and the girls would have been obliged to stoop before or over the stoves for much of their practice work. Now the school kitchens are cool even on warm days, and the utensils can be used where no kneeling or stooping is needed for getting at them. Besides, there is no scouring of smoky or sooty dishes, no cleaning up of a mussy stove and no spoiling of food.

In wiring the High School building for electricity, this was also introduced into the manual training rooms, where the use of motors does away with the unsightly overhead belting and shafting. But the more pronounced success was that scored in the domestic science rooms regarding which the superintendent of the Telluride public schools, Mr. J. A. Sexton, recently wrote: "Our installation here is a source of genuine pride and satisfaction, and were the question of installation up for consideration now, there would not be a dissenting vote in the matter of the installation of electrical cooking utensils."

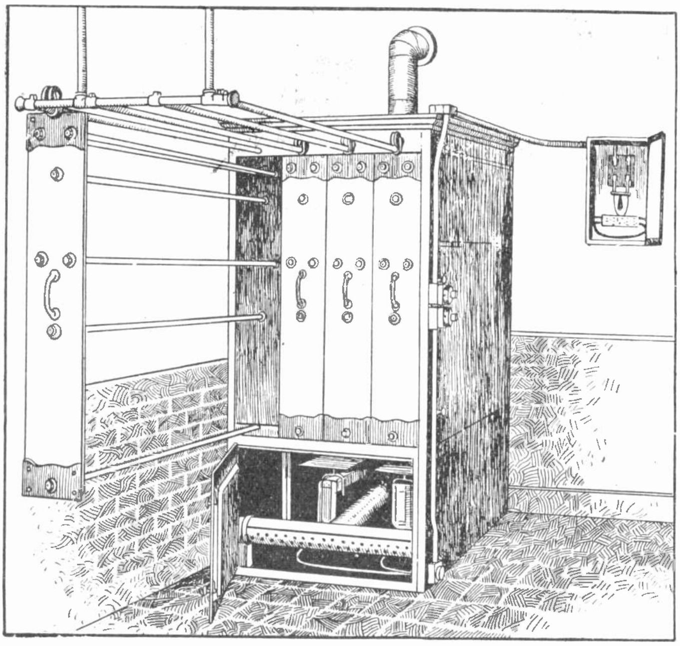
Clothes Dried Indoors

It is not necessary any more to hang the family washing out on the line to dry. A dryer installed in the basement and heated by electricity is one of the latest laundry devices.

In cities where houses are built close together with a porch on the alley instead of a yard, and with dust and dirt from everywhere blowing on and specking the clothes, an electrically heated dryer is a most useful thing.

The Chicago dryer is built of galvanized iron and fitted with racks, which are drawn out while the clothes are hung on the rods. When one rack is full it is pushed into the dryer and another is pulled out and filled. Underneath are electric heaters which are turned on by switches mounted on the dryer.

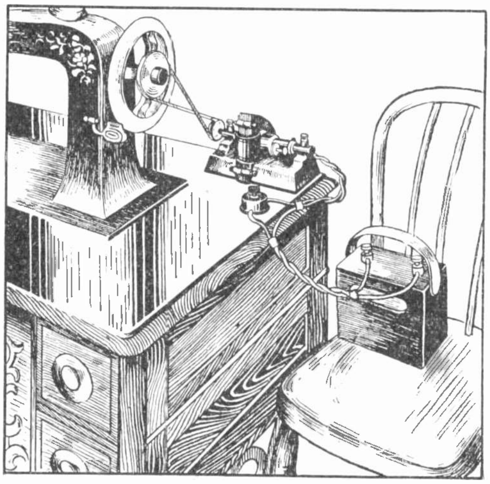
Though made of galvanized iron the equipment is also built and finished in polished brass or nickel plate, making its appearance such that it may be placed in the most elegantly furnished home without looking at all out of place.



ELECTRIC CLOTHES DRIER

Stop Treadling the Sewing Machine

It is not necessary to run your sewing machine by foot power even though the house is not wired for electricity. The



SEWING MACHINE DRIVEN BY BATTERY MOTOR

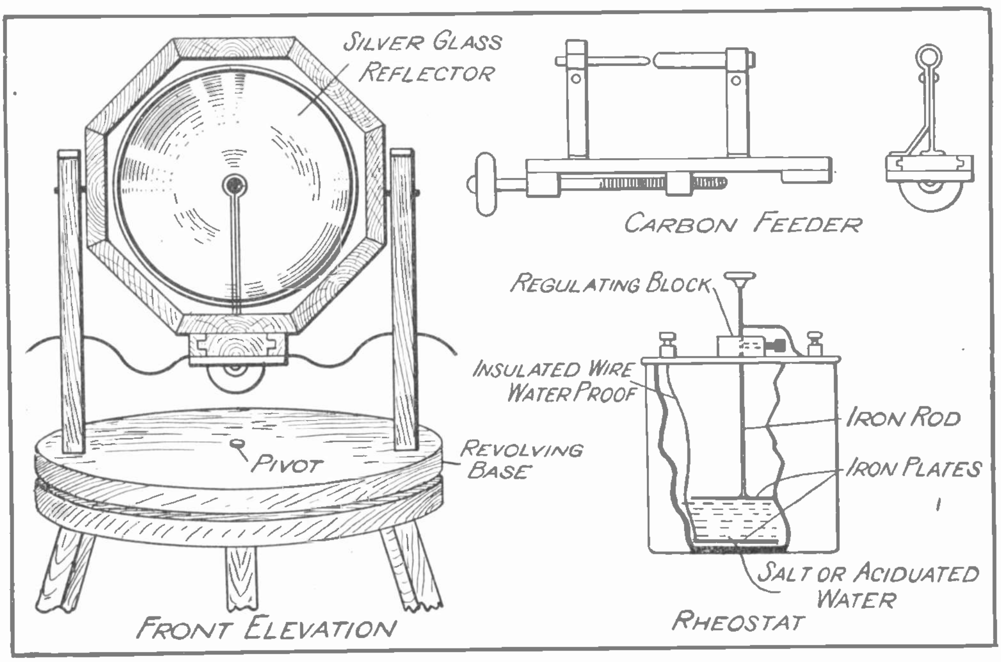
Electra storage battery and motor here illustrated can be readily attached to the machine, thus doing away with the laborious foot work. The battery will need charging about every two or three weeks.

A Home Made Searchlight

If, wishing some amusement and finding himself with nothing to do a boy can easily make a small searchlight providing he has a few tools and some knowledge of mechanics.

The light shown in the drawing was made as follows: The case was constructed of 5-16 inch wood, eight sided, ten inches in length and about the same in diameter with one section slotted 1½ by 5 inches. A back rights are securely fastened to one disk and tripod legs to the other; the uprights also have pivots for swinging the light. In this way the lamp may be swung up, down and from side to side.

The carbon feed is next and it might be well to say that the more care taken in making the better the operation. Three strips of wood about 1½ by 6 inches and 5-16 thick are tongued and grooved, one



SHOWING CONSTRUCTION OF A HOME MADE SEARCHLIGHT

which is made of the same wood is hinged to the case and in the center a hole is bored large enough to admit the metal end of a silvered glass lamp reflector.

The stand for the light is simply two disks of wood slightly separated by washers and pivoted in the center. Two up- piece having a tongue on both edges while the others are grooved only on one edge. The grooved pieces are fastened together at both ends by cross strips and just far enough apart to allow the middle strip to slip easily between them. Plane off the middle strip enough to eliminate any friction between it and the cross pieces. A rod of either iron or brass about seven inches long and 1/4 inch in diameter is threaded for about half its length and a knob attached to the end. Between the handle and the threaded portion it passes through a hole in one of the cross pieces.

A 1/4-inch nut is then fastened to the central section and the rod screwed through. When the handle is turned it will move the strip either backward or forward. One of the brass carbon holders is fastened to one of the outside strips while the smaller carbon is attached to the central piece. Connecting wires can then be attached to the holders.

The lamp is connected in the usual way with a rheostat in series and if alternating current is used the large front carbon should be cored.

Small points in the construction I have omitted as they are easily solved. The dimensions are approximate.

A searchlight of this kind may seem rather crude to many but the one I constructed could easily be seen several miles and it was of the same size as the one described.

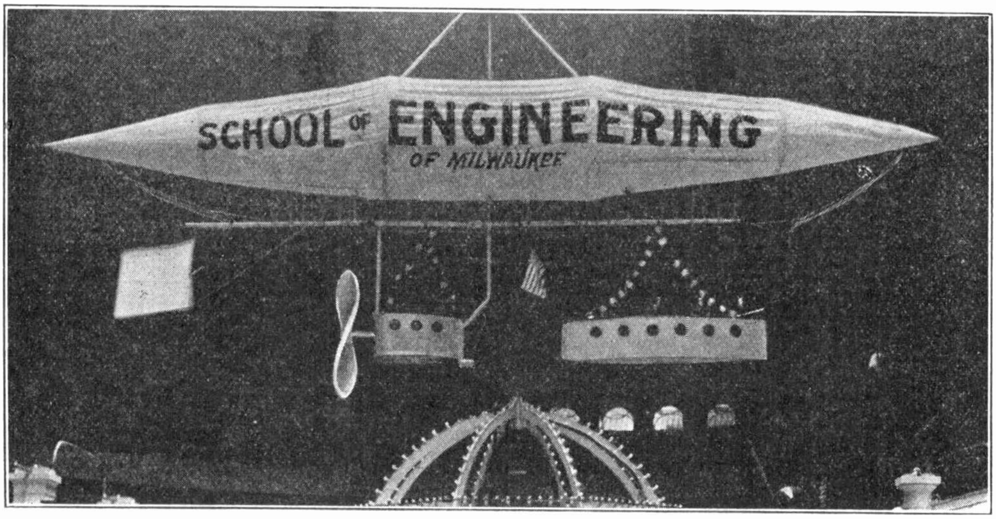
Wireless Operated Airship

This wireless operated airship was a prominent feature of the Merchants and Manufacturers' Industrial Exposition held in Milwaukee, September 2 to 12. It is the product of the students of the School of Engineering of Milwaukee.

In its operation advantage is taken of the transmission of energy waves through the ether. An electrical discharge is produced as in ordinary wireless telegraphy. A coherer on the airship gathers these energy waves and records each oscillation as received. The coherer through its attendant local circuit and relays then brings about the operation of the following features installed on the ship: First, the whistle sounds the signal for the commencement of operations; second, the propeller is set in motion and when the ship is under way the electric bell and electric lights are operated; next the flag on the flagstaff is unfurled, and lastly the cannon discharged, after which any of the operations may be performed at will.

How Silk Equalizes Temperature

It is known to everybody that silk is electrified by friction. Acting upon the suggestion thus furnished, a French savant, Monsieur Henry, has made experiments that show that the electrification of the air enclosed in a tissue of silk produces a circulation of its particles which tends to equalize the temperature. A similar effect is observable in wool, and hence the superiority of silk and wool for garments intended to protect the body against vicissitudes of climate.



WIRELESS OPERATED AIRSHIP

LEAD PENCIL ELECTRODES

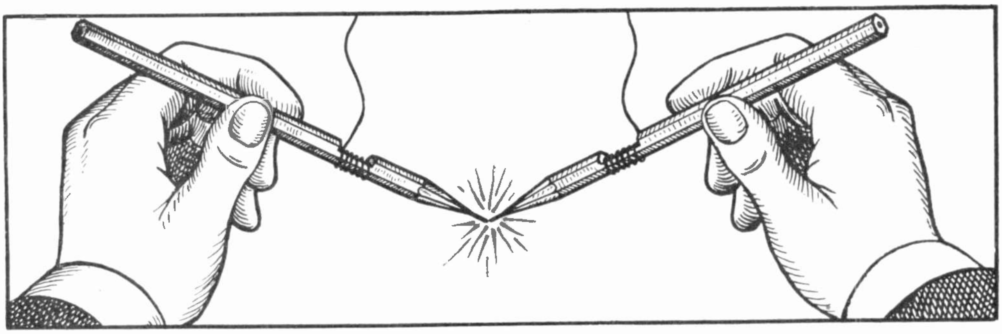
By A. A. SOMERVILLE

Furnace electrodes frequently consist of carbon rods, and if there is a short gap between them forming a break in the circuit the current jumps across that gap, forming an "arc." The "arc" is so called on account of the curved shape taken on by the lighted area. There is a big resistance to the flow of current right at the arc, so that a great amount of heat is generated here at the expense of electrical energy, and as a result of the large amount of heat liberated in a small space, that area attains a very high temperature.

As large electrodes are needed for use in furnaces where great masses of metal are to be melted, so small electrodes are adapted to finer or more delicate work. For instance, if two very fine wires, smaller than ordinary pins, or the size of a hair, are to be fused together by means of an electric arc, then very small terminals must be used to lead the current to the place where it jumps across the gap, or forms the heating arc.

The lead or graphite in a lead pencil is a form of carbon. In reality it is a sort of composition matter consisting of graphite and some kind of clay or binding agent used to make the particles of graphite adhere when moulded into a long stick or rod of a suitable size to use in a lead pencil. This composition material, however, does not melt easily, and conducts electricity, so it may be used the same as a stick of carbon for an electrode.

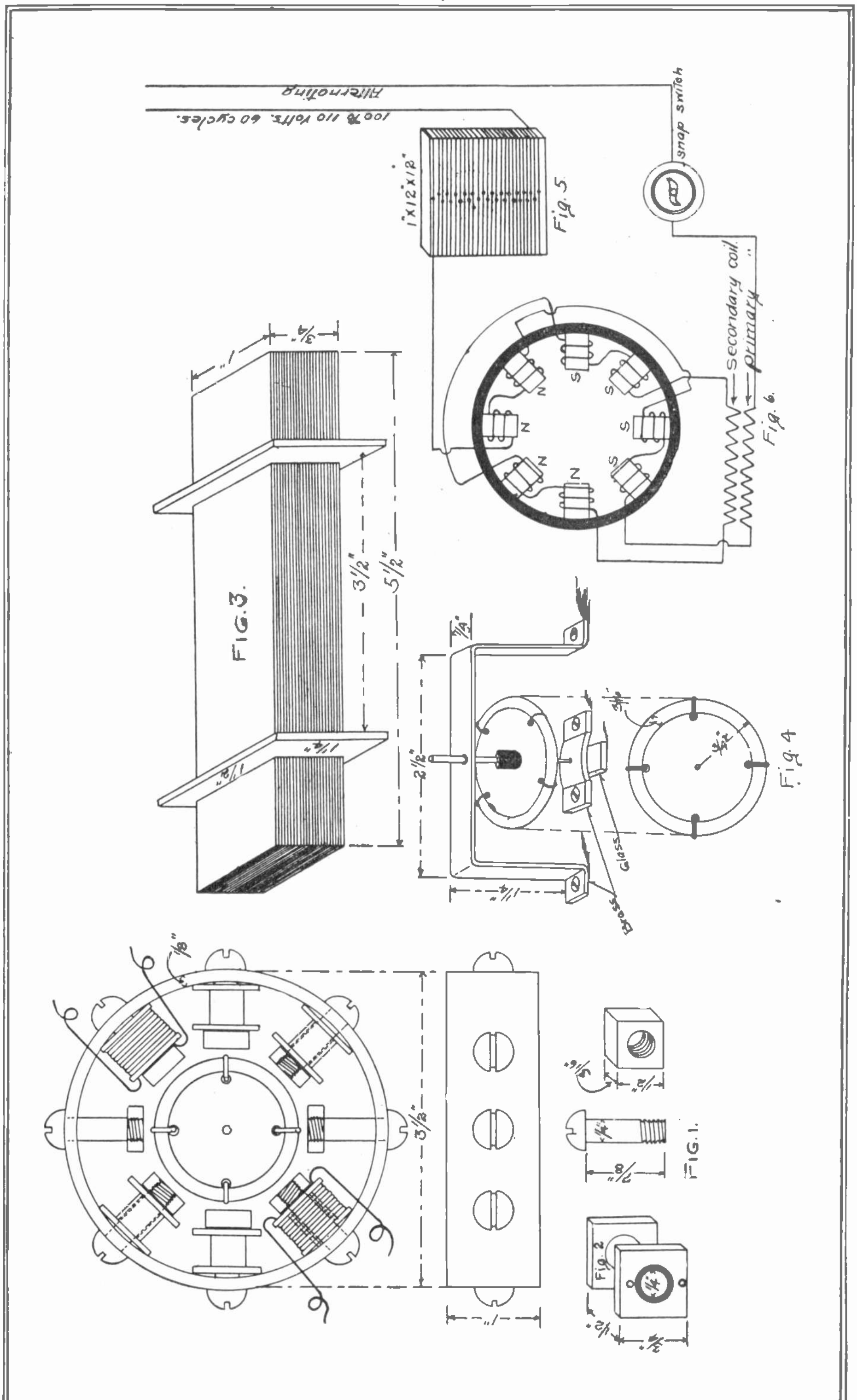
Two ordinary lead pencils costing only a cent apiece may be used. They are first sharpened as if they were to be used for the usual purpose of writing. Then a small notch is cut in one side of each pencil, laying the lead bare at a position about two inches from the sharpened end. A small copper wire is wound around the pencil and into this notch, thereby making contact with the exposed lead or graphite. By means of these small wires the pencils are connected to larger wires, which in turn are connected to a switchboard or source of electric current supply. At some place in the circuit there should be a resistance to prevent short circuiting and also to control the strength of the current. As the wooden sheath on the pencils offers sufficient insulation they may be picked up, one in either hand, and no electrical effect will be felt by the person so doing. If the pointed tips are touched together a fine little arc will be formed not much larger than the tips of the pencils themselves. The temperature of this arc, however, is such that the fine wires or small quantities of metal may be melted readily.



A LITTLE ELECTRIC WELDER MADE FROM LEAD PENCILS

These little lead pencil arcs may be used to fuse very small gold or silver wires or platinum thermometers or wires for tungsten or tantalum lamps. The bead or globule of molten metal formed on the end of a fine wire need be no larger than a small-sized grain of sand.

As a result of the weighing frauds in the customs house of New York last year the government has just placed electrical weighing machines in the customs houses of New York and Boston.



DETAILS OF A MINIATURE ALTERNATING CURRENT MOTOR

Miniature Alternating Current Motor

By A. L. MUMFORD

Materials quite readily obtained by the amateur are used in the construction of this motor. Fig. 1 represents the field ring, the field magnets and bobbins in different stages of construction, and also the armature. The field is made of an ordinary flat soft steel or iron ring one-eighth inch thick, one inch wide and three and one-half inches in diameter. It must be exactly round and is drilled with eight equally spaced ¼-inch holes, into which are put eight bolts with nuts. The bolts are ¼ by ⅞ inch. The nuts are 3-16 by ½ inch.

Eight magnet bobbins, Fig. 2, are made by rolling a ½-inch strip of paper to a thickness of 1-16 inch, upon a bolt or round piece of wood slightly larger than ¼ inch. The paper should be glued every other turn. For bobbin ends use photo cardboard, as this is quite tough. Make sixteen of these ¾-inch squares, punching or cutting holes in them so they will slip tightly on the bobbins. Put one on each end of a bobbin and glue very firmly. Next make a small hole near the inner and outer edge of the bobbin ends to bring the wires through. Now wind each bobbin evenly and carefully with fourteen feet of No. 26 B. & S. gauge d. c. c. copper wire, leaving about twelve inches of wire on the ends. Fig. 3 represents a transformer core. A transformer is used to make two phases from one or to split a single phase. It is built up of sheet iron strips or tinned iron strips. Each strip is one inch wide and 5½ inches long. Enough strips are made to make a pile ¾ inch high, after being tightly wrapped with tape. You can make bobbin ends of cardboard as in the drawing or build up ridges of tape ⅛ inch high and 3½ inches apart to hold the wire in place. Now wind one layer of No. 26 B. & S. gauge d. c. c. copper wire between the bobbin ends. Wind very evenly and tight, leaving about one foot of wire on the ends. This winding will be the secondary coil. Cover this coil with paper or tape, then wind two layers of the same size wire over the first layer, leaving about one foot of wire on the ends. This will be the primary coil. Fig. 4 shows the armature and method of mounting, which is vertical. The armature is nothing more than an iron or steel ring 1½ inches in diameter from outside to outside, and about 3-16 inch thick. It is fastened to a heavy cardboard of the same diameter with four pieces of wire. For a shaft use a short piece (about 1¾ inches long) of hat pin or steel needle with a sharp point. Stick this through the exact center of the cardboard, then take two short pieces of rubber from the end of a pencil and shove them on each end of the needle up against the cardboard to hold it firmly. Now make a yoke out of a strip of brass with a hole in the middle for the top end of the needle shaft, and provide a small piece of glass and a strip of brass over the glass with a small hole in it for the point of shaft to go through and rest on the glass.

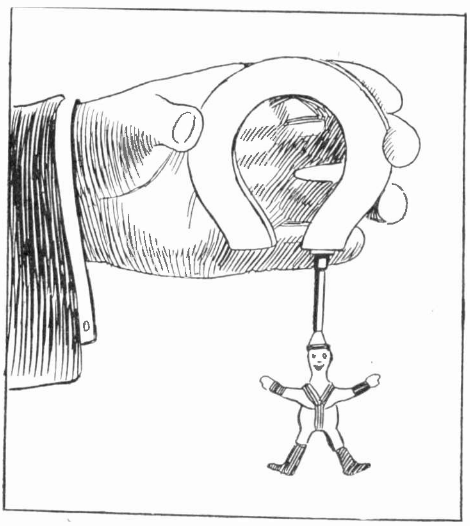
The resistance board, Fig. 5, is necessary to cut down the voltage and current. Without it the coils would burn out. The resistance wire consists of about 104 feet of No. 30 B. & S. gauge iron wire, which is about the size of that found in braided picture hanging wire. It can be mounted in any desirable way. One way is to wind the wire on a hardwood board, 12 by 12 by 1 inch, covered with asbestos. In winding separate the adjacent wires about ¼ inch. Tack each wire down in the middle of the board. Always keep the board on end when using by providing a base or suspending the board from a metal bracket. If asbestos board can be obtained it is most suitable to wind the resistance on.

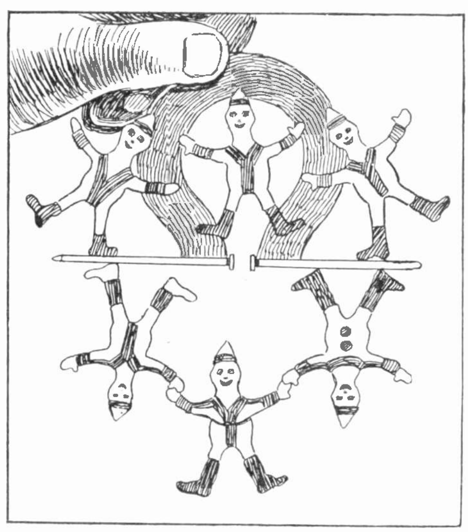
The method of connecting up is shown in Fig. 6. A test should be made with a battery and compass to make sure that the polarity of the field magnets is as shown.

After all connections are carefully made as shown, place the field ring over the armature and slide the armature to the middle of the pole pieces, and have equal clearance all around between the pole pieces and armature. Now close the switch and the armature will fairly hum as the speed will be considerable.

Clever Magnetic Toys

Several years ago the novelties imported from Japan included a little toy consisting of a tinned tube around which a steel wire was fastened near one end. With it were a set of three cardboard disks in assorted sizes, each having Japanese figures on one side, and each bound with a slender metal rim. The rims were of very thin sheet iron and the wire on the tube was magnetized so that if the rim of a disk was brought into contact with it, the magnet would support the disk. Then by blowing through the tube the disk could be made to spin in the air. The game (which did not prove popular in this country, probably because the instructions were printed only in Japanese) consisted in picking up the disks with the magnet, beginning with the smallest of the three and counting the number of times which each could be made to revolve by the blast of a single long breath while still clinging to the tip of the wire. Too sudden a puff would blow the disk right off the supporting magnet, particularly with



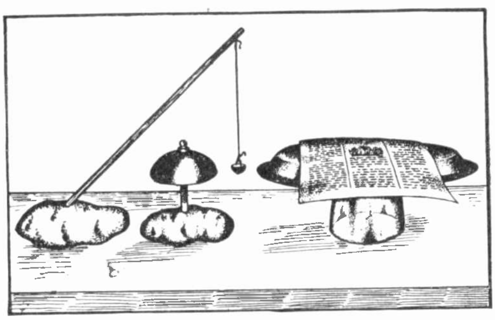


the larger disks, hence there was a chance for some skill in tilting the tube with the wire and in controlling the breath.

Recently another magnetic toy, somewhat similar in principle, has been brought out in Pennsylvania. Instead of the iron-rimmed paper disks with numerals on them, this toy has acrobatic figures punched out of sheet iron and lithographed in colors. These acrobats in connection with a horseshoe magnet can do a variety of evolutions, either by themselves or in combination with wire nails. Singly, they can also be spun around by a light breath when supported either direct from the magnet or by a wire nail.

Ringing a Bell with Static Electricity

An interesting home experiment with static electricity may be performed with the following apparatus readily obtainable about the house. Place an ordinary pie tin upon an inverted tumbler of thin glass. Cut a piece of newspaper as wide as the pie tin is in diameter and four or five inches longer. Take the bell out of an old alarm clock



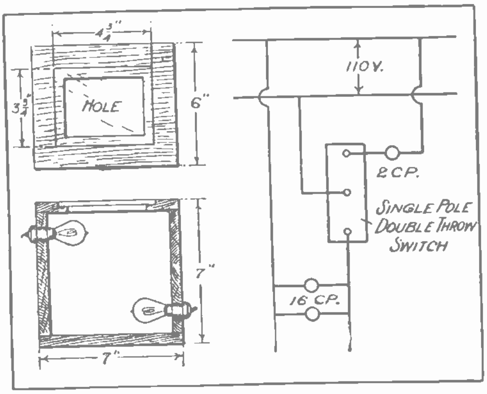
STATIC BELL RINGER

and fit it on a sharpened stick thrust into a potato which has a flat slice cut off the under side. A small shoe button suspended from a stick by a silk thread should now be arranged as shown by using another potato. Now warm a smooth board and laying the paper upon it, stroke the paper with the hand, rubbing it quite hard and fast. Taking the paper by the ends, place it on the pie tin. Immediately the button will begin to vibrate between the bell and tin and will continue for some time. When it stops lift the paper by the ends and the button will again swing back and forth. If the surface of the bell be made wet the experiment works better.

Printing Box for Photographers

For the benefit of amateur photographers permit me to describe an electrical printing box which will take a plate 4 by 5 inches.

A box is constructed such that the inside dimensions will be 6 by 7 by 7 inches. The inside is lined with asbestos, ⅛-inch thick, which will resist the heat of the incandescent globes used, and also be a reflecting surface. The top is hinged on the narrow side and has a hole 3¾ by 4¾ inches cut through the center. A ⅛-inch margin is



PRINTING BOX FOR PHOTOGRAPHERS

countersunk all the way around, the thickness of a glass plate.

The two sixteen candlepower lamps used for printing are mounted on opposite ends of the box (as per sketch) to insure even illumination. The control may be a double throw, single pole knife switch. A two candlepower 110 volt lamp is arranged in front of a 2½ by 3-inch window in the developing room that has tin guides to hold a ruby or orange glass during development. The small lamp acts as a pilot lamp to show when the sensitized paper is on straight. It is connected to the circuit as shown in the diagram. It is "off" during printing and "on" during developing, and will be found ample light, both for papers and negatives. While developing negatives the top should be covered with a piece of cardboard painted dead black.

I have used this arrangement for more than a year and have found it superior in every way to printing frames and it is much more economical of current than anything I ever tried.

WARREN C. THOMAS.

Construction of a 120-Watt Transformer

By CHARLES F. FRAASA, JR.

Of the various devices for supplying a small constant quantity of current for experimental work, none is as practical or as efficient as the small alternating current transformer. Dry batteries are expensive, cannot be depended upon for a constant continuous current, and frequent renewals are necessary, and the storage battery requires careful attention and frequent charging.

The comparative ease with which the ordinary 110-volt alternating current from the lighting circuit may be handled and transformed to various pressures makes it especially adaptable to amateur use. It is the purpose of the writer to give in this article complete and definite directions for the construction of a small transformer that will be found a very useful substitute for the forms of current source enumerated above.

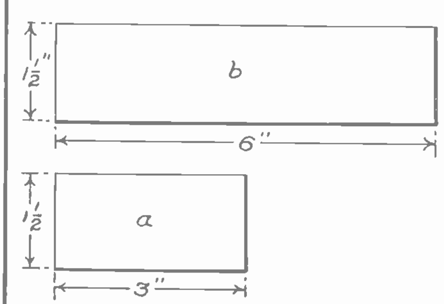
The principal parts of a transformer are the core, and on it two coils, each forming a separate circuit. The coil upon which the current to be transformed is impressed is known as the primary, and the coil which delivers the transformed current is known as the secondary.

There are two types of cores, one in which the coils surround the iron, known as the core type, and the other in which the iron surrounds the coils, known as the shell type.

A transformer which delivers a secondary voltage higher than the impressed primary voltage is known as a step-up transformer, while a transformer that delivers a secondary voltage lower than the primary impressed voltage is known as a step-down transformer.

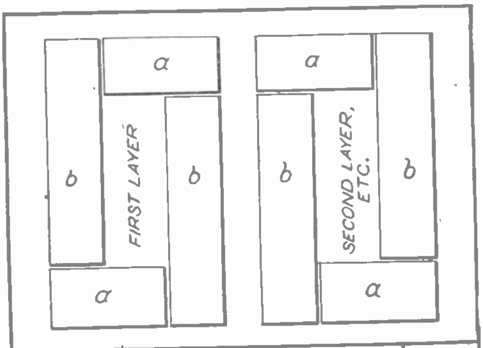
The transformer described and dimensioned in this article is a core-type, step-down transformer and transforms 110 volts 60 cycle alternating current to 5, 10 or 20 volts.

The core is composed of thin strips of sheet iron, cut to the dimensions shown in Fig. 1 (a) and (b). Enough strips of each dimension should be cut from No. 27 sheet iron to make a stack three inches thick. Then dip half of the sheets of each dimension in thin shellac or japan, giving each sheet a thin insulating coat. The final arrangement of the core sheets is illustrated in Fig. 2, which shows how the alternate layers of the core are laid. It would be very difficult to build the whole core up at once in this way, and then separate it for winding the coils on the core legs (b), so they will be assembled separately, and then joined by the (a) pieces. The core legs (b) cannot be assembled by stacking all the sheets up and then squaring them, but must be so arranged that alternate sheets project 1½ inches, leaving a space for the



CORE SHEET DIMENSIONS (a) (b) | FIG. 1

yoke strips (a) between them 1½ by 1½ inches square. To do this by hand is very tedious, so a device for assemblying the core should be made by mounting two parallel wooden strips 1½ by 1 by 3 inches and 7½ inches apart on a piece of wood about 3 by 9½ inches, with a 7½-inch strip along one side between the 3-inch strips. The sheets should then be assembled between the 3-inch strips, so that the sheet iron strips touch first one side and then the other, leaving a 1½ by 1½-inch space at the ends of alternate strips. When assembling, alternate the insulated strips with the others to insulate the core and prevent heating. When enough strips to make a thickness of 1½ inches have been assembled, remove and clamp them in a vise and wrap a layer or two of friction tape very tightly around the solid part of

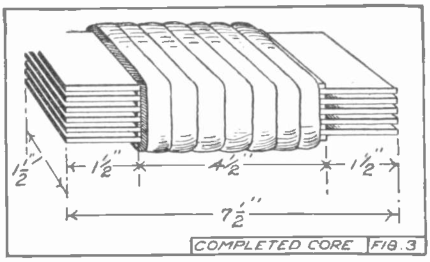


ARRANGMENT OF ALTERNATE LAYERS OF CORE FIG. 2

the core to hold the strips together. The core will then appear as in Fig. 3.

The core is now ready for the bobbin on which the coils are to be wound. Wrap a piece of 1-16-inch sheet fiber around the core over the tape to form a bobbin tube. The fiber should be about 6½ inches long and the joint may be secured where the fiber laps by applying some thick shellac. Fig. 4 shows the bobbin tube (T) and the heads (H). The bobbin heads are ⅛-inch thick fiber and are dimensioned in Fig. 5. The central opening is cut large enough to go on the fiber tube on the core, and should be secured by shellac. We are now ready to wind the coils.

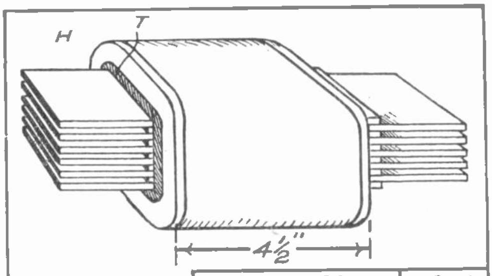
The secondary consists of 76 turns of No. 11 d. c. c. magnet wire per core, or a total of 152 turns on both cores. Since the space between bobbin heads is 4⅜ inches, this will make two layers per core. Each layer should be separate from the other. The beginning of the first layer should be tagged and marked No. 1, and the end No. 2. Cut the wire at No. 2, and let the wire project through the bobbin head.



COMPLETED CORE FIG. 3

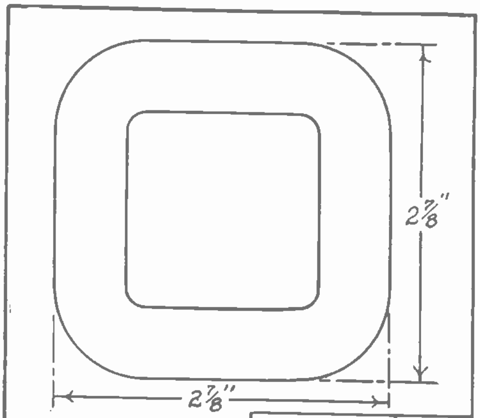
Then start the second layer on the same end of the core as the first layer, and wind in the same direction. Label the beginning of this layer No. 3 and the end No. 4; thus there will be four coils in the secondary, enabling connections to be made for three different voltages. A short piece of flexible lamp cord should be soldered to the beginning and end of each coil and brought out through a hole in the bobbin head, Fig. 6, as S1, S2, S3 and S4. The beginning of each coil will then be on the upper end, and the end on the lower end of the bobbin, though both are shown on the same end in the illustration merely for convenience.

Now shellac the secondary well, and wind on four layers of shellaced muslin or other insulating material, and then wind over this the primary of 380 turns of No. 18 B. & S. gauge d. c. c. magnet wire on each coil, winding it in five layers. The total number of primary turns is 760. The



COMPLETE CORE FIG. 4

beginning and end of each coil should have a flexible lead of lamp cord soldered to it for connections. Shellac each layer well, and wind on it a layer of shellaced bond paper. The whole coil should now have

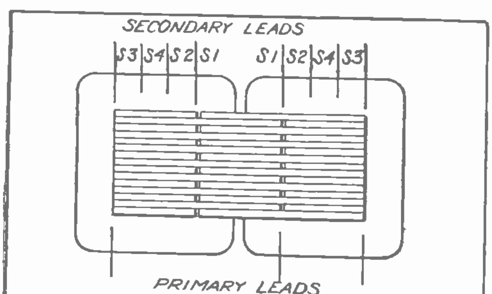


BOBBIN HEAD FIG. 5

two or three layers of muslin or duck wrapped on it and should receive a good application of shellac.

Fig. 4 shows how the completed coil will then appear. The coil should now be laid aside to dry, or if possible should be placed in a warm oven over night.

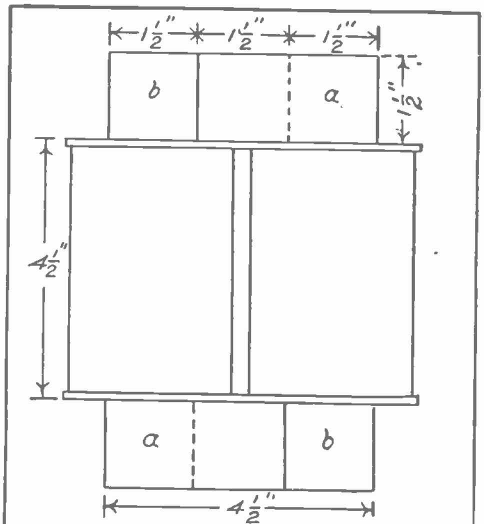
When the coils are dry the cores are ready for the assembly of the (a) strips. The process of assembling the core is shown in Figs. 2, 6 and 7. Place the two cores side by side, with a space of 1½ inches between them. Then insert strip (a) Fig. 2, from the right hand side in the space between the first and second core sheets, and let it touch the other leg. Then insert the next strip (a) from the left hand side between the first two strips of the left hand core. Continue alternating in this way until the top is filled with the (a) strips. Then turn the whole over and fill in the bottom in the same way. The alternate layers of the core will then be as in Fig. 2, and since the sheets overlap, a mechanical and magnetic joint will be the result. Fig. 7 shows the assembled core and coils.



SHOWING PLAN OF CORE AND LEADS FIG. 6

By clamping the ends of the core together the magnetic circuit can be improved, as the sheets will be forced together, thus shortening and getting rid of most of the air-gaps and preventing the natural tendency of the core to vibrate. These clamps are cut from some ½-inch oak, and are 1½ inches wide by 6½ inches long. A hole should be drilled in each end of the clamps for the clamping bolts which are ⅜-inch in diameter. The clamping strips should be placed on both short sides of the core when the ⅜-inch bolts may be inserted and the nuts drawn up tight.

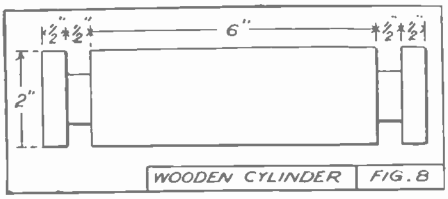
The transformer is now complete, except for connections. The simplest form of connections is to bring the flexible leads of the coils up to a connection board mounted



TRANSFORMER ELEVATION FIG. 7

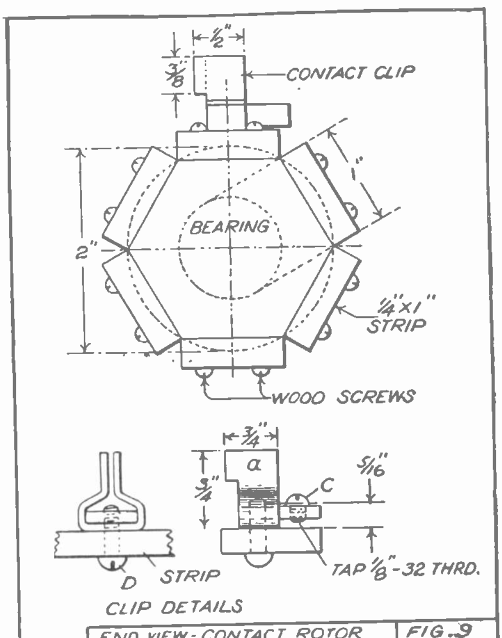
on top of the transformer and secured to it by screws turned into the clamps. Suitable connection screws and fuses can be provided on this block.

The primary coils should be connected in series and the connections should be such that at any cycle the current will flow in opposite directions around the two core legs. Should the builder desire to arrange the transformer so that the voltage and amperage of the secondary may both be varied, the device illustrated in Figs. 8 to 15 should be built. By means of this switching device the coils may be easily thrown in series, parallel, or a combination of the two.



WOODEN CYLINDER FIG. 8

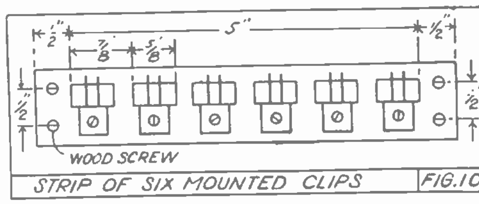
As will be seen in the illustration, the switch is composed of a rotating cylinder with a number of clips arranged in rows along its surface, which make contact with a number of suitably arranged switch or contact blades. The cylinder dimensioned in Fig. 9 should be turned down from a piece of hardwood, such as oak, and stained



END VIEW-CONTACT ROTOR FIG. 9

and polished. The central portion, which is six inches in length and two inches in diameter, should be marked off into six equal arcs, and then planed down, making each face about one inch wide. The dotted lines, Fig. 9, show the section of the center portion of the cylinder.

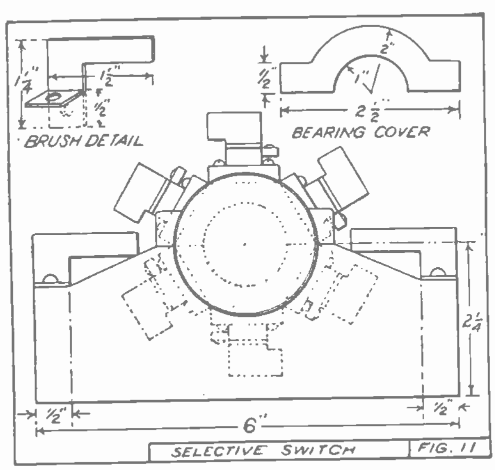
The clips (a) shown in Fig. 9 are made from 1-16-inch sheet brass or copper, and cut to the shape and dimensions shown. The connection lug (b) of the clip is a piece of ⅜ by ¾ inch brass or copper and should be cut from some ⅛-inch sheet or strip, and should have the two screw holes for the screws (c) and (d) drilled and tapped for a ⅛-inch 32-thread per inch screw. Then cut six strips of oak 1 by ¼ by 6 inches long, and mount the clips on them as in Fig. 10, by inserting the screws (d) through holes drilled in the strips, screwing them up very tightly. These strips are then mounted on the faces of the cylinder, Figs. 8 and 9, by means of small wood screws.



STRIP OF SIX MOUNTED CLIPS FIG. 10

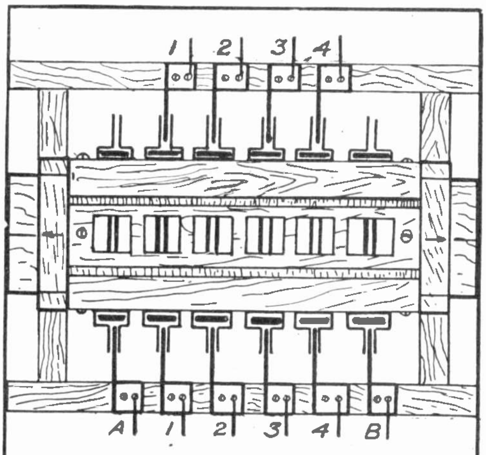
The cylinder support and switch blade holder, Fig. 11, should next be constructed from oak, and stained and polished. The stock is ½-inch oak, and should be put together with round-head screws. The switch blades should be cut from 1-16-inch brass or copper, and are mounted by means of two wood screws on the side strips of the cylinder support, as shown in Figs. 11 and 12. The cylinder should be put in place and the bearing block screwed down. The clips may then be cross-connected as in Figs. 13, 14 and 15, when the connections to the coils may be made on the switch blades. It is well to mark the voltage and amperage obtainable with the cylinder at a certain position, by marking it on the two end rings of the cylinder.

The cylinder may then be rotated, bringing around first the parallel connections, giving 5.5 volts, 24 amperes; then the series

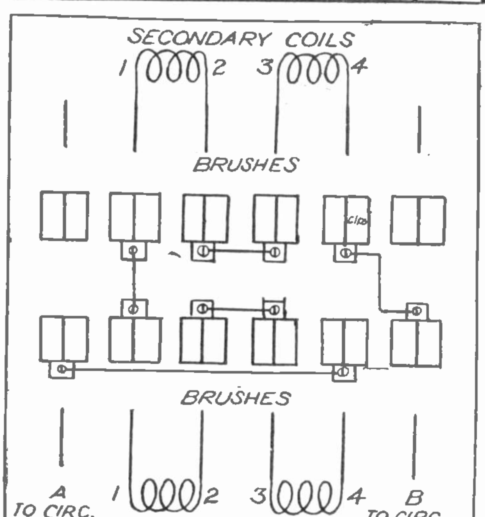


SELECTIVE SWITCH FIG. 11

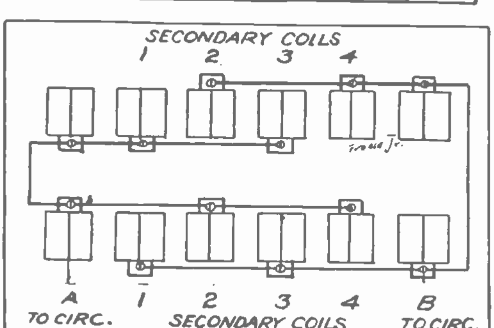
of 22 volts, six amperes, and finally the series parallel of eleven volts, twelve amperes, making no allowance for drop in the transformer coils.



SELECTIVE SWITCH FIG.12

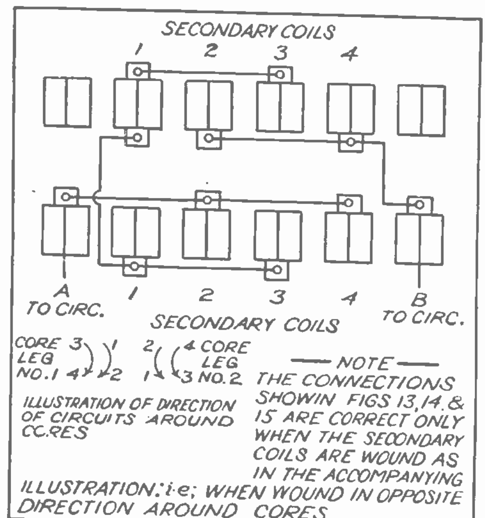


ARRANGMENT OF SERIES CONNECTIONS FIG.13



ARRANGMENT OF PARALLEL CONNECTIONS FIG.14

The switch may be mounted on the transformer, or on a switchboard, and is useful for changing connections of batteries, circuits of instruments, etc., as well as in connection with the transformer. A two-ampere fuse should be placed in the primary on each side of the line, and also a snap switch or better, a two-pole single throw switch. The secondary current obtained at the contacts (a) and (b) should also run through a double pole single throw switch, so that the circuit may be interrupted while



ARRANGEMENT OF SERIES-PARALLEL CONNECTIONS FIG.15

changing from one set of connections to another.

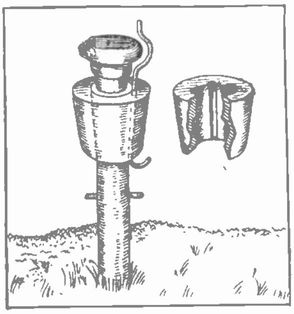
While the above transformer design is rated at 120 watts it is liberal enough in design to allow for 150 watts, which some designers would allow, but it will be found to operate cooler at 120 watts and leave an allowance for operating on small overloads.

Carrying Capacity of Brushes

When an engineer finds his generator or motor sparking he is often unable to immediately locate the cause, and if the load carried by the machine is heavy he sometimes wonders if the brush area is ample. Under ordinary steady running the number of amperes per square inch of surface contact brushes will carry is as follows: Woven wire or gauze brushes, 130 to 145 amperes; leaf copper, 175 to 200 amperes; carbon, 35 to 42 amperes.

Ground Wire Fastener

With the idea of making the grounding of electrical conductors simple and easy Milton H. Lawrence, Larned, Kansas, has designed and patented the apparatus illustrated. The device consists of a rod driven

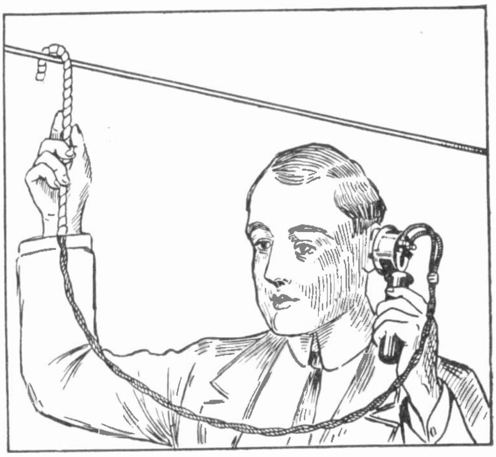


GROUND WIRE FASTENER

into the ground, a tapering thimble on the rod to fit over a tapered portion, and a groove in the thimble in which the wire with the end bent up is placed. By driving the rod into the ground the wire is tightened and the thimble grips the wire more firmly.

Detecting Alternating Current

It is often desirable to determine whether the current flowing in a wire is direct or alternating; if an alternating circuit whether the wire is "dead" or not. A very handy testing device may be made by using a telephone receiver, a length of No.



TESTING FOR DIRECT OR ALTERNATING CURRENT

14 flexible lamp cord, a few pieces of iron wire about ten inches long, and some No. 28 s. c. c. magnet wire.

Form the iron wires into a bundle, then wind on the magnet wire providing three layers, leaving three-quarters of an inch of the iron wires exposed at each end. Now solder the ends of the magnet wire to the ends of the lamp cord, the other ends of which are attached to the receiver.

The whole testing end should then be thoroughly taped as illustrated. By placing the coil now made close to a wire of an alternating current system in which current is flowing, a decided humming sound will be heard in the receiver. This sound is more intense if the voltage of the circuit is high. If current is not flowing, there will be no sound. Direct current does not affect the receiver. The coil and core may be bent up as shown and hooked over the wire tested if desired. The device operates on voltages as low as 110 while on 440 volt wires the noise in the receiver is very loud.

F. F. SENGSTOCK.

Insulating Gloves and How They Are Tested

It is often necessary to work upon high-voltage wires or cables while they are carrying current. The men who do this work protect themselves by wearing rubber insulating gloves. These rubber gloves are sometimes badly worn or punctured by contact with sharp projections. To guard against this as much as possible an English firm is placing on the market gloves having leather facings on the rubber over the palm of the hand and face of each finger.

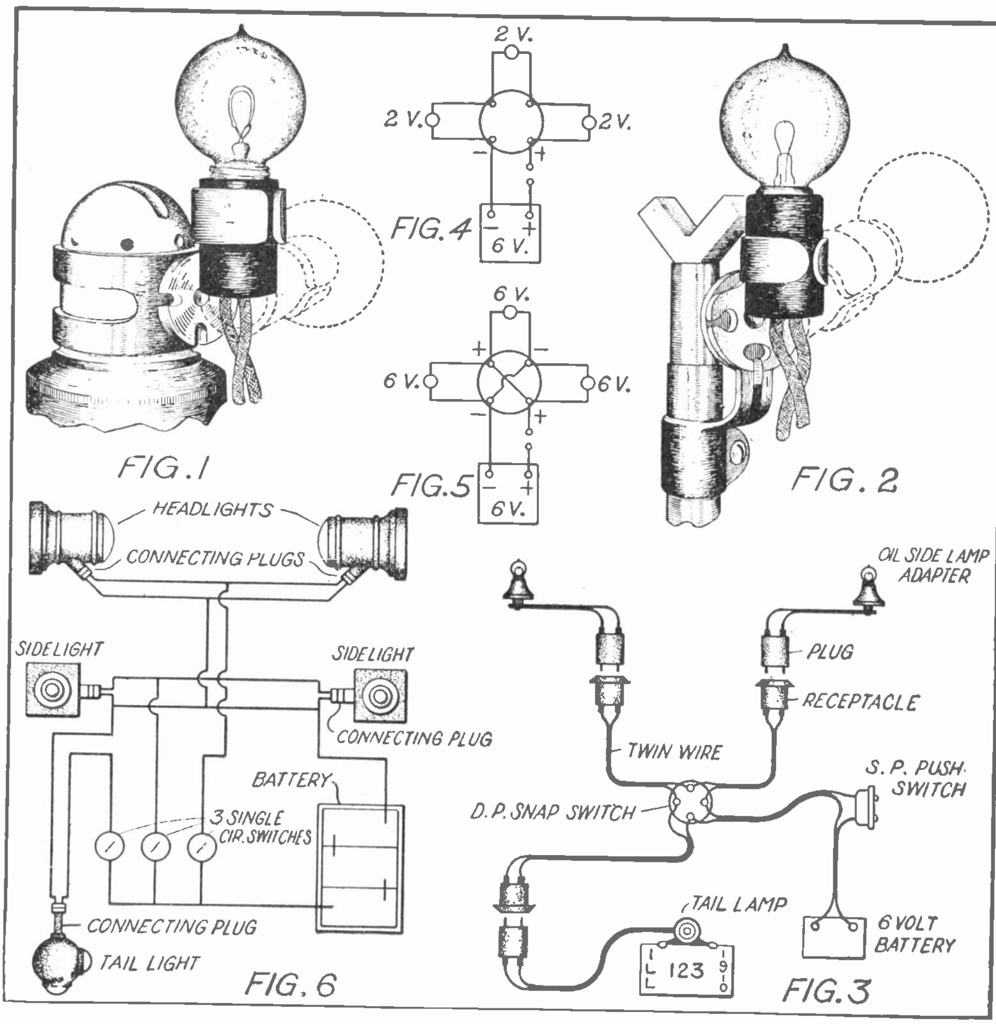
Extreme care is used in sending such gloves out to linemen, some light and power companies testing each pair every time they are used. In testing the glove it is filled nearly full of water and then lowered into an insulated tank of water with some of the gauntlet still dry extending out of the water. A wire from one terminal of a high voltage transformer is then placed inside the glove and a connection from the other terminal is dipped in the tank. A voltage much higher than that on which the gloves are to be used is applied and any weak point will be punctured.

Equipping the Auto with Electric Lights

Not infrequently the owner of an automobile which is lighted by gas or oil lamps comes to the conclusion that he prefers electric lights. The first thing to decide is whether the oil or gas lamps shall be retained and converted into electric, or whether these lamps shall be replaced by straight electric lights. If the original lamps are retained the change may be made by using a bracket constructed in two styles to fit either an oil or a gas burner and holding an electric lamp socket that may be adjusted if necessary so that the oil or gas lamp may be used.

Fig. 1 shows the device made for an oil lamp and Fig. 2 as adapted to the gas burner. If the oil or gas lamps are entirely discarded and new lamps put in place, these may be connected by plugs and receptacles to the permanent wire of the circuit, the plug being pulled out in case it is necessary to repair or detach a lamp. The wire, lamps, plugs, switches, etc., may be purchased from manufacturers complete, with directions and diagrams for installation. The wiring from the battery through the switches must be governed by the driver's desired control of the lights.

Fig. 3 shows one plan of wiring in which two side lights and a tail light are provided.



AUTOMOBILE LIGHTING CIRCUITS

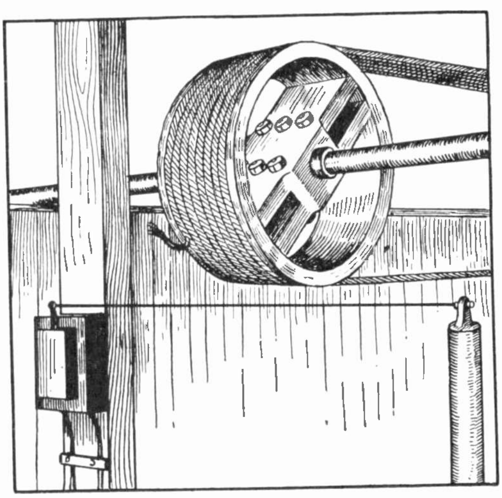
By using a double-pole snap switch and turning it to the "off" position, Fig. 4, two-volt lamps may be used for side and tail lights, the three lamps being thus placed in series with the six-volt storage battery.

By turning the double-pole switch to the "on" position the lamps are placed in parallel, Fig. 5, and six-volt lamps must be provided. A single-pole snap switch connected in near the battery enables the driver to turn off all the lights at once.

Another plan in which five lights and three single-pole snap switches are used, is shown in Fig. 6. The two headlights are controlled by one switch, the side lights by another and the tail light by a third switch. Where joints are made the wires should be scraped clean and after soldering, should be taped with a layer of rubber tape, then covered with friction tape. All connections should be firmly made and a diagram laid out beforehand often prevents making wrong connections.

Warns When Rope Frays Out

Grain elevators and flour mills use rope drive very extensively instead of belting for the transmission of power from the engine



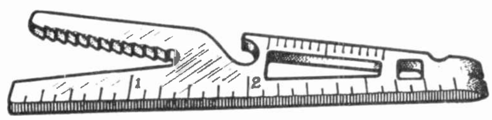
A FRAYED ROPE GIVES ELECTRICAL WARNING

room to the buildings and also in them. Occasionally a rope breaks and results are quite serious, doing considerable damage to shafting and stopping that part of the machinery which was driven by the broken rope.

The illustration shows a device designed to give warning when a rope begins to weaken by the breaking of a strand. A steel wire is stretched across and near the face of the pulley and securely fastened at one end. The other end of the wire goes to a contact making device which is in turn connected by wires to an electric signal bell. When a strand of the rope frays out it strikes the wire pulling a lever on a contact box. This lever closes a bell circuit, ringing the bell until the lever is reset.

Handy Tool for Electricians and Mechanics

A piece of steel four inches long and less than an eighth of an inch in thickness has been cunningly devised into a tool serving

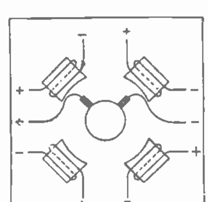


HANDY TOOL

no less than ten uses. The manufacturer of this tool is an electrical man himself and he has remembered the electrician in designing it. At the same time it serves such a variety of purposes that any one can carry it to advantage. At will it becomes: an alligator wrench; adjustable nut wrench; screw driver; wire peeler; tack or staple puller; Prest-o-lite key; bottle opener; rule; file; agate rule.

Changing 500-Volt, Series-Wound Fans for 110 Volts

We recently disposed of a lot of series-wound, four-pole fans to users of 110 volt direct current, by changing the connections as shown.



CHANGING 500 VOLT FANS TO 110 VOLTS

Each field and the armature was connected in multiple to the line, care being taken, of course, to give the fields alternate poles as originally. It is obvious that the motor will reverse by simply reversing the brush connections.

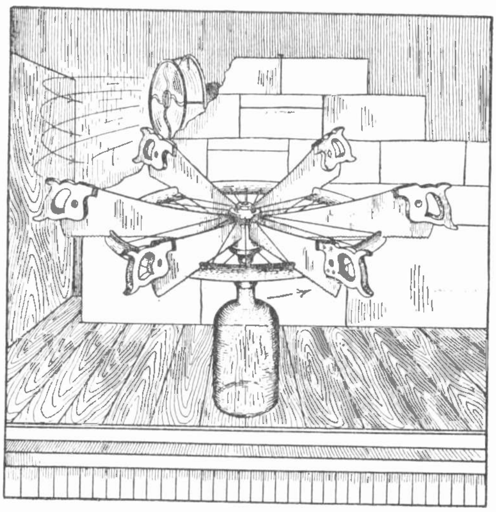
C. K. THEOBALD.

Electricity the Silent Salesman

Some helpful hints on the use of electric current in getting up show window displays. The following schemes have all been used with remarkable success.

A Window Merry-Go-Round

Few show window attractions make a stronger appeal to the keen observer than the ones which move and yet have no visible source of power applied to them. Down



A WINDOW MERRY-GO-ROUND

on Clark Street, in Chicago, a hardware dealer has taken an old bicycle wheel and has stuck its projecting bearing into the mouth of a large glass bottle. Then he fastened common hand saws (or rather uncommon ones, for the live dealer always has some particularly choice brand which he wants to advertise, above the spokes of the wheel, and lo, the saws seem to think themselves patrons of a merry-go-round, for the wheel turns slowly but steadily.

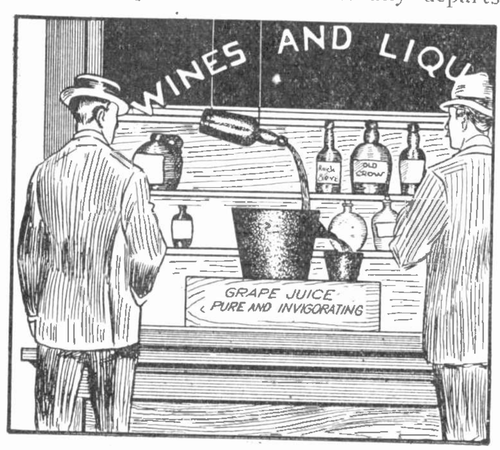
The transparent bottle supporting it shows that there are no wires leading to the wheel, and indeed, the small hub would hardly admit even a small motor. Then what makes it turn? Only the exceptionally keen observer will notice a little fluttering of a show-card pinned to the wall at the side of the window, which wall reflects the gentle breeze from an ordinary electric fan motor concealed behind the bank of goods at the back of the window. This breeze strikes the flat sides of the saw blades, making them serve as vanes of a little windmill which practically costs nothing to operate, as the fan is wanted anyhow for increasing the circulation of air in the store.

The Mysterious Bottle

A New York wine company is drawing attention by a most ingeniously contrived advertising device to a new brand of grape juice displayed in its windows.

In the window a wine bottle is suspended from two cords over a large tin tank having a spout placed half way down the side about on a level with an observer's eye. The tank can obviously never overflow and the level of the liquid is kept below the top of the tank and out of sight. The spout acts as an overflow into a smaller tank placed immediately underneath. The whole outfit is mounted on an innocent looking wooden box. A stream of grape juice pours continuously out of the mouth of the bottle into the tank below, from whence it overflows by the spout into the smaller vessel. As the bottle is suspended from two small cords and there is no visible influx of the liquid, a crowd stands and stares whether it rains or shines.

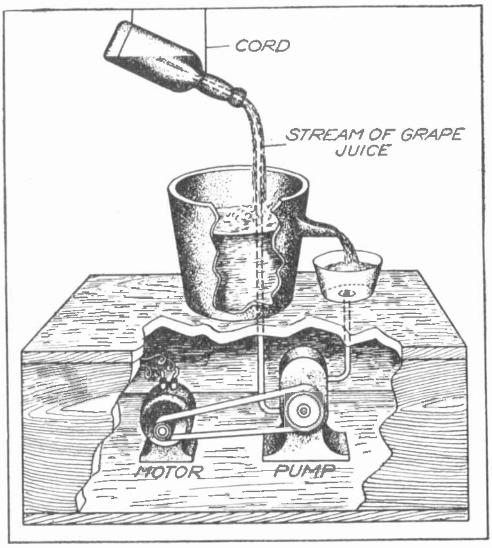
It is almost impossible for the average observer to believe his eyes and after vainly trying to puzzle it out he usually departs



THE MYSTERIOUS BOTTLE

with an expressed wish for a bottle like that.

The real principle of operation is very simple. The accompanying illustration, Fig. 2, showing the concealed part of the apparatus makes everything clear. A small



HOW IT IS OPERATED

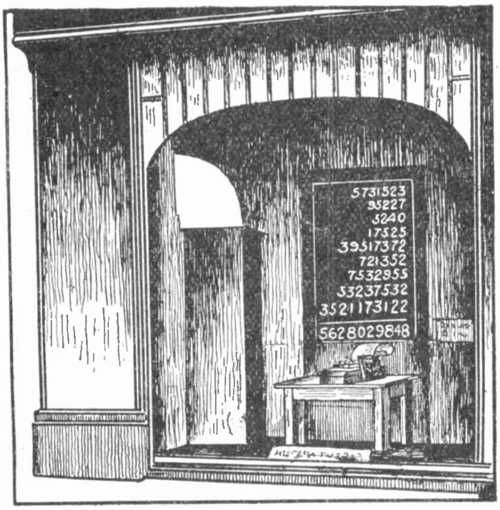
electric motor in the box drives a gear pump which pumps the grape juice from the small reservoir up through a glass tube into the neck of the bottle. The glass tube is curved so that it is the same shape as the natural form of the stream of grape juice flowing from the bottle. The pump forces the grape juice into the bottle faster than it tends to flow out. It therefore backs up in the bottle until the pressure of the air imprisoned in the top is sufficient to force it out as fast as it comes in. The grape juice flows down around the glass tube, completely concealing it from the observer. The illusion is further increased because the glass tube being full of the grape juice itself is of the same color as the surrounding stream and cannot be distinguished from it.

Dealers Imitate Coal Fire in Stoves

This being the season when coal stoves are in demand dealers are making their show windows worthy of notice. The stoves having a goodly supply of isinglass about their doors predominate in these displays not only because they are attractive, but also because they may be shown up from within in a way quite similar to their appearance when in actual use. This is done by placing a red glass incandescent lamp globe connected to an extension cord inside on the grate and laying over it some thin crumpled white paper. The red light shining through gives a strong resemblance to red hot coals. One dealer heightened the effect by using all red globes in the regular window light sockets giving the observer on a chilly evening an almost real feeling of warmth.

A Mysterious Adding Machine

An agency for an adding machine devised two clever departures from the usual show window display methods. A large board was arranged on which rows of figures could be lit up, one row at a time by concealed electric lights operated from within. Then the keyboard of the electric adding machine on the table in the window was connected with a similar one inside the store. Every time the operator depressed the keys of the machine in the store, the same keys would be depressed also on the machine in the window and the corresponding figures would light up on the

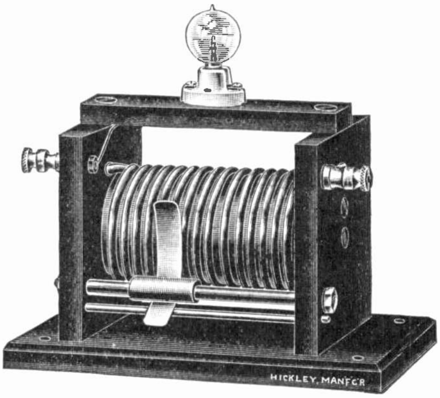


MYSTERIOUS ADDING MACHINE

board. When each row of figures had thus been shown, both the machine and the board would show the correct total. The display was so mystifying as to attract large crowds to the window.

Radiation Indicator

All the ordinarily used devices to show the relative current passing out from the station by way of the aerial have the disadvantage that they should be short circuited or taken from the aerial circuit when not actually in use for tuning purposes. The incandescent lamp, the Geissler tube and the hot wire ammeter are all in the same class in this respect. Of these three, the hot wire ammeter is the superior, for actual values of the current can be taken from the scale and compared. In the case of the Geissler tube and the incandescent lamp, there is no standard to go by, for the matter of relative intensities of the tube light or of the filament depend entirely upon the eye of the operator and consequently accurate tuning by this means is very difficult.

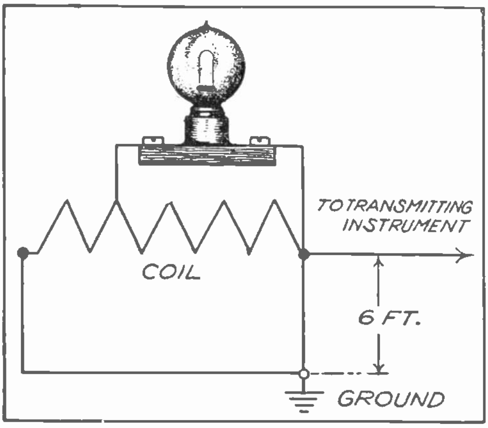


RADIATION INDICATOR

Each of the above mentioned devices possesses considerable electrical resistance, which if allowed to remain in the aerial circuit at all times, would cause considerable loss of the energy in the form of heat in the device itself.

The radiation indicator, invented by A. S. Hickley, is an instrument which may be left in circuit at all times. Although this indicator requires the use of an incandescent lamp, it is so arranged that a four or six candlepower six volt carbon filament lamp can be used through a wide range of transmitting powers, and for this reason there is not the danger of the lamp burning out while testing that there is using simply a lamp in series with the aerial and transmitting instruments. Moreover, since the device is in circuit at all times, it shows instantly any short circuit in the aerial or any break in any of the transmitting circuits, for in either event the lamp immediately goes out.

It consists of about 16 turns of No. 8 bare copper wire wound on a core of well seasoned wood 2½ inches in diameter. The turns of wire are spaced about $\frac{3}{16}$ inch apart. A sliding contact, connected electrically to the miniature lamp, permits variation of the number of turns of wire in use. A wire connects the other terminal of the lamp to one end of the coil of wire.



CONNECTIONS OF RADIATION INDICATOR

The diagram shows the method of connecting the indicator to the transmitting circuits.

It will be observed that the coil of wire is in parallel with about six feet of the ground wire, and that it is not necessary for the full quantity of the high frequency currents to pass through the coil. In stations of small power it may be necessary to bridge the coil by more than six feet of the ground wire to obtain better results.

Instead of increasing the resistance of the ground wire, this instrument decreases it, consequently improving the efficiency of the station. We believe that the action of the radiation indicator is due partly to resonance between the common section of the ground wire and the coil. The lamp will light up each time the key is depressed.

In "tuning up" a station with this instrument the following method may be used. Leaving the slider of the indicator so that all the turns of wire are in circuit, the transmitting circuits are adjusted until the lamp is lighted to maximum brilliancy. The slider is then moved to decrease the number of turns of wire in use, thereby decreasing the brilliancy of the light. Adjustment of the transmitting circuits is again made for full brilliancy of the lamp, and this process is repeated until the lamp lights full with the minimum number of turns of wire in use.

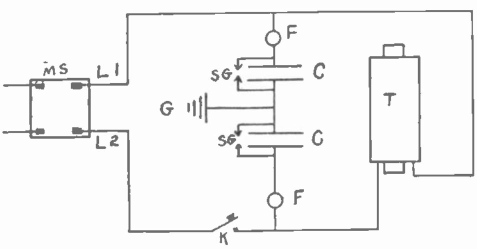
A. B. Cole.

Line Protector

In using large coils or transformers in wireless stations, connected to circuits of 100 volts or above it will be found that some device is desirable to prevent the high tension currents from backing into the primary circuit and doing damage. If this happens, the high tension currents will find their way along the line wires until they reach a spot where the insulation of the line wires is weakest, and will break down the insulation at this point. A spark will then pass between the line wires if they are close together, or between one line wire and a gas pipe or other grounded conductor which it touches. The line current will follow the spark, and fuses on the circuit are liable to blow out.

One of the best arrangements for line protection is shown by the diagram. Such a device should be used in all stations of ¼ K. W. capacity or over.

(T) represents the coil or transformer, (K) the key, (L_1) and (L_2) the power wires and (G) the ground connection. (CC) are condensers, each consisting of ten 5 by 7 inch glass plates separated by tin foil or metal sheets 3 by 7 inches. Alternate sheets in each condenser are connected together as in a glass plate receiving condenser. (FF) are three ampere fuse plugs. (SG) is a small spark gap with pointed brass rods for terminals. These rods are separated by a gap ⅛ inch long. Before connecting the condensers, they should be tested to make sure that they are not short circuited by connecting them in series with a battery of five or six dry cells and a battery lamp or a small battery motor. If the condensers are in working order no current



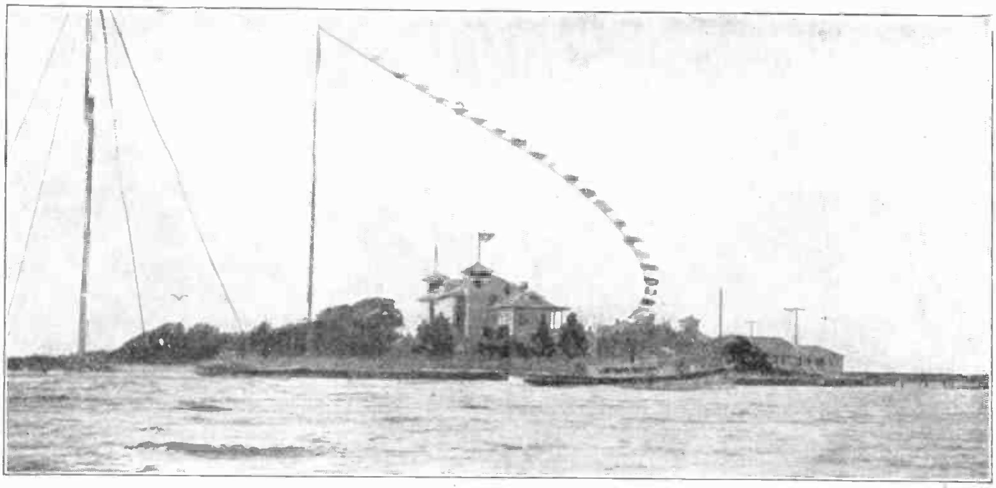
LINE PROTECTOR

will flow through the testing instrument. (MS) is a main line switch controlling the transmitting instruments, and should always be open when the station is not in operation so that no current will flow through the condensers. As this protector is connected across the power circuit it should be very carefully made. Attention is called to the fact that the spark gaps are directly across the line, and if their terminals touch a direct short circuit will be made.

In practice the line protector acts as follows: Suppose that high tension current should in some way back into line (L_1). If the quantity of current were small it would pass through the condenser to the earth. If the quantity of current were too large to pass through the condenser its voltage will cause it to jump across the spark gap (SG), and if it were so large in quantity as to be dangerous, would pass across both gaps, carrying the line current and blowing the fuses of the protector. It is better that these fuses should blow than to run the risk of damaging some electric light fixture or motor in the house.

If the high tension current should back into line (L_2), the same results would follow in the reverse direction, so that, no matter which line becomes charged, the protector will take care of it in most cases.

A. B. Cole.

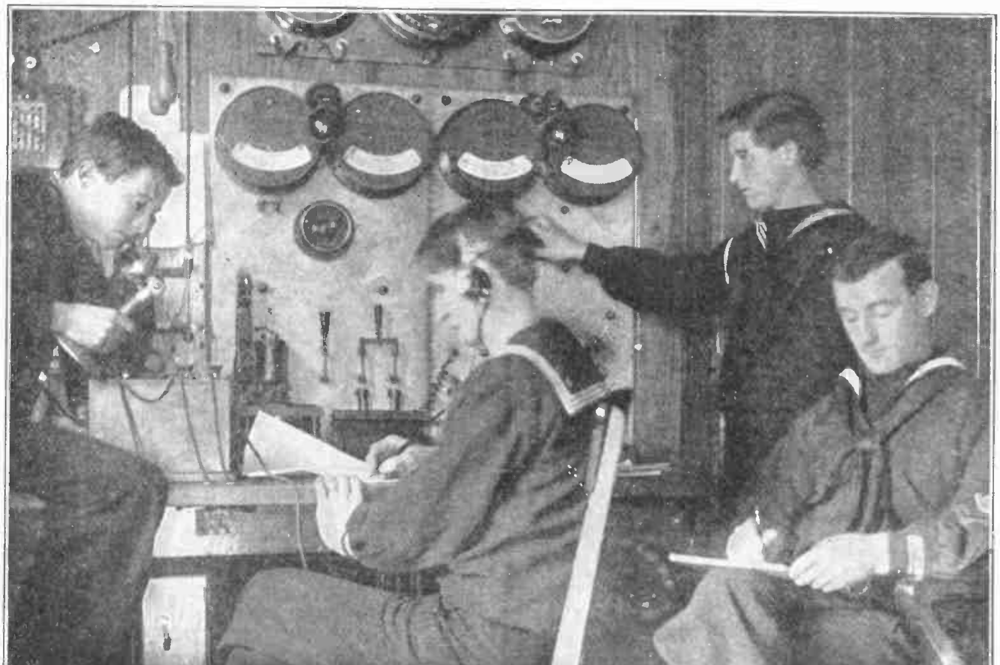


UNITED STATES LABORATORY AND WIRELESS STATION AT BEAUFORT, N. C.

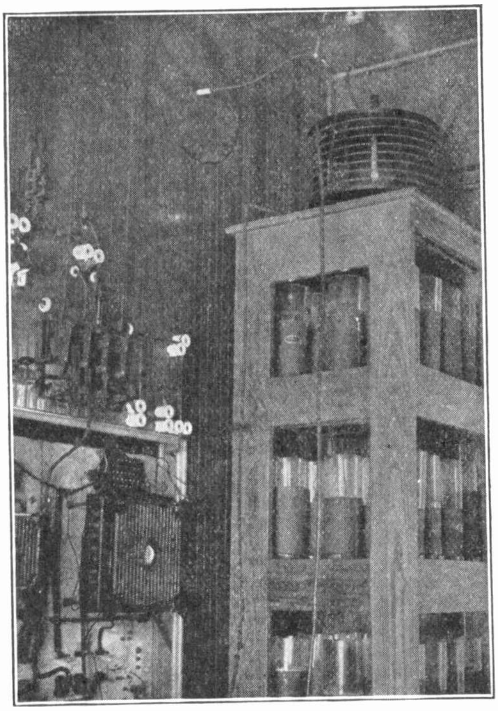
GOVERNMENT STATION AT BEAUFORT

The illustrations accompanying this article represent scenes at the Beaufort, N. C., U. S. wireless station. The station is beautifully situated on Piver's Island in the harbor, and is a relay, or half-way point between Washington and stations further south. The power developed is six kilowatts, capable of transmitting messages about 750 miles, under favorable conditions.

The operators are all enlisted men from the navy. One view shows the front switchboard, with four of the operators. Another



UNITED STATES WIRELESS OPERATORS IN THE BEAUFORT STATION



BACK OF SWITCHBOARD, BEAUFORT STATION

shows the rear of the switchboard with batteries, above which is seen the spark encircled by the wire cage. Still another shows the exterior of the station and laboratory.

The distance from Beaufort to New Orleans is 727 miles, to Key West 666 miles, to St. Augustine 372, to Charleston, S. C., 199, to Portsmouth, Va., on the north, 129, and to Washington, D. C., 249 miles.

Messages from far distant points are often caught. Last spring the operator could distinguish signals sent from the scout cruiser "Birmingham" off the coast of Liberia, to the cruiser "Chester," in Hampton Roads, but they were too faint to record the actual message.

At night in the winter, messages are sometimes heard from Panama and Colon.

On February 4, 1910, the "S. O. S." (Send out Succor) distress message from the steamer "Kentucky" sinking off Hatteras, was first caught at this station and immediately transmitted to Washington, from whence a message was sent broadcast over the sea, and responded to by the Mallory line steamer "Alamo," in time to rescue the crew of 50 from a watery grave.

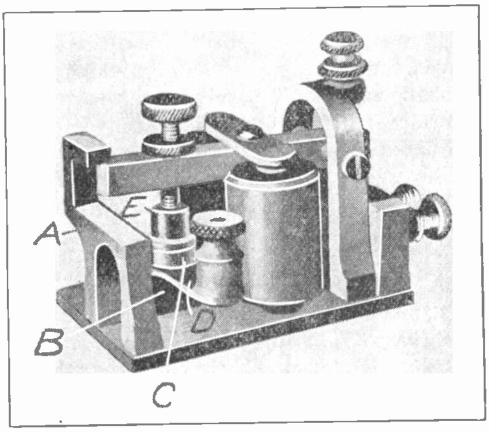
Handling Heavy Currents for Wireless

Owing to the heavy currents required for wireless telegraphic transmission purposes, the ordinary telegraph key will not suffice as the small contacts soon corrode and wear down.

In substituting larger contacts, such for instance, as silver dimes, which is often done, the key may be used to handle current on as high as ten amperes. A good deal of the snappy action of a regular Morse key seems, however, to be lost by substituting the larger contacts and, to those who have an old telegraph sounder handy, is suggested another simple means for handling heavy currents without necessitating the use of a clumsy key.

The wood base from a regular aluminum lever sounder is removed and the magnet terminals led to binding posts on a piece of fibre fastened by machine screws to the metal base. This is not absolutely necessary, but it aids in securing compactness, usually a prime consideration in wireless installations.

The brass "sounding" standard (A) is turned at right angles to its usual position



WIRELESS TELEGRAPH CONTACT MAKER

and a small fibre block (B), surmounted by a little brass cup containing a pellet of carbon (C), substituted. A stiff strip of brass (D) about ⅜ by 1¼ inches projects to one side from beneath the brass cup and at its outer end is fastened a binding post for connecting purposes. This completes the lower contact.

The adjusting screw to the front of the aluminum lever is replaced by a longer one of the same thread, at the lower end of which is fastened a round brass plug (E). Connection with this contact can be made at any point on the metallic part of the sounder.

In operation, an ordinary Morse key is used. One or two dry cells furnish the power to actuate the magnets and the contact may be made and broken in circuits of as high as 20 amperes without appreciable arcing.

Only one precaution need be observed in making the magnetic key described above; the lower contact must be of hard carbon. Soft carbon, cored carbon or impregnated carbon (for flaming arcs) will cause such severe arcing that clean-cut sending is impossible.

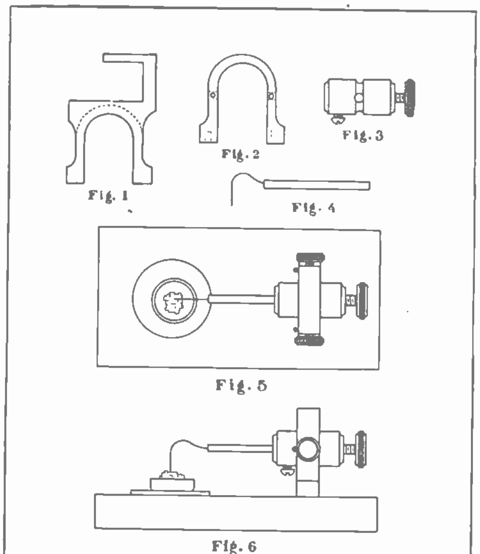
An Extremely Sensitive Galena Detector

There are not many people who employ galena as a wireless detector, because most of those who try it claim that it is of no account. This is simply because they do not know how to use it. I find that, if mounted in a properly constructed detector stand, galena is far more sensitive than either silicon or perikon. It will not give good results when spring pressure is employed for making the contact, which must be sharp and should barely touch the crystal. Therefore, I designed a balanced detector, the making of which I will describe below.

The parts needed for this detector are as follows: Rubber base, 2 by 4 by ½ inch; sounding plate from an old telegraph sounder; about two inches of ⅛-inch round brass rod; one ¼-inch round head brass 8-32 machine screw; two ⅛-inch round head brass 3-48 machine screws; nickel-plated wire connector; two small 8-32 thumb screws taken from the connector; two ⅜-inch flat head brass 6-32 machine screws; small piece of No. 30 phosphor-bronze wire; nickel-plated mineral cup; round plate for base for mineral cup.

First take the telegraph sounding plate and cut it down to the shape shown by the dotted lines in Fig. 1. Five-eighths of an inch from the top of this arch drill two holes, as shown by dotted lines in Fig. 2, with a No. 29 drill, and tap them out for an 8-32 screw. Next, drill two smaller holes from the face of the arch in until they meet the two just drilled, and tap them out with a 3-48 thread. Now fasten the two small 8-32 thumb screws in the holes just made for them. File the ends of the 3-48 screws to a point and fasten them in the holes made for them. They act as set screws to lock the adjustment of the larger ones.

Next, take the wire connector from which the thumb screws have been removed and fill up one of the holes where the screws were by inserting a tight fitting screw and filing it off flush with the surface of the hole. Tap out one end of the hole running



Balanced Detector.

through the connector with an 8-32 thread and fasten a large thumb screw in same. Through the exact center of the connector and at right angles to the hole running through it, drill a 1-16-inch hole. Countersink the extremities of this small hole, so as to make a small conical cavity on each side of the connector. Fasten the ¼-inch 8-32 round head brass screw in the remaining hole in the connector (the original one which was not filled up). It will now look like Fig. 3.

Next, support the connector between the two thumb screws in the arch by letting the thumb screws project into the cone-shaped openings. Make the screws just so tight that the connector will swing easily on them without wobbling.

Take the piece of No. 30 wire and solder it into a small hole in the end of the brass rod. Cut off the free end about 1¼ inches from the rod, sharpen the end to a point and bend to the shape shown in Fig. 4. Cut off the brass rod at the right length, which can only be found by experiment. It should be long enough to just balance the whole connector when fastened in the hole opposite the thumb screw when said screw is in half way. I found about 1½ inches to be a good length. When you have the rod the proper length to balance the connector rightly, fasten it in the end of same by tightening up on the ¼-inch set screw provided for that purpose.

Next, mount the arch and the round plate on the rubber base in the positions shown in Figs. 5 and 6, which are two different views of the finished detector. Mount your galena in the mineral cup and place the latter on the plate under the point of the wire. Make connections from binding posts to the arch and the plate. The appearance of this detector can be greatly improved if all of the metal parts are carefully nickel plated and polished.

In operation, connect the arch to the aerial and the base plate to the ground sliders of the tuner. Screwing in or out on the thumb screw at the rear of the connector disturbs the balance and thus gives a very minute change of pressure, which can not be obtained with even the smallest spring made.

EDWIN L. POWELL.

Noninductive Potentiometer

Detectors employing local battery current need a very fine regulation of the current to obtain satisfactory results.

Two ways of regulating the current may be employed. One is by using a rheostat, and the other is by providing a noninductive potentiometer. A wire rheostat introduces objectionable inductance due to the closely wound coils of wire, while the noninductive potentiometer has no wire resistance coils but causes a uniform increase or reduction of the current.

The potentiometer type may be made as follows: The base is of oak, and is twelve inches long, two inches wide and one-half inch thick. A piece of ¼-inch square brass rod, ten inches long, is needed for the slider rod. Drill two holes in each end, large enough for an 8-32 bolt to pass through. (A) and (B) are two pieces of ¼-inch square brass tube, each one inch long. Two brass machine screws (S, S)

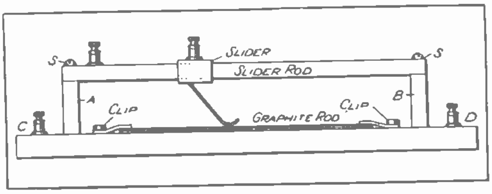


FIG. 1. POTENTIOMETER

hold all firmly to the base as shown. The resistance rod is a piece of graphite such as draftsmen use. It can be bought at almost any large stationery store, 6H being the mark denoting the degree of hardness.

Two spring clips are made of two pieces of thin spring brass, each ¾ by ½ inch. They are fastened to the base by two small

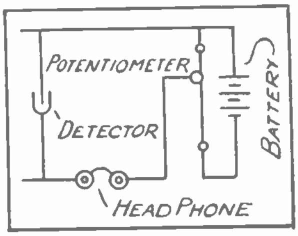


FIG. 2. CONNECTIONS FOR POTENTIOMETER

brass bolts which go through holes that are seven inches apart in the base. The graphite rod fits in a smal' groove directly under the slider rod. The ends of the resistance rod slip under the clips, which serve to hold them and make contact. The two binding posts (C) and (D) are connected to the spring clips. A binding post is fastened on the slider rod to make the slider connection.

The potentiometer connections are shown in Fig. 2.

B. FRANCIS DASHIELL.

Message from Biplane to Eiffel Tower

Captain Brenot and Lieutenant Menard, both of the French Engineering Corps, succeeded in dispatching wireless messages from a Farman biplane at a height of 1,600 feet to Eiffel Tower, a distance of 35 miles.

Fence Wire Aerial

On September 4th, at Asbury Park, N. J., we used for an aerial the iron wire which was stretched along a wooden picket fence. This odd aerial, in connection with a loose coupled receptor, enabled us to copy time sent out by the Brooklyn Navy Yard, some 50 miles away. This test was made by George Ferguson, H. Warren and myself.

R. SMITH.

Wireless at the Panama Pacific Exposition

A feature of the Panama Pacific Exposition which will be held in San Francisco in 1915 will be the wireless telegraph station on Telegraph Hill. It is planned to erect the largest station ever built on this occasion, by means of which the passage of the fleet of battleships through the canal can be continually signaled. Its range must therefore be about 4,000 miles.

Silent Aeroplane Will Aid Wireless

The whir of the motor of a flying machine is familiar to those who have witnessed flights and it is this noise that hinders the receiving of wireless messages from any appreciable distance by a receiving set mounted upon an aeroplane.

To overcome this M. Henri Farman, the well-known French aviator and designer of flying machines, is reported to have recently perfected a silent aeroplane. The improvement is in the gasoline motor, which has been successfully muffled without detracting from its working qualities. With this objectionable point overcome there seems to be no obstacle in the way of receiving long distances while aloft.

To Make Zincite

By those who use perikon detectors zincite is needed. While it may be readily purchased there is a certain satisfaction in making it and one may proceed as follows: Mix one part of zinc sulphate (white vitriol) with one part of sodium sulphate (Glauber's salts). Place the mixture in a small porcelain cup or in a crucible and heat until melted to a thin liquid. Then bring to a bright red. A gas (sulphur dioxide) will be driven off and an opaque, white crust will be formed at the edge of the crucible. The crust is zincite in the shape of small hexagonal crystals. The slower the mixture cools the larger the crystals will be.

MAURICE RUBIN.

Cincinnati Wireless Signal Club

The recently organized Cincinnati (Ohio) Wireless Club elected the following officers: A. J. Lyons, president; E. D. Achor, vice president; J. L. Anderson, secretary and treasurer. Cincinnati boys wishing to join address the secretary, 1839 Hopkins street.

Hannibal (Mo.) Amateur Wireless Club

The Hannibal Wireless Club recently organized with the following officers: Chas. A. Cruickshank, president; J. C. Rowland, vice president; William Nouse, treasurer; G. G. Owens, secretary, 1306 Hill street. Address all correspondence to the secretary.

Tri-State Wireless Association

The Tri-State Wireless Association has been organized at Memphis, Tenn., with the following officers: C. B. De LaHunt, president; O. F. Lyons, vice president; C. J. Cowan, secretary; T. J. Daly, treasurer; A. McKelvy, consulting engineer. The association would like to get into communication with individuals and clubs in Tennessee, Arkansas and Mississippi.

Southern Wireless Association

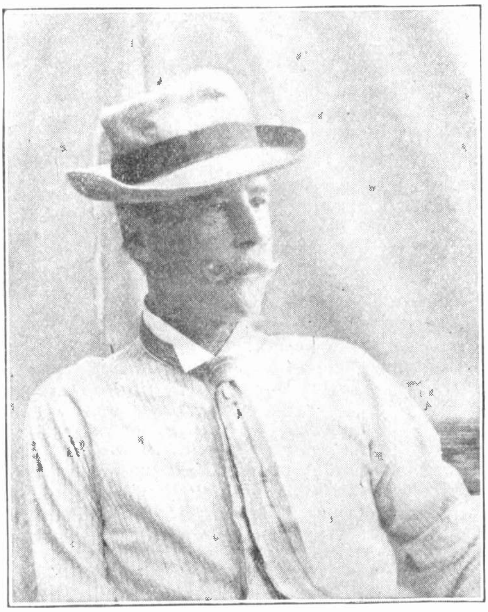
The Southern Wireless Association was organized July 30 at New Orleans, La., with the following officers: B. M. Oppenheim, president; J. Fishel, secretary and treasurer. The purpose of the association is to study the art of wireless telegraphy and to prevent interference with commercial stations.

All amateurs living in the southern states are invited to join the association, by corresponding with the secretary, 1435 Henry Clay avenue.

On Polyphase Subjects

The Founders of the Electrical Industry

In the 30 odd years which have passed since the use of electric current was first seriously considered as a commercial possibility men have witnessed probably the most wonderful and rapid growth ever made by any industry. Yet with electricity in use on every hand, and with the word as familiar as any in the language it is surprising the number of people who do not know of the two mighty companies that today dominate the manufacturing side of the industry. With immense factories in this country and connections in foreign countries these two concerns alone employ upwards of 80,000 men and do a business of approximately $200,000,000 a year.



GEORGE F. STRATTON AS HE ENJOYS LIFE ON HIS WESTERN FRUIT RANCH

It is a fascinating, not to say dramatic, story, the history of these two companies, and all through the narrative the great names of Edison, Brush, Westinghouse and Thomson are ever in the foreground. At first it was almost laughable, the squabbles they had over patents. No one knew where he was "at" in this young and extremely rich field of endeavor. Yet all prospered and slowly, from meager beginnings, the two great fabrics were constructed.

"The Founders of the Electrical Industry," which begins in this issue is very largely a story of the great men mentioned above. It was written by Mr. George F. Stratton, not unknown to the readers of this magazine and a frequent contributor of business and semi-technical articles to publications of such class. He has grown up with electrical things and knows their history well. He was born in England and came to this country in 1872 and has always been engaged in manufacturing, principally in electrical lines. For eight years he was on the staff of the General Electric Company in its great Lynn plant.

He has now retired from active business and purchased a fruit ranch in the Salt Lake Valley. Far away though he may be from the scenes of electrical manufacturing, he loves to recount the many interesting stories of its growth and the men who "made" it. This series of articles is, therefore, written by one who knows and one who can make you *feel* that there is something truly wonderful about it all.

The Radiant Heater

When the bite of Fall is in the evening air the house gets uncomfortably cool during those hours. Still it is hardly cold enough to start the furnace or get up steam without making the rooms uncomfortably warm. It is time, then, for the electric radiant heater to bring a pleasant warmth and cheerful glow to the sitting room. As depicted by this month's cover, musing by the electric firelight is every bit as soothing as by the old-time fireplace.

Short Circuits

A man whose first name was Roy recently had occasion to buy a pair of overalls in which he found the name of the girl who had made them. In a rash moment he wrote her a letter suitable to the occasion. He received the following reply, which he showed to a friend who "snitched" on him: "I am a working girl, it is true, but I make a good living, and I don't care to support a husband, as I would do if I married some silly noodle who gets mashed on a girl he never saw. Permit me to say that I do not know how my card got in that pair of overalls, and that when I do marry, if ever, it will be some fellow who can afford something better than a 47-cent pair of breeches." Oh, you Roy!

* * *

A young man took his sweetheart to a ball. She wore her party dress. As they began a dance he noticed what he thought was a raveling sticking out of her sleeve. He tugged at it. It came easily, and during the remainder of the dance, having started to wind up that raveling, he kept at it. It wasn't until the end of the dance that he had finished winding.

Next morning the girl said to her mother:

"Maw, an awful funny thing happened last night. You know I went to that dance. Well, when I got home and got ready for bed I found my union suit had disappeared."

* * *

A country clergyman, on his round of visits, interviewed a youngster as to his acquaintance with Bible stories. "My lad," he said, "you have heard of the parables?"

"Yes, sir," shyly answered the boy, whose mother had inducted him in sacred history.

"Good!" said the clergyman. "Now, which of them do you like the best of all?"

The boy squirmed, but at last, heeding his mother's frowns, he replied: "I guess I like that one where somebody loafs and fishes."

* * *

Willie (very sleepily saying his prayers)—"Now I lay me down to sleep, I pray the Lord my soul to keep—"

"If"—(prompted the mother)

"Willie—"If he hollers let him go, Eenie, meenie, miney, mo."

A spinning sat Priscilla fair:
John Alden came to woo her there.
So she put down the spinning wheel
While he put up the winning spiel.
—*Kansas City Times.*

Though near death's door, by all the signs,
A man got well who dealt in mines.
For death may love a shining mark,
And yet not love a mining shark.
—*Chicago Tribune.*

A dude went broke, and though it hurt,
He got a job at hauling dirt;
It's hard to be a son of toil
When you must haul a ton of soil.
—*St. Louis Star.*

A business man may be in debt
And seldom make a cent, and yet
A roll-top desk and telephone,
Et cet'ra, give the fellow tone.
—*Buffalo Evening News.*

A pastor scores the latest hats—
Likewise the use of puffs and rats;
He thinks the breadth of girlie pates
Might even clog the pearly gates.
—*Cleveland Plain Dealer.*

* * *

All the smart ducks aren't in the East. A small tailor in Butte has a bright green barrel in front of his store with the head knocked in, and in glaring red ink is painted, "Stand in my barrel while I press your suit for 50 cents."

* * *

A farmer who went to a large city to see the sights engaged a room at a hotel, and before retiring asked the clerk about the hours for dining.

"We have breakfast from six to eleven, dinner from eleven to three, and supper from three to eight," explained the clerk.

"Wa-al, say," inquired the farmer in surprise, "what time air I goin' ter git ter see the town?"

* * *

Edgar (at dinner, whispering)—"Darling, won't you have a little lobster?"

Florence (impatiently)—"Edgar haven't I told you repeatedly that you could not propose more than three times to-night?"


GETTING DOWN TO WORK IN THE MORNING
-THE ELECTRICAL WAY-
BING
TING
A-LING
BING
IS AWAKENED BY ELECTRIC ALARM CLOCK
TAKES MORNING EXERCISE
IT'S A PLEASURE TO COOK ON AN ELECTRIC RANGE
WATER HEATED BY ELECTRICITY
SHAVES WITH ELECTRIC RAZOR
CLEANS CLOTHES WITH VACUUM CLEANER
HERE'S A MAN GETS BIT IN THE 4TH WARD BY A DOG-
NEWS PAPER
EATS BREAKFAST
LIGHTS HIS CIGAR
STARTS
GOES BACK TO KISS WIFE GOOD-BYE
STARTS AGAIN-
CATCHES TRAIN-
"MY BOY YOU'RE THE MOST PUNCTUAL EMPLOYEE I EVER HAD-I'M GOING TO RAISE YOUR SALARY"
THANKS
BOSS
ARRIVES AT OFFICE.
-THE OTHER WAY-
GREAT SEEZER! I'VE OVERSLEPT MYSELF-THAT PESKY ALARM DIDNT GO-
THIS OLD GAS STOVE IS DRIVING ME CRAZY-
"WOW! THAT WATER'S TOO COLD FOR A WHITE MAN TO BATHE IN!"
CUTS HIMSELF WHILE SHAVING
I DONT CARE
THIS COFFEE'S COLD!
PAPER
EATS BREAKFAST
STARTS TO WORK
HEARS TRAIN WHISTLE
TOOT
TOOT
MISSES HIS TRAIN-
LATE AGAIN!
POOR OLE JONES
BOSS
ARRIVES AT OFFICE
CLARK DE BALL

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.

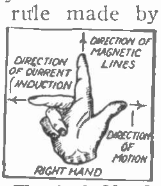
FIRE ALARM, ELECTRIC.—A system of building wiring on which thermostats are installed at intervals. A rise in temperature will cause the low melting alloy in these thermostats to melt and close an electric circuit which operates electromagnets and sends in an alarm. Electric transmission is used also from outdoor fire alarm boxes.

FLAMING ARC LAMP.—An arc lamp in which the carbons are at an angle to emit light from their ends. These carbons are impregnated with metallic salts or are rods of metal. The lamps burn with a brilliant light, colored according to the ingredients of the electrodes.

FLASHING OF INCANDESCENT LAMP CARBONS.—The treatment given the filament of incandescent lamps to deposit carbon thereon. The filament is placed in a chamber containing hydro-carbon vapor. Current is then turned on, the filament heating it to redness. The heat decomposes the gas depositing carbon on the filament in accordance with the heat at every point, thus producing a filament of uniform resistance.

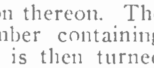
FLATS IN A COMMUTATOR.—A burning or wearing away of one or more segments of a commutator to a lower level than the other bars. Bad armature mounting or poor connections to the commutator may cause "flats."

FLEMING'S HAND RULE.—A rule made by Dr. Fleming to remember the relation between the motion, flux and electromotive force in a dynamo or motor. Referring to the cut and using the right hand, let the first finger point in the direction of the flux or lines of force, the thumb in the direction of the motion, then the middle finger will indicate the direction of the electromotive force in a dynamo. The left hand is used when applying the rule to motors.



Fleming's Hand Rule

FLEXIBLE CONDUIT.—A form of protection for electric wires, consisting of a spiral steel covering which makes the conduit flexible. (See cut.)


Flexible Conduit

FLEXIBLE CORD.—The term applied to conductors made of fine stranded wires, insulated and twisted together. Frequently used to suspend single incandescent lamps.

FLOOR INSULATOR.—A tube usually of porcelain protecting conductors which run through a floor.

FLUSH SWITCH.—A snap switch so made that its entire mechanism sets in the wall or woodwork. The mechanical parts of the switch are enclosed in porcelain and this in turn is set into an iron wall box when installed.

FOCI, MAGNETIC.—The two places on the earth surface where magnetic action is strongest. These two points are near the region of the magnetic poles but do not quite coincide with these poles.

FOLLOWING HORNS.—The projecting ends of the pole pieces towards which the uncovered part of the armature of a dynamo turns in its operation. Also called trailing horns.

FOOT-CANDLE.—See Candle-Foot.

FOOT-POUND.—The work necessary to raise one pound a distance of one foot, or to lift ten pounds one-tenth of a foot, etc.

FORCE OF POLARIZATION.—In decomposing a liquid as water by passing a current through it an e. m. f. opposed to the supply current is created. This opposing e. m. f. is termed a counter e. m. f. of polarization and in this particular instance is strongest when one electrode is covered with bubbles of oxygen and the other with bubbles of hydrogen.

FORMING.—The process by which both plates of a lead storage battery are put in condition. In the Planté process the plates are of pure lead and are "formed" or rendered porous or spongy by repeated charging and discharging until they reach this condition, which is necessary for efficient working of the type of storage battery.

FOUCAULT CURRENT.—See Eddy Currents.

FRANKLIN'S PLATE.—A simple form of condenser, consisting of a plate of glass coated on each side with a sheet of tinfoil, a margin of at least an inch being left between the edge of the foil and the edge of the glass.

FREQUENCY.—On an alternating current circuit the electromotive force starting at zero rises to a maximum value in the positive direction then falls to zero, takes a negative maximum value in and returns to zero. The complete set of values including positive and negative values through which the current repeatedly passes is called a cycle (see Cycle) and the number of cycles per second is called the frequency, designated by f. Frequency f equals p times n where p is the number of pairs of magnet poles on the alternator and n is the number of revolutions per second of the armature.

FRICTIONAL ELECTRICITY.—If sealing wax, resin or a glass rod be rubbed with a piece of flannel, the rod, wax or resin will be found to have acquired a property not previously possessed, that of attracting bits of paper, dust, etc. Thales, a Greek, mentioned this phenomenon as to amber as early as 600 B. C., but only since the time of Dr. Gilbert (1600) has it been termed electricity.

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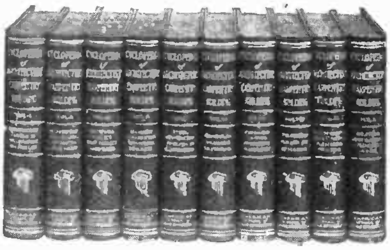

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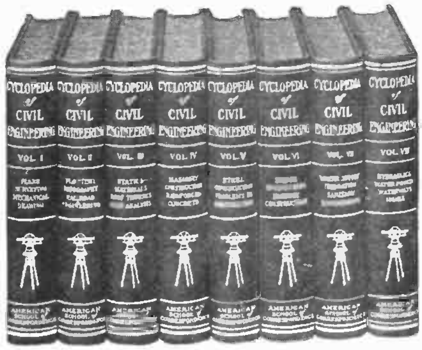

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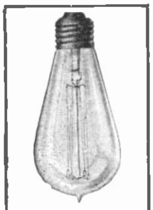

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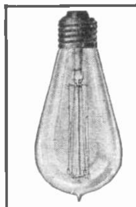

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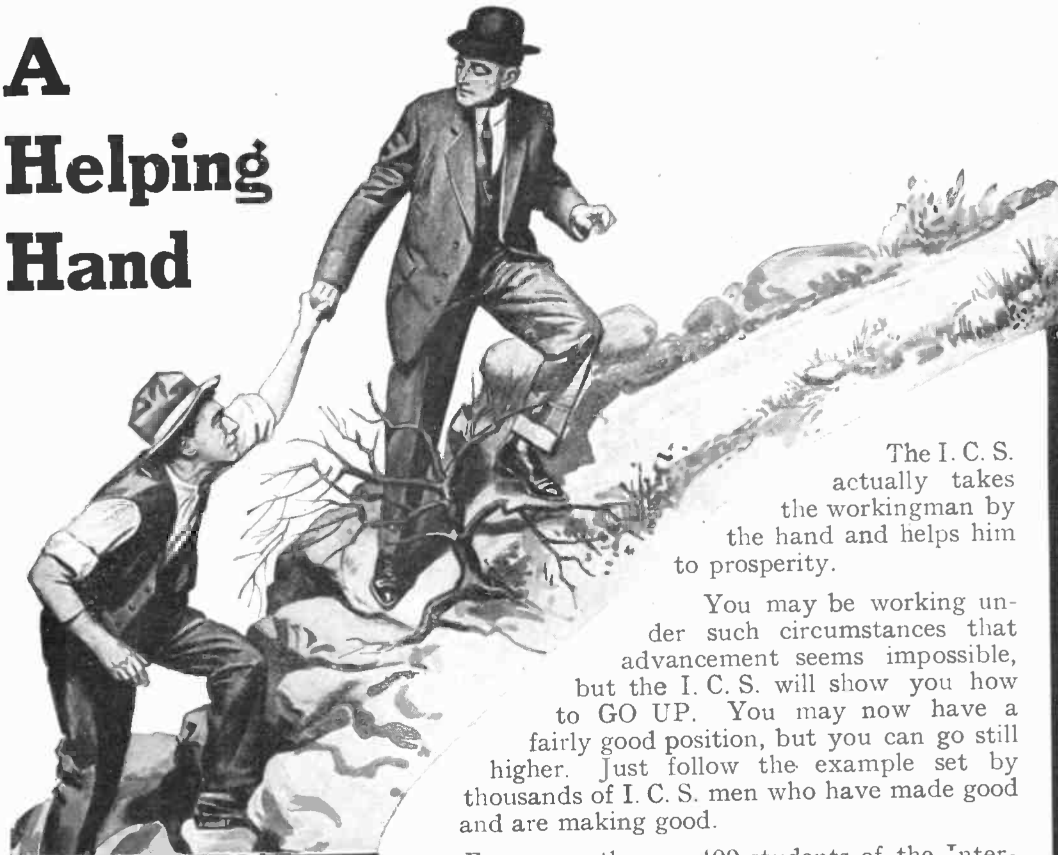
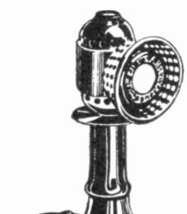


The Electric Cigar Lighter

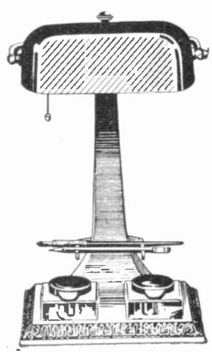
Every consideration for safety, neatness and convenience suggests the use of an Electric Cigar Lighter on the office desk. It is constantly ready for instant use. Does away with the annoyance of hunting for matches, eliminates the dangers attendant upon their use and saves littering the floor with burnt ends.



For the Office or Cigar Stand

Besides its safety and economy, its attractive appearance makes it a desirable adjunct to the office desk or the cigar counter. It is 7½ inches high, all metal parts of oxidized copper finish, and fitted with 6-foot connecting cord. The cost of electricity for its operation is about 3 cents a day. Price, **$2.80.**

A Handsome and Efficient Desk Lamp



There is a decided satisfaction to be had from a desk lamp such as this. With a handsome appearance, it combines the utmost efficiency in concentrating the light upon the desk, affording appreciable relief to the eyes. It is adapted for use on any flat top desk, whether in the home or office. It combines a lamp, double inkwell and pen rack. Finished in old brass or statuary bronze. **$15.00.**

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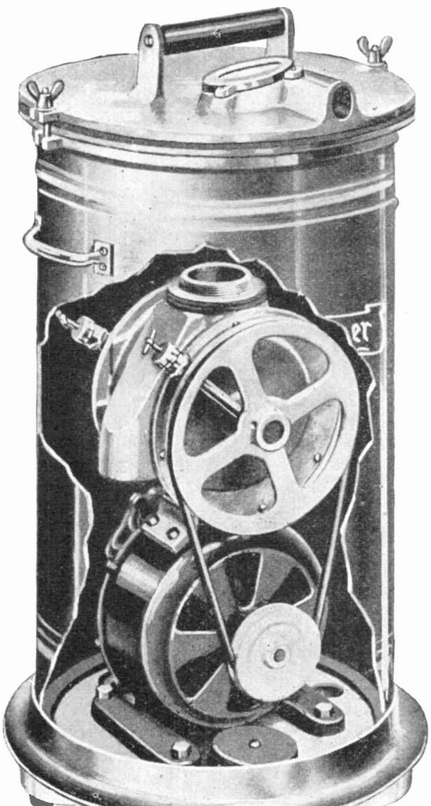
How to Buy a Vacuum Cleaner

When you have resolved to install a Vacuum Cleaner in your home, you have a still more important matter to decide. The amount of satisfaction you will get out of this sanitary cleaning method depends upon which machine you select to do the work



Look for These Five Features

First. A Powerful Machine that will take up all the dirt and dust, even that deeply imbedded in the very texture of heavy floor coverings. The FEDERAL VACUUM CLEANER has a Rotary Pump. Its pump revolves steadily in one direction, similar to a powerful turbine engine. It creates a positive and powerful suction that is not possible in other types of vacuum cleaners.

Second. A Simple Machine. The accompanying illustration shows at a glance the extreme simplicity of the working parts of the "FEDERAL," all of which are easy of access.

Third. A Durable Machine. The "FEDERAL" has no valves to work loose—no bellows to wear out. Its motor and Rotary Pump revolve always in the same direction—steadily, noiselessly, reducing wear to the minimum.

Fourth. A Vibrationless Machine. The Rotary Pump operates so smoothly, steadily and without jarring and jerking that it transmits no vibration to the floor. This makes it ideal for use in apartment buildings.

Fifth. A Noiseless Machine. The "FEDERAL" operates without noise. There are no gears to rattle, no piston to pound up and down. You get all these five features *only* in

The Silent Running

Federal Vacuum Cleaner

It is the Rotary Pump that makes the "FEDERAL" excel other Vacuum Cleaners. It is the Rotary Pump that gives it the powerful suction—that takes up all the dirt and dust, no matter how deeply imbedded in heavy rugs, carpets, upholstery, hangings and clothing. It is the Rotary Pump that makes the "FEDERAL" a simple machine, a durable one, a vibrationless and silent-running Vacuum Cleaner.

Weighs Only 60 Pounds

The "FEDERAL" is the lightest machine of its type and capacity. This is because all metal parts (excepting motor and light steel jacket) are made of aluminum. Even the cleaning tools are made of this light metal. The rug-cleaning tool with its handle weighs only 36 ounces. You need neither weight nor effort to clean with a "FEDERAL"—the air does all the work.

The Federal Guarantee

We will ship you a "FEDERAL" for 10 days' trial. If not satisfactory return it at our expense and any payments made by you will be promptly refunded. Price, $125, less 5% discount for remittance within 10 days after receipt of machine. Or $25 down and 10 monthly payments of $10 each. Write today for full particulars of this offer, complete descriptive booklet, etc. Address

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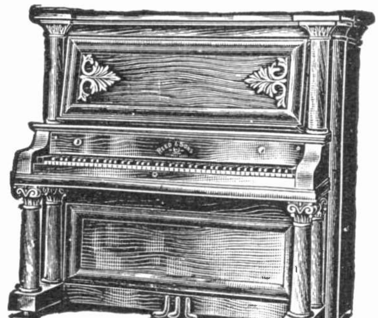

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This **piano** was formerly sold through dealers, agents and jobbers. Their profits have been wiped out. It is now sold direct to the buyer and the customer receives the savings that would otherwise go to the middleman. You save from $128 to $222, by buying a **Reed & Sons Piano.** Better still, a purchase plan has been arranged that makes it easy for you to pay. No money down.

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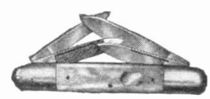

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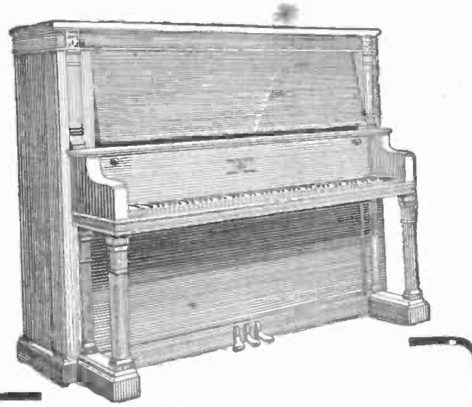

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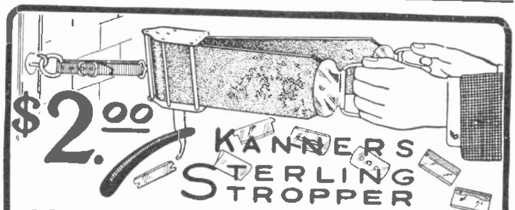

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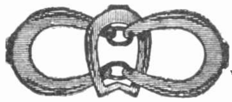

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All three run over the smooth well-ballasted roadbed of the *Chicago, Union Pacific and North Western Line*—the famous double-track line to the Missouri River. Safeguarded by automatic safety signals all the way.

The San Francisco Overland Limited
Leaves Chicago 8:30 p. m.
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The China and Japan Mail
Leaves Chicago 10:45 p. m.
The Best of Everything

These three splendid trains leave from the new (Chicago) Passenger Terminal, Chicago and North Western Railway—the most modern railway terminal in the world.

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If Your Dealer Doesn't Carry Signal Coat Shirts Send for a Couple at Our Risk

We want you to know the comfort, wear and good looks of Signal Coat Shirts—we want you to realize the advantage of the open front which enables you to slip the shirt on or off like a coat. No tugging over the head.

Ask your dealer to show you this shirt. Note the many points and advantages to be had on no other shirt.

Extra button at bottom of breast plait, to keep the front smooth, sleeve slit in the side not in seam and reinforced with rip proof band. Two double band collars, *hand turned,* two pockets. Made from fast indigo percales. Seams double sewed.

If not obtainable in your town, send size and we will express you a couple, charges prepaid. If satisfactory, pay expressman $1.00 each. (West of Missouri River $1.25.) If not what you want, return at our expense. Write for folder showing extra styles in neat colored designs for semi-dress at $1.50, collars to match.

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Hilker-Wiechers Mfg. Company
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Makers of Signal Overalls

Union Made

The American Boy

is a moral dynamo—a magazine devoted exclusively to the whole boy—a magazine that imbues the boy with high morals, honor and manliness. 500,000 boys are now enthusiastic readers every month.

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contains stories of the things boys like to read about—adventure, travel, history, photography, stamps, electricity, carpentry, sports, current events, etc., all beautifully illustrated.

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Give it to your boy!

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The Sprague Publishing Co.
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REVERSIBLE "Linene"

COLLARS CUFFS AND BOSOMS

TRADE MARK

Send for Sample

We will send you by mail, postage paid, 10 collars for 30 cents, or a sample for 6 cents in U. S. stamps. Cost at the stores 25 cents for box of 10.

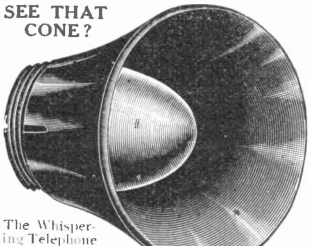
STATE SIZE AND STYLE

These collars look just like linen and are more comfortable, but cost so little that they may be thrown away when soiled. They may be reversed and worn both sides.

REVERSIBLE COLLAR CO.
Dept. U, Boston, Mass.

Here's Something New

SEE THAT CONE?



The Whispering Telephone Mouthpiece **Price 75c each.** Made of aluminum—strictly sanitary.

A Telephone Mouthpiece with a parabolic vibrator which distributes the *sound waves* perfectly and thus enables one to converse in a *whisper* or a very low tone as preferred.

THINK OF IT!

Telephone privacy without resorting to a booth. A distinct benefit to the Business Man, the Factory Man, the Housewife, the Merchant.

Cuss-no-more

THE S. & M. ELECTRIC CO.
DISTRIBUTORS
402 Monadnock Block Chicago

1.6 Volts

25 Amperes

Figures That Count

In purchasing a dry battery, everyone wants a battery which will not have to be replaced every week or so. This can be avoided by the selecting of

THE 1900 DRY BATTERY

which by actual test has proven its efficiency for all kinds of work.

Send for Booklet which contains full particulars.

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ELECTRICAL APPARATUS

Send two cent stamp for our circular of Castings, Armature Discs, Commutators, Brushholders, etc., for Motors and Dynamos, 1-20 to 2 kw. Electrical sheet steel for Transformers, Armatures, fields etc., cut to shape. GAS ENGINES finished or castings only ¼ to 2 h.p. We design and build small motors for machine drive and special requirements

F. E. AVERILL,
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WAYNE BELL TRANSFORMERS

Displace unreliable, troublesome batteries and use practically no current. Operate door bells, buzzers, toys, etc. Made in three sizes for different classes of work and can be connected to any A. C. lamp socket. Send for leaflet 4511.

FORT WAYNE ELECTRIC WORKS
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1803 Broadway FORT WAYNE, IND.

We Carry a Complete Stock of

Electrical Novelties and Toys

Including the Late Imported Inventions

Complete Wireless Equipments

Attractive Prices on Everything Electrical

THE ILLUMINATING SUPPLY CO.
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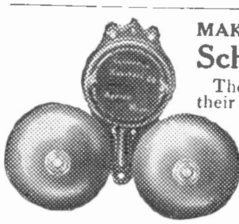

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They cure all Bell troubles and save their cost. For any current.

Send $1.50 today for sample Silver-Toned House Bell, all charges prepaid anywhere in the United States.

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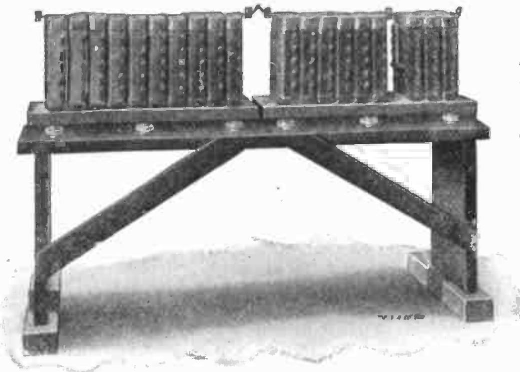
MEANS THE ELIMINATION OF FAULTS IN YOUR PRODUCT

Electrical and photometrical tests of every description. Checking electrical instruments of all kinds and classes. Inspecting and testing new electrical machinery, apparatus and material at factories and after installation. Tests on any electrical machinery and apparatus made anywhere. Arc and incandescent lamp tests, either electric, gas, acetylene or oil. Illumination tests made anywhere. Secondary standards of candle-power furnished. Facilities furnished to experimenters and investigators.

We have recently added to the above, Coal Testing, and are now prepared to make proximate analyses and calorific determinations on samples of coal, promptly and accurately.

ELECTRICAL TESTING LABORATORIES
80TH STREET AND EAST END AVENUE NEW YORK, N. Y.

The Use of a Storage Battery for Electric Lighting



The chief purpose of a storage battery for Electric Lighting is to furnish steady, continuous, twenty-four hour service without the necessity of running an engine and dynamo all of the time.

With the small low voltage electric lighting plants furnished by this company, it is only necessary to run a small gas engine with a dynamo a few hours occasionally, at which time the storage battery is charged, so that at all other times current is taken from the battery.

A storage battery is a very important part of an electric lighting plant as it furnishes current the greater part of the time.

The "Chloride Accumulator" furnished with the small electric lighting plants of this company is the same type of battery as is used by the large electric lighting companies, electric railways, telephone and telegraph companies. This is the best assurance of dependable lighting service. The storage battery is simple to install and very easy to care forland operate as it requires very little attention.

If your home or factory is not near a public electric lighting station, you can now have electricity at very small expense.

Write our nearest office for our book "How to Have Your Own Electric Lighting Plant"

THE ELECTRIC STORAGE BATTERY CO.

1888 PHILADELPHIA, PA. 1911

New York, Boston, Chicago, St. Louis, Cleveland, Atlanta, Denver, Detroit, San Francisco, Portland, Ore., Seattle, Los Angeles, Toronto

The "Exide" Sparking Battery gives the most reliable ignition service for gas engines.

ALL-METAL SELF-CLEANSING

Electric Washer

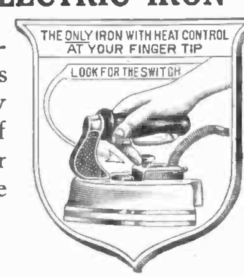
And WRINGER Complete for **$65**

Positive Drive—No Springs to break. Will wash any washable fabric **clean, quickly** at **trifling cost. Will save its cost** in 8 months in wear and tear of clothes alone, to say nothing of **time, money** and **hard work.** We will ship to you direct anywhere in the United States. A year's guarantee goes with every Washer sold.

Send for folder

Domestic Equipment Co., Dept. P, 30 W. Lake St., Chicago

PELOUZE ELECTRIC IRON

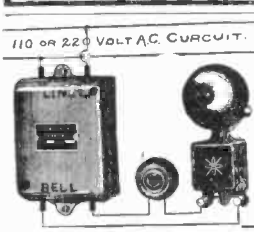


The most economical iron. Heats quickest. The only iron with control of heat at your finger tip. "Look for the Switch."

All leading dealers

PELOUZE ELECTRIC HEATER CO.

232-242 E. Ohio Street - Chicago



GREAT!!

That's what they all say when they receive one of our "Aphla" Transformers, for bell ringing and experimental purposes.

Here They Are—

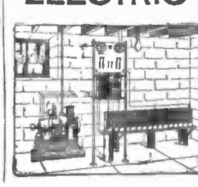
Type A-110 v. primary to 6v. Sec'ry $3.00
Type B-110v. primary to 2, 4, 6, 8, or 12v. Sec'ry $5.00

Takes the place of batteries. You can do it with an "Aphla."

K-B Electric & Mfg. Co., Mansfield, O.

Send stamp for circular

ELECTRIC LIGHT AND POWER



DAY AND NIGHT SERVICE

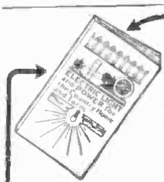
The Junior No. 1 Equipment

Direct Connected Dynamo, Gasoline Engine Set. Complete Switchboard, 16-Cell "American" Storage Battery } $265

The most complete, reliable equipment ever offered at this price. We want a representative in every county.

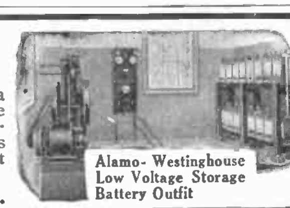
AMERICAN BATTERY COMPANY

Est. 1889 1143 Fulton St., CHICAGO



Do You Want Electric Light or Power for Your Country Home or Farm?

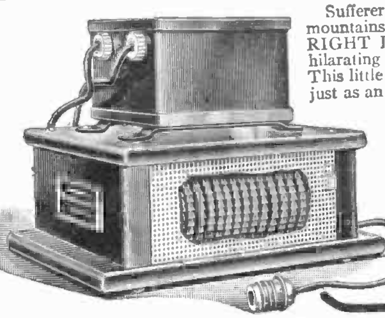
If you are out of reach of central station current and wish to install a gas engine electric outfit, either with or without storage battery, write for our Handbook, here illustrated. Alamo Electric outfits are standard. Our prices are as low as consistent with high-grade machines suitable for permanent installations. Investigate our proposition, it places you under no obligation.



Alamo-Westinghouse Low Voltage Storage Battery Outfit

The ALAMO MANUFACTURING CO., 73 South St., Hillsdale, Mich.

Let Electricity Make Pure Air for You



Sufferers from many ailments travel thousands of miles to breathe the OZONE of the mountains and pine forests. Yet a recent scientific invention enables everyone to have—RIGHT IN THEIR OWN BEDROOM—air constantly as pure, refreshing and exhilarating as the purest oxygen-filled atmosphere of the piny woods and mountain peaks. This little apparatus is operated by electricity and "ozonizes" the air of the closest room just as an electric storm purifies the out-door air. The

OZONE PURE AIRIFIER

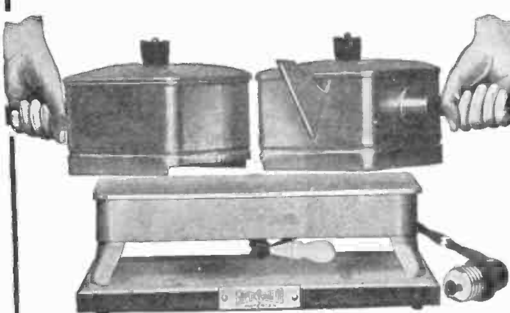
is of greatest benefit in the treatment of **Asthma, Hay Fever, Catarrh, Insomnia, Nervousness, Pneumonia, Typhoid and Scarlet Fevers, Diphtheria, Bronchitis, Tuberculosis, etc.** Endorsed by highest medical and scientific autho ritiesa thoroughly tested and demonstrated success.

Central Station. Electric Jobber and Dealer, this is the latest Electrical Appliance on the market. Write now for illustrated catalogue, price list and descriptive matter and plan of placing for liberal trial.

We want distribution throughout the United States in Every Place Where Electrical Appliances are Sold.

OZONE PURE AIRIFIER COMPANY
307-314 Rand McNally Bldg. **CHICAGO, ILL.**

SOMETHING NEW



The Simplex Electric Table Range

Useful in any home and a luxurious necessity in many.

The Table Range, operating from a single lamp socket, provides for all cooking requirements for a breakfast, lunch or other light meal for two or three persons.

Let us send you our illustrated circular which tells all about it.

Simplex Electric Heating Co.
CAMBRIDGE, MASS.

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612 Howard Street
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Convenience alone is sufficient reason for owning a

CADILLAC

COMBINATION ELECTRIC STOVE AND TOASTER

and when price, efficiency and appearance are considered, there is no excuse for being without one. ***Sent prepaid upon receipt of $7.50.***

CADILLAC ELECTRIC MFG. CO.
216 Mitchell St. Cadillac, Mich.

TO BE CLEAN

YOU NEED

The "BEE" Suction Cleaner

IT

costs only $65.00 with complete equipment.
weighs only 20 lbs. No Jar or Vibration.
equals the highest priced machines in efficiency.
does the best work with the least effort.
has NEW and EXCLUSIVE FEATURES.

SOLD ONLY BY RELIABLE AGENTS.

BIRTMAN ELECTRIC CO., CHICAGO, U. S. A.

THE "BLITZEN" TRANSFORMER

Closed Core
High Efficiency
Magnetic Leakage Type

Self Controlling
High Power Factor
A Year's Guarantee

Usual Clapp-Eastham Quality

An instrument of the "Better" kind mounted in a mahogany cabinet with nickel plated binding posts for primary and secondary connections.

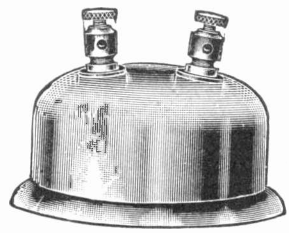
An unusual transformer at an unusual price, built by a company with an unusual reputation.

¼ K. W. $15.00 ½ K. W. $22.00

Complete catalogue of apparatus for commercial and private installation sent for 4c stamps. We are desirous of establishing several additional sales agencies.

Clapp-Eastham Co.
141 Main St. Cambridge, Mass.
Aylsworth Agencies Co., 143 Second St., San Francisco, Cal. Western Sales Agents

Fixed Receiving Condenser



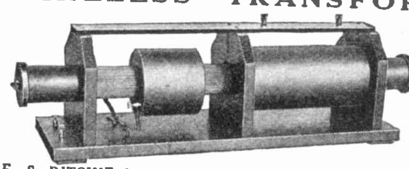
The above cut illustrates our new fixed receiving condenser. Enclosed in polished brass case. Has sufficient capacity for any station and a greater capacity than any other at the same price or less.

Price 75 Cents

Our Manual of Wireless Telegraphy and Catalog No. 1E will be sent on request.

Manhattan Electrical Supply Co.
New York, 17 Park Place **Chicago, 112-114 S. Fifth Ave.**

WIRELESS TRANSFORMERS



1-2 K. W. $30.00

Send for Catalogue

E. S. RITCHIE & SON, 117 Cypress Street, BROOKLINE, MASS.

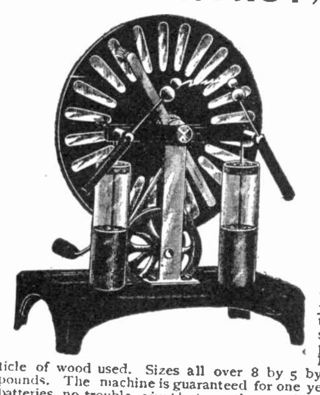
WIRELESS OPERATORS

As a Fall inducement we offer the following specials:
Black enameled wire sizes from 18 to 22 per pound.........45c
Black enameled wire sizes from 24 to 28 per pound.........50c

Do not fail to send for our new catalogue, which is just off the press. Send two (2) cent stamp for catalogue. (No postals answered.)

THE I. W. T. WIRELESS CO.
1038 Broadway Brooklyn, N. Y.

THE "ELECTRO" STATIC (WIMSHURST) MACHINE



Guaranteed to generate in any kind of weather, no matter how foggy or rainy. First machine ever constructed which can truthfully claim this. We absolutely guarantee fat, powerful 3-inch spark. Used successfully to operate Geissler and X-ray tubes, charging the biggest Leyden jars, firing powder, working wireless sets, raising a person's hair, etc. Anybody interested in electricity owes it to himself to possess one of these wonderful machines. Can be used to perform thousands of interesting experiments. Cut shows machine plainly. We furnish solid cast iron base, cast iron wheels, two fine Leyden jars and there are two electrite plates revolving in opposite directions. All metal parts are nickel plated or highly polished. Not a particle of wood used. Sizes all over 8 by 5 by 11 inches. The weight is 3 pounds. The machine is guaranteed for one year. Nothing to wear out, no batteries, no trouble, *simply turn the crank the machine does the rest.*

Price complete boxed, **$3.75. This price will be raised later.** If you are interested in this machine send at once for our new booklet giving a lot of experiments to be performed with same.

Send today 4c postage for our famous 106 page Electrical Cyclopedia No. 9 containing over 400 illustrations, lots of information on electrical and wireless subjects, etc. **POSTAL CARDS NOT ANSWERED.**

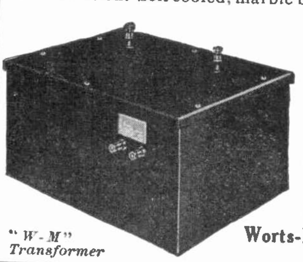
THE ELECTRO IMPORTING CO., 233B Fulton St., NEW YORK CITY
"EVERYTHING FOR THE EXPERIMENTER"

"W-M" HIGH POWER WIRELESS APPARATUS

Listed in New Catalog "D"

An entirely different type of transmitting condenser for high power sets (½ and 1 K. W.), guaranteed against breakdown. Hard rubber insulators for lead outs. Absolutely uniform conductor. Low corona loss. Variable capacity. Also glass plate condensers for ¼ K. W. and spark coils.

¶ Closed core transformers with the latest approved features of superior insulation and "solid secondary" construction. Self cooled, marble base zinc spark gaps. ¶ Solid mahogany helices. ¶ Lead in insulators. ¶ Anchor gaps. ¶ Hot wire ammeters. ¶ Impedences to be used in operating spark coils from A. C. ¶ "Long distance" receivers and tuners.

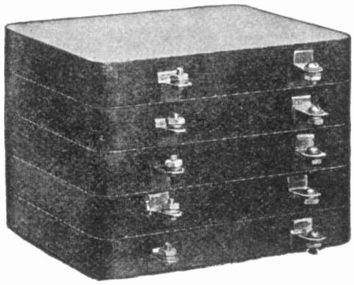


"W-M" Transformer

Send stamp for catalog. No postals.

Worts-McKisson Mnfg. Co.
Toledo, Ohio

MURDOCK MOULDED
TRANSMITTING CONDENSERS



$2.00 PER SECTION

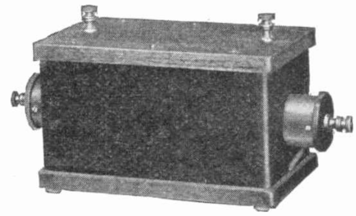
A radical departure from former condenser construction. Conducting foil imbedded in solid dielectric under pressure. Moulded in sections of .0015 mf. capacity, approximately.

Suited for **hard, continuous, satisfactory** service in any wireless station, experimental or commercial.

WM. J. MURDOCK CO.
50 Carter Street
CHELSEA, MASS.

162 Minna St. SAN FRANCISCO — 221 S. Clinton St. CHICAGO

Wireless Transformers



Open Core Type

1/8-K. W.	$12.50	INCLUDING IMPEDANCE	$16.00
1/4-K. W.	18.00	" "	22.00
1/2-K. W.	24.00	" "	28.50
1-K. W.	35.00	" "	40.00

Box is quarter-sawed oak, beautifully finished and substantial in every respect.

SECONDARY UNITS

For Open Core Transformers. These units will reach you all ready to assemble on your primary, and are so constructed that a mistake in the assembling is impossible.
Their insulation cannot be excelled.

SUFFICIENT UNITS FOR 1/8-K. W. OPEN CORE TYPE	$ 6.75
" " " 1/4 " " "	9.90
" " " 1/2 " " "	12.00
" " " 1 " " "	20.00

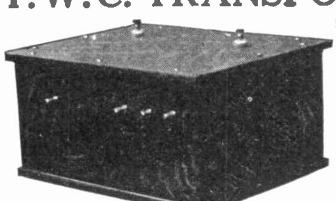
Complete specifications for balance of Transformer, such as length, diameter and weight of core, size of primary wire and number of turns, etc., will accompany each order for secondary units. All of above prices require that you pay the express charges yourself.

SPECIAL SECONDARY UNITS

For the benefit of the experimentalist, we are manufacturing secondary units both round and square in practically all sizes of internal and external diameters, in all sizes and styles of insulation of magnet wires. The number of turns per section should be left to our judgment and care should be taken to give us full information as to required secondary voltage, size of primary wire, kind of current and voltage used, etc. These specials can be adapted to your requirements, whether for wireless or extremely high frequency work. Prices will be submitted on request.

Dawson & Winger Electric Co.
727 S. DEARBORN ST. CHICAGO, ILL

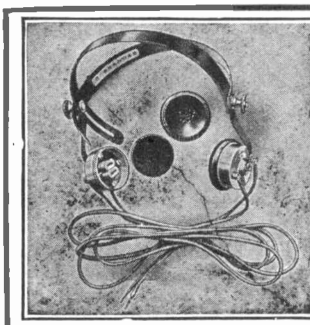
T.W.C. TRANSFORMERS



1/4 K. W.	$12
1/2 "	18
1 "	35
2 "	60

Owing to the increase in demand for our 1/4 and 1/2 kw. transformers, we are able to make a reduction of the price on these sizes. They are in no way cheapened, and, as it has always been in the past, only the best materials and designs are used. Send stamp for new leaflet listing transmitting sets.

TOLEDO WIRELESS COMPANY
Dept. B — Toledo, Ohio



BRANDES Long Distance Receivers

Why everybody prefers **Brandes Wireless Receivers—**

Because—Lightest receivers made. No more head or earache from constant wear. Clear long distance reading. Made of best material obtainable.

Guaranteed. Sent on trial. Money refunded if not satisfied. Send for pamphlet giving full description of all Receivers from $1.50 each up to $13 per set.

Pneumatic Rubber Ear Cushions to fit all types, 60c each.

C. BRANDES, Wireless Receiver Specialist
111-115 Broadway — New York

THE "BLITZEN" TRANSFORMER

An Unusual Transformer at an Unusual Price

1-4 K. W. $15.00 — 1-2 K. W. $22.00

Closed Core — Self-Controlling

High Efficiency — High Power Factor

GUARANTEED FOR ONE YEAR

The "Blitzen" Transformer is unquestionably the most efficient low priced transformer made. It is of our usual high quality, and is sold at a price that is truly revolutionary for an instrument of dependability and worth. It is mounted in a beautiful mahogany cabinet.

Big 250 Page Catalog Just Out
WIRELESS AND ELECTRICAL GOODS

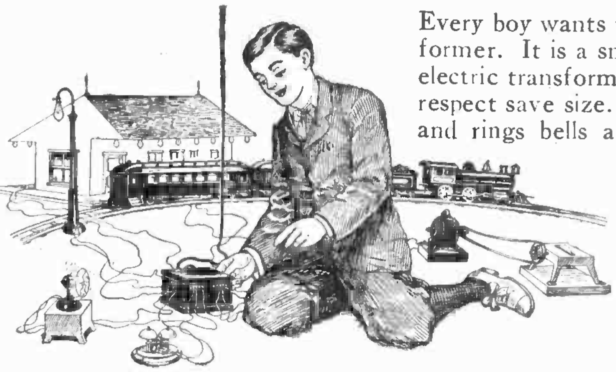
Mailed for 6c (Stamps or Coin) Which May be Deducted From First Order of $1.00

The largest and most elaborate catalog of wireless and electrical goods in existence. Our catalog will save you money. Highest quality combined with lowest prices.

WRITE FOR IT NOW

428 St. Clair Street — **J. J. DUCK** — *TOLEDO OHIO*

A MANLY TOY FOR MANLY BOYS



Every boy wants to own a Thordarson Toy Transformer. It is a small edition of the large, powerful electric transformers, identical with them in every respect save size. Connects with any lamp socket and rings bells and buzzers, and operates one or more electrical toys at the same time. The

THORDARSON TOY TRANSFORMER

is moisture-proof and practically indestructible. Not only amuses, but teaches fundamental working principles of electricity.

Style No. 1, 60 Watts, Price.......... $ 8.00
Style No. 1A, 60 Watts, Price.......... 5.00
Style No. 2, 120 Watts, Price.......... 10.00
Style No. 2A, 120 Watts, Price.......... 7.00

In addition to long connecting cord, Style No. 1 is equipped with three, and Style No. 2 with five flexible plug contact cords. No. 1A and No. 2A are each equipped with long connecting cord, and have binding posts only.

Thordarson Electric Mfg. Company
220 So. Jefferson St. Chicago, Ill.

ANYONE CAN OWN A WIRELESS STATION

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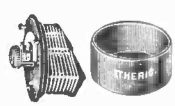

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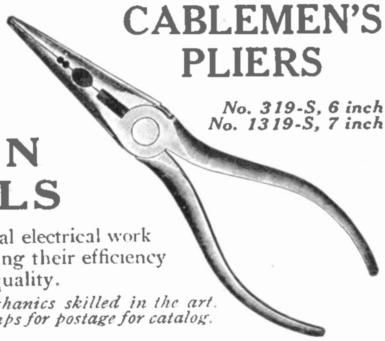

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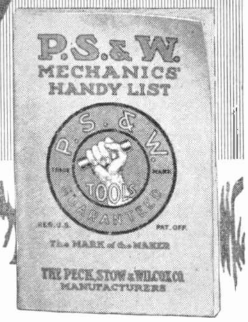

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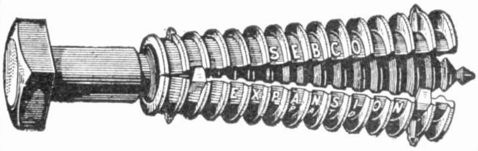

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simple in construction, easily attached, assures great strength, is rigid and suitable for fastening any kind of a fixture to a wall of stone, brick, cement, tile, etc.

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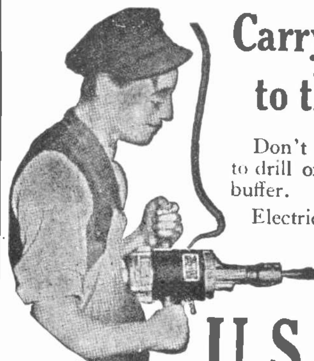

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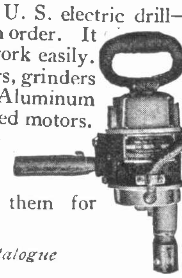

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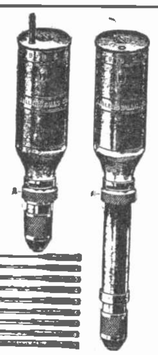

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This Star Pocket Borer No. 8 is a mighty convenient, compact tool. You can so compress it that it carries in your pocket with no inconvenience. But set it to work and you'll find it has all the good characteristics of any regular borer.

The cells in the handle hold eight drill points, ranging in size from 1-16 inch to 11-64 inch, and numbered from 1 to 8. Cell No. 9 contains a small screw driver to be used when the tool is compressed, with the plunger forced back into the handle and secured there.

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A Millers Falls Efficiency Tool

MILLERS FALLS CO., 28 Warren St., New York

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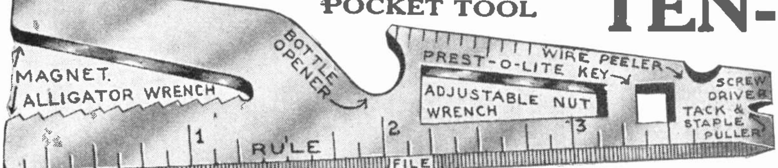

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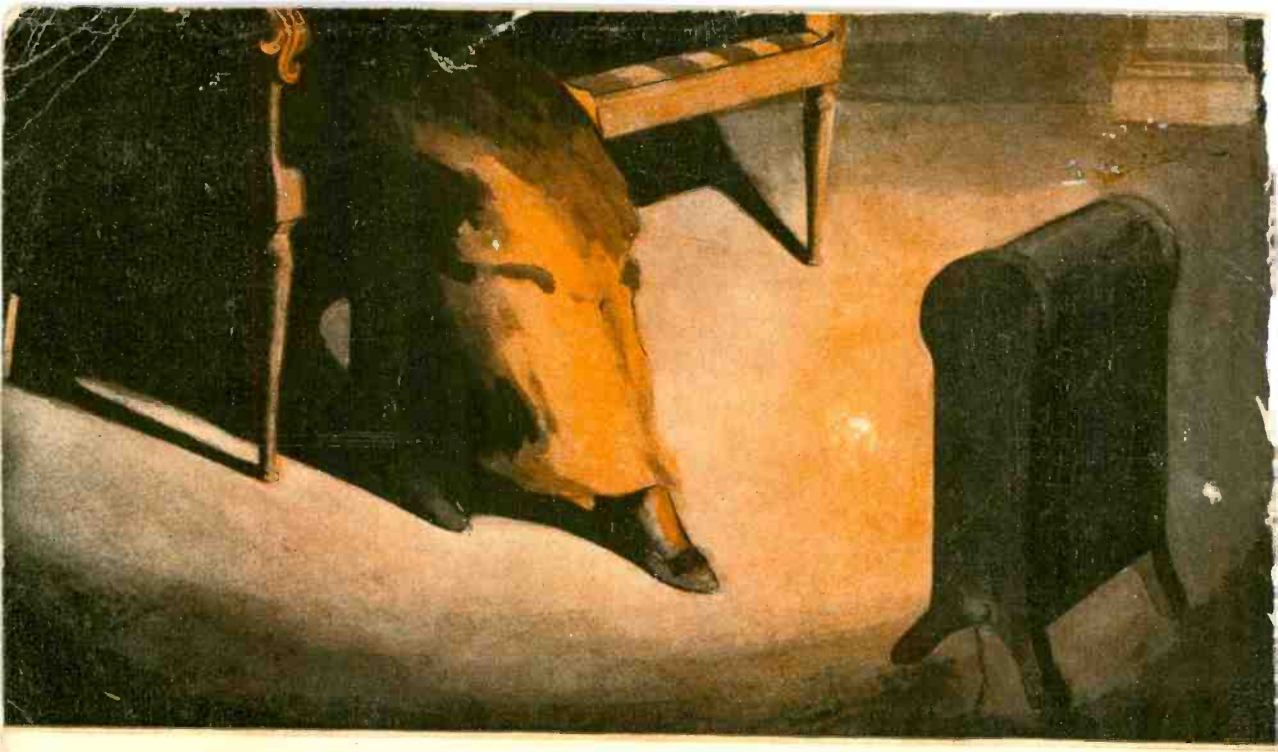

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