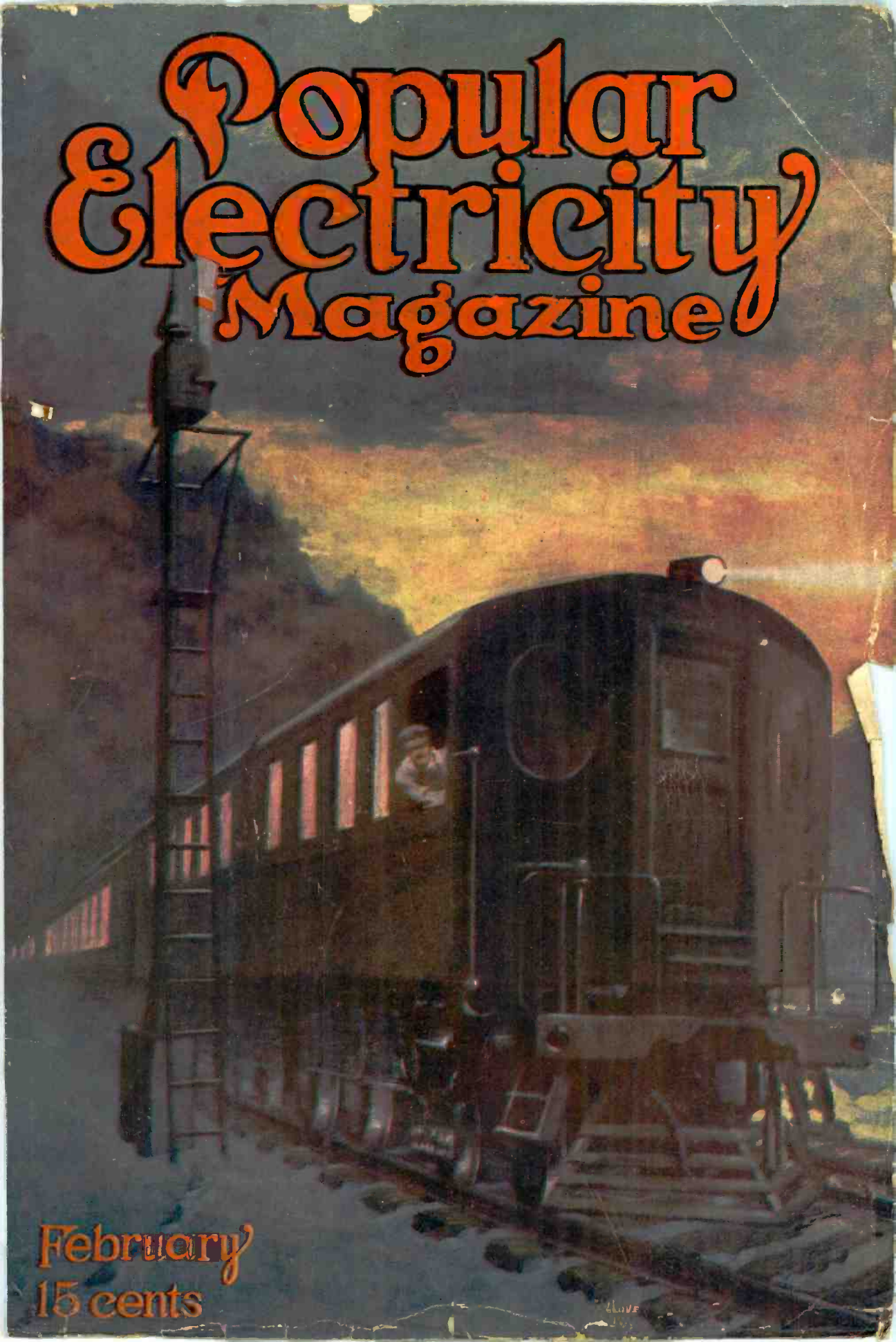
Popular Electricity Magazine



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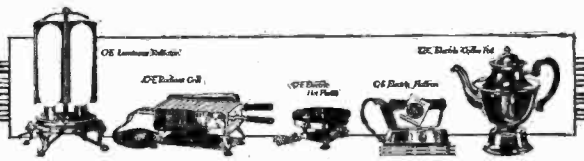

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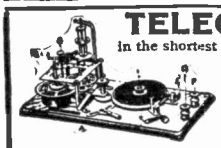

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POPULAR ELECTRICITY MAGAZINE

In Plain English

HENRY WALTER YOUNG, Editor

Vol. V | February, 1913 | No. 10

CONTENTS

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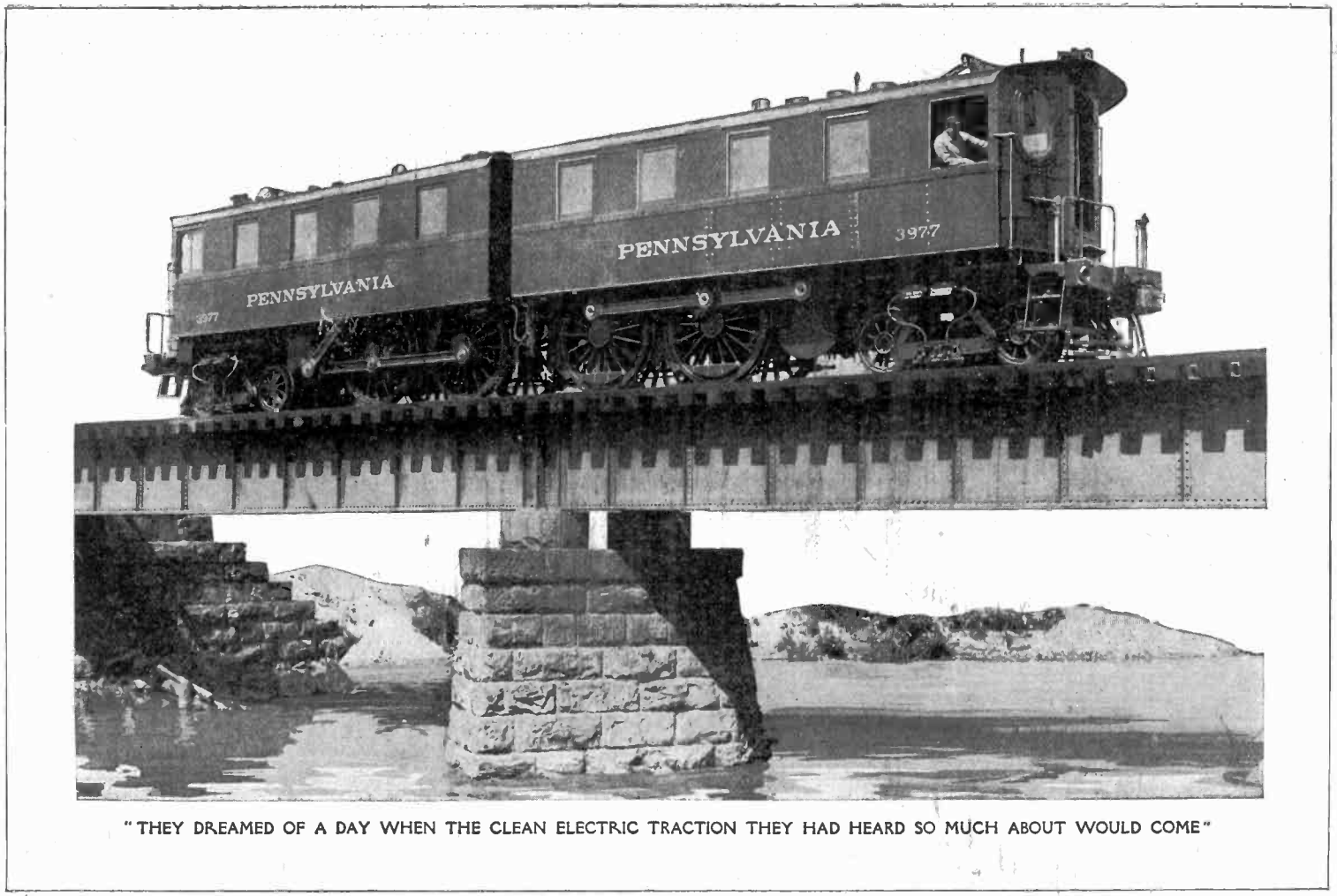


"THEY DREAMED OF A DAY WHEN THE CLEAN ELECTRIC TRACTION THEY HAD HEARD SO MUCH ABOUT WOULD COME"

Popular Electricity
In Plain English

VOL. V. FEBRUARY, 1913 No. 10

Electricity Ousting the Steam Locomotives

By EDWARD LYELL FOX

A blunt, shapeless cab, a string of cars in its wake, comes sliding along the tracks. On either side the meadows nod drowsily—brown reaches of rank grass. But so quietly does the strange procession move across them that not even a sleeping cat-tail is disturbed. On it comes until sighting the concrete platform at Manhattan Transfer its soft purring rises to a hiss, a strident, singing sound—for the air breaks are working and the train is rolling to a stop.

We watch it draw up beside the platform. We see the door of the cab roll open. The engineer steps out. His face is clean. In demeanor and appearance he is unruffled as a banker leaving his office. In the cab behind him the air has remained pure. The windows are free of smoke stains. None of the jar of the steam locomotive has shaken him. For he is the engineer of an electric train—a type that is rapidly supplanting the steam engine on most of the railroads in the neighborhood of New York City.

A few years ago the traveling public began to dream. They dreamed of a day when the clean, swift, electric traction that they had heard so much about would come—that it would cover railroad operation in the immediate vicinity of most of the big cities. For it to extend over the country was too much. That was a dream to dream when the first had been fulfilled. And now that the big railroads of the East are ousting the steam locomotive and equipping their suburban service with electric cabs it is about time that the second dream came into being.

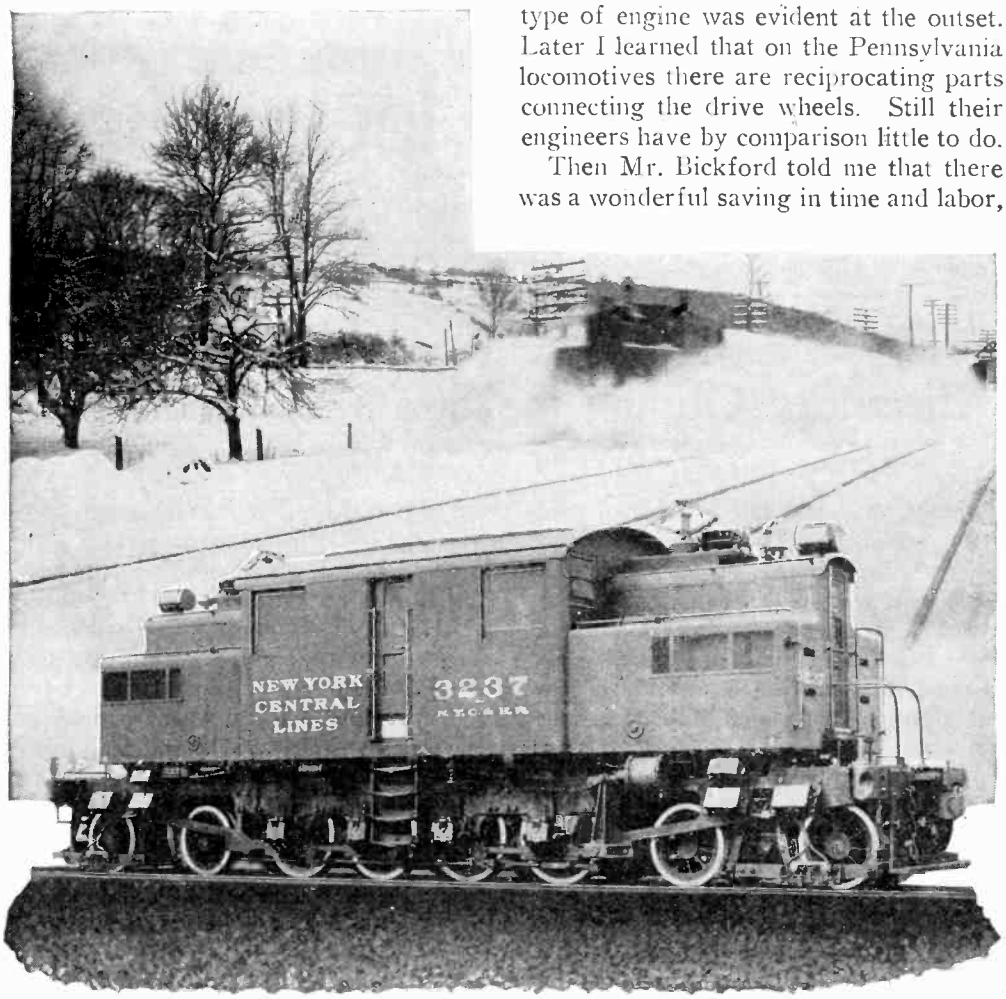
The sight of a gigantic locomotive bellowing through the night belching fire and smoke is inspiring—but it is not clean. People to-day demand the cleanest in everything. And in railroads cleanliness has been a long time coming to them. As a matter of fact there has been little advance in this respect since a day in August 82 years ago when the DeWitt Clinton, dragging three coaches, panted on its first trip between Albany and Schenectady. Of this trip we have read:

"The smoke and sparks poured back on the passengers in such a volume that they raised their umbrellas as shields. The covers were soon burned off these and each man whipped his neighbor's clothes to put out the fire started by the hot cinders."

It was a man named Bickford, road foreman of the New York Central's electrical equipment, who told me about their system. And Bickford speaks from a broad viewpoint. For he has been both engineer and fireman.

"How," I asked him when he was finally located off duty, "does an electrical engine's equipment differ from one run by steam?"

"An electric cab," he told me "is very simple. A steam cab is complex. On a



CLEARING THE TRACK IN WINTER—ONE OF THE NEW YORK CENTRAL ELECTRIC LOCOMOTIVES

type of engine was evident at the outset. Later I learned that on the Pennsylvania locomotives there are reciprocating parts connecting the drive wheels. Still their engineers have by comparison little to do.

Then Mr. Bickford told me that there was a wonderful saving in time and labor, motor engine the equipment by comparison is small. There is little for the engineer to bother himself with. Indeed he is responsible far less for his electric locomotive than he used to be for his steam engine. Trained inspectors do the work for him. Besides he has much less mechanical responsibility. On our multiple unit locomotive, for instance, there are no reciprocating parts. There are few things that can become loose. The motorman makes practically no mechanical inspection unless it be to examine the rigging of the air brakes."

And so the very simplicity of this new preparing the electric locomotive for work. Let me illustrate:

At High Bridge—what might be called the "suburban outpost" of the Central's lines—the trains on the Hudson division change engines. Steam gives way to electricity. On an extra track the great motors wait. Fifteen feet from them shine the windows of the train dispatcher's office.

And now a train from the West is coming down toward the city. At "F. H." tower three miles above High Bridge its coming is announced. A telephone bell jingles in the engine dispatcher's

office; the number of the approaching train is called out. Hearing the signal the motorman who has been asigned to take "the flyer" on the last leap toward the city hurries to his cab. In anywhere from two to five minutes he is ready. Then the inspector comes, looks at the fuses, at their openly exposed boxes; he examines the brake mechanism. Then he waves his hand.

"Clear away," he shouts.

In an instant the engine is cut out and moved out on the track.

To a man understanding railroading, the contrast between preparing a steam locomotive and the electric train is sharp. The saving in time is wonderful. Most steam locomotive engineers will tell you that it takes fully 40 minutes and sometimes more to put the big engine in shape. The railroad allots them a half hour under pay to accomplish this. But that isn't enough. Often they must encroach upon their own time to be sure that the great vehicles they drive respond nicely to throttle and brake. Steam takes 40 minutes, electricity five. The saving is obvious.

And once the incoming train is picked up the labor saving continues. Chiefly it is concerned with the reverse lever. Old engineers tell me that the reverse lever is the nightmare of their profession. They must graps it with both hands, brace a foot against the cab and pull with all their strength if the engine is to go backward. It is a task that makes an awful drain upon a man's strength. On a freight run, for instance, where there is much backing, the lever is a bugbear. Yet contrasted to this is the wonderful simplicity of the electric cab. In it the reverse lever looks like a little wrench. It can be handled as easily as the button that turns on the electric lights in a room. The strength of a child can move it.

Still another advantage is in safety. At the terminal I managed to get some information out of a Central engineer. He had just finished his run through the long tunnel, that runs under the city. Like the Pennsylvania engineer he was very calm and clean when I saw him—unlike the engineers with their black grimy faces that one sees so often hanging out of the windows of the steam cab when a run is finished.

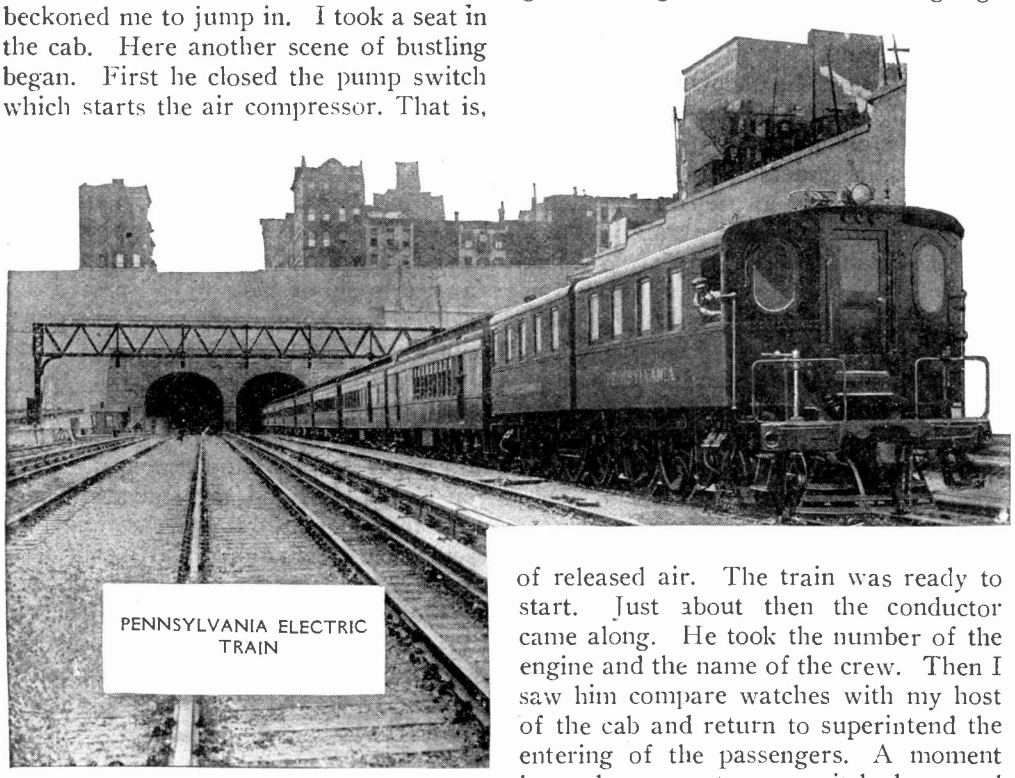
"Yes," he said in answer to a question. "Electricity has made travel through the tunnel much safer. This Park Avenue hole used to be full of smoke and steam and gas. A great number of trains ran through it. The gas came mostly from the hard coal that was used on the suburban service. All this made it very hard for an engineer to make out the signals. I know, for I got lost in there a great many times. Once I stopped as soon as it dawned upon me that we had passed signals and had not seen them. I got down with a torch and felt along the rail until my hand came in contact with the block. Then I knew for sure that we had it. Having a green fireman I wouldn't trust him to get down. I did it myself. I tell you it was hard and nasty work. There were four signals through the tunnel on each track. Sometimes that meant four stops. Now they have eleven signals. But I have never left my cab. With electricity in the tunnel instead of smoke and gas we can see everything clearly."

Later I received permission to make a run through the tunnel in one of the electric cabs. I was told to report half an hour before the leaving time of the train. When I got there I found the engineer—or motorman if you would rather call him that—examining the bulletin board. Then he compared his watch with the standard clock, registered "on" and the hours he had been "off." A moment later the train dispatcher came along and told him where his engine was stationed.

Often the electric locomotive is found on its right track, the man finishing a run leaving it there. This time, though, it was out in the yard and so we began a weary pilgrimage, crossing tracks, picking our way over third rails, and standing in the little safety stations when trains came whirling from opposite directions.

The yard being on a grade we found blocks under the wheels to keep the engine from sliding back down the tracks.

I watched the engineer. He gave directions to some helpers; the blocks were removed. Then he walked along the cab, examining the contact shoe and the motor fuses. A moment later he beckoned me to jump in. I took a seat in the cab. Here another scene of bustling began. First he closed the pump switch which starts the air compressor. That is,



PENNSYLVANIA ELECTRIC TRAIN

starts it unless the fuse is blown. Then he cut in all the necessary switches to move the engine and looking through the window waited for a tiny signal beside the track to give him the word to start back into the terminal.

It was not long before the signal flashed. A switching on of the current and we were sliding back over the rails. As we neared the waiting passenger coaches he moved the air brake switch and with a soft hissing the engine bumped lightly against the coupler of the first car. I noticed that the coupling was not done until an inspector came. Then with the necessary air pressure in the train line the inspector signaled to apply the brake test. Meanwhile he was walking back beside the cars watching the different pistons and brake cylinders, watching to see if they were working properly. Then he gave a signal to release the brakes and with another simple twist of the engineer's fingers there came a long sigh of released air. The train was ready to start. Just about then the conductor came along. He took the number of the engine and the name of the crew. Then I saw him compare watches with my host of the cab and return to superintend the entering of the passengers. A moment later the current was switched on and with a low moaning sound issuing from the huge motors, we began to whirr out of the train shed. Slowly and easily we went, never gaining speed. And I was wondering at the even pace when the motorman said:

"Through the yard the speed limit is from six to ten miles an hour. We have to be careful."

Before I could comment the dark opening of the tunnel had loomed ahead and we plunged into a chaos of rumbling wheels and moaning engines. And as we rumbled along he began to call my attention to the signals—disk signals with two lights. When a red hole burned through

the darkness it meant to stop. And as we rushed on the engineer told me that the bottom light turning to yellow meant caution. In two miles of the tunnel we passed eleven of these signals. All were automatic and as soon as we saw red there was a twist of the engineer's wrist and the air brakes releasing he brought the train to a stop. Then the brakes taken off he moved ahead slowly until another block was passed.

It was slow work going through the tunnel and not until a vague light quickly brightening began to show ahead did we pick up speed. Then the power lever was pushed ahead a notch and we whirled out into the sunshine. Here we found another set of signals, only instead of being along the tracks they hung above us. These he called "positive signals" and explained to me the difference—if an engineer finds an automatic signal in the stop position, he stops, then proceeds slowly; if he finds a positive signal he stops and does not proceed until it clears or until he receives a card from the signal man telling why it cannot be cleared. A few of these and the automatic signals began again changing at intervals to the positive until we rushed through the suburbs out into the country until the North White Plains yard was reached. So our run was finished—a 24 mile run entirely by electricity with 86 signals left behind.

Later I learned that the run of the Pennsylvania system between the big terminal in New York City and Manhattan Transfer out in the Hackensack Meadows was even easier. Indeed the Central engineer said it was hard to imagine greater comfort in train operation than the handling of an electrical locomotive through the clean straight tube under the Hudson River, under Bergen Hill and out across the meadows. The Pennsylvania engineer sits in a little compartment on the front of the locomotive. A big window is before him giving a clear view of the track. The master controller is at his elbow. Six feet away facing a similar window sits his companion.

With the left hand the engineer pushes over the lever of his controller very slowly. He does this so as to start the heavy train without blowing a fuse. With his right hand he works the little handle which applies the air to the brake. Interlocking signals guide him across the open station yard. In the tube system of blocks, signals, red and green, tell him the way is clear. A cool green light glowing ahead and he has nothing to fear. The motor is let out. It sings and the train whirls along slackening speed, perhaps, climbing the grade near the Jersey side of the river. But there is no panting like in a steam engine, no intolerable heat, nothing to make the trip anything but quick and clean.

Yet in spite of all these advantages old-time engineers are against the electric locomotive. Their attitude resembles the "stand-patter." The operation of an electric or multiple unit train calls, you see, for less expert knowledge. Long experience is unnecessary. It would take away from the profession of an engineer something of its exclusiveness. It would make competition more general and possibly reduce wages.

Four years before, Henry C. Case ran a steam locomotive for the New York Central. Now he wants to get back again into the steam service. He says he is lonely. It may sound a peculiar objection but it is the objection of most engineers who ride without helpers in the Central's cabs. Psychologists say, you know, that the only real punishment is loneliness. And loneliness is intensified when a man is whirling ahead 50 miles an hour with nothing but a piece of glass in front of him. Should there be a collision there is nothing to stand the shock of a crash. Nothing like on a steam locomotive where the long boiler takes the shock. So you see, they are not only afraid of wages being cut, of new men overcrowding the field, but they fear the loneliness of that wild ride—a loneliness that some day may make them think a red light is green and beckon them on to destruction.

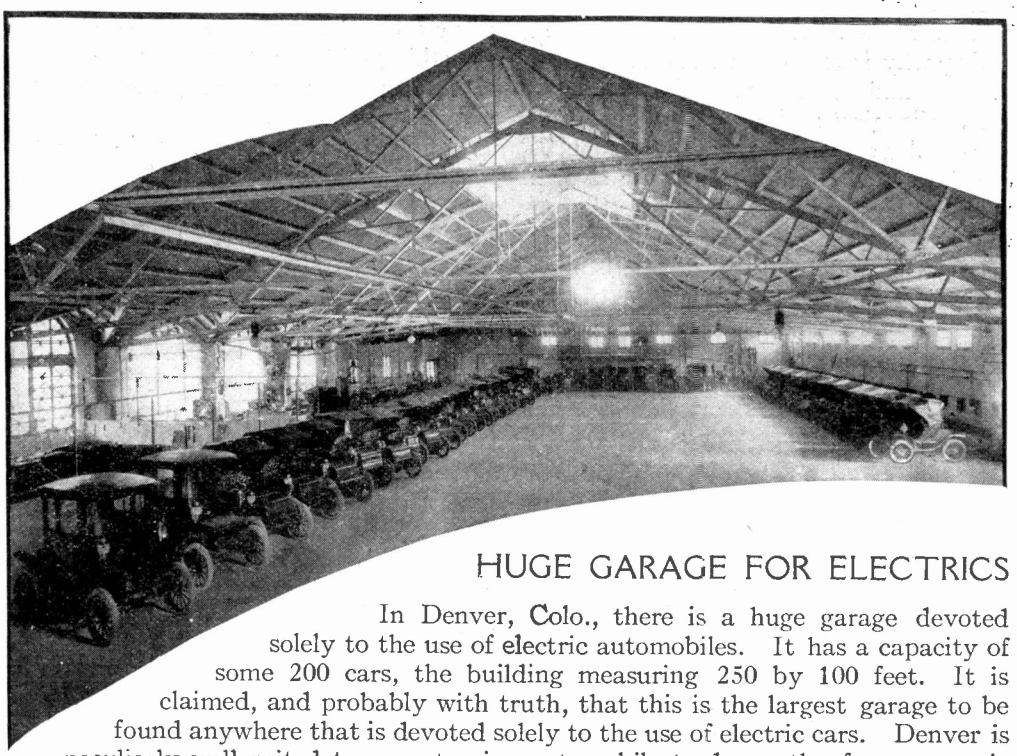
The First all Metallic Telephone Circuit

The telephone business did not really begin to grow big and overspread the earth until 1896, but the keynote of expansion was first sounded by Theodore Vail in the earliest days, when as yet the telephone was a babe in arms. In 1879, according to telephone history, Vail wrote to one of his captains:

"Tell our agents that we have a proposition on foot to connect the different cities for the purpose of personal communication and in other ways to organize a grand telephonic system."

This was brave talk at that time, when there was not in the whole world as many telephones as there are to-day in Cincinnati. It was brave talk in those days of iron wire, peg switchboards, and noisy diaphragms. Most telephone men regarded it as nothing more than talk.

Four months after he had prophesied the "grand telephonic system," he encouraged Charles J. Glidden of world-tour fame to build a telephone line between Boston and Lowell. This was the first inter-city line. It was well placed, as the owners of the Lowell Mills lived in Boston and it made a small profit from the start. This success cheered Vail on to a master effort. He resolved to build a line from Boston to Providence and was so stubbornly bent upon doing this that when the Bell Company refused to act, he picked up the risk and set off with it alone. He organized a company of well known Rhode Islanders—nicknamed the "Governors' Company"—and built the line. It was a failure at first, and went by the name of "Vail's Folly." But Engineer Carty, by a happy thought, doubled the wires, and thus in a moment established two new factors in the telephone business—the all-metallic circuit and the long distance line.—*History of the Telephone.*



HUGE GARAGE FOR ELECTRICS

In Denver, Colo., there is a huge garage devoted solely to the use of electric automobiles. It has a capacity of some 200 cars, the building measuring 250 by 100 feet. It is claimed, and probably with truth, that this is the largest garage to be found anywhere that is devoted solely to the use of electric cars. Denver is peculiarly well suited to an extensive automobile trade, as the famous scenic characteristics of the surrounding country draw thither thousands of summer tourists.

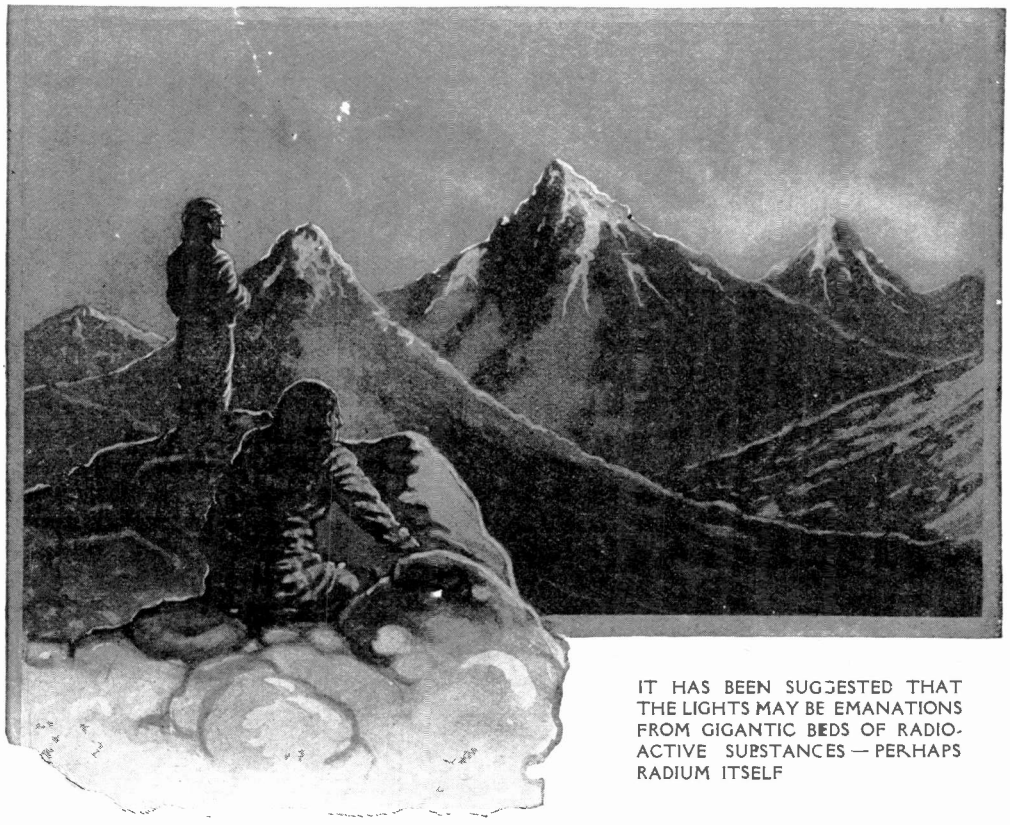
Strange Light from the Andes

The Chilean government, acting with Bolivia and Peru, has appointed a commission of scientists to investigate a strange light which flashes from the Andes in Chile. The light is visible 500 miles from the main range and is believed to be electrical in origin. It emanates directly from the mountains themselves.

Dr. Pedro Santinez, one of the commission selected, writing of the extraordinary phenomenon, says:

"The light is ordinarily of a glistening appearance and has the shape of a bold curve. It appears to have fixed points of issue and changes only in the frequency of its discharge and in its extent. The most vivid flashes come from a definite point, and the radiation sometimes reaches far above the zenith and away to sea. The extraordinary phenomenon can be seen with greatest ease when the sky is clear.

"The flashing begins late in spring and lasts until early winter. Toward the south then the light ceases almost altogether. But in northern and central Chile, in Peru and Bolivia the flashes are intermittent throughout the winter.



IT HAS BEEN SUGGESTED THAT THE LIGHTS MAY BE EMANATIONS FROM GIGANTIC BEDS OF RADIO-ACTIVE SUBSTANCES — PERHAPS RADIUM ITSELF

"A suggestion has been made that the light may not be electrical at all; that it may be emanations from gigantic beds of radio-active substances, perhaps radium itself. If this latter theory is correct, the Chilean Cordilleras hold a hoard which will change the destinies of the world.

"During the great earthquake of August, 1906, discharges occurred along the whole crest, for if we may accept authoritative statement, the sky everywhere in central Chile then flashed with a quivering 'fire.'

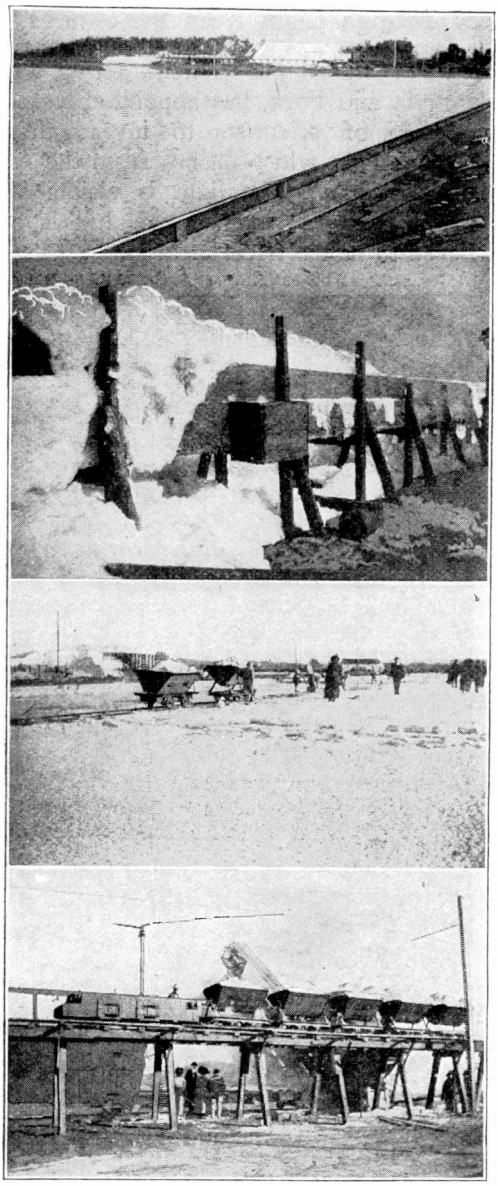
"Observation leads to the conclusion that this radiance of the Andes is the result of electricity. How these discharges, which are noiseless and produce no sparks may be designated at this day is not quite clear.

"It is probable that in the Andes is a source of power such as the world has never known and which, if it can be harnessed, will be found capable of providing energy for the whole world."

Making Salt from Sea Water

The sea water of the Pacific Ocean is the source of supply of the Western Salt Company, which has its works some ten or fifteen miles south of the city of San Diego, Calif. There are about one thousand acres in the entire fields controlled by the company, and this large area is divided up into rectangular evaporation reservoirs, from which the water flows, finally, into other reservoirs for the final crystallization of the then considerably condensed salt water.

These final vats have a total area of about 75 acres and yield annually a crop of over 12,000 tons of salt. Around these crystallizing vats there is a network of narrow gauge tracks on which are operated dump cars into which the Japanese laborers shovel the salt, taking off a layer eight inches thick from the whole surface area of the vats. For this labor they get fifteen cents per car. The salt vats have much the appearance of a northern ice field and the effect if the bright sun upon the large crystals is the same as the sun upon the snow. When a number of the small dump cars have been filled with the glistening crop they are run together and hauled to the main track by a gasoline motor and are there coupled to a small electric locomotive which draws them to the yards where the salt is dumped in heaps for further treatment preparatory to shipment. These heaps attain a height of 30 to 50 feet, the salt being carried up by automatic conveyors. The tracks are laid on a grade which allows the locomotive to take the dump cars well up the side of the heaps before they are dumped. The locomotive is of a low-down type of construction, the motorman sitting in the rear of the body. An upright pole carries the trolley arm which runs along the wires of the system.



A CALIFORNIA SALT PLANT

Aeroplane Phonograph

The army officers who have been engaged in training for aeroplane scouting work in the region of Paris find that although the aeroplane is excellent for revealing objects on the ground there is a difficulty in the way of recording the observations. It is in fact very hard to do any writing upon an aeroplane, and at the same time to keep on making observation, but this drawback will now be overcome by the use of the new Roneo phonograph apparatus.

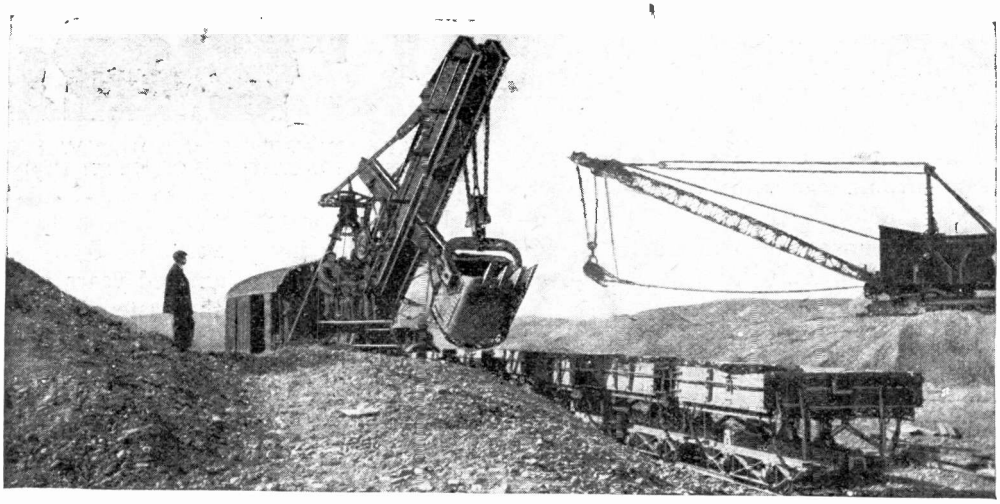
In using this the observer simply talks into his small machine which he has before him by the use of a speaking tube and thus he is able to record all his notes upon the disk instead of having to write them down. The phonograph is of special makeup for aeroplane work and is run by a small electric motor and battery. Even when in the air the disk can be put in a suitable box and dropped overboard without needing to stop, then putting in a new one and so on; or the disks can be kept and turned in to heaquarters at the end of the flight.

AEROPLANE PHONOGRAPH

Steam Shovels Give Way to Electric

Electric power has been successfully applied to operate the steam shovel and drag line excavators in use by the reclamation service in excavating at Lahonton, Nev.

A Bucyrus 60 ton shovel and a 60 ton drag line scraper are shown in operation in the picture. The power is generated in the government power plant near by, where the drop in the Trucker Canal is used to develop 1,000 horse power. With cheap power the machines are preferable to the steam shovel.



A 60 TON SHOVEL AND A DRAG LINE SCRAPER WORKED BY ELECTRIC POWER

The Wonder-Work of the Mohawk Valley

By H. Bedford-Jones

SATURDAY NOON AT THE SCHENECTADY WORKS. ABOVE IS THE PRETENTIOUS OFFICE BUILDING

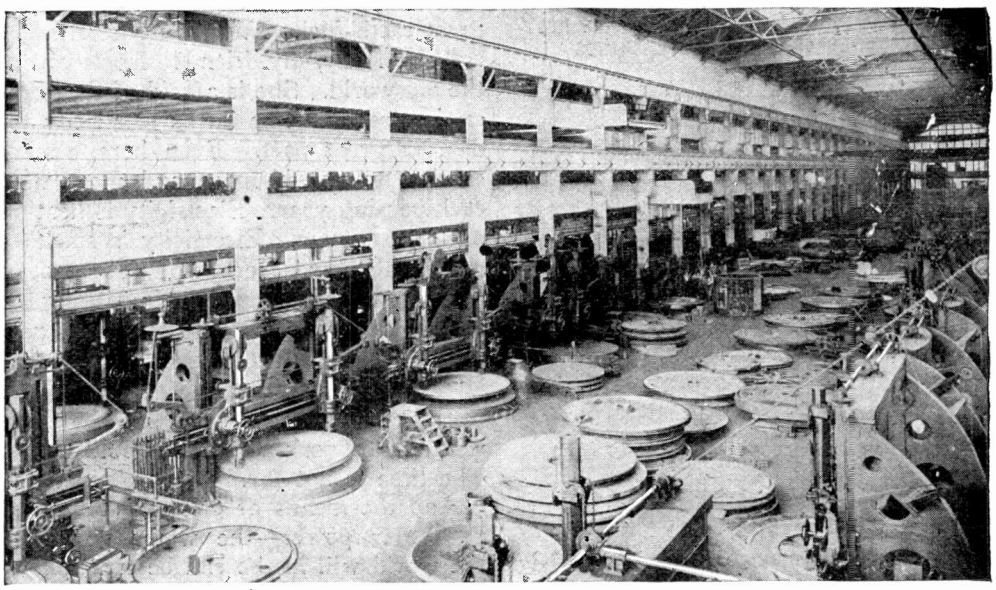
In 1901 the first large steam turbine in the world was put to work in Chicago—a 5,000 kilowatt giant which was revered as a master-work from sea to sea. Five years and eight months later it was dismantled—not of necessity, for its work was as perfect as ever—but for efficiency; in comparison of others of its kind it was no longer a giant but a dwarf, its room had become better than its company. Today that steam turbine stands in Company Street, a monument to efficiency. A few hundred yards away are constructed steam turbines of 24,000 kilowatt, or over 30,000 horsepower capacity.

It is a wonderful avenue, is Company Street in Schenectady. Starting at one end, the visitor has on either hand far reaching buildings of three or six stories. The startling thing about it all is that these buildings are numbered consecutively. These numbers are not ten or twelve, or 20 or 30, but 70, 80—on up to 150. Can you imagine it?

Here, little over a hundred years ago, were the "keepers of the eastern door," the aristocracy of the first American nation. From this valley went the delegates to the Long House—the grave Mohawks who were the proudest and oldest of the Iroquois confederacy, and who stationed themselves at the eastern door of their famous estate, the buffer against

the encroaching white race. And in their place today go forth to the uttermost ends of the earth the proudest and youngest representatives of that white race—monster steam turbine-generators from the greatest shops in the world.

And where the corn pits of the villages stood beside the river, stand today these shops and buildings where giants are brought forth. The Mohawk was inefficient. He had to go.



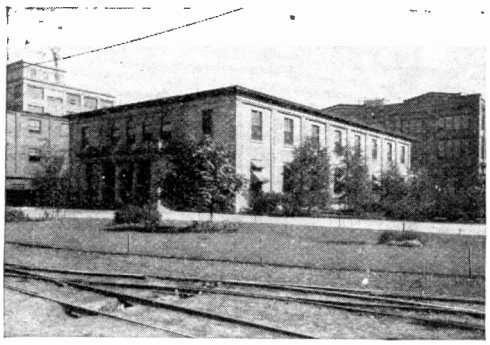
WHERE STEAM TURBINES ARE MADE—IN THE FOREGROUND WE SEE ONLY THE BEGINNING, THE GREAT STEEL DISKS; THE WORK PROGRESSES TOWARD THE OTHER END OF THE SHOP WHERE A TURBINE REARS INTO VIEW NEARLY COMPLETED

The General Electric Company has at this one plant nearly 350 acres of land in use—more, probably, than served to keep the entire Mohawk nation in corn. It is all historic ground about here, fought over by French and Indian, Britisher and Colonist. In the old town itself are houses dating from 200 years back, still occupied by the families of their builders. But the romance of the Mohawk valley was not ended with flint-lock and calumet. In the old days, it was the gods who made romance for men. Today it is men who make romance for the gods.

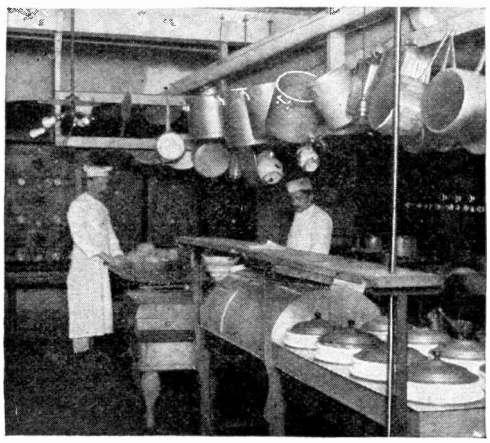
Where 18,000 men and women are gathered, working each to a given end, there must be government and systematic government. This government must be superior to the average if they are to respect it. Company Street and its environs might well be compared to a city, but they are more than that. Here are the trolley lines, the electric bus lines, the fire department, the police force, of a city. But here are also the electric railroads, the paving system, the thoroughness and efficiency in all things which many a city lacks.

One of the master-minds of the place is a thinking machine named Charles Proteus Steinmetz, a mathematician of world wide fame who is without doubt one of the greatest scientists and electrical engineers in this country. Steinmetz came into the United States 23 years ago a penniless immigrant, a political refugee from his own land. Today he is one of the greatest figures in the electrical world, and is equally noted in other phases of life as well.

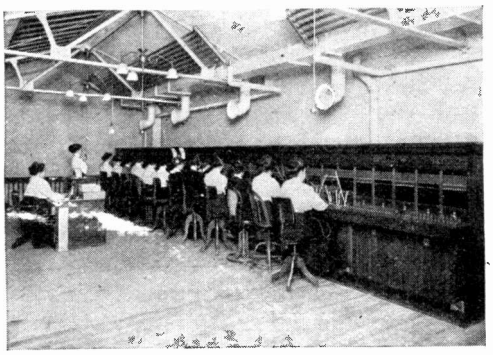
"Do you think," I asked, approaching rather diffidently to his favored topic,



THERE IS A VERY MODERN AND SANITARY RESTAURANT BUILDING ON THE GROUNDS



IN THIS RESTAURANT BUILDING ALL THE COOKING IS DONE BY ELECTRICITY



A PRIVATE TELEPHONE EXCHANGE THAT WOULD DO FOR A LARGE CITY SERVES COMPANY STREET AND ITS ENVIRONS

"that we have tapped much of the power of electricity? I mean, have we developed it as much as we may hope—"

"Ach, no!" came the explosive answer, with a wave of his ever-present cigar, long, thin and light. "Look at the coal fields of all the world—every one is mapped out and ready for development as soon as need be. Every ton of coal on this earth is known today. Even in China and Siberia, where they say so little is known, is this true. And then what? Some day, not so many thousand years ahead, there will be no more coal. Some day there will be no more of the great earth-fuel. And then what?

"Electricity, my friend! Look you at the old world. She is afraid of the great crisis already. She burns electricity today, in great part. Even here we are coming to use it more and more with each passing year. Electricity is heating our houses now. Electricity is smelting our metals now. Here in our laboratories we have electric furnaces—furnishing the hottest heat known to science. It is perhaps a little hard to control, yes, but that is nothing. All that will come. Electricity will take the place of coal, and will do the work a thousand fold better. The time is not far."

And the means of effecting this?

"Water power—the water power of the world will in the end be triumphant, my friend. Look at Japan, and our own western country. There is the greatest water power, and the cheapest electricity in the world. The cost of the power is still the great deterrent, but the future will solve that problem easily."

And this man, whose brain is in such appalling contrast with his physique, has very definite ideas on electricity itself.

"It is nothing more than a form of energy," he declared positively. "We know more about it than we do about any other form of energy. And yet it is paradoxical in that it remains mysterious to us—for intimacy kills the mystery of all other things. Only chemical energy is superior to electricity, for chemical energy alone is capable of being transported to a greater extent. But in order to save the energy which makes it pos-

sible for 90,000,000 people to live here where barely 10,000 aborigines were able to live, we must conserve our natural resources.

"The destruction of our forests will destroy our water power. Nothing else will. Utilizing the volume of its power will not hurt or diminish it. From water power we get only one or two per cent of this possible energy, and the electrical engineers of the future must learn to make use of all. We neglect it at present, because we are not forced to solve the problem. But the time is coming."

The underground system of this city of buildings is no less interesting to the engineer than the buildings themselves and the men in them. Under our feet were miles of pneumatic tubes, wires and piping systems. From the post-office to the farthest building, a mile-long tube transports a letter or order in a minute of time. There is perfect communication between the buildings, each of which is heated by the exhaust steam from the two power houses. And these power-houses, again, stand for the remarkable efficiency of this place.

I visited the old one, and stood with a fine sense of my own insignificance before the huge reciprocal engines, four of them, towering far above me, all working with whirring wheels and rumbling power. They were fed by the furnaces behind, whose automatic stokers were constantly at work, and this furnace room itself was cooler than many of the shops. Then we went to the new power house, and my guide pointed to one of the turbine generators.

"That generator," he said, "is more powerful than all those in the old power house put together!"

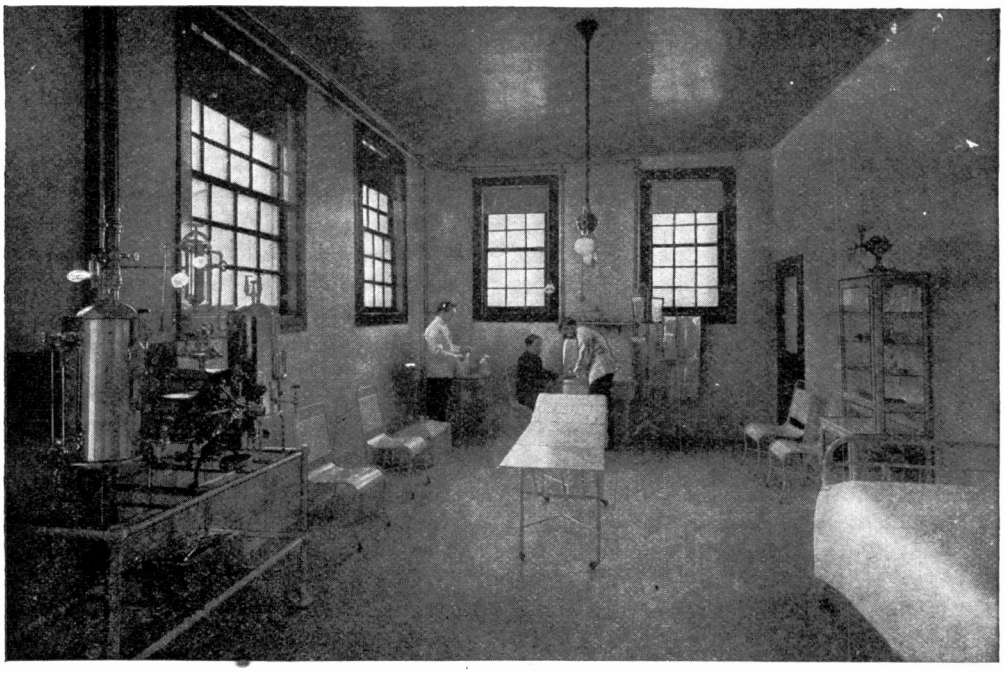
It was hard to believe, yet it was none the less a fact. The old power house is steadily at work, but it has outlived its day. Even now an addition is building to the new power house—begun before the building itself was finished. There is no standing still here.

A visit to these shops, in successive order, is a great education in efficiency. Here the wonder-work of today is the relic of tomorrow. We went through the smaller shops, where the tiny 1/30 horsepower motors are built, on to where the electric locomotive motors are turned out, and in another shop the locomotives themselves stood waiting for shipment. All these huge machines are put together and tested—the turbine generators in a special shop, the locomotives on special tracks, then they are taken apart and shipped out with the knowledge that they are perfect in every detail.

Here each of the mammoth buildings would have made a notable factory, were it found elsewhere. Cable works, wire works, foundries, insulating works, blacksmith shops containing rows of dozens of huge forges, shops where the smaller metal parts are punched out from strips of brass and wire and steel. Into one machine was feeding a steel wire, unwinding rapidly from a drum. I looked to see where it was going, and beneath the machine saw a huge basket, into which were dropping perfectly formed screws.

The pottery shop is an interesting place, together with the insulation presses. The latter of these are automatic moulders. Girls fill a row of depressions with the malleable rubber composition; a turn of the switch, and down comes the steel die, welding and hardening, until when the die is lifted the perfectly formed buttons and switches are there ready made. In the pottery shop much the same system obtains.

Here the clay and mixed combinations are delivered from the grinding shops. Before rows of machines stand men and women who tamp the loosely mixed stuff into the massive molds. The die comes down, exerting heat and pressure simultaneously, and when it goes up the yellowish powder has been transformed into a perfect insulator of porcelain. These are of as many different shapes as electrical work has uses for them. Rows on rows stand ready for the ovens



A FULLY EQUIPPED HOSPITAL WITH MODERN OPERATING ROOM. ACCIDENTS WILL OCCASIONALLY HAPPEN IN A PLANT SO LARGE; EVERYTHING IS READY TO MINIMIZE THEIR ILL EFFECTS

—great cylinders of brick, where the porcelain is baked and glazed and finished. So perfect are these molds that one is impressed by the very minuteness of them—the little details of their work, the delicate tubes for wires, the tiny screw holes, work done in a second which a potter could not do in hours. But all mighty works are simply matters of detail, whether destructive or constructive. The desert sand grains have worn away the Sphinx; the tiny thousands of soft-iron punchings build up the turbine generator.

The draughting department is an interesting place to the visitor, when he considers the work done here. Four hundred of the finest draughtsmen in the country work here, under engineers whose names stand in the forefront of their work. Here are nearly 300,000 plans and drawings on file in specially constructed fire proof vaults, and these are made at the rate of 35,000 a year, for there is always new work going forward and new designing to be done.

Nearby is the laboratory building—room after room filled with up to date apparatus, from electrical furnaces to huge retorts. Here the various appliances are tested and the new inventions tried out to the last detail before going forth to the outer world. But greater than all else in this wonder-plant, where electrical apparatus of almost every description is built, is the final cumulating point of all, where one may witness the birth of the giants—the turbo-generator shop.

Here are built the Curtis turbines—the mightiest machines that man has ever put forth to quell the gods of earth. And this shop is worthy of them. It is the largest machine shop in the world—large enough to contain a three-ringed circus and a one-third mile running track besides. But the visitor is more amazed here than he ever was at the feats of the circus troupes.

Entering the building, we stood beside great disks—mills which revolved around us. At first glance one would take these

for entire machines in themselves; then, looking closer, one sees that on each mill reposes a massive disk of cast steel, and that on the upper surface of this disk one or two steel gravers are at work stripping off thin lines of the metal. After all, they are nothing but piece-machines, each turning out a certain portion of the work done on the tremendous castings. This is significant of the shop itself, for these towering machines are but magnified cutters such as may be seen at work in any smaller shop. Then we pass on, and our wonder becomes changed to awe.

Down the hall space over us swept a crane, bearing in its clutches a swaying mass of steel from the foundries, a mass 20 feet across, 40 tons in weight—a single casting. It stopped before us, dropped imperceptibly among other masses, and finally came to rest on a mill which would plane and purge it of all roughness. The wonder of the thing was that this mass of steel was lowered into place among wheels and turbines, missing some by a fraction of an inch, swinging back and forth but never touching any of the things around.

Over us towered these masses of steel, portions of the largest power units in the world. Beside us rose the field of a 30,000 horsepower generator, on which the cap had been lowered. I stepped through one of the openings in its side, and it was as if I had stepped into a house of metal, for men were at work all about me—working above my head at this single piece of steel.

Here were being placed the soft-iron punchings, in concentric layers all about the interior. To count these was an impossible task; dozens of them, pressed tightly together, all laid in by hand, all forming the same office that the little wires in an induction coil core perform, for this whole generator is but one mighty magnet itself.

Going on, it was hard to see much of the surrounding work. Walls of metal were all around, shutting off the view. One could peer through the spaces in these walls, seeing men and machinery at work on the other side, and the walls themselves were nothing more than small parts of the whole machine.

Other disk mills received the planed and formed disk castings for the steam operated element of the turbines, and placed around their edges the buckets, on which the turbine principle is founded.

The steel sectional flooring of the place reverses the usual shop process; it is specially constructed to bring the tools to the work, instead of bringing the work to the tools, for here the work is mightier than the tools or workmen. The tools, also, are easier to move and lighter to handle than is the work under construction, and this sectional flooring is used in all the larger shopbuildings.

The revolving blades of the turbine, which are sheared off roughly only, are milled and planed to the right thickness, and when the buckets have been bolted into position the blades are assembled on the shaft and the completed unit is set up in the rear of the shop for testing.

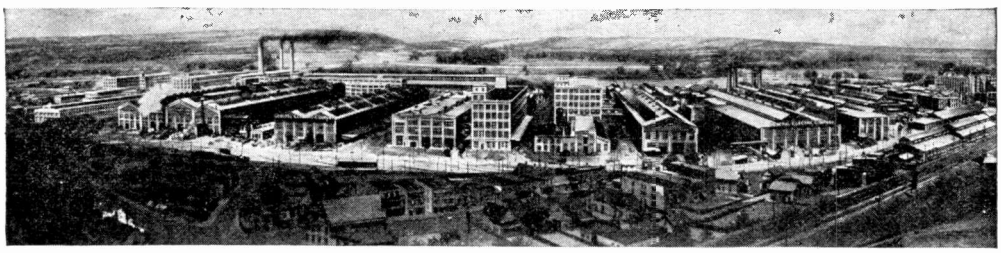
But a view from the "bays," far up in the top of the building, changes all this impression of magnitude. From here the workmen are dwarfed, together with their work. The giant disks and fields seem little things, and the 50-ton cranes pass us, swinging them easily and lightly from place to place. Here in these bays, at each side of the shop proper, is done the small work, the punchings and drillings that go to make up the whole.

As may be seen in the testing department, there is little or no friction to these great generators. The engine and rotary part of the turbine are put on the same shaft. When the steam is turned on this shaft spins like a top, revolving on its film of oil, governed as to speed by the governor above. The turbine whirls the generator at high speed, producing more electricity than any other type of engine, and a notable point of it is that there is no waste. The steam passes on down, losing some part of its velocity as it passes from disk to disk, and so on down

into the vacuum below, where it is condensed and drawn off, to be turned into steam again and sent back over its course.

And as the visitor leaves all this behind, too much impressed to even desire to see the rest of the place, too overwhelmed by the immensity of this one shop to care to spoil his visit by the memory of lesser things, what is the one thought he carries away? This, it seems to me, is the final test of these industrial institutions of ours; however great they may be, there is always one general impression which they leave with their visitors, a sub-conscious feeling.

This feeling, here, is one of contrast. The native of the district is too familiar with his surroundings to be impressed, but the visitor, who knows that here in the old days was the village of the Black Prince and the Great Swift Arrow, feels keenly that the survival of the fittest has given place to the survival of the most efficient. The entire world is in the thrall to Company Street. From Japan and Siam to Peru and Spain, from the Turanian to the Eurasian races, stretches the hand of power which has no limit and knows no master save the tiny brain of man. The farther we live from Nature, the more we must depend on the forces of Nature. The Indian revered these forces and stood afar off in worship. We, in his place, revere these forces equally—but we make them worship us.



GENERAL VIEW OF SCHENECTADY WORKS

A General Alarm for Telephone Systems

In manufacturing plants, public buildings and schools or other institutions which have private telephone systems or are planning to have such a system, there is frequently need for a device which will ring a number of bells or buzzers simultaneously. Such a device has been perfected by the Western Electric Company, in what they term "general alarm or code signaling sets."

The functions of the sets, which will probably find their greatest application in connection with private branch exchanges and interphone systems in business houses, factories, hospitals and schools, will be to call to the nearest telephone any one of a number of men by an arbitrary selective code, to sound an alarm in case of fire or other emergency and to sound bells for recess or recitation periods. The sets may also be used independently of telephone systems.

The signaling set may be mounted at any central point and bells and buzzers scattered wherever signals are to be given. A simple turn of a key handle will sound a call simultaneously on all the bells and repeat the call four times, each key sending out a different code signal. The sets can be connected into the telephone or interphone system together with an auxiliary resistance and condenser box. They are furnished in any capacity up to ten different signals.

Light: Its Use and Misuse

Under direction of the Illuminating Engineering Society a primer of illumination has just been prepared having for its purpose to assist the user to make artificial light effective. Through the courtesy of the Society photographs are here reproduced with accompanying extracts from this publication.—Editorial Note.

To see easily and comfortably you must select the lamps, fixtures and globes and arrange the lights so as best to suit the particular conditions which have to be met, but certain principles which must always be followed may safely be laid down. To understand these principles better let us see how the eye works. Figure 1 shows the parts of the eye as they would appear if the eye were cut through from back to front vertically.

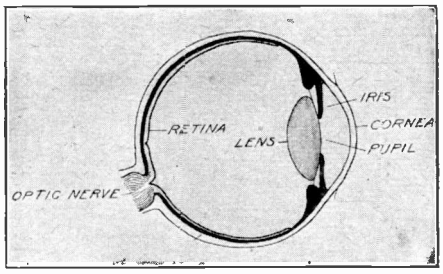


FIG. 1. A VERTICAL SECTION THROUGH THE EYE FROM BACK TO FRONT

In the process of seeing, the light passes through the cornea, pupil and lens of the eye to the retina just as in a camera light passes through the lens to the sensitized film. The picture is, therefore, formed on the retina, which is a layer made up of the ends of nerve fibers which gather into the optic nerve and go directly to the brain. The optic nerve sends along the picture to the brain for notice. The lens of the eye, unlike that of the camera, automatically changes in thickness to focus or make a clear image on the retina for seeing at different distances. This focusing action is called the accommodation of the eye and when the light is dim or bad the focusing muscle vainly hunts for some focus which may make objects look clear and gets tired in trying to do it. The muscles which move the eye about also get tired in the same way and the result is eye-strain, which stirs up pain and headache just as any other over tired muscles of the body may set up an ache.

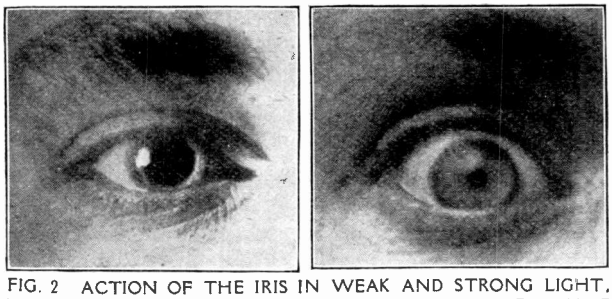


FIG. 2 ACTION OF THE IRIS IN WEAK AND STRONG LIGHT, MAKING THE PUPIL LARGE OR SMALL, AS THE CASE MAY BE

The iris (which gives the eye its color) serves to regulate the amount of light which reaches the eye. In very dim light it opens out, making the pupil big, as shown at the left in Fig. 2, and in very bright light it shuts up as shown at the right, and thus keeps out a flood of brilliant light which might hurt the retina.

Judge the light you are getting by the way it helps you to see. Do not think because a lamp looks glaring and brilliant that it is giving you good light. It may be merely giving you too much light in the wrong place. On the other hand, a well shaded table lamp may look dim because it is well shaded and still be giving first class light for working purposes.

You must get enough light to see by and as you see things chiefly by the light which they reflect it is evident that dark colored objects which reflect light badly require more light than do light colored objects to see them comfortably. That which is quite sufficient for sewing on

white cloth, for example, will not do at all for working on black cloth.

See that your light is steady. If you leave a dark room and go into bright sunshine the sensation is unpleasant to the eye; if you use a light that flickers, you get this same unpleasant sensation even, perhaps, if the rapidity of the flickering is as high as 20 times a minute. Furthermore, the eye endeavors to adjust itself to suit the light. If the light flickers it keeps the iris of the eye "see-sawing," as from polished metal or glass, from bright varnished surfaces, or even from glossy white paper upon which the light falls as in Fig. 4.

A bright light fairly in the field of view means a very brilliant light on the retina, producing fatigue. Everyone knows the blinding sensation of looking at the sun with its sequence of dazzling colored images. Babies are common sufferers from this when careless mothers or nurses allow them to lie in their carriages with eyes exposed to the unclouded sun. Bright artificial lights in a less degree do the same thing to all of us.

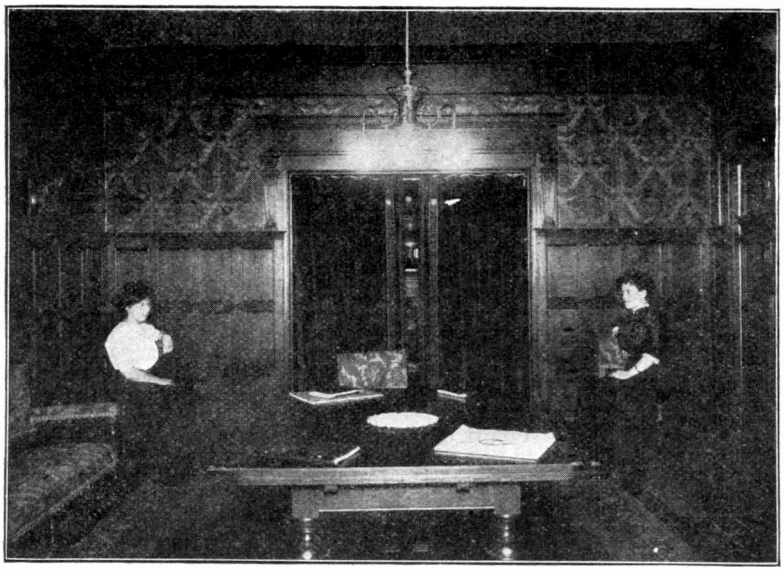


FIG. 3. IT IS BAD TO HAVE AN UNSHADED, BRILLIANT LIGHT GLARING DIRECTLY INTO THE EYES. THIS IS A COMMON AND FAULTY ARRANGEMENT

it were, and the muscle that governs it gets tired and reacts on the nerves to cause discomfort and pain. Reading in railway trains causes similar strain; the eye muscles get tired of trying to follow the shaking page and may provoke a headache.

It is bad to have an unshaded brilliant light glaring into the eyes, for it throws hard labor upon them in an effort at adjustment. Figure 3 is an example of this. While artificial light may be made a good substitute for daylight, you have constantly to beware lest rays that are too bright, either from the lamps or from their reflections, hurt the eyes. You can get reflections so bright as to be harmful,

From time immemorial mankind has received its light mostly from the sky. Consequently the part of the retina on which the light from above chiefly falls is pretty well used to it, while bright light from below falling on the part of the retina which commonly gets light only from grass or dark pavements, may be very irritating and unpleasant. Thus the glare from snow and sand is not only disagreeable on account of its intensity but because of the unusual direction from which it comes. Just so with a brilliant beam reflected from glossy paper on

FIG. 4. A DAZZLING REFLECTION FROM GLOSSY PAPER MAY BE AS HARMFUL AS DIRECT GLARE FROM THE LIGHT SOURCE

which you are writing. Its rays strike you from an unusual direction and are harmful for that reason. Other smooth and shiny surfaces deliver an equally hurtful assault on that sensitive and much abused organ—the eye.

It is best to have the light come from above and somewhat sidewise, as it commonly does in nature, so that you will not get a brilliant reflection or glare from what you are trying to see. In reading and writing it is better to have the light come from the left, to avoid getting a shadow of the hand that holds the book or pen. Let the lamp be just far enough behind to keep direct reflections from the paper out of the eyes, Fig. 5.

By using reflectors you can put the light from a lamp where it will do the most good, much as an automobile headlight sends the light along the road just where it is wanted. An unshaded lamp does not throw the light where it is wanted. To ensure the light falling upon a table you must use a reflector that will bring it there.

Of such reflectors there are three general types, either of glass or of metal, which we may call concentrating, semi-concentrating and distributing. The three kinds are shown in Figure 6, from the top downward, respectively. The first acts almost like an automobile headlight, throwing its light

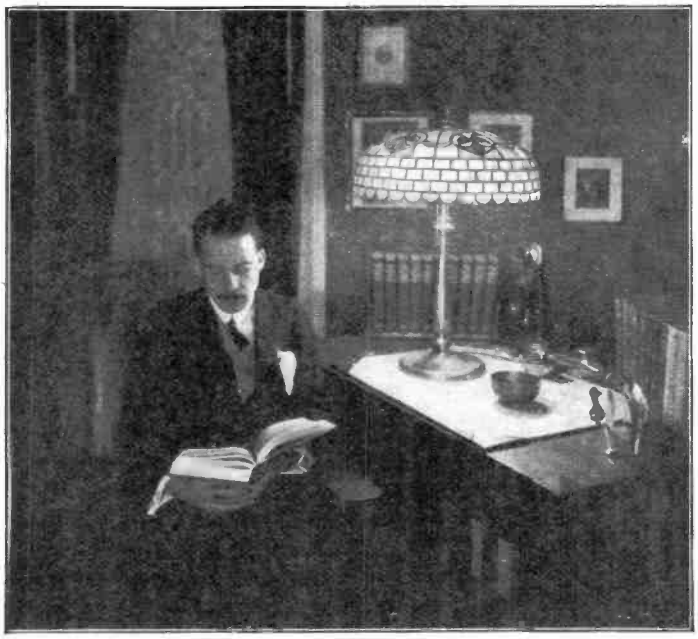


FIG. 5. THIS IS A GOOD POSITION FOR READING, AS THE LIGHT IS NOT REFLECTED DIRECTLY INTO THE EYES

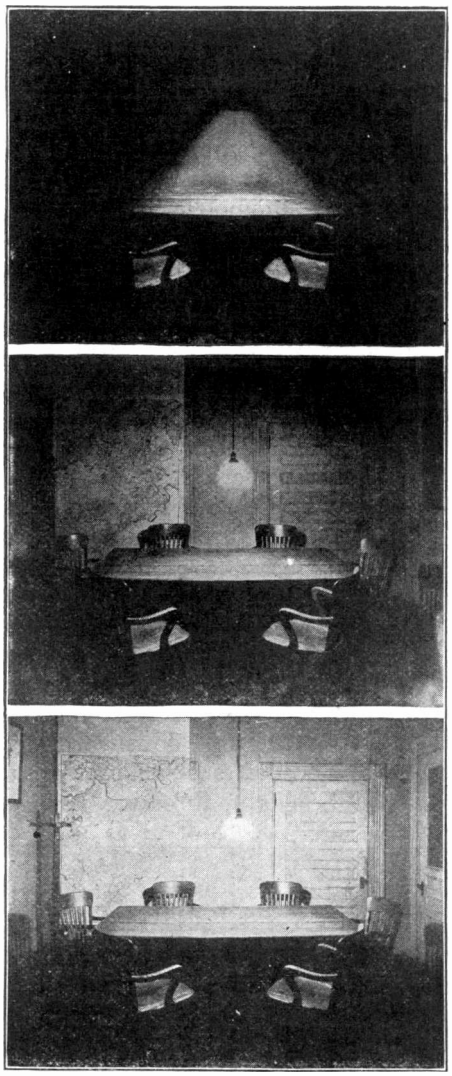


FIG. 6. ILLUSTRATING THREE TYPES OF REFLECTORS—CONCENTRATING, SEMI-CONCENTRATING AND DISTRIBUTING

downward into a comparatively small area. The second kind spreads out the light over a much wider area, of diameter perhaps as great as the height of the lamp above the table, while the third is planned to light a comparatively big area not very intensely at any one spot.

No reflector ever increases the total light that streams out of a lamp; it only puts the light where it is needed instead of letting it go unguided.

All reflectors should come far enough down over their lamps to prevent you from seeing the bright sources of light themselves without actually looking upward.

Because dark walls absorb light strongly instead of reflecting it they demand much stronger lamps for sufficient illumination than do light walls. A very dark wall paper or a dark wood finish may require three or four times as much light as a really light finish. Dark reds, greens and browns reflect only ten to fifteen per cent of the light which falls on them. White, cream color and light yellowish tints may reflect over one-half the light.

Likewise, deeply tinted globes and shades absorb much light—a fact which must be borne in mind in considering economy.

Dirt on electric bulbs, globes or reflectors absorbs and wastes much light. The country over, it is safe to say that millions of dollars are wasted every year by letting lamps become foul and dust laden. Nor is there any economy in using electric bulbs until they blacken. It pays to renew promptly blackened bulbs.

Saving light at the cost of the eyesight is false economy. To get good lighting it is generally necessary to diffuse the light from the lamps either directly by opal or ground glass shades, or indirectly by turning the light first on the ceiling or wall. The use of ground glass involves the absorption of fifteen to 20 per cent of the light to secure diffusion, opal glass of various kinds from 20 to 40 per cent while some forms of art glass and most diffusing ceilings absorb more than half the light that falls upon them. Even though all these appliances absorb light in the process of diffusion, there is gain in their use because they yield rays more grateful to the eyes. But your eyes may tire easily even with good lighting. If so, consult an oculist and don glasses if you need them. Eye-strain often comes from defective eyes as well as from faulty lights.

In a room suitably arranged for com-

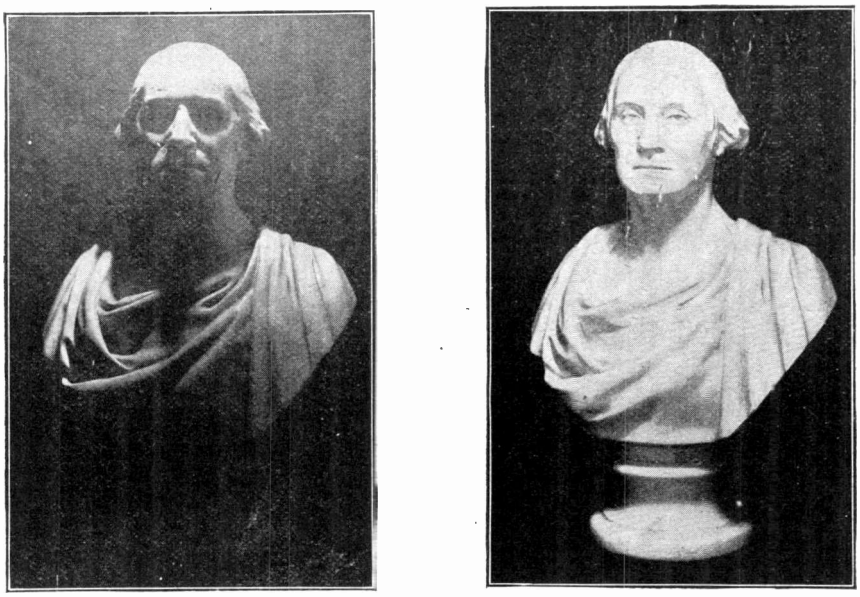


FIG. 7. IN THE FIRST PICTURE THE BUST IS ILLUMINATED FROM DIRECTLY ABOVE. IN THE SECOND IT IS ILLUMINATED AS IT SHOULD BE—FROM ABOVE AND IN FRONT

fortable seeing, you may have plenty of light but the general effect may be displeasing. The illumination may quite fail to bring out the good points of the room in architecture and decoration, or may play pranks with the appearance of persons and things in the room as shown in Fig. 7 in the two illuminations of the marble bust. One may not object to ghastly tints in a factory, but in lighting a drawing room such effects would not be tolerated. Hence one often should sacrifice strict economy to get the most pleasing effect in the room. The fixtures that carry the lights should harmonize with their surroundings if the general effect is to be agreeable. Handsome fixtures have a decided decorative value whether their lamps are lighted or not. As strongly colored objects give something of their own hue to all the light which they reflect, the color of lamp shades, walls and furnishings plays an important part in the artistic effect.

Sentenced by Telephone

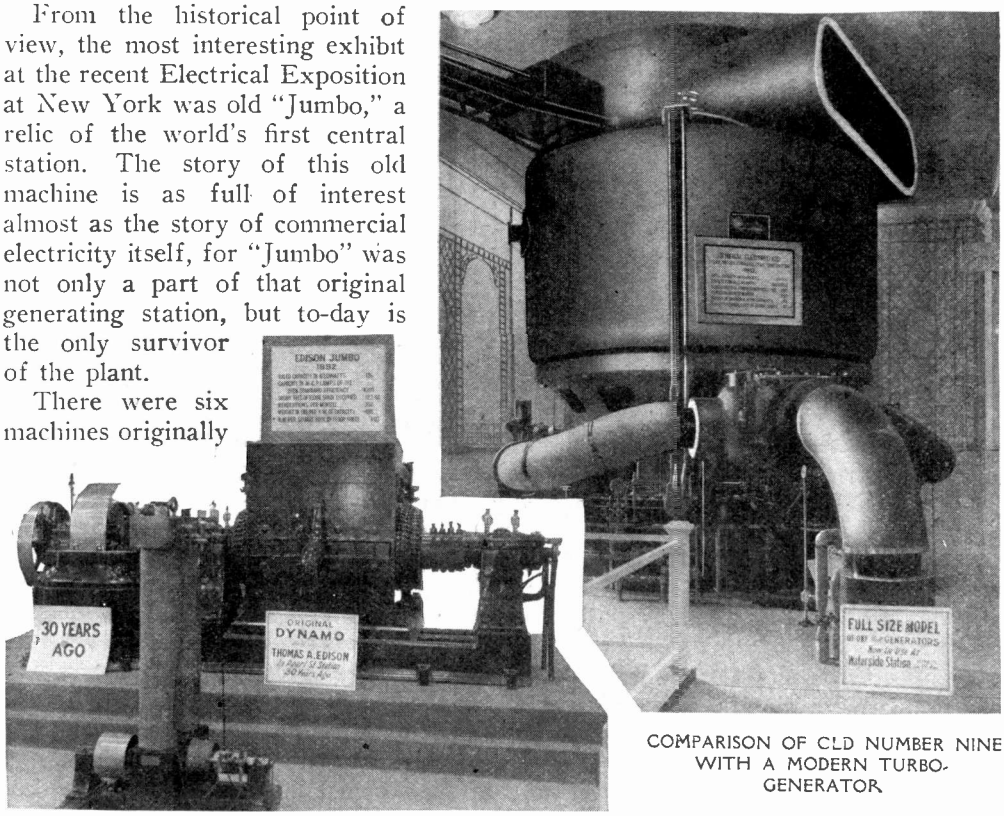
A rather strange court proceeding was held in California recently when a man was arrested, had his hearing, pleaded guilty to the charge and was fined, all without coming face to face with his accuser or judge, the long distance telephone being the medium.

While passing through the town of Red Bluff on his way to Chico, this man ran his automobile over a dog and killed it. A warrant was sworn out against him on a charge of exceeding the speed limit. When he reached Chico he was met by the sheriff who told him that he was wanted on the long distance telephone from Red Bluff. The man experienced a shock (not electric) when told what was wanted, but he pleaded guilty to the charge and was fined $35.00. If he had been made to telegraph the amount to the judge at Red Bluff it would have completed this strange "electric court," but he was only asked to hand it over to the sheriff.

Jumbo — A Relic of the World's First Central Station

From the historical point of view, the most interesting exhibit at the recent Electrical Exposition at New York was old "Jumbo," a relic of the world's first central station. The story of this old machine is as full of interest almost as the story of commercial electricity itself, for "Jumbo" was not only a part of that original generating station, but to-day is the only survivor of the plant.

There were six machines originally but five were destroyed by a fire that put the plant temporarily out of business. In 1895, outgrown and practically useless, the plant was dismantled, and the building sold. "Jumbo" is now a pensioner and is only shown on important occasions.



COMPARISON OF OLD NUMBER NINE WITH A MODERN TURBO-GENERATOR

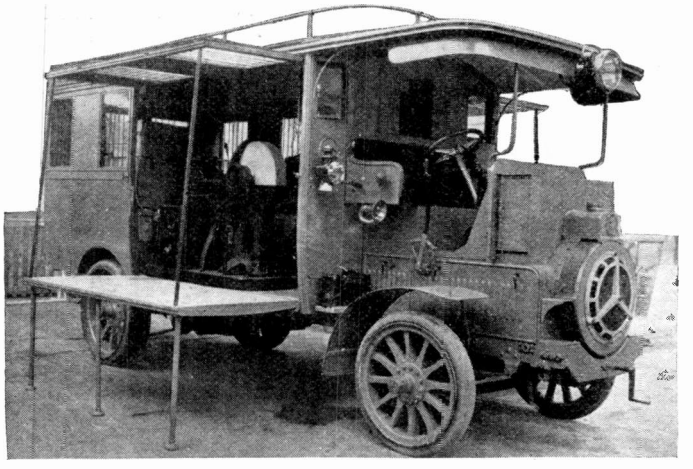
For this 30th anniversary of electric light in New York, the 125 horsepower machine was exhibited side by side with a full sized model of the very latest type of turbine generator, one rated at 30,000 horsepower.

Built in the old Goerck Street factory, where all the apparatus of the early Edison Electric Illuminating Company was constructed, this "Jumbo" generator was known as Number Nine. It was one of six machines designed especially for the Pearl Street station, the three earlier machines built at the factory having been shipped to London and Paris.

Number Nine, which was located near a window, was placed in operation at the opening of the Pearl Street plant in the afternoon of Sept. 4, 1882. In January, 1890, when fire destroyed the building and the other generators, this "Jumbo" was saved, but only because its position near the window enabled the firemen, who were on an elevated railroad structure to keep a stream of water on it. After this interruption, which lasted only a few days, "Jumbo" again went to work and continued until 1895, when the new Duane-Pearl Street plant was ready to relieve the outgrown central station of its burden.

Army Repair Shop on Wheels

One of the interesting features of the recent French army maneuvers was the use of a specially fitted power wagon of large size, which serves as a traveling repair shop and is used in connection with the aeroplane corps. The new car is equipped with an electric system for



FRENCH ARMY REPAIR WAGON

running the motor driven machine tools contained in the roomy quarters. When on the road it has the appearance of the usual closed power wagon, but when stationed on the spot at the aeroplane camp it is ready to be used for repairs, and the large side panels are let down so as to form a platform at each side of the car and thus add to the floor space of the workshop. Inside the wagon are a number of machine tools driven by small electric motors, such as lathe, emery wheel and forge, and there are also the necessary work benches for mechanics' or carpenters' use.

The wagon is run on the gasoline-electric plan, and has a powerful gasoline motor at the front part with a dynamo directly connected to it. In the middle of the truck are two electric motors, which drive the rear wheels by means of the current coming from the dynamo. This latter also gives the current for the workshop motors and the lighting.

Color Composition of Gas and Electric Lights

According to the familiar explanation, white is produced by a blending of the three primary colors—red, blue and green. Consequently, if we separate and measure the color components in any given source of light, the proportion of the primary colors will give us a clearer indication of how the light will affect whatever it illuminates. Such an analysis was recently reported to the London and Southern District Junior Gas Association by Mr. D. J. Winslow, of Lea Bridge, England. Taking the light at angle of 45 degrees with the axis of the lamps, both from an inverted gas mantle and from a tungsten lamp, Mr. Winslow found the color composition as follows:

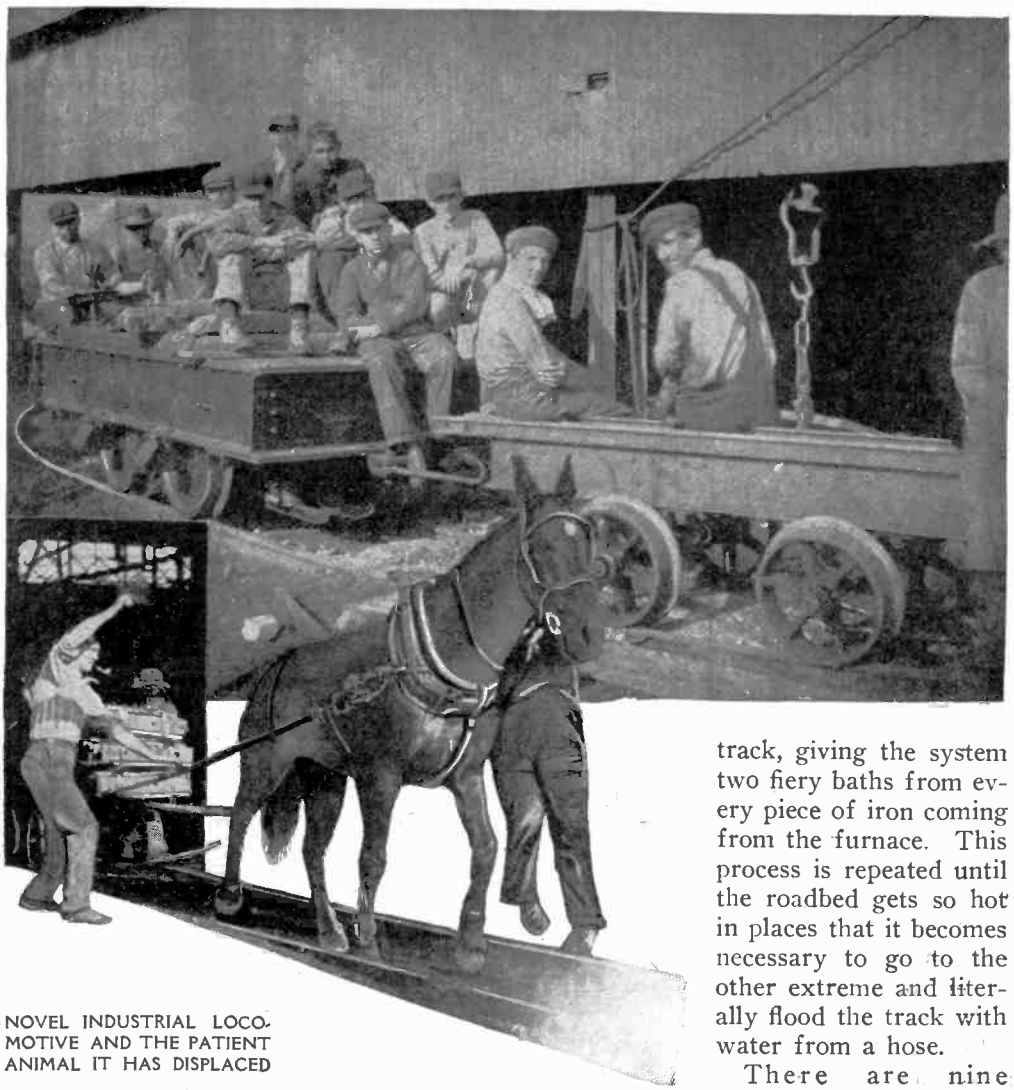
	Electric	Gas
Red	58.1%	48.1%
Blue	13.1%	16.9%
Green	28.8%	35. %
Total	100%	100%

As every one knows, it is the red rays of a lamp that impart a warm or cheering glow to the light, while any excess of green gives a ghastly hue. The figures show why the tungsten lamp decidedly outstrips even a highly modern gas mantle lamp in the cheerfulness of its light. No wonder Mr. Winslow, in presenting these figures to a gas convention, added quite significantly: "The object of bringing this question of color composition of artificial lights before you is to point out the advisability of serious consideration of the matter; so that we may, if possible, be in a position to control the color of the light required, as this would undoubtedly lead to greater business."

Miniature Railway in a Steel Plant

A small industrial railway, little over 100 feet long, has been established at the plant of the Logan Iron and Steel Works, Burnham, Pa. An electric locomotive no bigger than a hand car is busy all day in its work of supplanting the horse for transporting iron and materials through this section of the plant. There is no trolley wire used in connection with the miniature system, current being collected by a shoe under the locomotive which follows a third rail in the middle of the track; and this rail is "dead" except during the time that the locomotive is passing over it.

This mill is much crowded with furnaces, machinery and rolls and the main thoroughfare for traveling through the plant is over the track equipped with this new system. The white hot iron from the furnaces on one side of the track is being continually transferred to the rolls on the other side. The rolls in turn shoot the hot, spitting bars back again across the track, giving the system two fiery baths from every piece of iron coming from the furnace. This process is repeated until the roadbed gets so hot in places that it becomes necessary to go to the other extreme and literally flood the track with water from a hose.



NOVEL INDUSTRIAL LOCOMOTIVE AND THE PATIENT ANIMAL IT HAS DISPLACED

There are nine

switches and cross-overs with seven spurs leading off from the main track over which the locomotive pushes the cars of iron to the furnaces. Each spur leads from the main track with a curve of fourteen feet radius. To cap the climax, it rounds four curves in a distance of 93 feet by the tape line.

The Eustis Turbine Windmill

W. E. C. Eustis, an engineer by profession, possesses a magnificent estate in the beautiful Blue Hills section, south of Boston, whereon is a complete electric equipment which is operated by an ingeniously constructed windmill. This cylindrical windmill is provided with a clever arrangement of fluted slats which catch even the slightest breeze. The wind enters the outer stationary cylinder through these curved pine boards and strikes an inner rotating cylinder containing oposite curves. It is thus a very close analogy to the Curtis steam turbine.

The inner cylinder turns a shaft which is connected with a dynamo in the little power house below. The current generated is carried by insulated wires to a 100 volt storage battery in the house. Sufficient current is available from the battery to light about 200 incandescent lamps on the estate, run a sawmill and pump water into a reservoir at the house.

The tower is said to be the largest of its kind in existence and an army of masons and steel workers was employed in its construction. The tower is supported by eight steel girders reaching 100 feet into the air to the base of the 50 foot wind cylinder at the top.

At the summit are arranged a number of scientific instruments including an aerometer. Every whim of the weather can be recorded.

Upon the ground at the base is the power house which contains the dynamo and instruments for registering watts, volts, amperes and wind velocity. At the power house a windlass can be put in operation that will control or stop the cylinder whenever desired. Upon the walls are numerous instruments which register every vibration from the wind and the amount of electrical energy sent into the big battery in the mansion. With each puff of wind one of the instruments scratches in red ink, upon a moving roll of paper, the report upon the air movements.

Although Mr. Eustis is employed as an expert by the huge Metropolitan Parks, Sewerage and Water District of

NOVEL CYLINDRICAL WINDMILL ON THE EUSTIS ESTATE

Boston and 30 surrounding towns and is occupied with engineering and business affairs when he is working, he makes this electric plant his plaything for amusement hours. And indeed it comprises a principle that could be made of vital importance in any community.

Although the Eustis tower has done an immense amount of work and furnished power to run dozens of machines upon an estate of scores of acres, the designer states that he has not as yet put it to its utmost capacity.

Miners' Electric Safety Lamps

Two kinds of accidents in coal mines—falls of the roof and the ignition of fire damp—have resulted in a movement for better safety lamps for miners' use and for better general illumination. That the electric lamp will be the future source of light is already asserted both in America and Europe.

In the recent international competition promoted by the British Home Office, England, for the best type of electric lamp for mines, the $5,000 in prize money was divided into nine parts. The first prize of $3,000 was awarded the Ceag lamp and eight prizes of $250 each were awarded other lamps of merit.

TYPES OF MINERS' SAFETY LAMPS

In the illustration is shown an American miner's electric lamp mounted on the cap for service so that the miner is in no way hindered in his work, while above and to the right it is shown as a hand lantern.

The light is brighter than that of the oil lamp and is steadier. The outfit is also cleaner, there being no filthy smoke and no dropping of oil. The battery will last for twelve hours and it can then be recharged overnight. Its weight is two pounds and the battery carried on the belt in no way interferes with the wearer's freedom in his movements, whether he uses a pick, a drill or a shovel.

The prize winner, in the center of the picture, and a close competitor, the Stach safety lamp, are here shown. The Ceag lamp was invented by a German coal miner. The lamp consists of three parts—the accumulator and the bottom and top parts—and weighs a little over four pounds. It is so strongly constructed that it may be thrown onto a stone floor

without receiving any serious damage and this experiment was repeatedly made during the practical trials carried out by the judges.

The lamp is a metal filament lamp of 1.5 candlepower and burns after charging—which takes four to five hours—continuously for a period of sixteen hours. The lamp bulb is protected by a thick glass dome in a cage of four iron rods and is placed between spiral springs which take up any shock due to a knock or violent vibration and hence it is not so liable to damage as bulbs rigidly held in position. The chief advantage, however, of this arrangement is that it ensures absolute safety against igniting firedamp, as should this protecting bulb become broken the electric circuit breaks automatically.

The Stach lamp consists of a cylindrical wrought iron welded case, carried on trunnions in a stirrup handle which is at the top provided with the usual spiked iron hook for the purpose of suspending the lamp by driving the hook into a wooden prop during work. The accumulator consists of a two volt, round, semi-dry, lead accumulator in a celluloid case. The lamp gives two candlepower and after charging will burn for a period of fourteen hours. The accumulator should be charged with a current of 1½ amperes for twelve hours. Its weight, however, when ready for use is about six pounds, which is a serious objection.

It may be well to remember, however, that the oil lamp gives the miner warning of the presence of bad air by the way it burns. The electric lamp, therefore, should have added to it a device that will detect the pressure and amount of the dangerous fire damp, thus giving the miner a chance to get away and give warning.

"Our colonies might be well enough," was a saying among Englishmen in 1774, "were it not for Dr. Franklin, who has, with a brand lighted from the clouds, set fire to all America."

Pursuit of the Nitrogen Atom

Wherever the investigator turns the nitrogen atom is found either for good or evil. It is the most restless and powerful of all the elements and its activities predominate in its many combinations which have given us our most delicate perfumes, our thousands of colors in the aniline dyes and the hundreds of synthetic medicines. It is the reigning power in a host of deadly poisons and ptomains, a constituent of violent explosives, dissolves the metals in the arts, extracts gold from the ores and in many ways contributes to the welfare of mankind.

The perfecting of the process of making calcium cyanamide or "kalkstickstoff," as the Germans call it, by liquid air and the electric furnace has led electrochemists into new territories and the energy of the furnace has perfected many new processes in the field of chemistry alone.

When the calcium cyanamide is fused in the furnace with sodium carbonate or common salt, the cyanamide forms cyanide of soda, which is used in silver plating, gold extracting and for other metallurgical uses, while cyanamide itself is being extensively used in case-hardening of steel, producing a superior article. Another substance produced by the action of acids on cyanamide is used in the dyeing industry and contains 66 per cent nitrogen. It is also used in the manufacture of explosives as it has the property of lowering the temperature in the barrel of the gun.

Through all these processes we see the elusive nitrogen atom garnered by the genius and ingenuity of the electrochemist and his methods made commercially possible primarily by the electric furnace. The future of this element as related to the needs and uses of mankind is hard to forecast. No other element has the tendency to "fly off the handle" as has the nitrogen atom and the slightest disturbance will send it flying from one community of atoms to another.

Behind the "Scenes" in a Moving Picture Theater

By BENNETT W. COOKE

As you sit in a moving picture theater and watch the unfolding of a quarter of a mile of film upon the screen you are aware that if you were to follow the beam of light back into the little house in the rear of the room you would come to the source of the pictures, the films themselves. But very few, comparatively speaking, ever get to see that source, just as comparatively few ever get back of the scenes in the regular theater. Realize, then, that in this little house of the moving picture operator some wonderful advancements have been made in the last three or four years—you have a hint of this in the improved appearance of the pictures that stand before you on the screen with scarcely a perceptible tremor. What was once a little box-like inferno, containing little else than an improved form of electric furnace for roasting operators while they slowly cranked the films and, as Poe would put it, "Muttered and mumbled low," has now become, in the better class of theaters, a spacious room, well ventilated and with an electrical equipment to compare favorably with that on the regular theater stage.

To begin with, instead of inexperienced men operating the moving picture machine the operator of to-day must first prove his ability not only to operate the machine but to meet with any emergency that may arise. In the larger cities before a man is allowed to become an operator he must first pass a rigid examination given by the city.

In order to understand something of the nature of the task which an operator undertakes and the conditions under which he works, no better method presents itself than to make a "visit" behind the scenes in one of the modern theaters as, for instance, the Kedzie Annex Theater, recently completed in Chicago, with a seating capacity of 890.

The walls of the booth, shown in Fig. 1, are built entirely of hollow tile, plastered, and it has a cement floor. Not a piece of wood is used, either in the construction of the booth or in connection with the apparatus. Every possible means for the prevention of fire has been adopted. The small openings in front of the machines have doors which slide up and down and are held up by a piece of cotton twine. This twine is run through loops on an arm fastened to the wall and extending out over the front of the machine. The twine is then brought down and fastened to the machine near the place where the light strikes the film. If the film catches fire this twine burns and the doors will be released and drop down in front of the openings.

On the rear wall of the booth is a telephone which connects the operator with the ticket office, manager's office and the stage. In this rear wall is also an opening about two feet square to the fresh air inlet. An electric fan at this opening furnishes the booth with fresh air, the impure air leaving by a ventilator in the ceiling which is connected to the exhaust fans.

The machine at the extreme left is the spot light; its purpose is to throw the light on the vocalist. The two machines in the center are used to project the moving pictures and the machine at the right is the dissolver, used for projecting the song slides. The two gauges on the wall between the doors are called ampere meters and show the strength of the current used, which determines the strength of the light. The operator watches these meters to gauge the strength of his light.

It will be noticed that the dissolver for the song slides has two houses; each contains an arc lamp and is called a lamp house. There are a number of handles projecting from the rear of each lamp

house. By means of these handles, the carbons in the lamp can be adjusted to and desired position. By looking through a small colored glass window in the side of the lamp house the operator can see just what position the carbons are in while the machine is in use. In front of the lamp house are the lenses that project the pictures on the screen and the song slides are placed between these lenses.

When the slides are to be projected both lamps are lighted. A slide is put in the upper carrier and projected on the screen. The next picture to be projected is put in the lower carrier in front of the lower lamp. By pulling a lever a shutter gradually closes over the upper opening and at the same a similar shutter draws away from the lower opening allowing the lower picture to be shown on the screen and the effect produced is of one picture dissolving into another.

The two center machines are for the moving pictures and are used alternately. By having two machines the assistant can get one in readiness while the operator is using the other. And if one should break down, they could rely upon the other. The two circular metal cases on the front of the machine contain the reels upon which the film is wound. These are called the "magazines" and there is no solder used in their construction, the seams being bent and fastened with rivets so that in case of fire the magazines will not fall apart and expose the film.

Each reel contains about 1,000 or more feet of film consisting of one or more subjects. The reel is first placed in the upper magazine and is threaded over various rollers and sprocket wheels and fastened to the empty reel in the lower magazine. The film consists of a narrow strip of celluloid composition 1¼ inches wide, the pictures being one inch wide and three-fourths of an inch long. The film is pulled down by means of a sprocket with teeth. These teeth fit into sprocket holes on both sides of the film.

The light strikes the film at one place

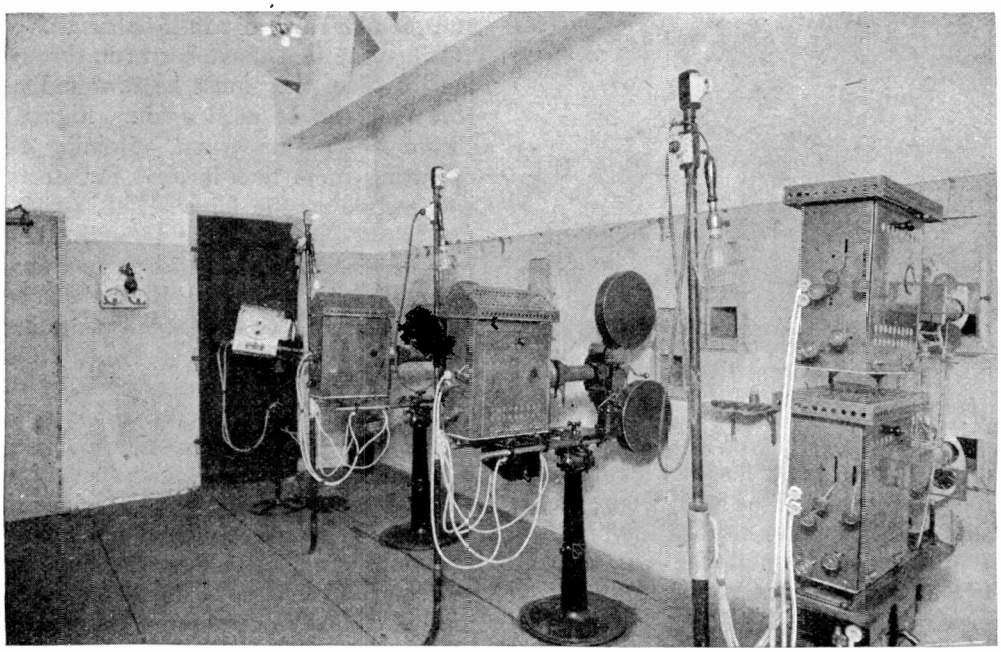


FIG. 1. NOT A PIECE OF WOOD IS USED IN THE CONSTRUCTION OF THE MODERN MOVING PICTURE OPERATING BOOTH

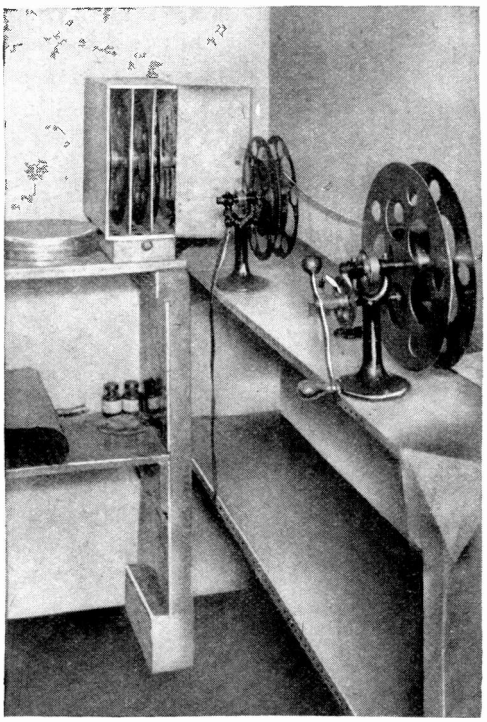


FIG. 2. IN A SEPARATE ROOM THE FILMS ARE REWOUND AND STORED

only. It passes from the lamp house through two large lenses then through the tube that can be seen between the lamp house and the head of the machine: It then passes through the film, through two more sets of lenses and to the screen or curtain. The light is never allowed to strike the film unless the film is in motion (at the rate of sixteen pictures a second) as the film is highly combustible and would catch fire instantly.

There is a concern that makes fire proof films but as yet there are very few on the market although nearly all are waterproofed.

Each picture as it comes in front of the light stops there for an instant and is projected on the screen. The light is then cut off for an instant by means of a revolving shutter and the next picture is brought in front of the light. This picture is in turn projected upon the screen as the shutter moves away and allows the light to pass. This of course is done so rapidly that the spectator cannot distinguish the intervals between the pictures. If it were not for this shutter there would be nothing but a blur on the screen. It is very evident from the above explanation that the picture on the screen does *not* move at all but is merely a rapid succession of perfectly stationary pictures. Thus the modern moving picture is really an optical illusion.

These machines are operated by hand in Chicago, motors not being allowed for fear the operator will leave his machine and the film catch fire in his absence.

When the films have been run through the machine, they must be rewound before they can be used again. Figure 2 shows a separate room adjoining the operating room that is used for storing and rewinding the films. This room is fire proof throughout and on the table may be seen a galvanized iron box large enough to hold three reels, the number used each day. In the same case underneath the reels is a compartment filled with a liquid. Holes are made in the top of this compartment which allow moisture to reach the reels, thus keeping them soft.

On the same table may be seen the rewinding apparatus with a film partly rewound. In most places the films are rewound in the same booth with the machines, in this case the reels must be enclosed in metal magazines and not more than two feet of film exposed at any time.

Every film shown in Chicago must be first passed on by the chief of police or one of his assistants as to its moral character and a permit is issued to accompany the film. The permit sometimes states to cut out a certain scene that is deemed objectionable and this must be done by the film exchanges which rent the films to the theaters. When the operator takes his three reels from the exchange he must also take the permits for the reels and if a permit states that a certain portion be taken out the operator must see that it has been taken out be-

fore he starts his show, for if he is caught showing a reel without a permit or one from which the objectionable part has not been removed he will lose his license and will not be allowed to operate again in the city and the reel cannot be used again.

When the picture stops suddenly on the screen the film probably has broken. The film tears easily and a small rough spot on the film is very likely to catch as it passes through the machine and tear the film apart. When this happens the most up-to-date operator does not stop to cement it together but simply brings the broken end down to the lower magazine, slips it under the other end, threads the film into the machine again and proceeds with the picture. After the film has been run through the assistant rewinds it and then patches it where it is broken. This is done by cementing the two ends.

The reader has probably noticed that the picture will be running along smoothly when suddenly a line will be seen across the picture and above the line will be seen the lower half of a picture, below the line will be seen the upper half of a picture. This is caused by not patching the film properly. Between every two pictures is a line. When patching the film properly one line must come exactly over another. When the picture jumps this way on the screen the operator must "frame" the picture. This is done by moving a lever which adjusts the picture so that it is exactly framed by the aperture. The aperture is a hole just the size of a picture, through which the light passes immediately after going through the film.

Figure 3 shows another room adjoining the operating booth. This room contains the switchboard and two mercury arc rectifiers. The operator here controls every light in the house except the emergency lights.

Besides his own apparatus he controls the stage pocket lights, electric exhaust fans, electric house fans, electric organ and the house lights.

The two machines beyond the switchboard are called mercury arc rectifiers. These are used in connection with the moving picture machines to change the usual alternating current to direct current which is best for operating the arc lamps.

When the operator is running his last reel for the evening his assistant gets the dissolver in readiness. As soon as the reel is finished a "Good-Night" slide is projected upon the screen. The operator now rushes to the switchboard and turns on the house lights and the show is over.

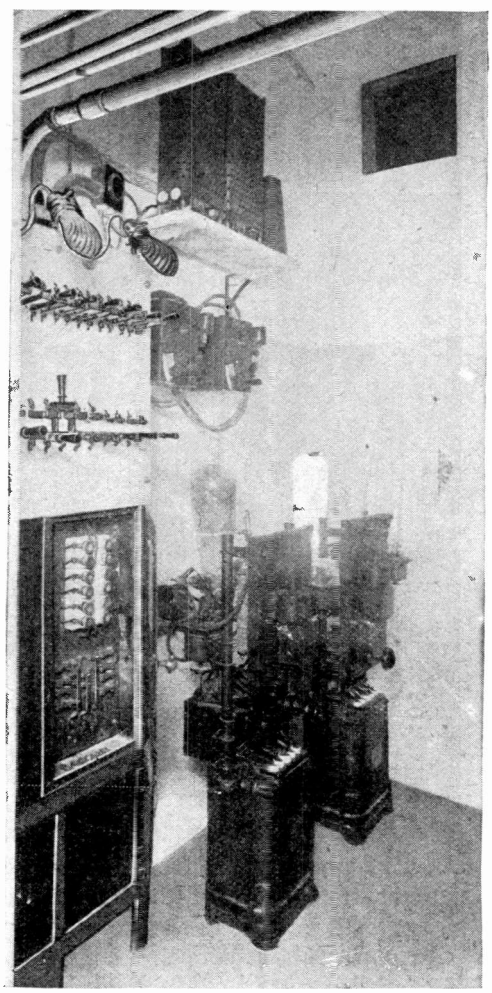
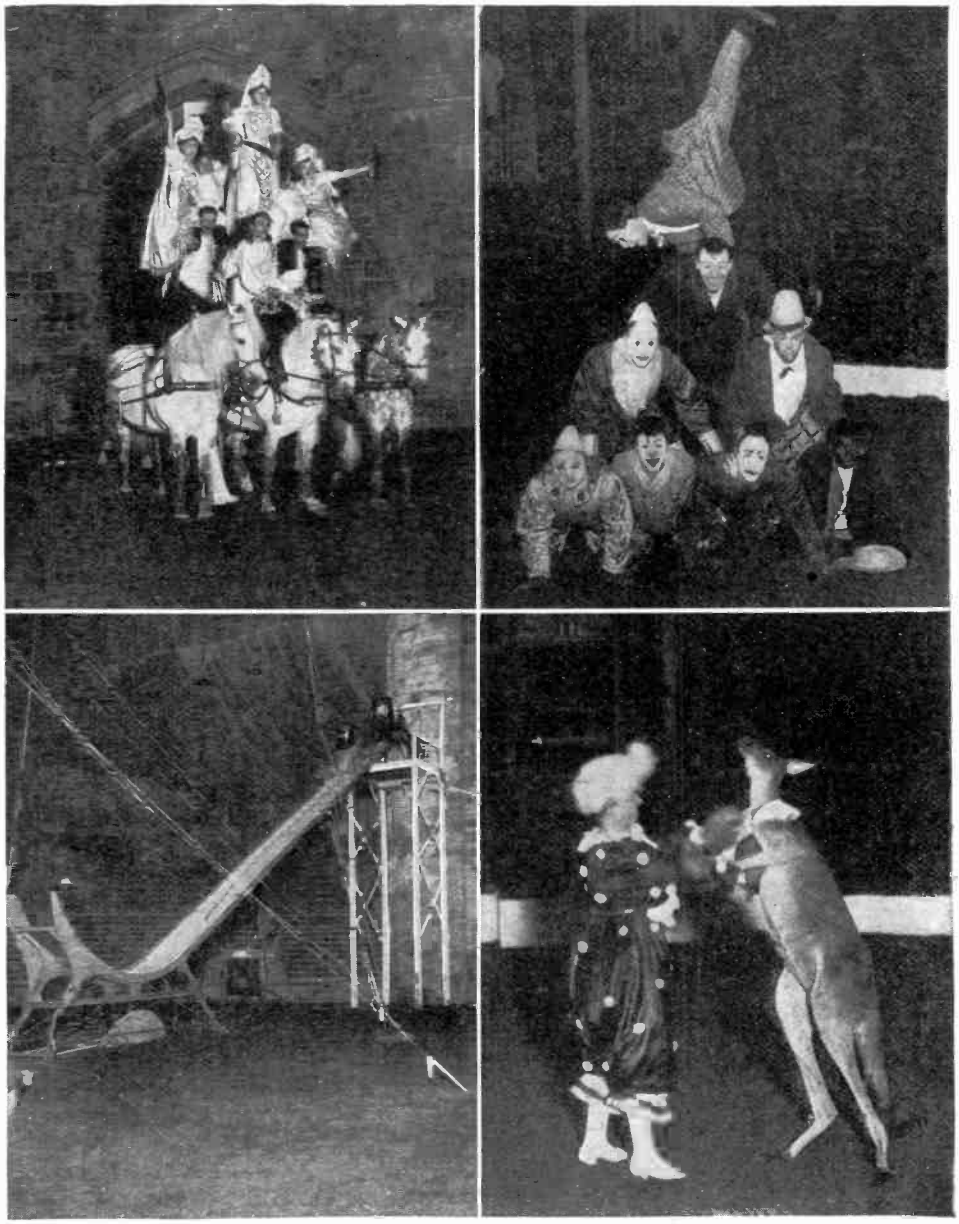


FIG. 3. AN ELECTRICAL PLANT OF NO SMALL PROPORTIONS IS AN ADJUNCT OF THE MODERN MOVING PICTURE THEATER



ARC LIGHTS AND HIGH CLASS PHOTOGRAPHY

The photographs from which the above illustration was produced were taken at Earls Court, the famous London amusement resort. No flash light was used in making the exposures which were made under the illumination of powerful arc lamps. Unusual sharpness of detail was obtained which is partially brought out by the halftone reproduction. Taken in order the subjects are as follows: Equestrian act; acrobatic clowns; looping the loop with a tandem motor car, and the boxing kangaroo.

Modern Underground Work

Less than twenty years ago, the streets of all great cities were encumbered by the rows of high poles that lined each curb, and often were actually darkened by the clusters of telegraph, telephone, arc light, burglar alarm and stock ticker wires. There was practically no legislation regulating the erection of these poles or the stringing of wires, and there was no way even to compel the operating companies to remove useless wires or to protect the public from broken ends which dangled over the sidewalks. In the business districts the poles often reached to the tops of the highest buildings, and as there were sometimes fifteen or more cross arms on each pole and each arm supported ten wires it may easily be seen how they overshadowed the street.

Somebody once remarked that they would make a most effective fire-escape, if only the fire trapped person who jumped among them was fortunate enough to land on one of the dead wires.

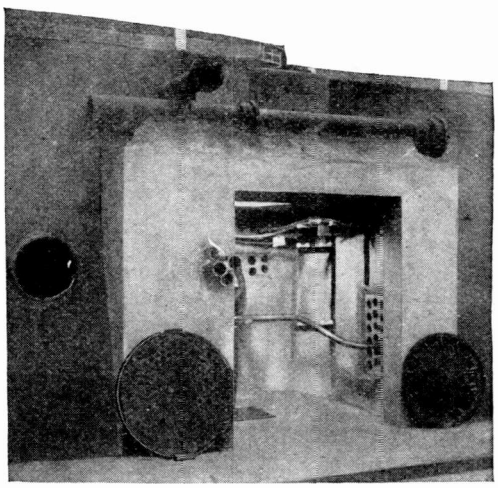
The beginning of the end of this overhead method of construction came when the Edison Electric Illuminating Company, under the direction of Thomas Edison, laid out the distribution system of the world's first commercial central station —underground.

Even the underground system had its critics, and it is recorded that some one remarked that while most companies were satisfied with all the air, Edison only wanted the earth. Edison generally answered such criticisms by asking why the gas and water mains were not put in the air on stilts.

However, the underground conductors were extended through about fifteen miles of streets in a territory a mile square.

The old conductors were quite different from those of the present day, for instead of a cable a hundred or more feet in length, the wires were put down in twenty foot sections, which had to be welded together. These sections consisted of iron pipe in which three copper rods had been placed and into which an insulating compound had been forced to completely fill the pipe.

Some of those old iron pipes with their copper rods are still in service in New York, but as the newer method of underground distribution is being extended, sections are being replaced. Some of this old material that has been dug from the



A MODERN CABLE VAULT

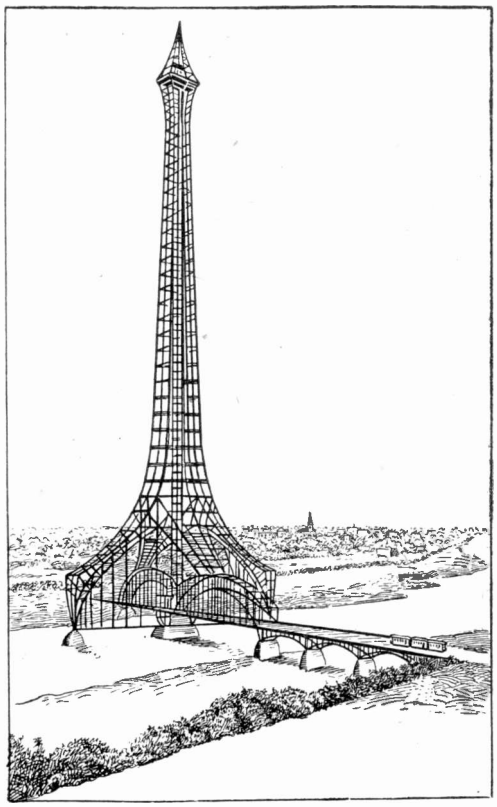
streets was exhibited at the recent Electrical Exposition in New York by the Consolidated Telegraph and Electrical Subway Company.

This company builds the underground ducts in which the present day cables are laid and at their display they showed a street cross section, the exhibit consisting of a man-hole, the clay ducts, the pipe galleries, and the adjacent gas and water mains. This showed how the cable is drawn through the ducts under the street, thus eliminating the necessity of tearing open the thoroughfare every time a repair is needed.

It has been estimated that there are close to three thousand miles of electrical subways in New York, yet even with this vast underground system there are still poles on some of the streets, just as the horses are still doing service on some of the car lines.

Plans to Outdo the Eiffel Tower

A German engineer, M. Czech, of Düsseldorf, has brought forward a project for a structural steel tower which will be the highest in the world, higher even than the Eiffel Tower at Paris, which now holds the record. It will be no less



TOWER 1600 FEET HIGH CONTEMPLATED TO SPAN THE RIVER RHINE

than 1,600 feet in height (the Eiffel Tower is 984 feet) and aside from this feature it has a very original construction from the fact that it is designed to span the Rhine. It is intended to be used for wireless telegraphy and no doubt the mesages sent from a tower of so great a height would carry for unheard-of distances.

According to the plans the base of the tower is a steel bridge having two long spans of 650 feet as well as several shorter spans. The tower rests partly upon the bridge piers and partly upon two extra piers which are built in the river at the sides of the bridge, these latter piers being 650 feet apart. From the four supports, the base part of the tower rises in the form of an arched construction 315 feet high and from here the structure narrows and continues to the top in a tapered form, as will be noticed. Near the top is an upper platform 160 feet below the extreme summit, this platform being about 80 feet square. Should the project be carried out and a wireless station be built in connection with it, some interesting results may be expected.

Telephoning Through the Tow Line

An invention to make possible telephone communication between a tug boat and the vessel which it is pulling by a

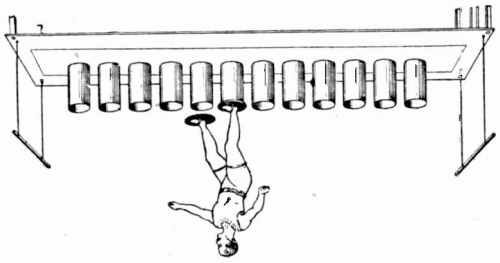
A TELEPHONE WIRE IS EMBEDDED IN THE TOW LINE

tow line has recently been patented by Robert H. Lindal, Gloucester City, N. J.

The telephone circuit consists of a single wire preferably spirally laid within the tow line which at each end has terminals for flexible wire connection to each pilot house. The other side of the circuit is formed through the water by grounding each end of the line upon a metallic plate on the outside of the hull.

Vacuum Act

Theatrical apparatus to enable a performer to walk, head downward upon the ends of a series of hollow cylinders



SUSPENDED HEAD DOWNWARD FROM VACUUM CYLINDERS

fastened to a temporary ceiling high above the stage floor is the subject of a patent granted to John W. Frakes, Chicago, Ill.

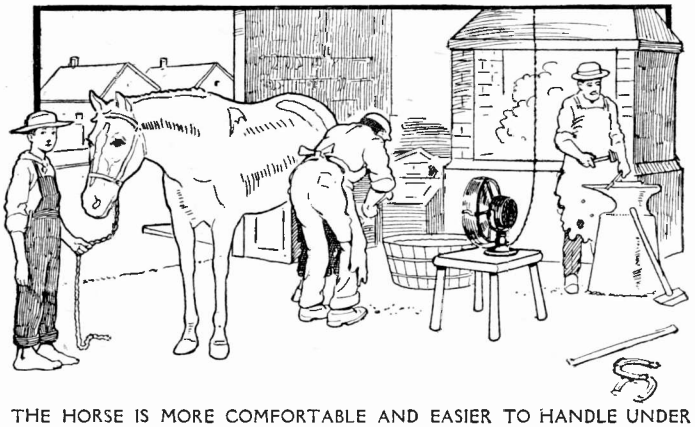
The cylindrical air chambers are all connected by piping to an air pump. The pipe to each chamber is equipped with a valve controlled by an electro-magnet from which wires run behind the scenes to a keyboard. The performer wears upon his feet disks of heavy leather fitted with pliable material such as rubber or felt. From the trapeze bar he places one foot upon the nearest air chamber while the operator at the keyboard causes the electro-magnet at that particular air chamber to open the exhaust pipe to the pump. A vacuum is formed. When the next step is taken air is admitted to the first cylinder while a vacuum is formed at the second.

Fan in Blacksmith Shop

An electric fan placed on the floor a few feet away from the blacksmith as he fits and fastens the shoe upon the horse's foot blows the fumes of the hoof away and in summer scatters the flies. The horse so protected is comfortable and easier to handle.

The Divining Rod

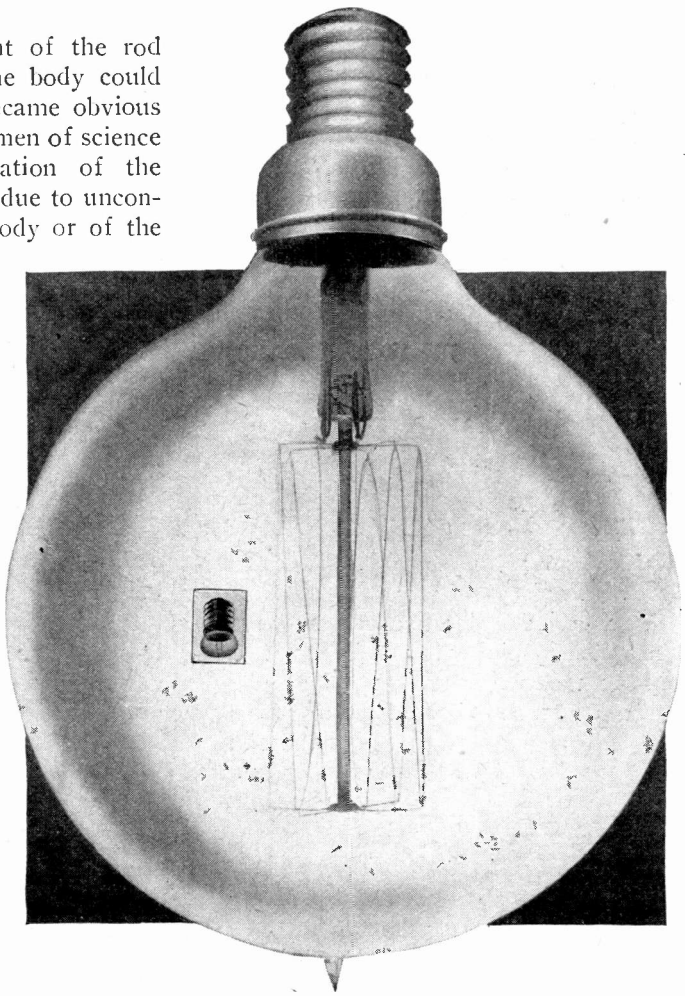
The United States Geological Survey, in Water-Supply Paper 255, entitled "Underground Waters for Farm Use," just reissued, states that no appliance, either mechanical or electric, has yet been devised that will detect water in places where plain common sense and close observation will not show its presence just as well. Numerous mechanical devices have been proposed for detecting the presence of underground water, ranging in complexity from the simple forked branch of witch hazel, peach or other tree to more or less elaborate mechanical or electric contrivances. Many of the operators of these devices, especially those who use the home cut forked branch, are entirely honest in the belief that the working of the rod is influenced by agencies—usually regarded as electric currents following underground streams of water—that are entirely independent of their own bodies, and many people have implicit faith in their own and others' ability to locate underground water in this way. In experiments with a rod made from a forked branch it seemed to turn downward at certain points independent of the operator's will, but more complete tests showed that this downturning resulted from slight and, until watched for, unconscious muscular action, the effects of which were communicated through the arms and wrists



THE HORSE IS MORE COMFORTABLE AND EASIER TO HANDLE UNDER THE FAN'S INFLUENCE

to the rod. No movement of the rod from causes outside of the body could be detected, and it soon became obvious that the view held by other men of science is correct—that the operation of the "divining rod" is generally due to unconscious movements of the body or of the muscles of the hand. The experiments made show that these movements occur most frequently at places where the operator's experience has led him to believe that water may be found.

The uselessness of the divining rod is indicated by the facts that it may be worked at will by the operator, that he fails to detect strong water currents in tunnels and other channels that afford no surface indications of water, and that his locations in limestone regions where water flows in well-defined channels are no more successful than those dependent on mere guess. In fact operators are successful only in regions where water occurs in a definite sheet.



THE LARGEST AND THE SMALLEST INCANDESCENT LAMP

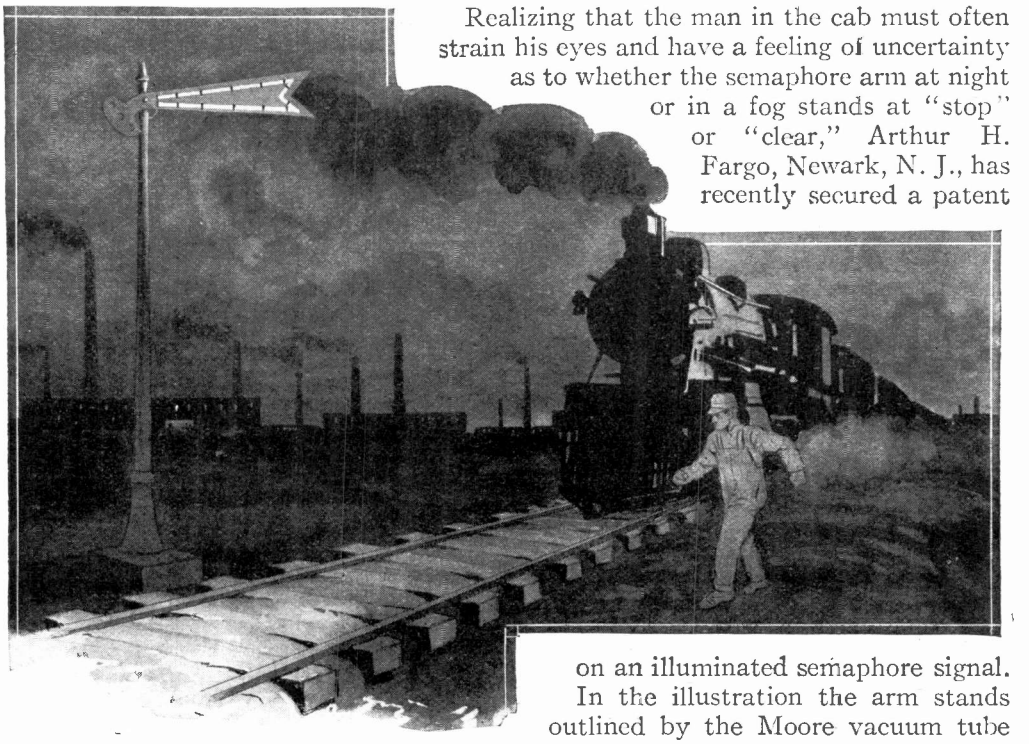
Brobdingnag and Liliputian

Something of the wide variation in the size of tungsten filament lamps is shown by comparison in the accompanying illustration of one of the largest and of one of the smallest lamps regularly manufactured by the lamp division of the General Electric Company.

The globe of the big one is eight inches in diameter and the lamp is 11¾ inches over all. The bulb of the little one is only 7/16 of an inch in diameter and the length of the bulb and base together is 23/32 of an inch. The giant is a 500 watt lamp made for voltage ranges of 100 to 130 and 200 to 260. In the 100 to 130 volt type it operates at an efficiency of one watt per candle, giving a candlepower of 500. In the 200 to 260 volt type the efficiency is 1.23 watts per candle giving 405 candlepower. The life of this lamp up to the point where the candlepower drops to 80 per cent of the initial candlepower is 1,000 hours. The filament is of drawn tungsten wire and is extremely strong as compared to the former pressed filament lamp.

The filament of the small lamp is also of drawn tungsten wire and has a total life of eight hours. At 2½ volts it gives one candlepower and requires 3/10 of an ampere of current.

ILLUMINATED SEMAPHORE SIGNAL



Realizing that the man in the cab must often strain his eyes and have a feeling of uncertainty as to whether the semaphore arm at night or in a fog stands at "stop" or "clear," Arthur H. Fargo, Newark, N. J., has recently secured a patent on an illuminated semaphore signal. In the illustration the arm stands outlined by the Moore vacuum tube light in which rarified gas in the tube acts as a conductor and is rendered incandescent by electric current.

Electric Ghosts

In an address to electrical engineers in London a distinguished scientist thus defined an electron:

An atom is ordinarily associated with a charge, and force is required to separate the charge from the atom. The atomic charge when separated is called an electron. In an electrolyte, i. e., a substance decomposed by an electric current, there is a bodily transfer of atoms with their charges; in a metallic conductor the charges are handed on as electrons from atom to atom. In the discharge through highly rarefied gases the electric current is in its most simple form, for here there is a flow of electrons travelling by themselves, of disembodied charges or electric ghosts. Electrons, it should be added, are the fastest moving of all known terrestrial objects, their speed being one-tenth that of light, which is 186,300 miles per second.

Lights Send Children Home

To remind the children who are on the streets at night that it is getting late and time to go home the Los Angeles police juvenile officer has suggested what he calls a "skip home" signal, to the chief of police.

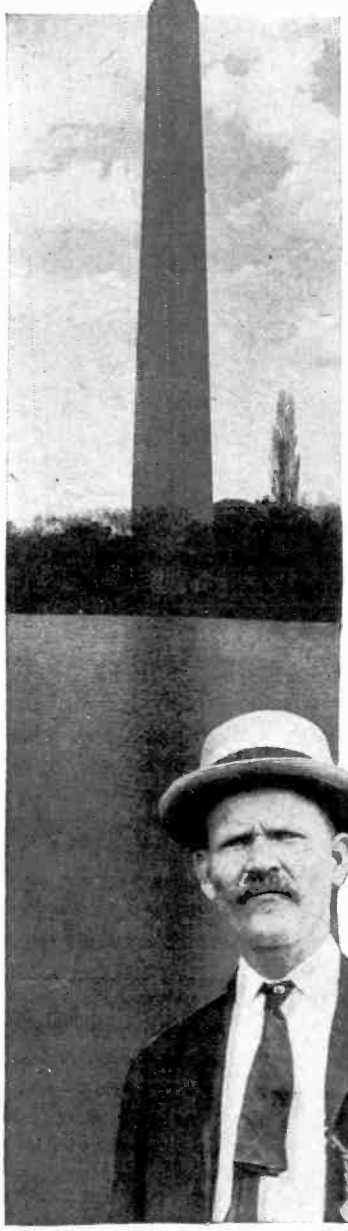
His plan is to have the electric lights flash shortly before nine o'clock as a warning and promptly at nine to have the lights turned out for a few seconds so that these children will not have the excuse of being ignorant of the hour.

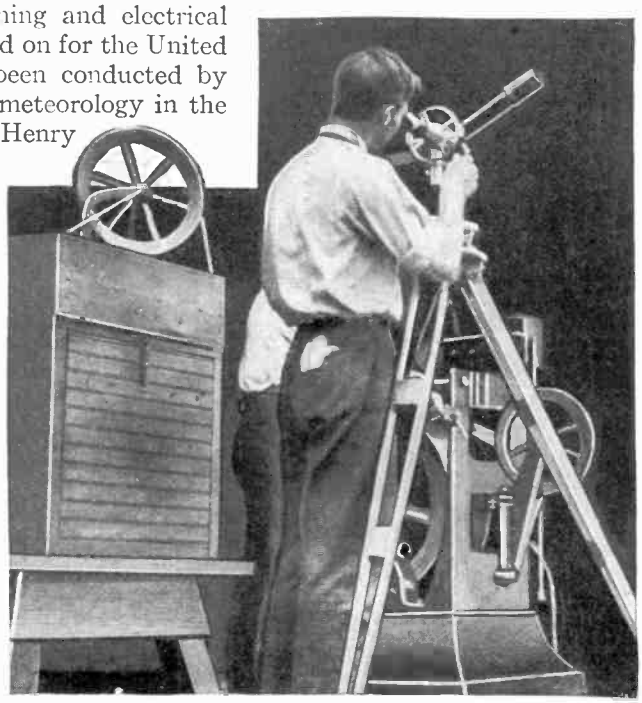
This plan will probably be adopted as a large number of very small boys who sell newspapers are in the habit of remaining out until late in the night even after their stock of papers have been disposed of.

Uncle Sam Investigates Electrical Disturbances

By WALDON FAWCETT

Such investigation of lightning and electrical disturbances as has been carried on for the United States Weather Bureau has been conducted by Alfred J. Henry, professor of meteorology in the U. S. Weather Bureau. Prof. Henry





PROF. ALFRED J. HENRY, THE WEATHER BUREAU'S EXPERT ON LIGHTNING, AND THE MT. WEATHER OBSERVATORY WHERE HIS EXPERIMENTS ARE MADE. THE WASHINGTON MONUMENT IS A FAVORITE MARK FOR LIGHTNING, HAVING BEEN STRUCK AS MANY AS FIVE TIMES IN 20 MINUTES. IT IS PROTECTED BY AN INGENIOUS SYSTEM OF LIGHTNING CONDUCTORS TERMINATING IN A SMALL PYRAMID OF ALUMINUM.

has long had instinctive interest in the subject and he has opportunities such as are vouchsafed to few men for studying lightning, being in charge of the research work at Mount Weather, a peak of more than 1,700 feet altitude in the Blue Ridge Mountains and in the heart of a region famous for its cloud effects and severe electrical storms.

Prof. Henry says that he is convinced that were the subject of lightning better understood there would be a reduction in the number of persons killed from this cause, a mortality that totals 700 to 800 persons annually, in addition to twice that number injured by lightning. He also emphasizes the fact that the great increase in recent years in the number of electrical light and power

transmission lines has stimulated the development of means of protection so that nowadays the electric power plants and lines are better protected from lightning than are the average farm buildings.

Speaking for the benefit of rural and suburban residents Prof. Henry says that he is confident that while absolute protection cannot be secured unless the building is incased in a network of wires he is confident that a building with a properly installed system of lightning conductors will fare better than one without such a system if a discharge of the most violent type should fall upon it. He also urges that wire fences be grounded at every fifth post, the galvanized ground wire extending at least two feet into the earth. As for lightning conductors on buildings, particularly farm buildings, the Weather Bureau expert holds that in a general way, a terminal 20 inches long should be erected every eighteen or 20 feet along the ridge of the roof, in addition to short terminal wires on each cupola, chimney or other salient point on the roof liable to be struck.

According to all the governmental investigations, lightning (a violent discharge of electricity either between one cloud and another, between a cloud and the earth, or between two strata of air differently electrified) is commonly assumed to discharge from a higher to a lower level although it may be from either or both. Clear air, it has been found, is, as a rule, electrified positively but in rain the electrification ranges from a high negative to a high positive although it is more often positive. During a single storm the air may change back and forth several times from a positive to a negative condition and the difference in potential between the earth and a point ten feet above it may amount to hundreds or even thousands of volts.

Up to date no one of the scientists has been able to determine the exact nature of a lightning flash. Experiments with kites have shown the varying potentials between air strata and there is the general theory that electricity flows from a positive to a negative body, but for all that there is evidence that a lightning discharge is in most cases pulsating. It is claimed that a lightning stroke differs according to the direction of the flash and as to whether the earth is positive or negative. The violence of a discharge and its effects are matters of pressure or tension, say between the earth and a cloud. There may be an adjustment of potentials following a discharge.

The lightning experts some time ago discovered that most flashes are composed of several discharges following one another at certain intervals in the path made by the first discharge. This is the line of investigation which the Smithsonian Institution is following by means of grants from the Hodgkins Fund. It has been ascertained that a flash may be composed of anywhere from fourteen to 40 separate discharges and not only is what appears to the naked eye as one flash in reality a number of parallel flashes but the flash has width like a ribbon. The Smithsonian Institution is also endeavoring to time the duration of lightning flashes. Meanwhile at the Harvard College Observatory attempts are being made to photograph the spectrum of lightning.

With linear lightning making up the first general class we have as a second class ball lightning or, as it is sometimes called, fire ball or globular lightning. The balls vary in size from a half inch to several feet in diameter and they also differ in motion from linear lightning being possibly even more erratic. Ball lightning is not however to be confounded with St. Elmo's light, a blue or red electric discharge sometimes seen on the masts of ships and more rarely on church spires.

In their observation of lightning flashes and tests of lightning conductors the Federal experts have found an ideal testing station in the Washington Monument.

The famous obelisk is struck by lightning a number of times every year but no havoc has ever been wrought, thanks to an ingenious system of lightning conductors, the keynote of the installation being found in a small pyramid of aluminum weighing about 100 ounces, which crowns the capstone of the monument. This headpiece is connected with rods that descend 600 feet to a well sunk to a considerable depth below the level of the earth. The monument has been visited by as many as five electric bolts within an interval of 20 minutes but the protective system has always proven equal to all the exactions imposed upon it.

Hints on Using the Long Distance Telephone

To use the long distance telephone there are some rules that will be of value in making the minutes count for something, in making the hearer understand readily and in disillusioning ourselves of the horror that is sometimes noticeable in speakers, even when talking over a local telephone.

There is, or there should be, a reason for calling one on long distance. The subject matter should be well in mind first, and the exact nature of the questions should be either in mind, or written down as carefully as possible. Every minute counts in this way, and there is so much lost in these calls by inexperienced people that the real value of the telephone loses some of its charm for them.

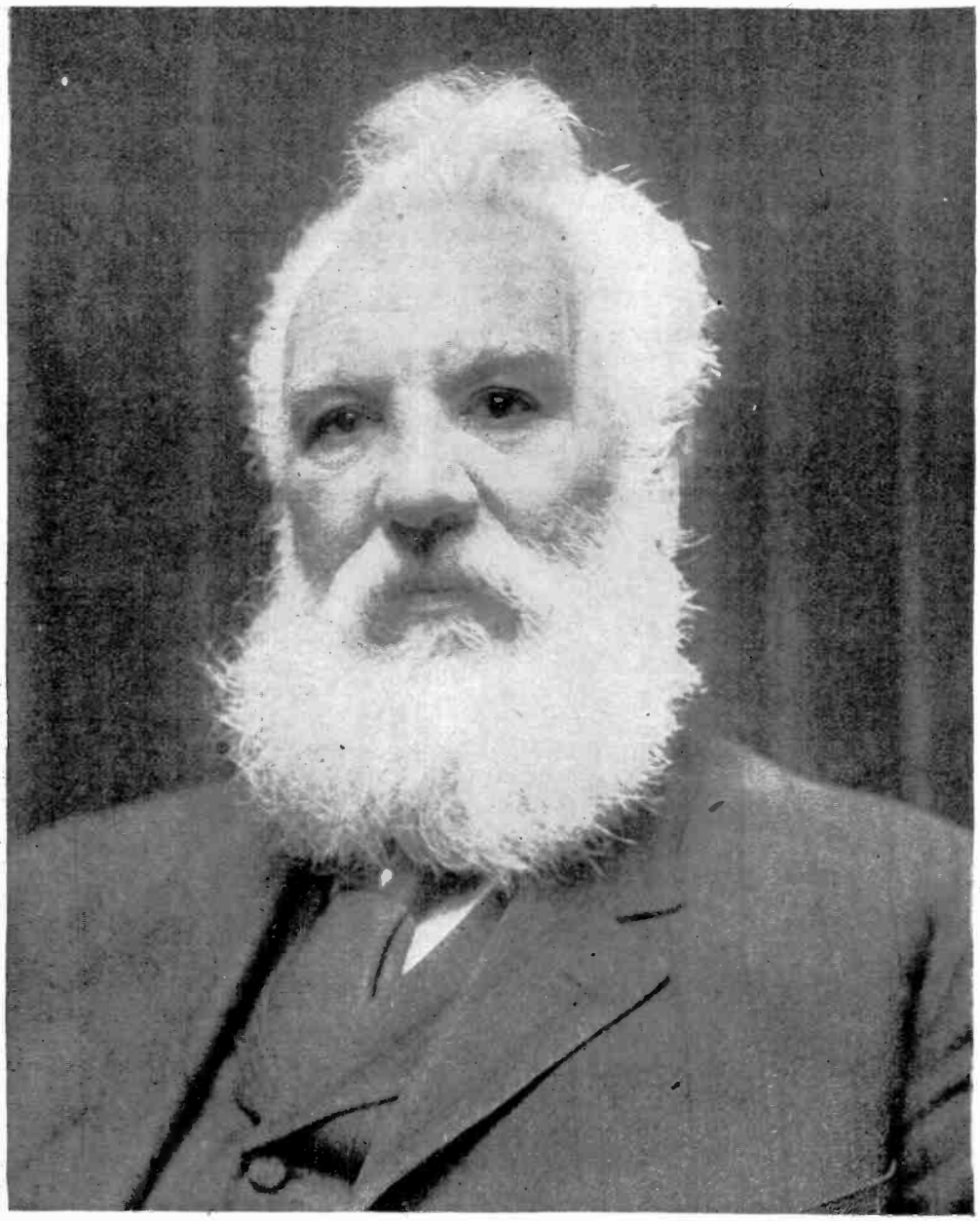
When the subject and the questions have been clearly grasped and put in order, there must be composure of mind to insure both being heard and hearing. Talking in a moderate tone, speaking with slowness and distinctness and giving the hearer ample time to grasp the meaning of each word, brings satisfactory results. You are simply talking to your friend or neighbor, or business acquaintance, and the matter must be treated as an every day occurrence. The person who becomes excited or who lets his nervousness get the better of him has accomplished little toward a realization of the object desired.

Use some little imaginary power in this case. Consider that the person with whom you are speaking is but a few feet distant. Bring the personality into the subject, and there will at once arise a feeling of complacency and an ease of conversation that will be surprising. So many, in using the long distance telephone, forget that it is the same as the local telephone save that the distance is greater. The voice is just as easily understood and the feeling of a personal conversation should not be less so because you are conscious of a greater distance.

There is so much simplicity and such sure satisfaction to the user of the long distance, provided he has first given that consideration to the matter that it justly demands. It may be the fact that there is a certain sum invested that he feels should be made to produce something tangible that arouses his feelings of anxiousness and concern; and that, in reality, is the real secret of his unsatisfactory service.

There are but a few simple rules to follow in the use of the long distance telephone, and these are applicable to the local telephone as well. A cool head; a clear voice; a definite object in using the instrument; a plan of questions to be asked and the elimination of unnecessary words. Time is a factor that should be considered.

If, therefore, we adopt and follow a few well defined rules there will be a feeling of satisfaction and a conscious gratification in the use of the long distance telephone that will amount to many dollars in both time and temper, and save a loss in other ways that is common to the man who does not understand the disadvantage of talking with a meaningless jargon and a lack of true value of this modern instrument of distance annihilation.



DR. ALEXANDER GRAHAM BELL

This photograph of Dr. Alexander Graham Bell, inventor of the telephone, was taken approximately three years ago and is the latest picture obtainable, as well as the one preferred by him for publication. It was sent to us through the courtesy of Mr. Ernest Gregory, editor of the *Volta Review,* which is the magazine published by the American Association to Promote the Teaching of Speech to the Deaf. Dr. Bell was the founder and first president of the association and his present activities are principally along the line of this work.

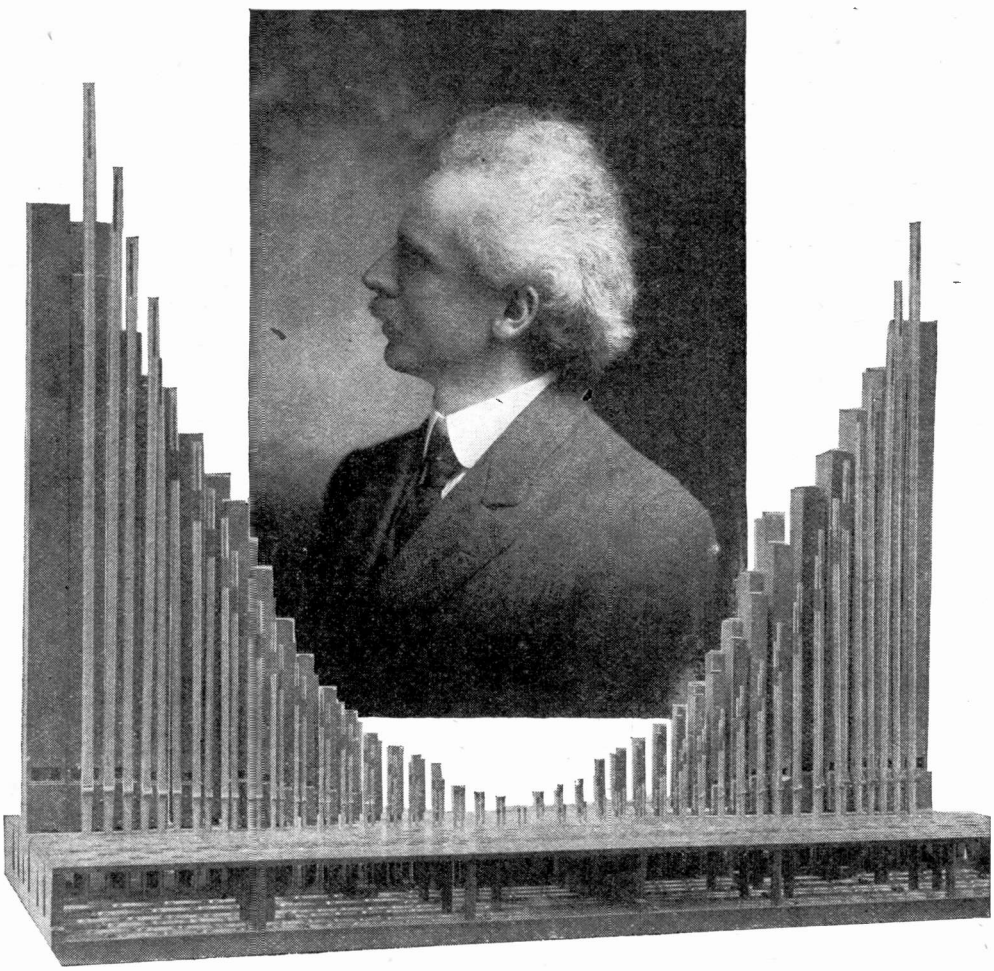
The Master Organ Builder

Robert Hope-Jones and his Unit Orchestra

By ARTHUR H. MILLER

It will be remembered that in the May, 1912, issue of this Magazine a brief description was given of the Unit Orchestra, the invention of Robert Hope-Jones, referring particularly to the trial installation in the Cort Theatre in Chicago. However, not all the interesting facts connected with this wonderful piece of mechanism and the electrician-musician who made it possible were told. In the article which follows the author has added some more details concerning the man and his achievement.—Editorial Note.

The greatest organ builder of modern times is an electrician. He builds wonderful electrical orchestras. This man, who has risen from electrician and church organist in a little English town near Liverpool to one of the most prominent figures in the musical world, is Robert Hope-Jones. Only recently the head of the music department of one of the large Eastern universities, in speak-



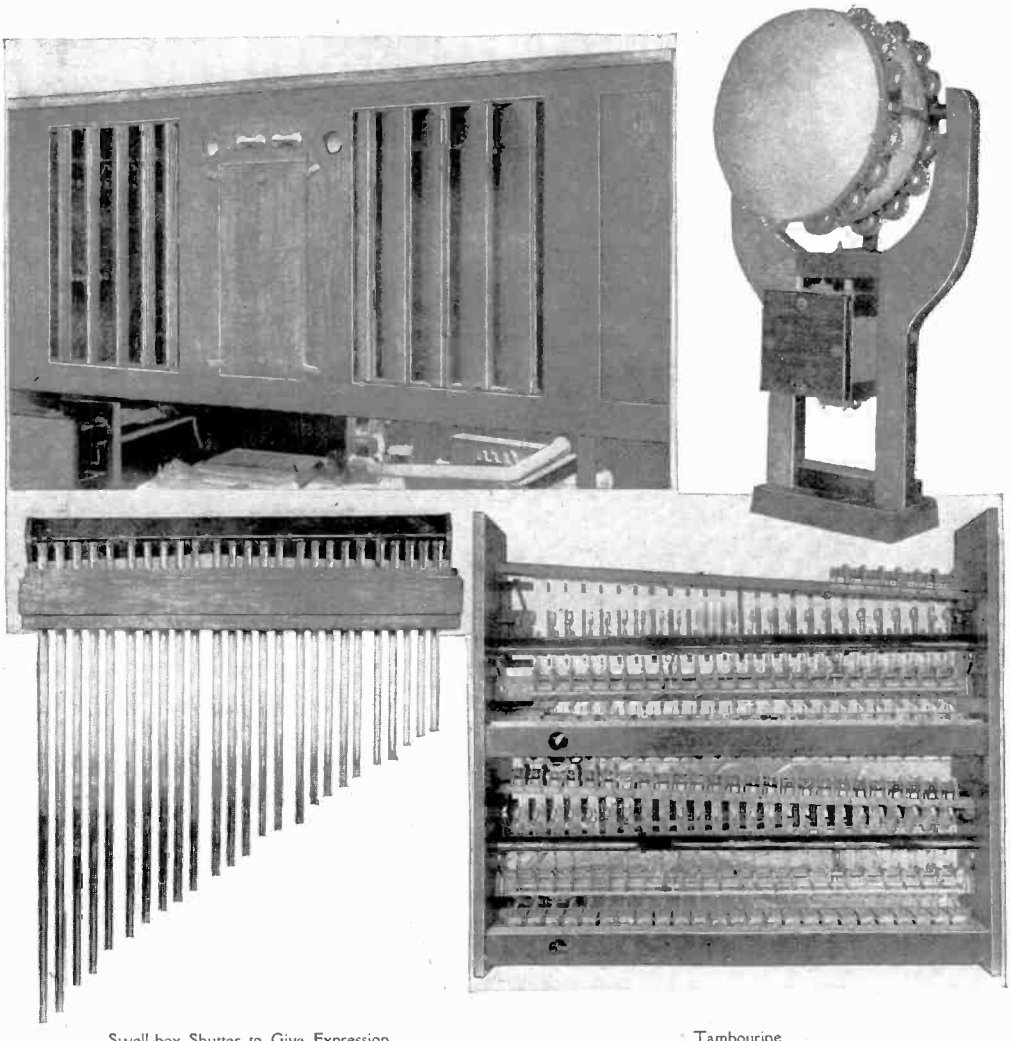
ROBERT HOPE-JONES SPOKEN OF AS "THE GREATEST MIND ENGAGED IN THE ART OF ORGAN BUILDING"

ing to his students, referred to this electrician organ builder as "the greatest mind engaged in the art of organ building in this or in any other age." As the name of Stradivarius recalls rare, wonderful violin tones, mellow with passing centuries, so does the name of Robert Hope-Jones bring to mind a more modern achievement—beautiful music transmitted to thousands through the tones of a majestic orchestra played by a single musician. Years ago, Robert Hope-Jones was chief electrician of the English telephone company and at the same time was organist of St. John's Church in Birkenhead. Then it was that he conceived the idea of playing an organ by electricity. With the aid of his choir members he built such an instrument which, though crude, was the wonder of musicians who came to play it. This gave him the idea of the unit orchestra and in the end led him to give up his position and his country to follow out his work. He combines the typical inventor with the artist. In enthusiasm, ability of conception, concentration and persistency he is the inventor. In his devotion to his art, in expression and personality he is the artist to his finger tips. A true English gentleman, courteous to everyone, modest, chivalrous. It was his country's misfortune when he took his leave and America's decidedly good fortune. To use his own words, which more than anything else—unless it be his early financial failures—illustrate his unmercenary attitude:

"I am thoroughly happy so long as I am building perfect instruments. The profit does not concern me." When he was first sought after to build organs like the first one, finally being prevailed upon to build several, he agreed to do so with only a vague idea of the cost it would involve. "I merely guessed at the cost," he said, "and went to work. It was not until I had lost many thousands of dollars that I discovered my mistake. That is why I came to America a poor man, after selling my British patents to settle my obligations there. I was poor in everything except courage and confidence in myself and my ideas. I brought with me a number of the men who helped build my first organ in St. John's Church, Birkenhead. They are splendid fellows and have stuck by me through thick and thin."

An illustration of what Mr. Hope-Jones meant by this is given us in the building of that celebrated instrument in the Ocean Grove Auditorium. The sum originally subscribed to build it fell short several thousand dollars, and the inventor and his faithful workmen continued their labors almost without compensation. During much of the time he was ill and worked with a fever. The instrument will thus always stand a tribute to the loyalty of these men and the truly heroic perseverance of the builder. Those who have heard the fantasia, "The Storm," played on this remarkable organ need no description of the dignity, beauty and refinement of its tone.

Tone reproduction is one of the things which Hope-Jones has mastered. He is probably the first man who has ever made the study of tone a really scientific one from its practical standpoint. In the realm of tones he duplicates the wonders of Edison in the realm of applied electricity. Imagine, if you can, entering one of the famous old cathedrals on the Continent, in which the organ is noted for one or two particularly rare tones and by means of a little instrument photographing those particular tones. Then to stretch your imagination a bit further, conceive of taking the negatives home with you to America and in your laboratory reproducing that tone identically. That is precisely what Hope-Jones has done and is doing. This instrument is necessarily of his own invention and consists of a lead funnel, in the apex of which is suspended a silvered aluminum mirror. As the sound waves enter the funnel the mirror vibrates and a needle-point ray of electric light is reflected on a screen some ten feet away. The move-



Swell-box Shutter to Give Expression to the Tones. Chimes

Tambourine Chrysoglott

SOME OF THE PARTS OF THE HOPE-JONES UNIT ORCHESTRA

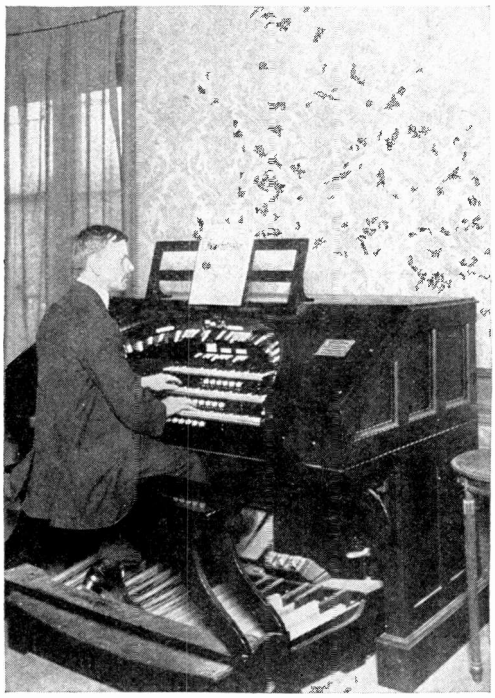
ment of this tiny light spot is recorded by a camera and from the photographic prints the inventor reproduces the tone in his workshop. He says that this scientific tone language is a wonderful thing and its accuracy is absolute. Once you have learned the language it tells you all about sound. He has himself discovered many new tones. One of these he calls the "Kinura" which in the Hebrew means "wailing voice."

Electricity is the basis of operation of the unit orchestra. Tiny electric wires connect the keyboard, or console, as it is called, with the instrument itself. There are thousands of these little electric nerves and they make bundles as thick as a man's wrist. All of the electrical contacts are made of pure silver which has never been known to fail. The voltage used is low, always being less than ten volts. Electricity also drives the fans and compressors which supply the wind for the instrument itself.

On one keyboard of the unit orchestra are grouped the wood wind stops. On another keyboard all members of the string family are available, on another the

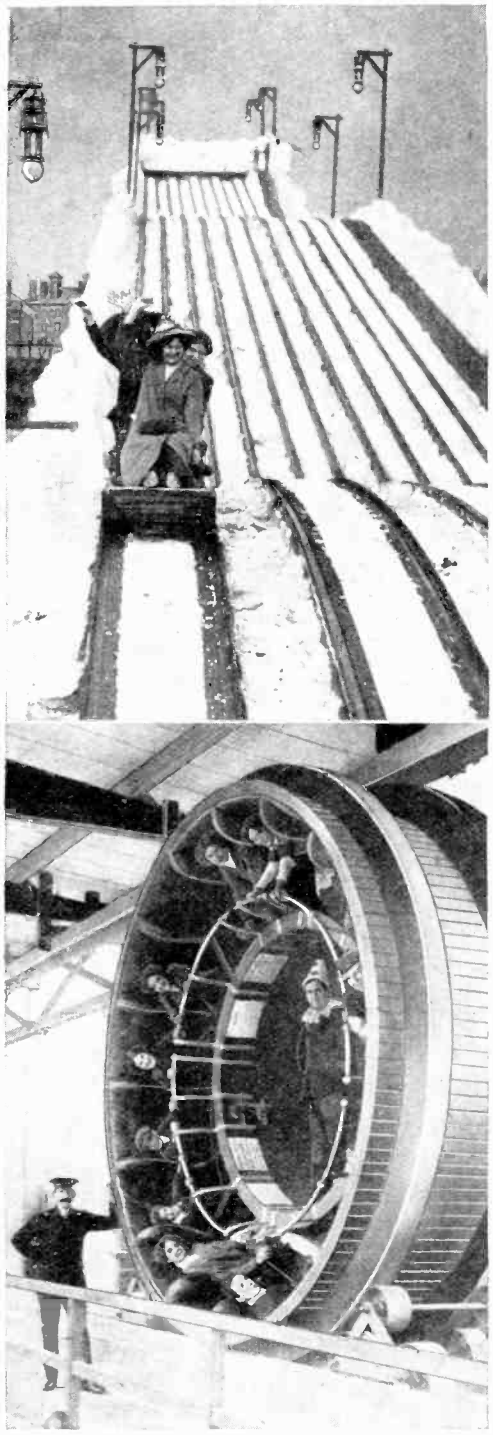
brass instruments, on another the basses and so on. Each one of these families is under expressive control. A touch of the players foot or of one of his fingers, will bring the string group into prominence and will cause the other families to retire until wanted again. Another touch and the strings are subdued, while the plaintive oboe, the clarinet, or another member of the wood wind family makes its voice heard. Instead of one clarinet, able to produce but a single note at a time, there are clarinets capable of playing in full chords at all parts of the compass. The same is true in the case of the brasses, the strings, the flutes, the oboes and all of the others. Thus it can be seen that a musician having control of such great resources can produce effects that are in many points not obtainable from any orchestra, even though it has a hundred performers. It can be swelled up until it rivals the largest church organ in dignity and power and it can be reduced to the merest whisper, as is done in the Chinese music at the "Daughter of Heaven" production. By placing a "vowel cavity," governed by a sliding stopper on each pipe, its tone can be altered at the will of the player so that like the human voice it will sing ah, eh, e, i, o, or u.

The basis of the work is the diaphone, the most powerful foundation stop in the instrument. This resembles the diapason in tone quality, though many distinct colors of tone can be produced from it. It consists of a small aluminum piston which rapidly and freely vibrates in an enclosing cylinder and if supplied with sufficient air pressure can be heard 20 miles away. In fact, one is now used by the Canadian government on the shore of Lake Ontario for signaling purposes and is effective for a distance of 40 miles across water. It is believed that the possibilities of this strange stop have not as yet been fully realized. Strange to say, there are no bellows in the unit orchestra, the wind being supplied by electrically driven fans and compressors, which deliver it at pressures of ten, 25 and 50 inches, meaning the pressure of a column of water ten, 25 or 50 inches high. The highest pressure hitherto used in any organ has been 26 inches, and the pressure on the average church organ is only three inches. By means of the swell shutters, it is thus possible to control the great volume of tone produced by these pressures so that the *tuba mirabilis* of 50 inch pressure can be used to accompany the human voice. The foundation, string, woodwind, brass and percussion departments, are enclosed in their own independent cement swell boxes. All of the stops may be drawn upon any of the manuals or on the pedal at any pitch.



ALL FAMILIES OF TONES ARE UNDER EXPRESSIVE CONTROL FROM THE CONSOLE

The touch, moreover, is as light as that of a grand pianoforte. By exerting a trifle more pressure on any key it sinks an eighth of an inch lower and the stops drawn on another manual then come into play.



Photos by Boston Photo News

THE GLACIER GLIDE AND THE ROLY POLY—LONDON NERVE SHATTERERS

London Nerve Shatterers

Londoners are just as ready to pay money to experience novel sensations as the people in this country who patronize amusement resorts. They love to be bumped and jerked and whirled through space in a manner which would cause them to collapse if they were to undergo a similar experience in an accident. Two of the latest London novelties in this line are known as the Roly Poly and the Glacier Glide.

The Glacier Glide is very similar to our Shoot the Chutes except that a smaller car is used, something like a toboggan which glides down a track over real ice and snow. The car is drawn back by means of an endless cable operated by a motor.

The Roly Poly revolves like a pinwheel and is steadied by two horizontal tracks, one above and one below. It looks like the commutator to a huge electric generator. It is operated by cogs, geared to a track on the inner side. Friction wheels at the base serve to stop or brake it. The passengers climb in at the bottom, and as seats are filled they are whirled to the top of the wheel. When all are in it is revolved along the double rail track by hidden electric motors.

Neon—A New Element With a Future

The surrounding atmosphere contains a number of strange gases which have only recently been discovered and have not as yet been put to any commercial use, but are being investigated and experimented with and there is no doubt that there are future possibilities both in the fields of chemistry and electricity. These gases, among which are helium, argon and neon are known as negative gases, and are most inert and lazy, have no color, odor or taste and will not combine with other elements, chemicals or among themselves. Their names are characteristic, argon being Greek for lazy, neon means new and helium the sun.

Neon constitutes one one-hundred-thousandth part of the bulk of the atmosphere and was discovered by Ramsay and Travers in 1898 in liquid argon. While it resembles both argon and helium its properties are not yet thoroughly known, but its density is ten times as great as that of hydrogen. These gases have the property of glowing with a beautiful, soft, phosphorescent light of various colors when sealed in a glass tube with platinum electrodes, and a strong current sent through.

While they all have this property, neon gives the best results and its light approaches nearest to sunlight and is almost pure white. Experiments so far have shown that a neon tube gives much light in proportion to the current used and after being perfected commercially may be an economical substitute for the incandescent lamp.

The investigators have had two problems to solve before it was possible to even consider the practicability of it as a new form of illumination, apart from the commercial exploitation. The first was the small proportion of the gas as contained in the air and the difficulty of its extraction and purification. This can be overcome by application and perfection of apparatus and process, as the source of supply is unlimited and the proportion never varies under any conditions. The other drawback is also simply a question of experimenting and is in a fair way of being solved.

It was found that the great heat generated by the flow of the current, disintegrated and vaporized the platinum electrodes and deposited it in fine particles on the side of the tube. This deposit of platinum has the peculiar property of absorbing the neon gas, consequently diminishing and finally extinguishing the light entirely. By increasing the size of the platinum electrodes, the current does not heat the electrodes enough to vaporize and the power of the tube is extended. Experts have declared that the future electric lamp will be along these lines.

Electricity in Volcanoes

What a dynamo a volcano in action would make if its power could all be turned to the creation of electricity! This thought is suggested by the observations on Mount Vesuvius which show that strong electro-magnetic currents flow up and down the sides of that mountain, the direction depending upon the condition of activity of the volcano.

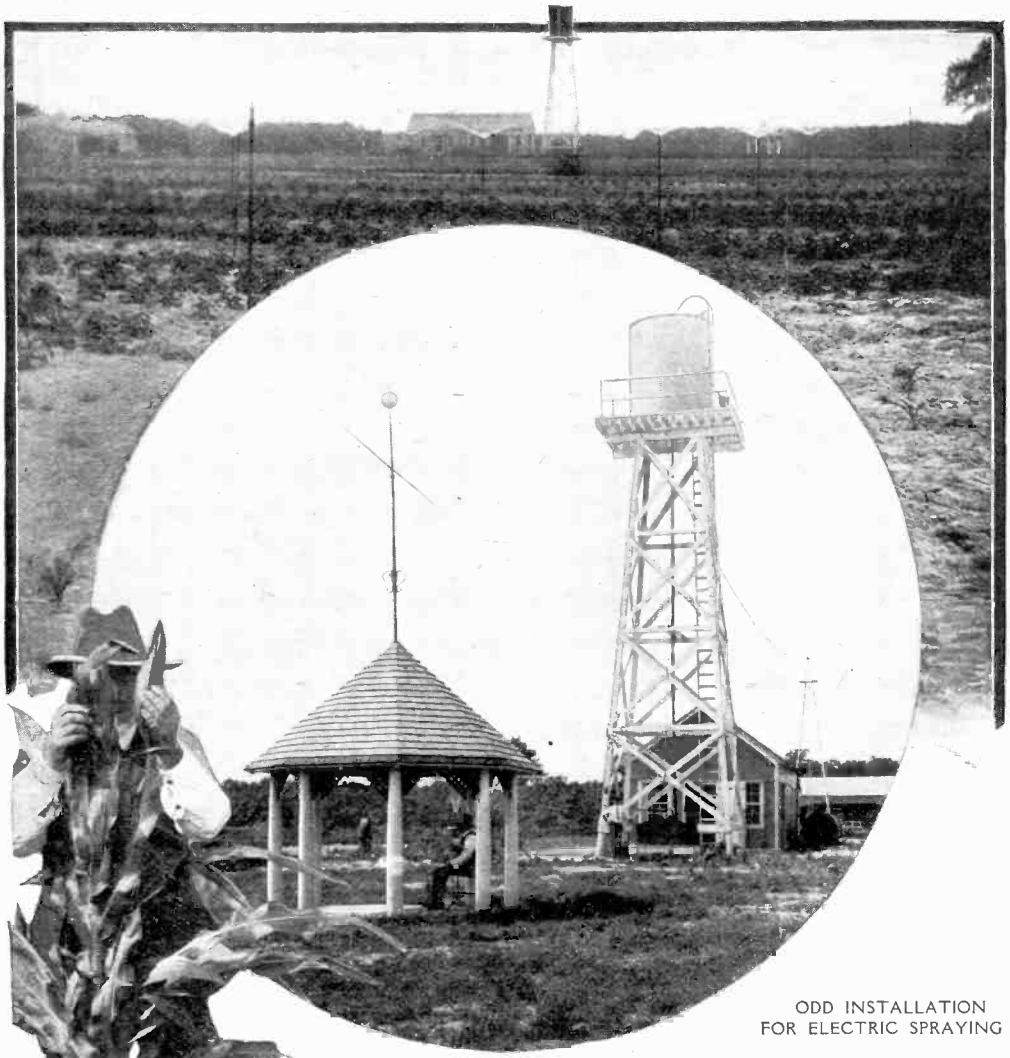
When the volcanic forces are at rest, or nearly so, the currents ascend the mountain, but as soon as an eruption approaches they instantly change their direction and flow down its sides to the surrounding valleys. The needles of the galvanometers employed in the study of these currents show the greatest excitement, trembling and leaping this way and that when the lava rises to the throat of the volcano and begins to issue from its vents. At other times the currents are feeble and their effects barely perceptible.

Another indication of the powerful play of electric forces in a volcano is given during great eruptions, when immense clouds of steam rise high above the mountain and stones and ashes are shot hundreds and even thousands of feet into the air. In such cases a brilliant display of lightning occurs in the cloud over the crater although no storm is raging in the surrounding atmosphere.

Man has put a bridle on Niagara and made it work for him in the production of manageable electricity, but it would be too much to expect that he could ever harness Etna, Vesuvius, or Cotopaxi for a similar purpose, even if their power were exercised with sufficient regularity to tempt him to the trial.

For the insect collector the incandescent lamp is suggested as a bait or attraction for nocturnal lepidoptera and other insects. It is proposed to surround the lamps with a globe coated with a sticky composition. The light attracts them and once they touch the globe they are secured.

ELECTRIFIED WATER SPRAYS TO ENCOURAGE CROPS



ODD INSTALLATION
FOR ELECTRIC SPRAYING

On Pon Quogue Road, Good Ground, Long Island is a farm upon which are being carried on some unusual experiments with electricity and growing crops. The farm which contains fifteen acres, eight of which are under cultivation, is equipped with a modern electric power plant and pumps. Upon an elevated, insulated platform is a 5,000 gallon metal tank. From the tank run insulated supply pipes over the area cultivated. These pipes at intervals are fitted with spray nozzles. The water in the tank is raised to a voltage or potential of 2,000 and as it sprays out of the nozzles upon the plants these become the medium for discharging electricity from the tank and water to the ground. According to Dr. Emilio Olsson, the owner of the farm, the electrified water stimulates the growth of the plants and also keeps them free from diseases.

By Courtesy of the Bell Telephone News

CABLE SPLICING ON SNOW SHOES

In the Upper Peninsula of Michigan, where this picture was taken, winter is winter with snow and lots of it. Although this cable is upon poles the linemen do not find it necessary to climb them but reach the lines on snow shoes, as is here evidenced.

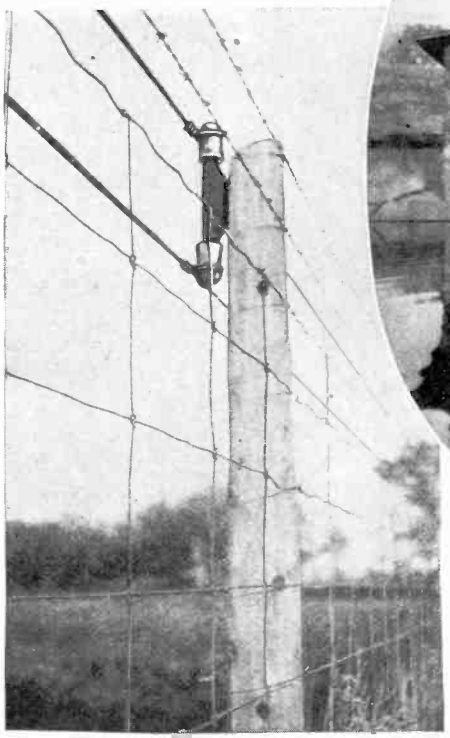
Running a Farm by the Power of a Brook

By GEORGE F. WORTS

Mr. Henry Ford, of automobile fame, regards his farm as an interesting diversion—a hobby worth while. It is his aim to apply here, through a corps of able assistants, the most modern of agricultural and dairying principles in an effort to create the farm ideal. The farm is situated a few miles out of Detroit on the banks of the picturesque River Rouge which winds in and out among the extensive acres.

TWO VIEWS OF THE LITTLE PLANT ON THE RIVER ROUGE

One day I noticed, stretching along the post tops of a high, woven wire fence, two electric power wires extended inconspicuously, finally disappearing in the distance into a large white barn. From natural curiosity I followed the wires and entered the barn.



TWO ELECTRIC POWER WIRES STRETCHED INCONSPICUOUSLY ON THE WOVEN WIRE FENCE

It was milking time and the last of the blooded Jersey stock had been driven into the clean concrete stalls. Brilliant rows of tungsten lamps along the walls and ceilings threw out a radiance almost equal to daylight. At the correct psychological moment for a group of picturesque milkmaids to appear on the scene, two farm hands approached and commenced to unravel a queer looking paraphernalia which they designated, to our inquiry, as the vacuum milking machine. As the name implies, no milkmaids are required.

The operation of the machine seemed simple; merely necessitating the attachment

of the rubber tubes, the starting of an electric motor which drove the vacuum pump and in a very short space of time the warm white streams bubbled and foamed in continually increasing volume into the waiting pails.

After the milk had cooled it was poured into the electric separator and the cream removed, a portion being retained and sent into an adjoining room where it completed a most interesting series of manipulations by being churned into sweet, fragrant butter for some fortunate "city folks."

The miniature power plant which accomplishes all this work, possesses all of the elements of a large commercial installation, but on a very small scale.

The water falls a distance hardly greater than a man's height; yet sufficient energy is developed to spin the little generators and carry with ease their load of numerous large motors and hundreds of electric lamps, "taking the undesirable work out of farming and the darkness out of night," in the words of one of the supervisors.

The farm is under the joint supervision of two young men, typical examples of the modern school in which no place is allowed for old fashioned methods or principles. As to the success of their specific experience in the application of electricity to modern farming practice they spoke glowingly and, further, voiced their intention of extending the uses of the electric current to the very limit of their scope—even into the fields—an innovation not yet attempted, to any extent, in this country.

The machine shops, containing the lathes, drills and presses; the dairy plant, including the milking, the cream separating and the churning; the elevators, grain, corn and fodder—all depend upon the electric current for their source of motive power.

The spacious dwellings, the immense dairy barns, the sanitary stables and the numerous small sheds are aglow every night with the radiance of an abundance of brilliant tungstens. Electric heating is one of the latest institutions.

And from a secluded bend of the hurrying little river comes the unmistakable, penetrating hum of an electric generator —the factor which has made the venture a practical success.

"Cold Light"

When the current of a Rühmkorff induction coil is passed through a glass tube in a vacuum the tube glows with a brilliant light. Certain authorities hold that this is the light of the future. Hitherto it has not been found possible to produce light without producing heat; but, in the view of experts, this difficulty has perhaps been met by the invention of the improved Geissler tube. The light of the future, we are told, will glow through long transparent tubes of all sizes and calibers, able to take the most varied directions and to run horizontally, vertically or obliquely, forming stars, rosettes, spirals, arabesques, etc.

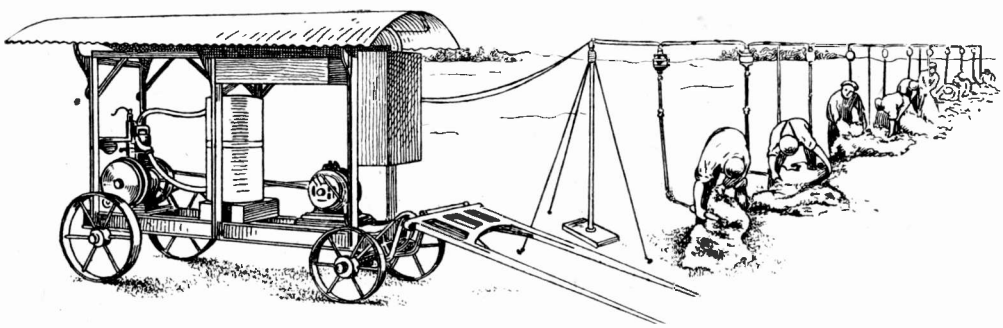
The tubes are said to radiate a diffused glow from end to end, the effect being that of intense lunar light. This, it is added, is the colorless light demanded by painters for their studios, for museums, to say nothing of homes. By charging the tubes with different gases various colors can, it is alleged, be obtained. Nitrogen gives a warm golden glow.

College Men in the Central Station Business

It was recently stated by Mr. Holton H. Scott, second vice president of the National Electric Light Association, that up to June, 1912, there were about 30,000 graduates of electrical courses in all the leading universities and colleges of the country. Of that number there were not to exceed 3,000 in the electric central station business. So there seems to be some foundation to the complaint which has been made that the central stations are not getting their share of the technically educated men.

Sheep Shearing in England

In England use is made of a portable electric sheep shearing outfit of a type shown in the drawing. A small gasoline engine mounted on a light truck drives a dynamo which sends current out over the improvised transmission line. At regular intervals motors are operated from this line, each motor driving a flexible shaft carrying on the end a set of clippers or shears. A very high speed must be maintained by these motors—2,800 and 3,000 revolutions a minute—in order to give sufficient vibratory speed to the shear blades to enable them to cut through a heavy fleece.



SHEEP SHEARING BY ELECTRIC MOTOR DRIVEN CLIPPERS

The same machine can be used for horse clipping also. In that case a speed of only 2,000 revolutions a minute is required. The English company which makes the machine has, therefore, devised a two speed motor which is available not only for its regular work but for other power purposes about the farm.

Two Great Scenic Railways of Mexico

The Mexico Tramways Company, Limited, is at present actively engaged in the installation of two very costly and important interurban railway lines. The line to Toluca, capital of the State of Mexico, will be 41 miles in length, measured from the principal park in Mexico City. This road will pass over mountains and into valleys which will make it one of the most beautiful and scenic roads on earth. When the road will have been completed one can step into one of the elegant cars at the principal park in Mexico City and be in the city of Toluca one hour and 50 minutes later, a distance which now requires very nearly four hours by steam locomotion owing to the excessive grades.

The City of Mexico will be visible until the summit of "Las Cruces" is reached, affording one of the most beautiful panoramic views, that of the Valley of Mexico, to be seen anywhere in the world, lasting for at least 20 miles from Mexico City. From here the down trip will commence and again scenic beauties will be open to the gaze of the passenger.

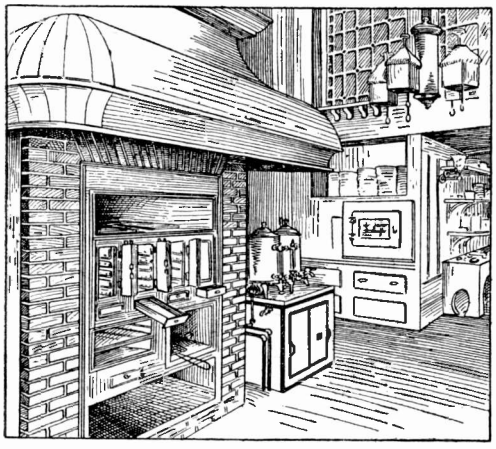
This road will pass through the towns of Santa Fe, Cuajimalpa, Acapilco and Lerma. The highest point reached will be at the summit of "Las Cruces" when the passenger will be 10,200 feet above sea level. The electric line will reach a point about 330 feet higher than the Salazar summit—the present highest railway summit in Mexico, of the National Lines between Mexico City and Toluca.

Besides being the highest standard gauge electrical railway in the world, the line between Mexico City and Puebla (another still more important interurban electric line under construction) will rival the famous scenic railways of Switzerland and other parts of Europe. The trains will leave the principal park in Mexico City and pass

through the town of Xochimilco and from there on between the two snow capped volcanos of Popocatepetl and Ixtaccihuatl. The highest point of this line will be 12,500 feet above the level of the sea. Here the traveler will get a breath of the pines, be impressed by the majesty of the near-by volcanoes and feel the crispness of the air caused by the perpetual snows of these celebrated peaks. This road will be 111 miles long.

Electric Broiling in the Engineers' Club

One of the show features of the Engineer's Club in New York is a six oven electric grill for broiling steaks, chops, etc., and its successful operation shows what may be done in the way of electric



ELECTRIC GRILL IN THE ENGINEERS' CLUB

cooking. The club serves many members and guests, and broil orders coming to the chef in rapid succession are executed quickly with perfect control of the cooking temperature. The ovens have three heats, from a dull red to white hot, controlled by an outside adjustable resistance. During the busy hours at meal times the ovens are kept permanently on the lowest heat so as to be warmed up and ready.

Suppose the order is for a nice, thick steak. The chef turns the controller of one of the ovens to the high notch, which brings the walls of the oven instantly to full incandescence. He then picks out the sirloin or other cut desired, slips it into a double wire holder and inserts it between the two glowing walls where it is exposed on both sides to the strong, even and perfectly controlled heat of the resistance units. The intense heat promptly seals the surface of the meat, preventing undue escape of the juices and the cooking is completed in the remarkably short average time of thirteen minutes. Any gravy which drips down falls into a small trough of water at the bottom of the oven and can not catch fire as it would be liable to do if exposed to an open flame of any kind or to glowing embers of coal or charcoal.

The electrical energy is supplied from an isolated plant on the premises at a very low operating cost. But in this installation the cost of operating does not figure. It is the time saving and the quality of the broiling that makes this club grill a success, there being less diminution of weight than in ordinary broiling and complete freedom from the smoke and ashes which are met with in the use of charcoal, coal or gas.

Of Interest to Elks

Electricity has found a place in memorial services. Once every year the Benevolent and Protective Order of Elk, known the country over as the Elks, holds what the order terms a Lodge of Sorrow. Services are held in honor of the dead and speakers are called upon to eulogize the members who have died during the year. At Seattle recently, during a session of the Lodge of Sorrow, electricity was used in flashing the names of the departed members in big, bright letters as they were called off from the roll of the dead. This arrangement was so impressive that it will be carried out in future years, and no doubt other Elk lodges throughout the country will not be long in adopting this effective and dignified addition to the ceremony.

A Future for the Farm Engineer

By FRANK KOESTER

Up to the present time, especially in America, the aid of the technical man is little sought in solving many of the problems which arise in rural industries. Probably there is no better authoritative statement on the value of technically trained men as an aid in modern farming than that made by Col. Roosevelt on August 23, 1910, at Ithaca, N. Y.

"One reason why the great business men of to-day have gone ahead while the farmer has tended to lag behind is that they are far more willing and eager to profit by expert and technical knowledge. No great industrial concern can nowadays be carried on save by the aid of a swarm of men who have received a technical education in chemistry, in engineering, in electricity or in other subjects. The big business man or the big railway man, does not ask college trained experts to tell him how to run his business, but he does ask numbers of them to give him expert advice and aid on some one point indispensable to his business.

"In just the same way the farmers should benefit by the advice of technical men who have been trained in phases of the very work the farmer does. While there should undoubtedly be such a training as a foundation (the extent differing according to the kind of work each boy intends to do as a man), it is nevertheless true that our educational system should more and more be turned in the direction of educating men toward, and not away from the farm."

PORTABLE ELECTRIC GENERATING PLANT AS USED FOR PLOWING IN GERMANY

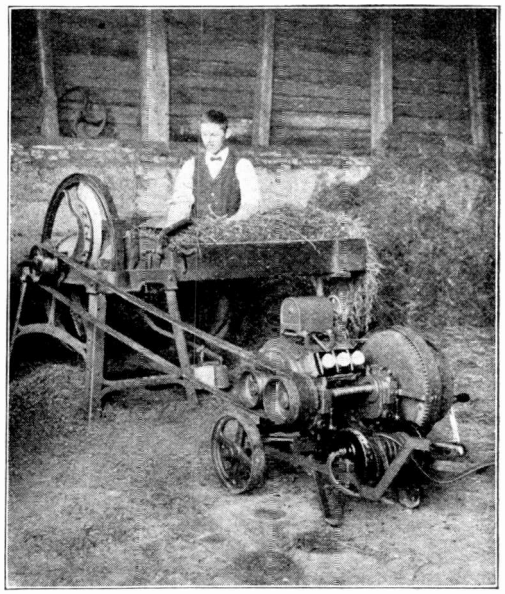
An up-to-date farmer should possess his own electric generating station which may be operated by water, steam, gas or engine power. In many instances where a stream runs through the property or neighborhood, cheap power may be derived from this natural source as regards the first cost and operating expenses.

The main feature in which the great advantage of an electric farm lies is that the farmer himself has at all times under his direct control the entire supply of electric energy being used, which may be obtained from some public service corporation at from five to ten cents per kilowatt hour, or better still, the energy may be supplied from his own private generating plant at cost varying from one cent per kilowatt hour and upward.

A policy much adopted abroad is to install a rural central station for the purpose of supplying a number of farms, rural industries, country residences and estates with electric current. By establishing a rural central station, a great saving in the production of electric energy may be secured. To-day we find in Germany as many as 100 to 150 consumers being supplied with electric energy from one of the numerous rural central stations.

Another very decided feature is that a few motors properly selected can operate all of the machines on the farm. It is just in this feature that there lies a great advantage in electrically operated farm machinery. Take, for instance, a motor placed on a low four wheeled truck and brought to the threshing machine and connected by means of a belt. The motor is connected to the electric supply mains by a flexible cable plugged into a suitable outlet. After the threshing is completed, the motor may be connected to the baling machine which packs the straw into bales and if necessary the motor can be used in loading the bales onto wagons by operating a hoist. At other times the same motor drives the water pump, wood saw, etc.

Electric plowing has been carried on in Germany for some fifteen years and in the last few years great strides have been made. Of the several systems employed, the one and two motor systems are most extensively used. Both methods attain the same result; that is, a plow is pulled across the field by a cable wound on a drum.



HAY CUTTER OPERATED BY A PORTABLE MOTOR

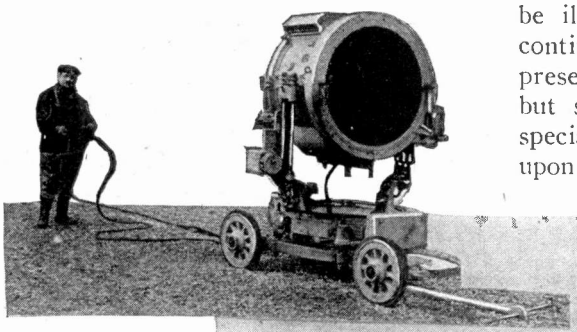
In the single motor system, on one side of the field is a motor mounted on a self propelling wagon, while on the other side is an anchor wagon which automatically travels forward parallel with the motor wagon with each new furrow. The two motor system has two motors on self propelling wagons, one replacing the above mentioned anchor wagon. The former system is lower in first cost but the latter has greater flexibility—it can readily cultivate any form of field.

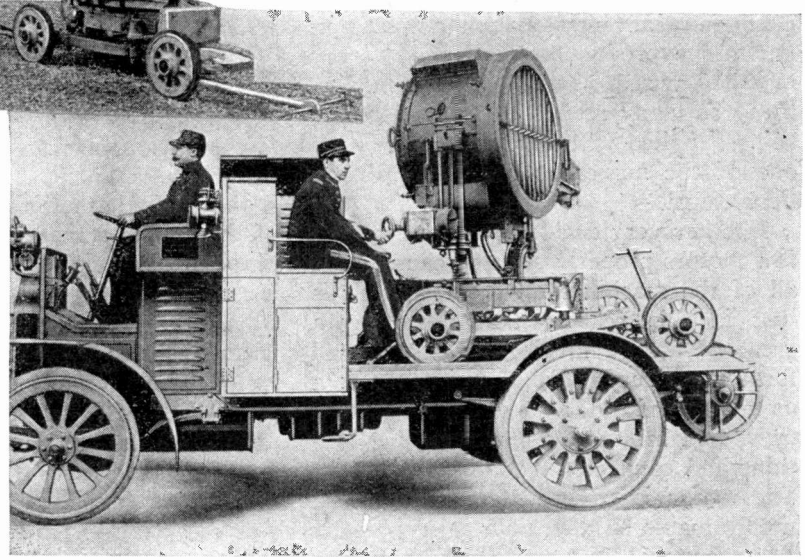
Electric plowing has great advantages over gasoline or the steam engine plow system; for instance, in the latter case a great amount of coal and water must be brought to the field. The electric plow too can operate in soft or loamy soil where horses cannot work and also in hilly ground.

As far as the cost of electric plowing is concerned, experience shows that it can be done cheaply. The field of electric plowing to-day is found principally in Germany; it is an established fact however that American agricultural machinery, in its wide practical application, in most respects is far superior to that of any foreign make and should domestic

manufacturers devote themselves to electric plow machinery it would be a question of only a short time when our farmers would recognize the advantages of the system. The practical application of electric plowing is not confined to farms of large acreage; it can be carried on to good advantage on farms of small size.

Another great advantage in using electric illumination is that like the street, the yard and field may be lighted and controlled from the residence. This feature is especially convenient when in the fall of year harvesting is necessarily carried on after dusk in order to ward off any chances due to weather conditions. In such cases, the field under harvest can be illuminated to advantage and work continued long after night fall. To the present day farmer this may seem absurd but such things will come with highly specialized farming which must soon be upon us.





FRENCH AUTOMOBILE SEARCHLIGHT THAT CAN BE REMOVED AND OPERATED AT A DISTANCE FROM THE CAR

An article on electricity on the farm would be incomplete without mentioning lighting. The need for an efficient lighting system is well recognized as one of as much importance for the country as for the city. It will assist in fixing hours of labor as they are in the city, which is necessary to satisfy the just demands of farm hands as well as others abiding in the country. Due to better light, great efficiency and cleanliness are secured all around, fire risks are diminished and insurance rates are reduced. Electric lamps require no matches, burn without flame, consume no oxygen and therefore do not vitiate the air of the room. Electric lighting is particularly serviceable for stables and barn, where the use of lanterns has caused numerous fires.

French Automobile Searchlight

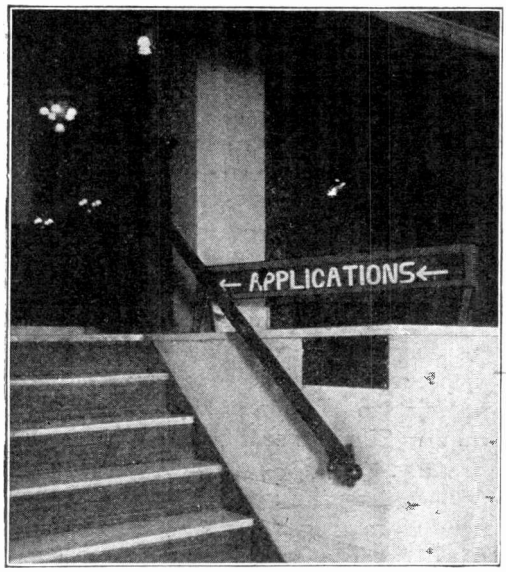
The French war department has lately put in use an improved type of automobile searchlight for use in field operations, especially to detect an enemy's movements at night. What is to be noted about the new apparatus is that a single automobile carries the whole outfit. The gasoline motor serves not only to propel the autmobile but also operates a dynamo for the searchlight, and even when on the road the searchlight can throw its power-

ful beam of 7,000 candlepower in any direction. As the whole searchlight is mounted on a four wheeled carriage it can be taken off and run for as much as 300 feet from the automobile.

The officer is always stationed on the automobile and directs the projector by the use of a distant control method such as is now used in order to avoid standing beside the searchlight as this gives a blinding glare and prevents good working. An electric cable unrolls from a drum on the automobile for carrying the current.

Effective Indoor Sign

The accompanying picture shows an effective indoor electric sign located at



EFFECTIVE INDOOR SIGN

the entrance to the application department of the Commonwealth Edison Company's offices, Chicago.

The sign is formed of miniature lamp letters, each letter being a tube of glass, within which at intervals are tiny carbon filaments supported upon platinum wire in the back. With the current on, these filaments or "beads" as they are called, form a perfect, glowing and effective sign letter for indoor use.

The Great Arlington Towers

This striking photograph was taken looking up from the bottom of the highest of the three enormous wireless towers

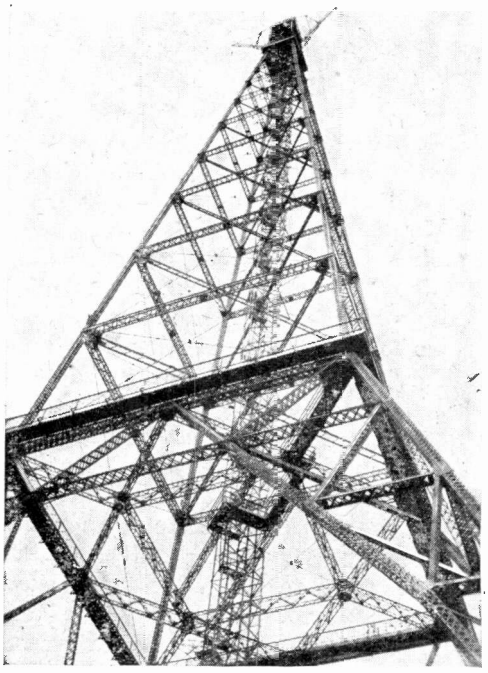


Photo by Paul Thompson

LOOKING UP ONE OF THE ARLINGTON TOWERS

at Arlington, Va., which the Navy Department has just built. This tower is a little over 600 feet high. The operators have been tuning up the station since the plant was completed and have been gradually extending their zone of communication until at last they have exchanged messages with the Mare Island station near San Francisco. These points are 2,117 miles apart. A message was received recently from the steamship Tennessee on her way to the Straits of the Bosporus when she reported as being 1000 miles out of New York.

It is expected that these towers will form a point of interest for tourists and that a great many visitors to Washington will go there to see them. They have stairways up to the tops and people will perhaps be allowed to ascend.

How Rubber Came Into the Electrical Industries

That rubber has been an important factor in the development of all sorts of electrical apparatus and in our ability to utilize electricity so variedly, is too well known to need further comment. But that rubber covered wires are almost as old as American rubber boots and that a threatened jail sentence speeded the developing of rubber coatings for wires—that will be new to most readers. And thereby hangs a tale.

Going back a full 300 years, we find that the Mexican tree which yields the highly prized rubber sap was already known to Europeans. At that time Juan de Torquemada—a Spaniard noted alike for his gifts to charity and for his theological writings—mentioned this remarkable tree in his writings, adding that the sap was made into shoes or used for waxing canvas cloaks to make them resist water. A century and a half later the English began to use what they called "elastic gum" for erasing pencil marks. But it was not until about 1820 that the Scotch chemist, Macintosh, developed the process of waterproofing fabrics which has made his name famous the world over, and not until about five years later that rubber shoes were first sold in this country. By 1840, something like a million pairs of rubber shoes and boots had been imported into the United States. Efforts to produce them here had been a failure until in 1838, Charles Goodyear—then a bankrupt hardware merchant—invented the process of "vulcanizing" rubber by heating it with sulphur.

Meanwhile, British travelers had been bringing samples of rubber sap from the Malays and one of them who had greater business foresight than the others had brought with him several hundred pounds. This soon attracted the attention of Carl Siemens, then just of age, who had been sent to England to exploit his brother's inventions. The elder Siemens (Ernest Werner) was extremely anxious to educate his sister, but sadly handicapped by his meager salary as an artillery officer. Being of a scientific turn of mind, he had already made a number of inventions, including a silver plating process for which his brother promptly sold the British rights. Werner had also made improvements in the methods of using gun cotton and while his advances in this line were not so noteworthy as to be historic, they still secured for him the official clemency which afterwards meant so much for electrical progress.

Alert of mind as might be expected in a scientist, he also was not bound by conventionalities in his thoughts along other lines. Consequently, when some officially tabooed free thinker gave a lecture at a near-by point, Siemens was one of the officers who incurred the displeasure of the authorities by openly attending it. The offense was too serious for mere censure and jail sentences were dealt out to all except Werner Siemens. In his case, the sentence called for confinement at the fireworks laboratory at Spandau, where it was thought that his experimenting might lead to further developments of value to the German army. There he was delighted to receive a sample of the gutta-percha which Montgomerie had brought to London and which the younger Siemens sent on as an industrial curiosity.

On testing the new material, Werner Siemens readily found that while it became plastic when heated, it hardened upon cooling and formed a good insulator—a fact which delighted him all the more when he found that he could coat a wire with this strange material. But the coating had a way of peeling off again which was rather distressing, so Siemens interested an able mechanic in the same. It was G. J. Halske, who soon planned a press for forcing the rubber covering upon the wire and thus making a more durable insulation. That was in 1847 and during the following year the newly formed firm of Siemens and

Halske had occasion to demonstrate the value of the rubber covered wire by using it in connection with the first submarine mines. So, also, Siemens was commissioned by the Prussian war department to run some of his rubber covered wires underground, but the suggested use of an iron pipe or of a wrapping of iron wire as a mechanical protection for the rubber was vetoed as being too costly.

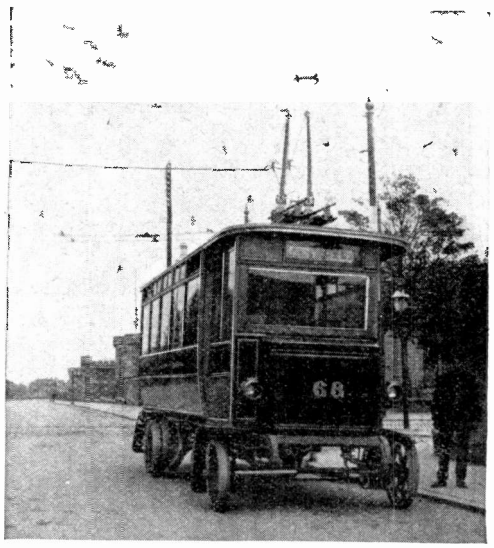
However, Siemens had not been alone in finding ways of utilizing gutta percha. Others had done the same and the price of the raw material jumped up at a rate that might have permanently stopped its use had not Goodyear's invention of vulcanizing enabled manufacturers to obtain an equally high insulation with a much smaller quantity of the gutta percha. Incidentally, Siemens had learnt that his rubber wire coverings had occasional faulty spots, which he located in a crude but undoubtedly effective manner by passing the wire slowly through a vessel of water into which a workman dipped one finger. One end of the wire and the man's other hand were connected to a source of current and whenever a poorly insulated spot was reached, the human leakage detector jumped.

Thus the use of rubber covered wires was developed 30 years before rubber was used either for wheel tires or for gossamers, and 20 years before the Civil War created the demand which led to the making of rubber blankets and heavy rubber coats. But rubber insulations might have been delayed many years longer had not Siemens' independence of thought earned for him both the threatened jail sentence and its commutation to laboratory service.

RAILLESS ELECTRIC TRACTION IN DUNDEE

Dundee, situated on the river Tay, is the third city in Scotland, has a population of 170,000 inhabitants and is the center of the British jute industry.

The general layout of the city is most suitable for a successful trackless trolley car service, as nearly all the main streets converge to High Street, which is in the center of the city and is a starting point for all cars. "A penny (2.03 cents) all the way" is the fare, which means to the end of the line. Half-penny stages are also arranged, the longest ride being 3½ miles.



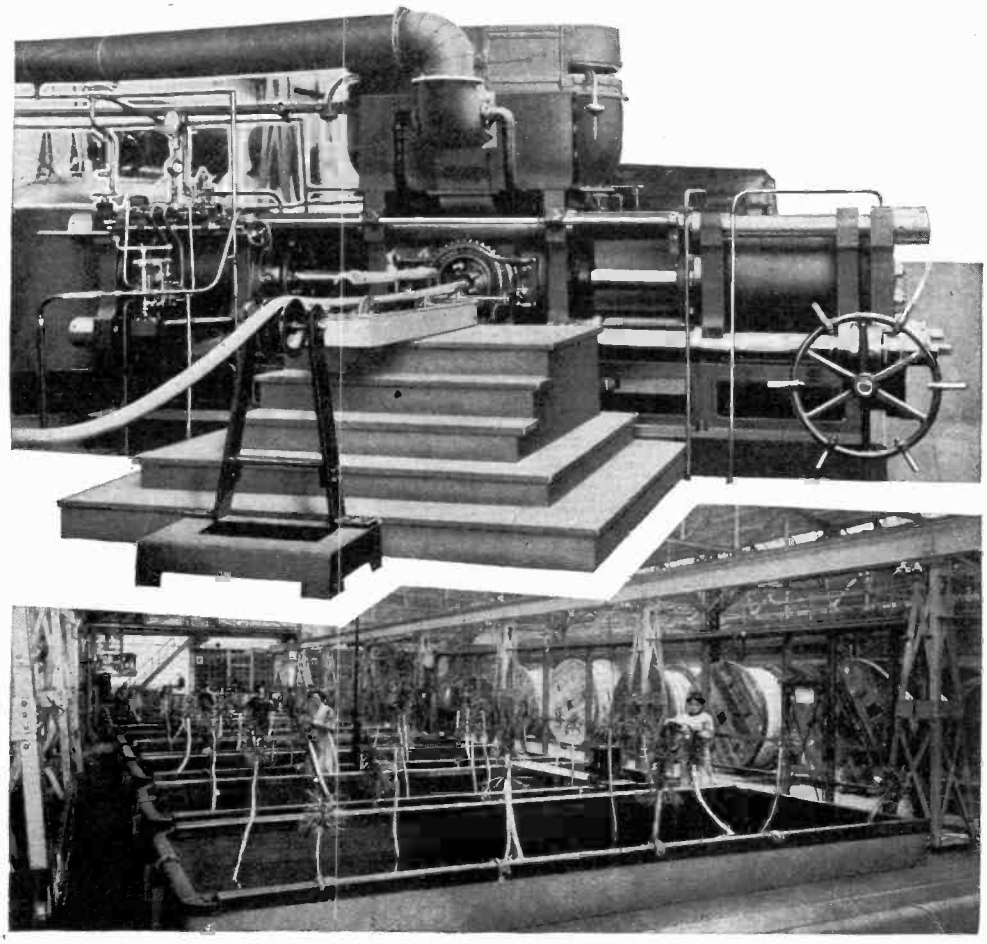
RAILLESS TROLLEY IN DUNDEE

The cars are owned by the town council and current is supplied by the electric lighting department, which is responsible for the erection and maintenance of the overhead equipment. This is carried out on the span wire system, negative and positive trolley wires running the whole length of the route, with extended curves at each end for turning the cars.

Poles are spaced about 100 feet apart and erected on the edge of the pavement to prevent obstructing the roadway and at the same time to allow as much room as possible for the cars when passing other traffic. As the average width of the road is 27 feet, two cars traveling in opposite directions can similtaneously pass a vehicle or an obstruction.

Putting the Lead Sheaths on Cables

Few people living in cities where telephone lines are placed underground have not seen the great reels of lead-sheathed cable standing at the mouths of the manholes. Many have no doubt wondered how the seamless sheaths are put over the bundle of wires within, for it is obvious the latter could not be drawn through.



THE UPPER VIEW SHOWS THE HYDRAULIC PRESS WHICH PUTS THE LEAD CASINGS ON CABLES. BELOW IS A CABLE TESTING ROOM

In explanation it may be said that the lead cover is put on the cable by means of hydraulic pressure, the wires of the cable (there may be a hundred or more pairs of them, each individual wire wrapped in a paper cover) are twisted together into a cable an inch or more in diameter. It is then passed through the hydraulic machine shown in one of the illustrations. The lead for the cover is heated to a plastic stage and forced under a pressure of 2,080 pounds to the square inch through a matrix. A hollow plug gauge corresponding to the section of the cable is projected into the matrix and the cable made to slowly traverse the gauge. At the same time the lead which is forced through the annular space between the matrix and the gauge comes out along with the cable as a round, seamless cover or jacket. The machine shown

is one in the Oberspree Cable Works near Berlin, Germany.

Any number of wires up to 800 pairs can be twisted and covered with a jacket in this manner. When the cables are completed the wires must be tested out to find if there are any broken ones, crosses, grounds with the lead cover, etc. In the above works this is done by women, as shown in the second illustration. The cables are immersed in tanks of water for 24 hours, in order to ascertain if they are water tight. The ends are then bent upward and the wires all "fanned out" until they look like miniature palm trees. This enables the women to make the electrical contacts with each individual wire and proceed with the tests.

Electrocution of Superfluous Animals

The Animal Rescue League of Boston, Mass., was organized many years ago to provide homes for stray cats, dogs and other animals and to humanely end the lives of such animals as are found to be diseased or for whom a good home cannot be found. During 1911 over 23,000 cats and kittens, 5,454 dogs, 175 horses and numerous birds, rabbits and squirrels passed through its hands. As many of these must be exterminated, an electrocution outfit was developed for this purpose that has been found completely successful, both from the humanitarian and economic standpoints. It is operated by one man, who can destroy 200 cats or 100 dogs in an hour, while two men can destroy 300 animals in an hour.

In the bottom of each dog cage is a metal pan forming one electrode; a metal collar placed about the animal's neck forms the other. On closing the door the primary circuit is suddenly closed and the animal is instantaneously rendered unconscious. The cat cage is somewhat different, in that no collar is used and in place thereof two electrode bars are in the bottom, on one of which the cat's fore feet are placed and on the other the hind feet. Closing of the cover closes the transformer primary and the high-voltage secondary current immediately passes through the animal's body.

"Readiness to Serve"

An epigrammatic and philosophical paper with the above title was read before the recent convention in Boston of the New England Section of the National Electric Light Association by Mr. Levin J. Chase, manager of the Concord, N. H., Electric Company. An excellent passage is as follows:

"One of the stereotyped expressions of the lighting business is 'Readiness to Serve,' and that phrase taken in its broadest sense is to my mind the vital principle of public service. In order to broaden its sense, I will amend it slightly and let it stand 'Readiness to Serve Faithfully and Graciously.' Some service has all the essential characters of assault and battery. There is no moral quality in service, either personal or public, unless it is performed graciously and with a wholesome faith in humanity. Moreover, it is my settled conviction that no man is qualified to direct the public policy of a corporation unless he believes in human nature and in the general worth and integrity of the people he serves."

Tungsten Electric Furnace

Two German scientists, Fischer and Nede, have made an electric furnace in which the heating part is of tungsten and it appears to be very good for melting small quantities of metals. Current comes to the electrodes made of a thick copper tube closed at one end and cooled by a water circulation inside them. The two tubes are mounted with the ends facing each other and in the space between is placed a glass globe with double opening. Over the glass there is a constant water flow to keep it below the melting point.

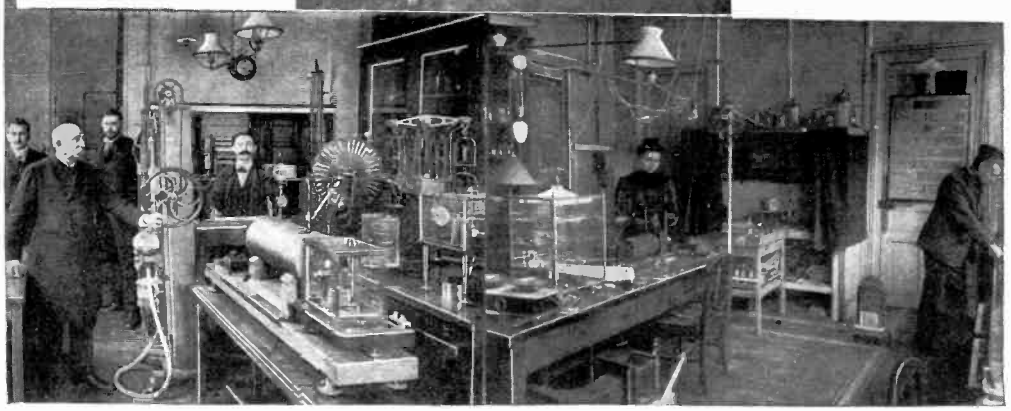
Between the ends of the copper pieces lies the tungsten heater and this is made of a tungsten tube prepared by compressing the powdered metal.

Wonderful Laboratories of the Sorbonne

SOME VIEWS IN THE FAMOUS LABORATORIES OF THE SORBONNE, PARIS, UNIVERSITY· HERE MADAM CURIE MADE HER REMARKABLE DISCOVERIES IN CONNECTION WITH RADIUM AND NOTED SCIENTISTS LIKE HENRI AND LIPPERMAN CARRY ON THEIR WORK

Almost everyone has heard of the Sorbonne the famous college of physics of the Paris University. It was in the laboratories of the Sorbonne that Madam Curie worked in connection with her discoveries concerning radium, and many other great scientific achievements have originated there. It is of interest therefore to present here a few pictures of the interior of this wonderful laboratory or rather set of laboratories many of which are devoted to electrical work of various kinds. Here are carried on experiments which often lead to very valuable results not only for science but also for the practical world.

A striking instance is the work of Prof. Henri upon the effect of ultra-violet light upon microbes, which had its beginning in experiments in this laboratory and the result is now being applied for water purifying apparatus, even for large city supplies. In another of the laboratories, Mr. Lipschitz is working on a compressed air phonograph which imitates the human voice by means of air passing through photographically produced holes in a rapidly moving strip. Prof. Lippmann also has his laboratory in the buildings, and is engaged in electrical work at present.

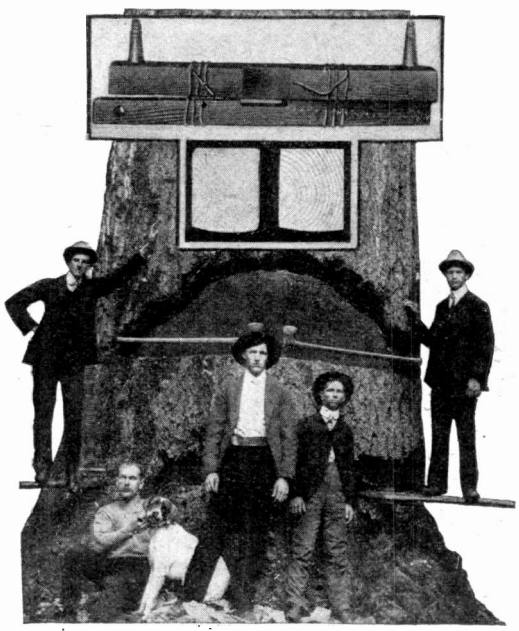


The photographs reproduced show all manner of electrical apparatus—great induction coils, static machines, light measuring devices and delicate apparatus used in electro-chemical experiments—and we wonder what world astonishing discovery will next be announced from the Sorbonne.

Telegraph Crossarms After 43 Years

Relics of the early days in telegraph line construction in the form of crossarms that have withstood 43 years of hard service amid sleet and sandstorms in rough Western country may be seen in the Chicago offices of the American Crossarm Company.

The crossarms were taken from a line of the Western Union Telegraph Company between Cobre, Nev., and the Utah state line and have been in actual



A CROSSARM RELIC OF THE EARLY DAYS

service since 1869. The illustration shows the old time lightning arrester consisting of No. 13 gauge wire wound a few turns around the arm. This was connected to a ground wire running down the pole. The outside of the crossarms is full of grooves worn by sandstorms, the softer portion wearing away more rapidly. Within, the wood is dry and hard, showing positively no sign of rot or decay, and the arms are sound and strong enough for another half century of use. The arms are of Washington fir or yellow fir or, as it is sometimes called, Rainier fir. These trees, like the one shown, are giants of the forest and grow on the Cascade Mountains in Washington. Some of the trees run from fourteen to sixteen feet in diameter and 400 feet in height, 200 to 250 feet without a branch. The fine grained cross section shows a Rainier fir wood while the other section, a piece of red fir, is taken from a small or second growth tree, and explains by its coarse rapid growth why it is poor crossarm timber.

And Then the Turks Began to Fight

On the very eve of the outbreak of the present war in Turkey a letter was written to POPULAR ELECTRICITY MAGAZINE by one of its subscribers—Theophil George whose address is Vill Yacoruda-Ragby, Salonica, Turkey. In view of the great upheaval there, certain parts of this letter will be interesting, and we quote them in his own wording.

"The letter I am writing it now has to go on horseback through very bad roads for four days or 120 miles, that is the railroads in turkey is far from us, and the other roads are in bad condition.

"The navy is good for nothing just at the moment when, must defend the country in the war with Italy she is around Constantinople or in Marmor Sea.

"The rule is also bad enough if it was a good one no revolutions would exist as it is now the anarchy is allover the country, the explossions of hell machines and bombs is very often followed by numberless victimes only at the explossion of a hell machine at city of Kochany which is said to be brought by Bulgarien Revolution organization, were killed about 12

men from the bomb after that the turkish people get mad and started to kill every one they meet with Bulgarien's name as a result from that in the next morning in the church's yard were lying about 140 bodies—and many more.

"Then how should you call such a country? civilized(!!?) where a man is worth no more than a fly.

"The anarchy in the empire forced the government to instal telephones in every village and 'corp dee gard.' Let me give you the conversation of two turks about the telephone.

"The first, Mehmed—'Say Xidar do they made a talifone in your village?'

"Xidar—'What is that hell talifone? I don't know anything about it.'

"The first, Mehmed,—'That is something like horn—inserted in a empty box, and this box conected with another one with iron thread, if you talk to one of them boxes some one can hear you at the other box.'

"'Once the children of our major of the village, Murtaza aga, ordered by the talifone for some vegetables at their father which was at the town that time, for a great surprise, next evening, Murtaza aga came with the vegetables.'

"Xidar—'How is such a thing possible to talk here and be heard such a long distance as you say, that is impossible for a man to do it except Allah (God) and it such a thing is made it is from Kiafirs (Non Musulman)—they know such deivilish things as that, and it a great sin for a musulman to use it.'

"Mehmed—'That is right, Xidar, that is deivilish work and Allah (God) will not allow to a musulman (right believer) to use it.'

"Xidar—'Do you see now that it is a trick?'

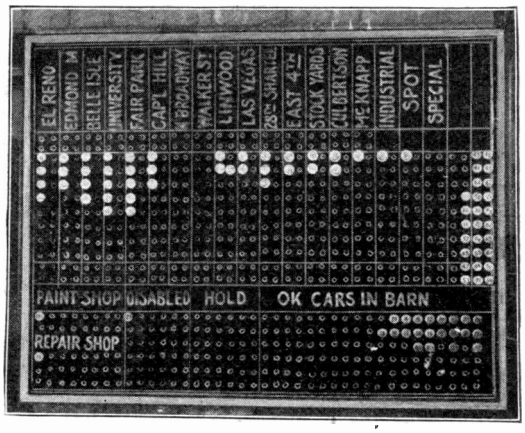
"Mehmed—'Ya-a trick, deivilish trick.'

"That is the way they think about Mr. Graham Bell's invention and the alytric, [electricity] as they call it.

"Anarchy is in its highest point and the murder is a plessure in Turkey. Bulgarie—aidded by france Russia and some other countries gave a note to Turkey, either to give Autonomy of Macedonia or with Christian General Governeur or to fight, Turkey refused the note and now from 15 to 70 old is on foot, great preparations are made at the frontiers. The roads being in bad condition everything, food, explossives has to be carried on horse back about 120 miles to reach where we are our village is about ten miles far from the frontier the people is very much afraid because the war is to begain to night or in the morning (if fight is to be) and if yet a life I will let you know, what I am doing and how I become interested in POPULAR ELECTRICITY MAGAZINE."

Car Location Board

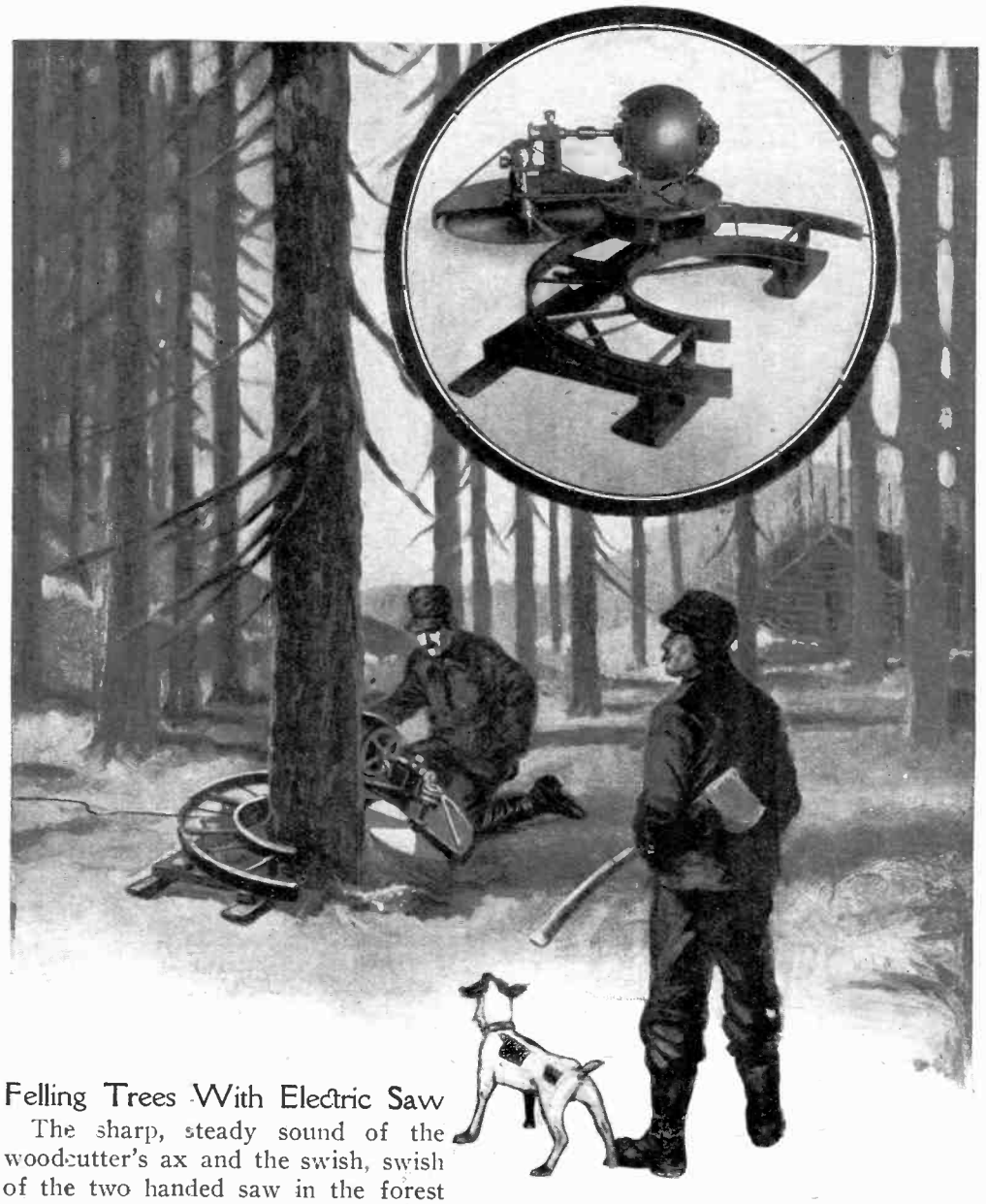
For keeping an accurate record of the location and condition of all cars at the shops of the Oklahoma Railway Com-



CAR LOCATION BOARD

pany, Oklahoma City, Okla., a car location board, as it is called, is used.

This board is laid off in sections to represent the different lines and divisions on which the cars operate; also to represent cars in the paint shop, repair shop, disabled cars, and O. K. cars in the barn. There is a plug for each car, the number of the car in question being printed on the head of the plug. As the cars are moved from one division to another or from one location to another the plugs on the board are changed.



Felling Trees With Electric Saw

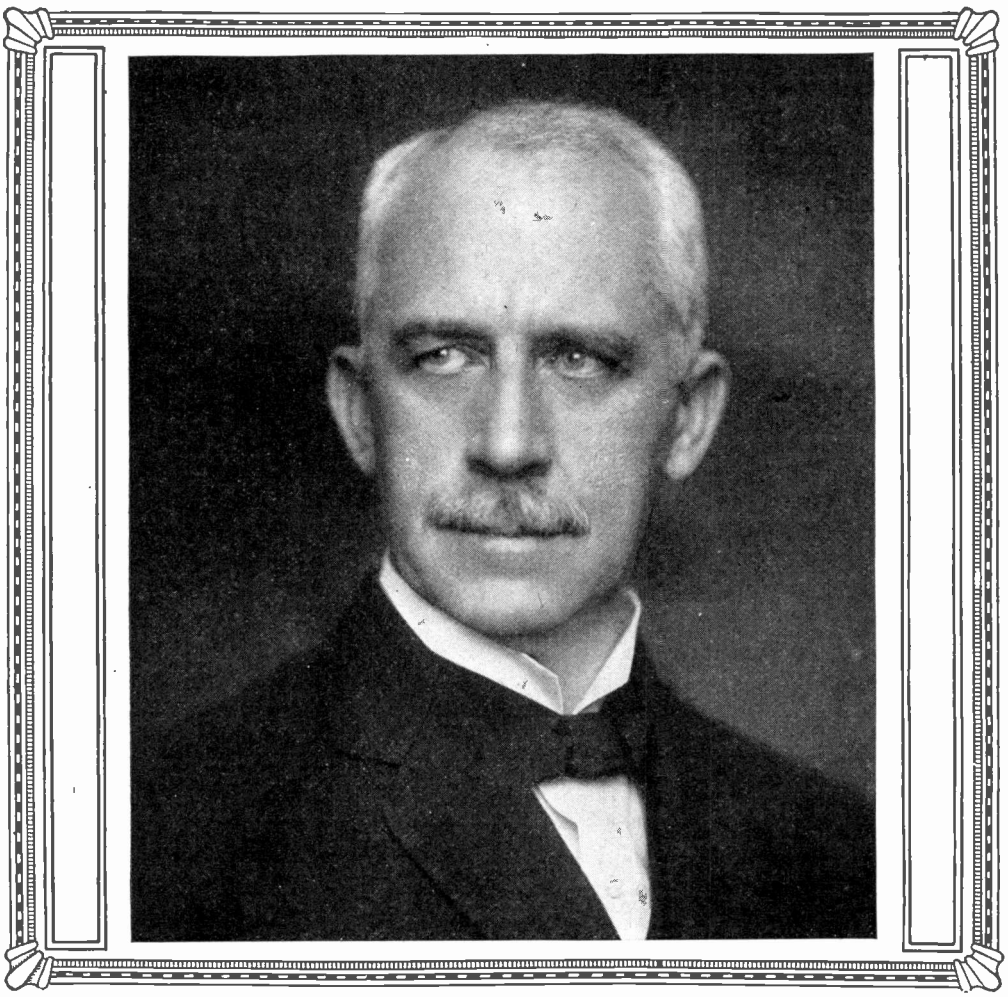
The sharp, steady sound of the woodcutter's ax and the swish, swish of the two handed saw in the forest are giving way to the hum of the electric motor and the buzz of the circular saw which it drives.

The Crescent felling saw is geared to an electric motor, the whole resting upon a track which is in the form of a half circle. By setting the open side of the track about the tree to be felled, the operator can guide the saw so that trees up to four feet in diameter can be cut down.

Where electric power lines are not within reach, several of these saws are operated from a gasoline driven generator mounted upon a truck, current being delivered to each motor through a cable laid upon the ground between the generator and saw.

Electrical Men of the Times

GENERAL GEORGE H. HARRIES



There is something about the keen, steady eyes of this man that suggests to one those "nerves of steel" with which the hero of a novel is so often endowed. Back of them lies that singleness of purpose which enables a man to bring the bead of a rifle sight squarely on the mark and pull the trigger at the right instant. It is not surprising, then, to learn that the subject of this sketch has won a national reputation as a marksman with both rifle and pistol. Neither is it surprising to find that this same calm, cool precision which has scored so many hits in pastime sport he carries into the administration of the numerous undertakings that have been placed under his supervision.

A survey of the career of General George H. Harries clearly indicates a very human side to his nature, for his many achievements in the electrical and other fields have been remarkably free from the accompaniment of envy on the part of those in any way associated with him. Early in life he realized that a man could not succeed without the confidence

and help of his fellow men and this he freely admits. It has proven to be largely responsible for his success which has been crowned, so to speak, by his election to the highest office within the gift of the American Railway Association, representing 365 companies whose tracks form a veritable network of trolley lines over this country and whose membership, numbering 2,550, comes from operating, executive and, in fact, from every department in the electric railway traction field.

General Harries was born in Haverfordwest, Wales, in 1860, came to this country with his family at the age of sixteen and settled near the present location of Winnipeg, Manitoba.

As an army scout on the frontier in the '80s he proved his mettle as a man, for Indian campaigns in the old fighting days demanded the bravest and best. His knowledge of the red man, gained from this source, enabled him while a member of the Sioux Commission (appointed to settle many Indian difficulties) to arrange important matters amicably and satisfactorily to both sides, thereby making for himself many friends among the various tribes in conflict.

There are two cases of Indian curios at the National Museum loaned by General Harries and every piece represents an adventure—some pathetic, many dangerous and each interesting.

In 1897 President McKinley made him a brigadier general, a commission that carried with it the command of the National Guard of the District of Columbia and the defense of the City of Washington. During the war with Cuba General Harries was in command of a regiment of infantry. Service at the Capital and his ability carried with it a wide acquaintance with men in public life.

Twenty years ago traffic conditions in the City of Washington were in what seemed to many to be a hopeless condition. General Harries made a study of the situation and presented his views to the public through the *National Republican*. He was immediately taken from the editorial desk and made consulting engineer of the old Metropolitan Railroad. Step by step he progressed, finally being largely responsible for the formation of the Washington Railway and Electric Company which controls the traction and lighting interests of the Capital. For over twelve years he was vice president and general manager, resigning in 1911 to assume a place in the growing interests of H. M. Byllesby & Company, of Chicago. He has just been elected a vice president and also has direct charge of the Byllesby interests centering in Louisville, Ky.

At the farewell dinner given General Harries on the eve of his departure from Washington, unusual tributes from all classes were paid him.

"Some men attract our hearts," said Thomas C. Noyes, the newspaper publisher, speaking at this dinner, "some attract our intellects and some attract both our appreciation and our intellect, and such a man is George Harries."

"He was in the trenches before Santiago," said a well known army officer, "and few know of it from his lips. No beating of tom-toms is necessary to tell the story of his record in the war with Spain."

"For years he served this city loyally and faithfully and has done a service not only to the District of Columbia, but to the whole country, which merits this expression of gratitude," said a former commissioner of the District of Columbia.

In response to all these laudatory speeches General Harries modestly replied, "I am only conscious that I have kept the faith."

Personally General Harries possesses that happy combination in his character that wins success yet makes and retains friendships. He is a clean fighter and never knows defeat. He illustrates his points with stories that are fit. He knows how to draw the fire of the opposition and when not to fire, himself. Men-

tally alert, physically vigorous, knowing exactly what he wants to do and how he wants it done, he is a distinctive force in the public utility field.

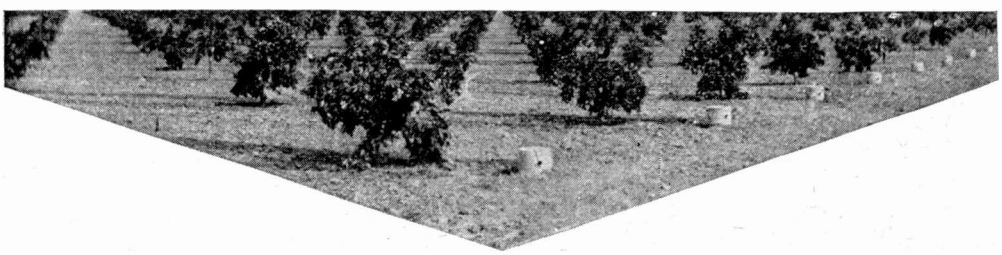
He has just retired as president of the Association of Edison Illuminating Companies and is a member of the public policy committee of the National Electric Light Association, having also served this body as its treasurer.

He is an associate member of the American Institute of Electrical Engineers, a member of the Illuminating Engineering Society, the Washington Society of Engineers and the Washington Academy of Science.

In Louisville General Harries has been both a delight and the source of many surprises. The purchase of the Louisville Gas Company, the Fetter plant, the Campbell plant, the consolidation of these and the great impetus given the company's business is directly traceable to his inspiring presidency of the gas and lighting companies. He is beloved by his managers and employees for what he is—hence the spirit of co-operation. To the public he has repeatedly said, "You are a partner in our enterprise; we want you to exercise partnership rights so as to serve the best interests of the people. We will work together for the mutual welfare of everyone."

General Harries makes his home in Louisville with his son but spends a part of his time in Chicago and Minneapolis; he is vice president of the Minneapolis General Electric Company.

ELECTRICITY TO SETTLE CEMENT DUST



Lawsuits between the orange growers about Riverside, Cal., and the cement manufacturers in that vicinity have been before the courts for years. The cause of the trouble lies in the fact that a fine layer of dust from the cement mills, so the citrus men claim, settles upon their trees and fruit and damages them to the extent of many thousands of dollars annually. And now electricity is called upon to end this dispute and bids fair to settle matters without putting either the mills or the orange groves out of business. A new device is now being installed at the Riverside Portland Cement Company's plant that will settle the dust and remove all cause of complaint.

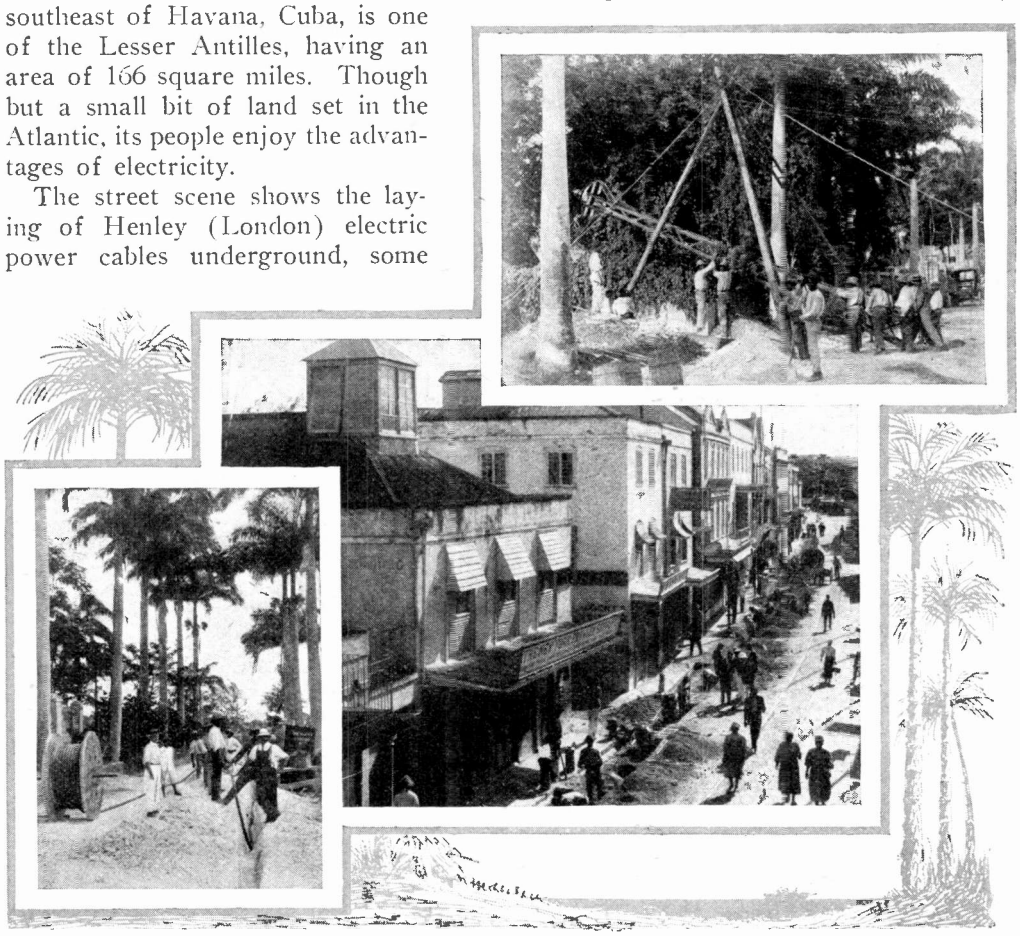
It is the invention of Prof. Cottrell of the University of California, perfected with the assistance of Walter A. Schmidt. The treaters will be installed at an expense of about a quarter of a million dollars, but the expense seems justified by the results of two test treaters which have been in successful operation for three months. All ten of the stacks will now be supplied with the device. While many of the details are not made public, the invention makes use of electric wires carrying 50,000 volts of direct current which has the effect of precipitating the dust from the stacks to a number of soft iron plates set at twelve inch intervals within the dust chamber. Thence the dust is drawn into bins placed below the treaters. The treaters are erected 80 feet

above the ground with a floor area of 60 by 200 feet and 2,400,000 pounds of steel will enter into their construction.

Laying Cables in Barbados

The island of Barbados, 1800 miles southeast of Havana, Cuba, is one of the Lesser Antilles, having an area of 166 square miles. Though but a small bit of land set in the Atlantic, its people enjoy the advantages of electricity.

The street scene shows the laying of Henley (London) electric power cables underground, some



LAYING CABLES IN BARBADOS

eight miles of this construction being now in service. In digging the trenches the soil was found to be full of coral formations.

In some portions of the island power is carried by overhead transmission lines. The type of pole used at the distributing stations which these overhead circuits enter is shown in process of installation. The native laborers are fairly intelligent and are good workmen.

Electric Seasoning of Wood

There is a method of seasoning wood through the agency of electricity which, in Europe, has been credited with much success. It is called the Nodon-Bretonneau process. The timber is nearly immersed in a tank of water containing ten per cent of borax, five of resin and a little carbonate of soda, and rests on a lead plate connected with the positive pole of a dynamo. Another similar plate, lying on the exposed surface of the timber, is connected with the negative pole. Thus a current of electricity can be passed through the wood from which all the sap appears to be removed, while the borax and resin take its place in the pores.

Electrical Interests of Women

EDITED BY GRACE T. HADLEY

A Valentine Tale

"I think I shall give a St. Valentine spread," announced Mrs. McGinnis to her husband, one evening early in February.

"Of course Mrs. Flannerty is invited," he observed.

"Of course she is not!" sniffed his wife with decided emphasis in the negative.

"Mrs. Flannerty not invited! Why, you are the best of friends!"

"Were," corrected Mrs. McGinnis.

"Have you fallen out?"

"Not exactly, but there is a coolness between us."

"What happened?"

"Well, it was like this. I had a first class colored laundress, you remember Susy, who used to work for me on Mondays and Tuesdays?"

"Very well indeed."

"Mrs. Flannerty openly lamented the fact that she could not get so good a laundress as Susie for love or money, so out of the kindness of my heart, I loaned Susie to her on Wednesdays —and now, what do you think?"

"It would be hard to say."

"Well, Susie has quit me almost entirely and works for Mrs. Flannerty. On Monday she washes there, Tuesday she irons, Friday she cleans, and Sunday she cooks dinner if the regular cook is out and she says that is as much work as she can do. You see how it is, one's best friend will often play a petty trick."

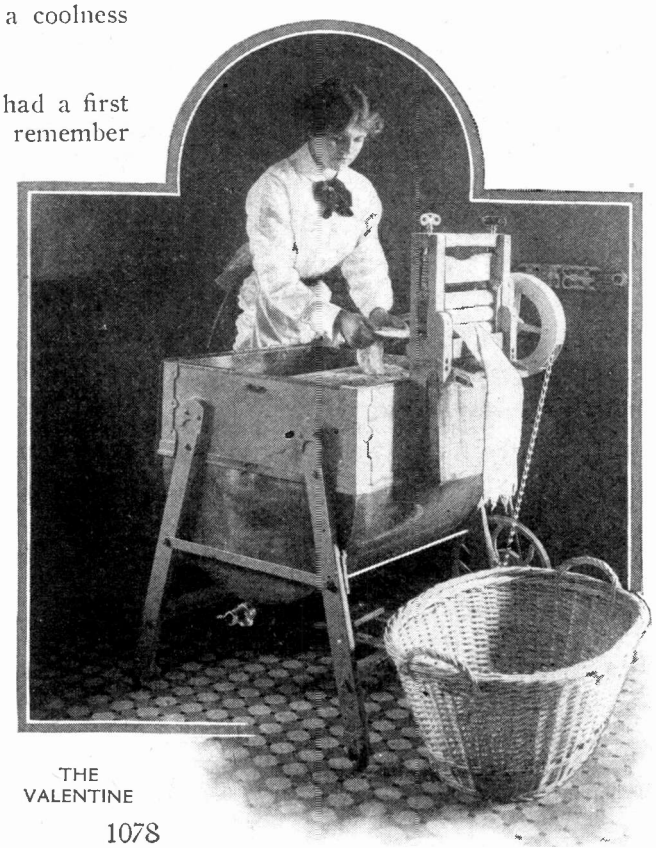
"The next time you get a good laundress," suggested Mr. McGinnis, sympathetically, "nail her down."

"What!" exclaimed his wife.

"Nail her down; fasten her in the laundry and don't lend her to your best friend."

"Then get me a laundress I can fasten down," suggested Mrs. McGinnis artfully.

"What!" exclaimed her husband.



THE VALENTINE

"Get me an electric washing machine. I might succeed in keeping that. To be sure, it may seem rather expensive at first but it saves in the end. I understand such a machine will be sent out on trial and a maid to demonstrate it. As to the cost, one pays so much down, and so much a month—" but Mr. McGinnis had disappeared behind the evening paper and conversation came to a sudden close.

On the morning of the fourteenth of February, Mrs. Flannerty's telephone rang vigorously. Mrs. McGinnis was at the other end, affable, agreeable and friendly.

"You must come over this afternoon to my St. Valentine spread; and what do you think? My husband sent me the funniest valentine you ever saw. By the way, how is Susie? Laid up with rheumatism, and you're without a laundress again! So sorry I can't lend you mine, but it's an electric washing machine and its permanently attached in the laundry. It's my valentine. Be sure to come over this afternoon. Good-bye!"

Cleaning Silver

The house-wife can "make" in her own kitchen enough electricity to clean her tarnished silver, and it will take very little "elbow grease." A few scraps of tin and zinc (I bought five cents worth at a stove and hardware store) a heaping tablespoonful of baking soda, the same amount of common salt and two or three quarts of hot water are all that are needed.

Place the tin on the zinc, in the bottom of a pan, put in the soda and salt, and pour over them the hot water. When the salt and soda are dissolved, immerse the silver in the liquid for two or three minutes and then take it out and rub it dry. Except in very obstinate cases, you will find the silver bright, after this bath and drying.

When all the silver is cleaned, remove the zinc and tin from the liquid and wash and dry them thoroughly.

Electricians would no doubt tell us that there is an electrolytic action between the zinc and tin in the solution, which is a reasonable supposition, since the salt and soda solution alone will not do the work. —HARRIET G. CANFIED.

Illuminated Flower Holder

A somewhat unusual lighting fixture in the way of a flower holder is shown in the illustration, its purpose being to provide

LIGHT IS TRANSMITTED UPWARD THROUGH THE DISH

subdued and pleasing lighting on a table or stand.

The entire holder is designed to be made preferably of glass which increases the artistic effect of the light upon it. Under the glass dish holding the flowers is an oval shaped translucent glass receptacle within which are incandescent electric lamps. The light is transmitted upward through the dish and downward through the translucent receptacle.

Electric Cooking

In the household there are two distinct kinds of heating required—the radiated heat for warming large air spaces, and localized heat for use in the cooking processes. Electric cooking offers the widest field for localized electric heat and there is no method which can be compared with the electric method. Instead of sending a good proportion of the heat up a chimney or into a room, while the small remainder does what it can to heat the cooking utensil, in electric cooking all the heat is concentrated in the place where it is wanted. The fundamental principle of electric cooking is that the heat is where it is wanted and nowhere else.

This is not the only advantage to which electricity as a means of cooking can lay claim; in addition to the fact that no heat is wasted going up a chimney or passing into the surrounding atmosphere, directly the heat is no longer needed, the current can be turned off and again there is no waste. Then too, heat can be obtained at a moment's notice and the cooking utensils are portable and can be carried from room to room as needed. An electric oven may be placed on a table so there is no need for stooping, but best of all, no dirt can accumulate on cooking utensils on account of combustion, and washing up is not such a disagreeable task as heretofore.

Cooking with gas results in the formation of carbon on the bottom of the utensils making them very dirty, and as carbon is a non-conductor of heat, utensils so coated lose much of their usefulness.

COOKING CONDUCTED WITH ALMOST MATHEMATICAL ACCURACY

With the use of electricity no carbon deposit is formed and all electric cooking utensils remain perfectly clean on the outside thus making less trouble for the housewife.

One of the special features of cooking by electricity is the uniformity of temperature that can be maintained. The heat can be regulated and it is not greater in the oven one day than another, and the bread that is baked in the modern electric oven is perfectly browned and perfectly baked at all times. With this most favorable characteristic the science of cooking by electricity can be conducted with almost mathematical precision.

Wonderful electric cook stoves have been invented that bear little resemblance to the old time ranges and they are automatic in operation. They are fit companions in science to the aeroplane and the automobile. The last and final step in the development of a modern method of cooking is the application of the automatic control feature. This improvement has eliminated much of the labor and drudgery of cooking. Imagine having in the house an automatic silent servant that will get up at any hour in the morning that may be predetermined and start the breakfast, heat the water, cook the cereal, cook the coffee, prepare everything correctly and keep it all in perfect condition until the family are prepared to sit at table.

The Art of the Housewife

At the twelfth annual vocational art and industrial conference, Mr. Carroll G. Pearse, superintendent of Milwaukee schools, declared that the art of the housewife is becoming increasingly difficult. Consider the situation of the young housewife who takes charge of a modern home. Her work is progressive. She is bound by necessity to acquire the arts of home furnishing and interior decoration; then there is the consideration of the commissary department, planning the meals and purchase of food; then in time come the children, and she must acquire some knowledge of the training of children; so, according to Mr. Pearse, the modern housewife is like a modern electric light plant that takes on an ever increasing load as night comes on.

New necessities in the home call for a necessary vocational training for boys and girls. As so many women assume the responsibility of home making, girls are now being taught the elements of home making in the elementary schools —the elements of cookery, making beds, setting the table, and the simple arts of the housewife—so that when they take on the increasingly difficult "load" they may be better prepared for it.

Veluria Glass Table Lamp

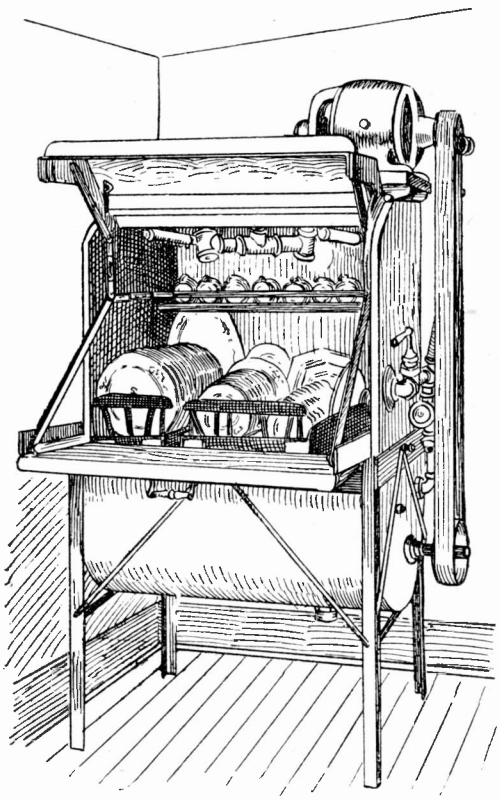
Those seeking something different in table lamps will find it in the Nelite portable. The base as well as the shade of the lamp is of Veluria glass. This glass is a pure white alabaster when not

SOMETHING DIFFERENT

lighted from within but when so lighted it takes on a faint blush or fire that is extremely pleasing. The decorations on the base and shade are deeply etched. Within the base is a small light which turns on with the light under the shade causing the base to glow and heightening the lamp's artistic appearance and richness.

Electric Power Dishwasher

That a dish washing machine could be made entirely practicable was an idea which had its origin in the mind of Mrs. Josephine Garis Cochrane 30 years ago. Two months after the thought occurred to her there was a little working model



DISH WASHING MACHINE INVENTED BY A WOMAN

in operation in the woodshed of her home. That was long before the time of the application of electricity to household appliances and she probably never dreamed at that time of a motor being applied to the operation of the device.

As time went on the dish washer was perfected, placed on the market and dignified by a trade name—the Garis-Cochrane. Then an electric motor became an essential part of it, performing all the manual labor necessary in cleansing the dishes.

The drawing illustrates the machine as it stands to-day. It is of considerable capacity and largely used in cafés, clubs, restaurants and similar places. But even in the household where the size of the washing is large enough to make it an economy it is finding a place.

The machine is handsomely finished in white enamel with nickel trimmings. As each dish has a place by itself in the wooden racks all breakage is prevented. The dishes are placed above the tank of heated soap suds and a pump submerged in the tank forces the suds over and through the dishes with great force. This process is thoroughly cleansing in itself and is discontinued by touching an electric button and stopping the motor. Then the clean, boiling hot water from the hot water supply is admitted through the automatic rinser which rinses and sterilizes the china, silver and glassware. They become so very hot that they dry instantly when taken from the machine.

An Ideal Bed Blanket

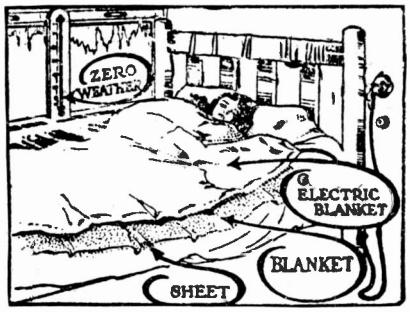
Everybody appreciates the great advantage to mind and body of outdoor sleeping; but everybody is not physically fit to enjoy outdoor slumber unless the necessary warmth of the body be insured by some special means. To-day the electric blanket makes it possible for everyone to gain all the refreshing and invigorating effect of sleep in the fresh air. With this blanket you can sleep on the porch or keep your bedroom windows open on the coldest nights in winter.

The blanket is intended for continuous operation and consumes only 50 watts. It replaces electrically the heat naturally radiated by the human body. A fine enameled wire is used as the resisting element and this is woven into the cloth of the blanket. There is no possibility of a shock as the wire is well insulated.

The best sateen is used in colors of old rose, red and blue. The blanket is soft

and flexible and may be folded in compact form.

The electric blanket should be covered with another light blanket to hold the



GOOD FOR ZERO WEATHER

heat generated. The inventor, Mr. Russell Clapp, made the first blanket for the benefit of his mother and for use in their own home.

An Entered Apprentice and the Electric Laundry Machine

The back door bell rang and the janitor's wife appeared on the threshold, aggressive and authoritative, with arms akimbo.

"Did some one in this apartment put some clothes to soak down in the laundry?"

"Yes, I did," I faltered, guiltily.

"Well, take 'em out right quick and put 'em in the tub on the other side," she ordered, loftily. I flew down stairs and seizing the wet mass of clothes, hastily threw them into the middle tub on the other side before the janitor's wife appeared. It seems I had put the wash into tubs that she was going to use.

"You see," I explained, "I am not a regular wash lady and I did not know the rules of the laundry. In fact," I confessed, "I have never washed before. This is my first washing. I am about to become an entered apprentice and take my first degree." The janitor's wife melted immediately.

"Well, I dunno if I know what an entered apprentice is, but if you mean you don't know how to wash, why, I can tell you lots."

"Please do," I entreated. "I shall be so grateful." The woman beamed at me from over the dividing line. "Of course," I ran on, "I know that you soap 'em and souse 'em up and down and rub 'em on a board." The janitor's wife laughed heartily. "And then you bile 'em?" I asked. I remembered our colored laundress always "biled" the clothes.

"You're forgettin' the starch, ain't you?" inquired the janitor's wife. "I always put a little shaved candle into my starch," she explained, "and as long as I'm makin' the starch I'll starch a few pieces for you." I thanked her very kindly and from that time on our relations were most amicable. She regaled me with gossip about the other tenants, concluding with: "Most of our tenants go away for the summer. Are you going away?"

"I don't know yet. You see, I work for a living, not at washing exactly, but I wash today from sheer desperation. My washwomen have driven me to it. My laundry last week almost made me weep when it came home." The janitor's wife was keenly sympathetic.

"Sho' now they's lots of washwomen that ain't worth their salt, but I must say, there are no flies on you when it comes to washing." I surveyed my three lines of clothes with unmitigated pride.

"I should think you'd come down often and wash," she ran on, "seein' as how you've done so well. This is a good basement to work in."

"If all the tenants can afford to go away for the summer," I observed, "I should think they could afford to have an electric washing machine installed down here. I am inclined to think they would do so, if they did one washing with their hands. My hands feel like fury."

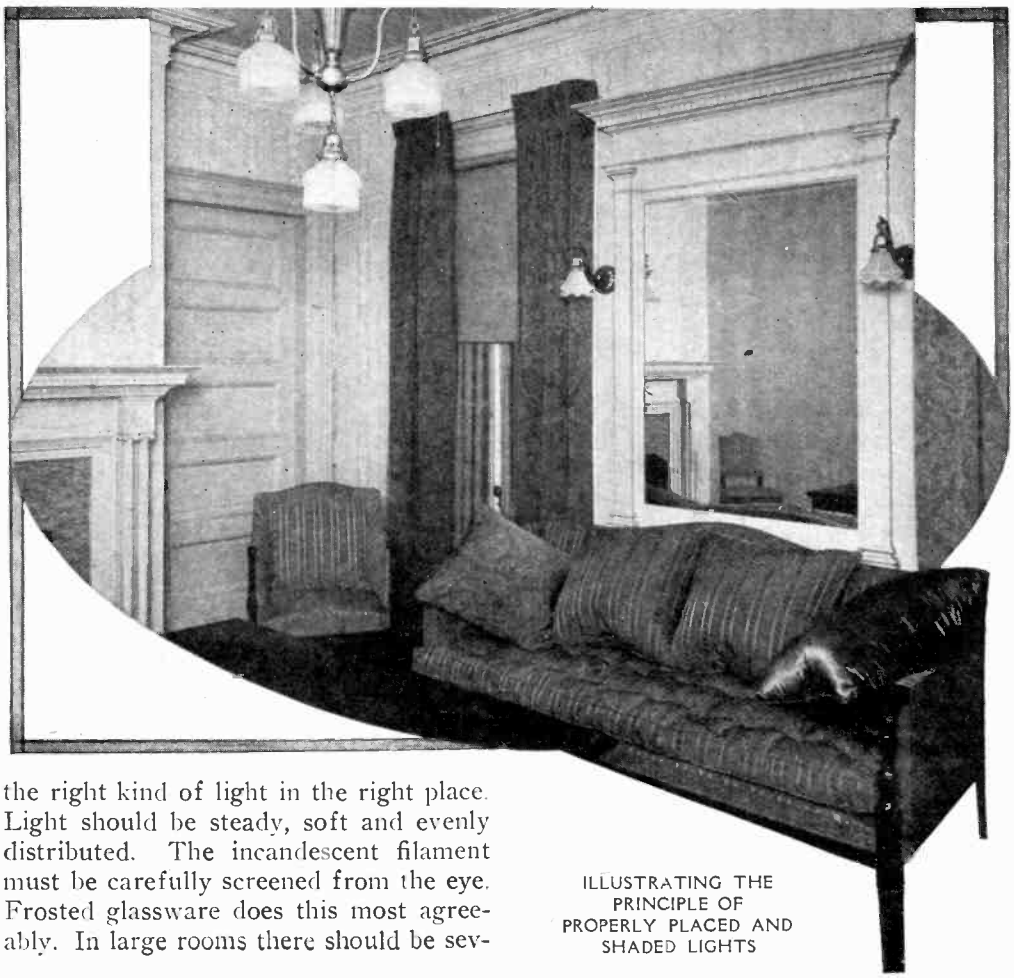
This suggested an immediate line of action. Suppose I secure the installation of an electrical washing machine. I figured that it would soon pay for itself in

rental to the other tenants. It would only be necessary to demonstrate its ability to wash quickly. The cost of washing in the old way is: 52 weeks at $2.00=$104. Price of good electric washing machine—$85. Difference for one year, $19. Instead of the backbreaking washboard, behold two levers, one to start the motor to oscillate the perforated cylinder, the other to start the reversible wringer. Instead of linen frayed and ragged out, you have a snowy pile of clothes, clean and whole.

The Proper Placing and Shading of Lights

In the lighting of the Twentieth Century home the problem is how to secure the right kind of light in the right place. Light should be steady, soft and evenly distributed. The incandescent filament must be carefully screened from the eye. Frosted glassware does this most agreeably. In large rooms there should be several sources of light. Wall brackets should always be within easy reach. They are used principally for the direct light that they give and should be provided with frosted bulbs.

A corner in the parlor of the Edison Twentieth Century Home illustrates these principles of properly placing and properly shading the lights.



ILLUSTRATING THE PRINCIPLE OF PROPERLY PLACED AND SHADED LIGHTS

The Lighting of Cafés

The lighting of a hotel, café or club—in fact, any place frequented by a large number of people searching for amusement, recreation or rest—presents its own peculiar phase of illumination. Dining rooms, palm gardens, rathskellers and

CAFÉS LIGHTED BY THE INDIRECT SYSTEM ARE KNOWN AS "COMPLEXION ROOMS"—VERY POPULAR WITH WOMEN

other classes of lighting must each be treated according to special requirements. Plans for lighting designed for general purposes would add little to the attractiveness or spirit of such places; it is essential that they receive special consideration.

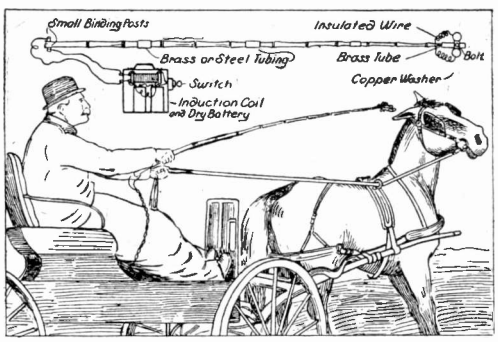
Illumination to conform with the cordial atmosphere of such places must be cheerful, attractive and of a nature to place patrons in a receptive mood. The agreeable and inspiring influence of light has been recognized from the earliest days. Primitive man enjoyed his crude feasts under the light of flaring fagots; the Greeks and Romans depended upon the light from huge braziers to make their banquets places of pleasure and inspiration; the early Saxons and Britons gathered to their feasts by the light of torches placed in receptacles upon the walls of their lodges and castles; the pleasure loving French a few centuries later lighted their gatherings with chandeliers resplendent with candles and during the period just before our own, our ancestors had their pleasures by the light of candles or lanterns. Present conditions are so exacting, it is absolutely imperative that an abundance of light should always be available in public buildings; and where the light is, there will the crowd go.

The most successful systems so far devised are those that furnish results which most nearly approach daylight conditions in quantity and quality of light and at the same time are convenient and economical. The almost universal adoption of incandescence electric lighting attests the fact that it has met these requirements with the highest degree of success.

Various cafés lighted by the indirect system are known as "complexion rooms" and in consequence are very popular with women.

Electric Starter for Balky Horse

Take a common bamboo, fish pole and cut it into lengths of about five feet. With a three foot bell hanger's bit bore a hole through the center of the pieces. Join the sections with brass or steel tubing. Insert two insulated wires through the pole terminating at the larger end in two small binding posts. On the other end of the pole place a brass or copper tube that will fit snugly and flatten it out slightly. Bore a hole through the middle



TURN ON THE BATTERY AND REACH FOR THE BACK OF THE EARS

of this and bolt a wooden piece about three inches long across the tube.

At the outer ends of the small cross piece fasten two brass or copper washers about an inch in diameter and attach the two insulated wires running through the pole, one to each. If a metal cross piece is used, one terminal should be insulated by a rubber or fiber washer. By means of a flexible wire attach the secondary of an ordinary shocking coil to the terminals at the near end of the pole. The coil and dry batteries of two or three cells can be carried in a small box on the wagon. When the horse is balky all you have to do is to turn on the battery, place the two terminals at the outer end of the pole back of the ears of the animal and it will go at once. This apparatus has been tried out by the writer on some of the worst balky horses and has never failed yet.—Edw. E. Harbert.

The Electric Crater

Everybody knows that an arc light is formed by causing an electric current to pass between the points of two carbon rods. One of these is called the positive and the other the negative electrode and the current passes from the former to the latter. Particles of carbon are carried off from the positive electrode until its end becomes cup shaped.

To the little cup thus formed the name of crater is applied and from this crater four-fifths of the light is emitted. The negative electrode does not become as hot as the other.

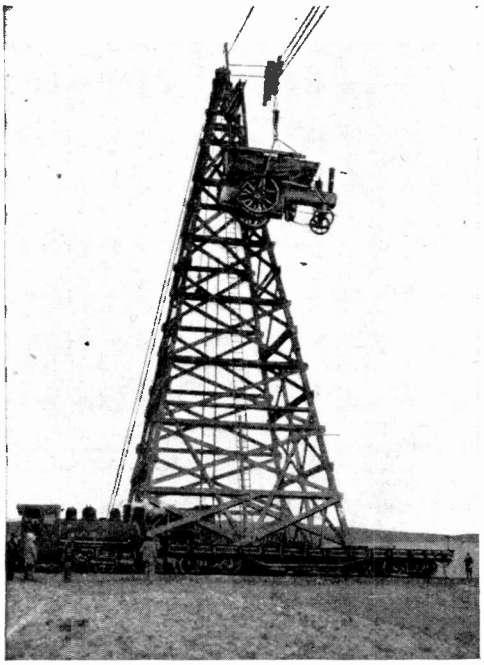
Between the two a little cloud of vaporized carbon is formed, rising from the crater, and this vapor gives forth a golden yellow light. But it is overpowered by the light of the crater itself.

The fact that most of the luminosity comes from the crater explains the reason why the light does not appear equal in all directions.

A very interesting effect is often noticed when flies or other insects flutter about an arc light. Their shadows cast on a neighboring wall appear gigantic. The reason is that the light of the crater is concentrated in a point smaller than the bodies of the insects and the boundaries of the shadows widen with distance.

Transporting an Engine by Cable

The ten ton traction engine is being transported on the cableway from the top of the canyon walls above Carson River to the bed of the stream more than



THE TEN TON TRACTION ENGINE READY FOR ITS CABLE RIDE

100 feet below. Without the cables it would have been necessary to build a road down to the river. These cables are built to carry a load of 20 tons and are operated by electricity developed in the government's power plant.

Magnetized Borers

It has been noticed in the Transvaal that bore holes driven to a depth of 500 to 1,000 feet show a strong deviation, which is generally toward the north. This is held by some probably to be due to the magnetization of the long stem of the boring tool, resulting from its rotation in the magnetic field of the earth. The south magnetic pole forms near the top and the north near the bottom. The effect of the attraction exercised by terrestrial magnetism is to impart to the rod a curve, with its convex side toward the south, and thus to produce a deviation of the hole toward the north, which becomes more pronounced as the depth increases. When the hole deviates in other directions than north, it is believed that the cause lies in the obliquity of the strata of rock that are traversed.

Native Telegrams in China

In China the transmission and receipt of telegrams in the native tongue is not so easy as is telegraphing in Western countries, since the Chinese language lacks an alphabet, expressing itself by means of ideographs.

The result is that, for purposes of telegraphing, an exact list of ideographs in quantity has been drawn up sufficient for ordinary correspondence and to each one of these ideographs a different number is given which is transmitted by the Morse telegraphic code. The Chinese code consists of some 9,800 ciphers, the whole forming a pamphlet of 49 pages, each one of which contains ten series of 20 characters with its corresponding number. On receipt of a telegram the operator looks up in his book the characters represented by the numbers transmitted.

Columbus and the Magnetic Needle

For many years the belief persisted that Christopher Columbus was the first to note the declination of the magnetic needle. In 1906, however, there were discovered three sun dials, dating from a time anterior to Columbus' first voyage and bearing upon the compasses accompanying them lines indicating the declination of the needle. One of these, found at Innsbruck, was made at Nuremberg in the year 1451. Not only has it an engraved line indicating the declination at the time of its construction, but shows other lines indicating subsequent changes of direction undergone by the needle.

THE ONLY EARTH ELECTRICAL CLOCK

DANIEL DRAWBAUGH

"It will run for a hundred years —more than that. If the bearings would not wear out it would in all probability run forever."

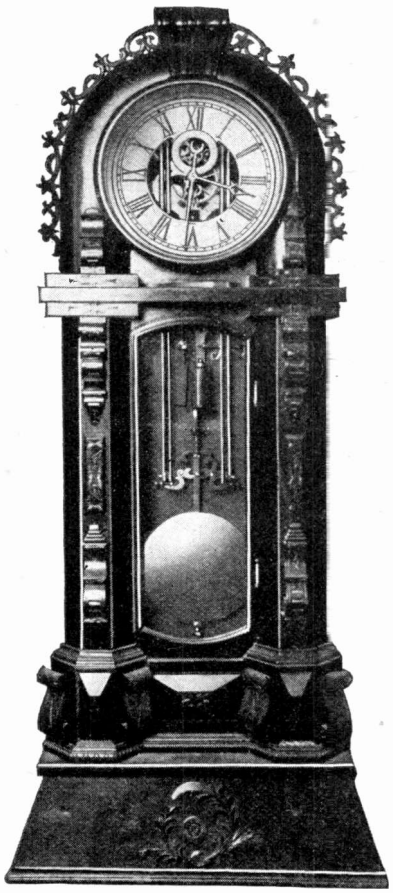
The speaker was not crazy, nor a perpetual motion crank. His statements were not the outline of some hazy dream invention yet to be, for there before us, ticking away merrily as it has continuously since 1870, stood the clock, physical and undeniable proof of the foregoing statements.

This wonderful timepiece stands in the office of Charles H. Drawbaugh, at Camp Hill, Pa. It was invented by Daniel Drawbaugh, the father of its present owner.

The clock is operated by electrical forces drawn directly from old Mother Earth. It requires no extraneous assistance, and all its units are self contained. Its principle is the nearest man has yet come to perpetual motion; time has proven this.

The working of this clock is simple. It has a heavy pendulum, about four feet long, weighing nearly 50 pounds. In the center of this pendulum, half way between the ball and its point of suspension, is fixed a permanent magnet. Behind this and fastened to the back of the clock's base is an electro-magnet the wires of which lead to the ground and are attached to metal plates which are buried and surrounded by cake, to hold moisture. This terrestrial battery never requires the slightest attention.

When the pendulum above described swings away from the perpendicular the poles of its magnets first attract and then repel, thus continuing the oscillation and making up for the natural reduction of force. The clock can be run so that it will not vary two seconds in a year.



DRAWBAUGH'S EARTH CLOCK, WHICH HAS RUN WITHOUT STOPPING SINCE 1870

Another remarkable feature about this clock is the fact that it has only four points or bearings that are subject to the least friction.

Daniel Drawbaugh invented many wonderful things besides this perpetual clock. Indeed, there are many of the older residents of Camp Hill who will stoutly assert that he was the first man to conceive the idea of an electric telephone.

However that may be, he was beyond a doubt one of those unfortunate beings—an unrecognized genius, upon whom publicity had never turned its all revealing beam.

Drawbaugh was a wizard for mechanical and electrical ingenuity. He invented hundreds of marvelously clever devices for furthering the world's work, and

was looked upon with a certain amount of awe by his fellow townsmen, as a superior sort of being.

Electricity in the '60's was in its swaddling clothes; hadn't its eyes open, so to speak, and one who dabbled with this mysterious "fluid' was regarded as a sort of necromancer.

So when Drawbaugh conceived the idea of a clock that would draw its energy from the vast reservoir of earth's potential electricity, he said nothing about the matter until the work was done and the clock was running.

Then he showed the result of his labors to wondering friends and proved to them that his clock ran all by itself. He showed them that there was no spring or motor anywhere concealed within the works, and that the motion was imparted by a ratchet and pawl operated solely by the pendulum. For over 50 years the clock has never stopped, never faltered, requiring no attention beyond a drop of oil now and then.

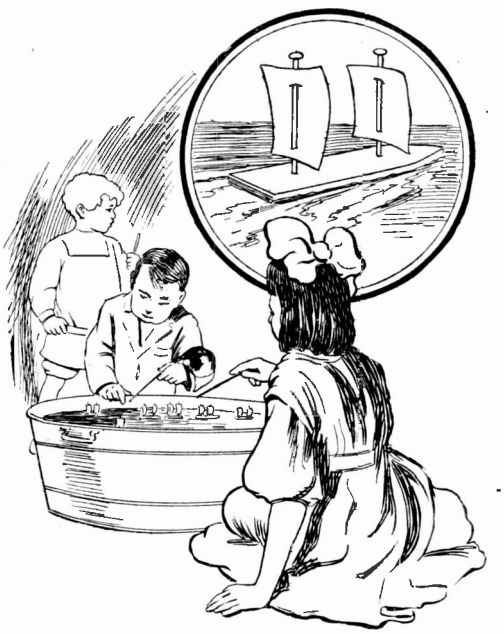
Simple Experiments With Electricity

From an ordinary newspaper cut a piece of paper 2½ by 3½ inches. Trim the corners. Warm the paper over a lamp or on a stove almost hot enough to make it smoke, then rub it over your hair, which should be dry. Use a little pressure when rubbing. The paper will now cling to any surface on which it is placed.

Small shreds or bits of paper are necessary for the second experiment. By taking a piece of paper and cutting a deep fringe on one side, then cutting at right angles to the fringe, one can quickly get a sufficient quantity. The pieces should be ⅛ inch square or less. Place the bits of paper on a sheet of paper that has previously been warmed in order to drive off the moisture. Again charge the piece of paper which was used in the first experiment, by heating and rubbing on the hair, then hold it from one to two inches over the bits of paper, and they will dance back and forth. This same experiment can be tried with a hard rubber comb if preferred. The comb, after being warmed, can be charged by combing the hair or rubbing with a piece of silk.—S. T. NASH.

A Magnetic Navy

To build this navy thin pieces of cedar or pine wood and some magnetized sewing needles are necessary. Cut the pieces of wood into lengths a little longer than the needles used and about one-fourth of

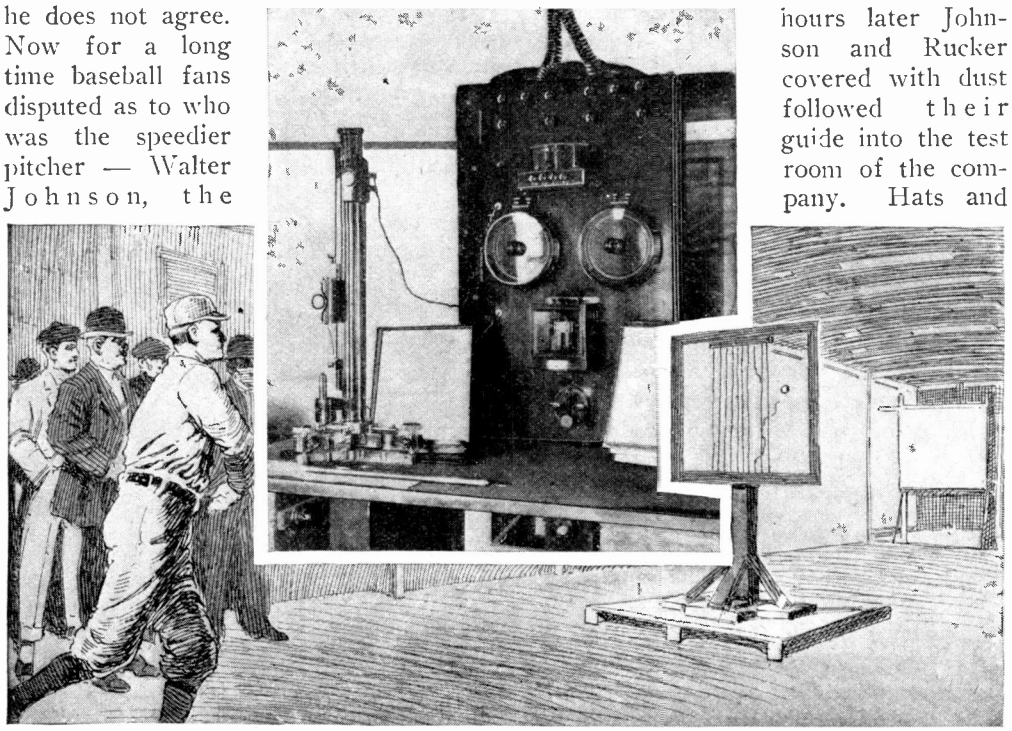


THE MAGNETIC NAVY

an inch in width. Make one end of each boat pointed for the bow. After the boats are all ready turn them upside down and lay a magnetized needle upon each where the keel should be. Now light a paraffine candle and let a drop of hot paraffine fall upon each needle and boat. Take a hot nail and smooth the paraffine out over each needle. The boats are now ready to place in a large vessel of water where they will act very queerly toward each other. By holding a magnet near the boats they may be made to move about in a mysterious way.

Speed of Pitchers Tested by Electricity

Baseball fans are the strangest people in the world. One of their peculiarities is that each thinks he knows more than the other about the game. Also the fan being so extremely opinionated is quick to take exception to and dispute any remark with which he does not agree. Now for a long time baseball fans disputed as to who was the speedier pitcher — Walter Johnson, the blonde giant of the Washington American League Club, or Napoleon Rucker, a quiet Southerner who pitches with his left hand for the Brooklyn Nationals. Many disputes have occurred and an antagonistic spirit developed among friends. To settle the dispute, to hush it for all time, electricity was called into action. This is how it happened:

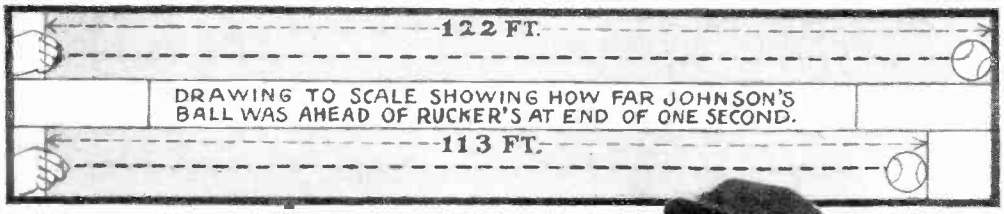


ELECTRICAL APPARATUS ORDINARILY USED FOR MEASURING THE VELOCITY OF BULLETS BEING UTILIZED TO TEST A PITCHER'S SPEED

Before the close of the league season when Washington happened to be in New York and Brooklyn was playing in its home city, an automobile chugged away from a Broadway hotel. There was nothing very unusual about that nor about its destination which was Bridgeport, Conn. But the men in the automobile were going to Bridgeport for one thing. And that was to conduct an electrical pitching test in the testing room of the Remington Arms Company.

A little over two hours later Johnson and Rucker covered with dust followed their guide into the test room of the company. Hats and coats were dispensed with and soon $75,000 worth of pitching material was propelling a ball to and fro in the air. For the benefit of those who are not fans and who do not understand the phrase "$75,000 worth of pitching material," let it be said that were Johnson and Rucker to be sold to other clubs their total prices would be $75,000. That sum is their worth to Washington and Brooklyn. So while the costly arms were unlimbering, the Remington people looked on curiously.

Their muscles ready, they glanced at



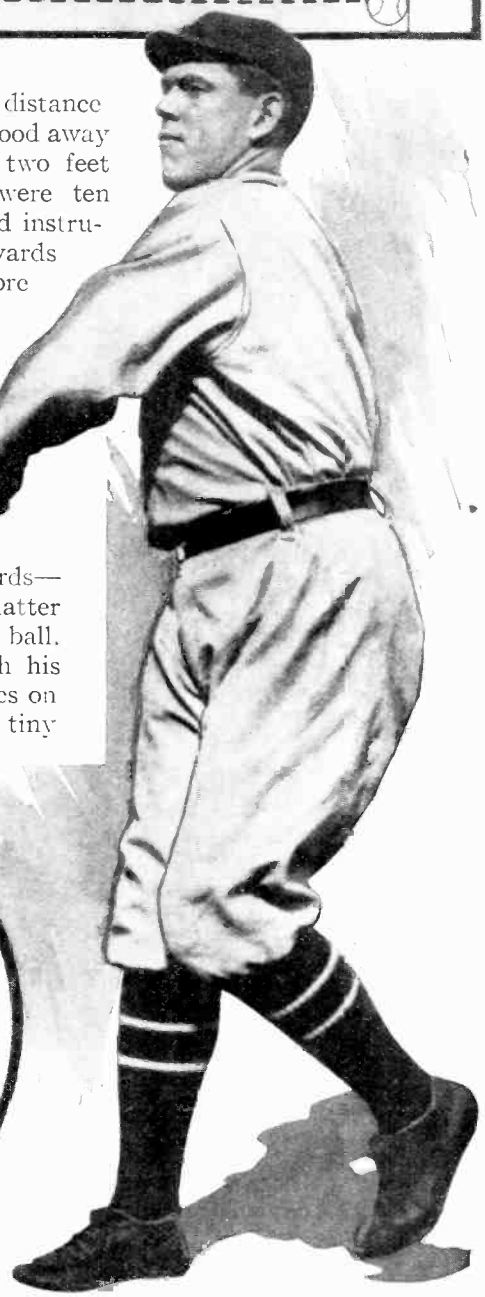
the electrical recording machine. About the distance of the home plate from the pitchers box it stood away from them. First was a frame of wood two feet square. Running from top to bottom were ten fine copper wires. It looked like a stringed instrument of some sort—an odd harp. Five yards behind it was a steel plate from which more wires led.

As Johnson made ready to pitch, it was explained to him that he must throw the ball through the wooden frame breaking one of the wires. This would record electrically the time the ball left the frame. Then upon striking the steel plate the other wires would record the time of its arrival. The distance between the two points—five yards—being known, it would then be an easy matter to figure the rate of speed of each pitcher's ball.

Johnson faced the line. He raised both his arms overhead clasping the hands as he does on the ball field, and swinging easily drove the tiny

Photo by Paul Thompson

WALTER JOHNSON



NAP" RUCKER

sphere from him. Now Johnson has good control on the ball field but he didn't have it up in the Remington place. Five times he threw before he could break one of the thin wires of the wooden frame. Then they made the readings, calculated his speed and found it to be 120 feet per second.

Then Rucker came to the line. He thought it would be easy to break one of the wires. After a first try he changed his mind. Time and again he let go of the ball before completing his swing. Missing the outside wire, he caused the horsehide to whistle harmlessly through the air bringing up against the steel plate without result. Finally he hit the mark, smashed two wires with a sweeping curve and found that the tester had recorded 106 feet per second.

On his second attempt Johnson increased his speed. Missing the wires twice he broke on his third attempt and found that his throw had been 121 feet per second. Again Rucker went through the motions of his delivery; again he broke a wire. So did his speed increase, climbing to 109 feet per second.

It was not until the last trial though, that Johnson made his record, drove the ball through the air 122 feet per second. Rucker bettered his mark too. But the best he could do was 113 feet. After the test was over Rucker said that Johnson had not thrown his best; that if he were to make the attempt in his baseball clothes and on the open field his record would be 150 feet. Then one of the company men told the pitchers that the new army revolvers sent a bullet 800 feet a second. Whereupon Rucker and Johnson fled to their car and hurried back to the city.

Convicts See Moving Pictures

With the prison gates still locked and with the guards as vigilant as ever, 500 convicts of the Joliet, Ill., penitentiary recently spent 30 deliriously happy minutes in the outside world of sunshine, joy and freedom.

And in that half hour of happiness men who had never seen a racing motor, a winging aeroplane, or a diving submarine, looked with wonderment at these commonplaces—to us without—of the Twentieth Century.

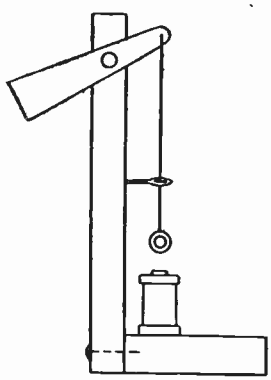
The "movies" did it. One whirring film machine in the darkened prison chapel brought about the 30 minutes of freedom and wonder to the men. Following glimpses of various bits of science which many of the men had never seen, flashes of European scenery, American skyscrapers and other strange things whirled before the childlike audience, many of whom had never even seen a motion picture.

"I didn't know there wuz sech things," said one "lifer" to Warden E. J. Murphy after the show.

"Well, there are, and lots more you haven't seen," replied Murphy.

Electrically Operated Toy Semaphore

Place a small electro-magnet upon a platform as shown. After securing the

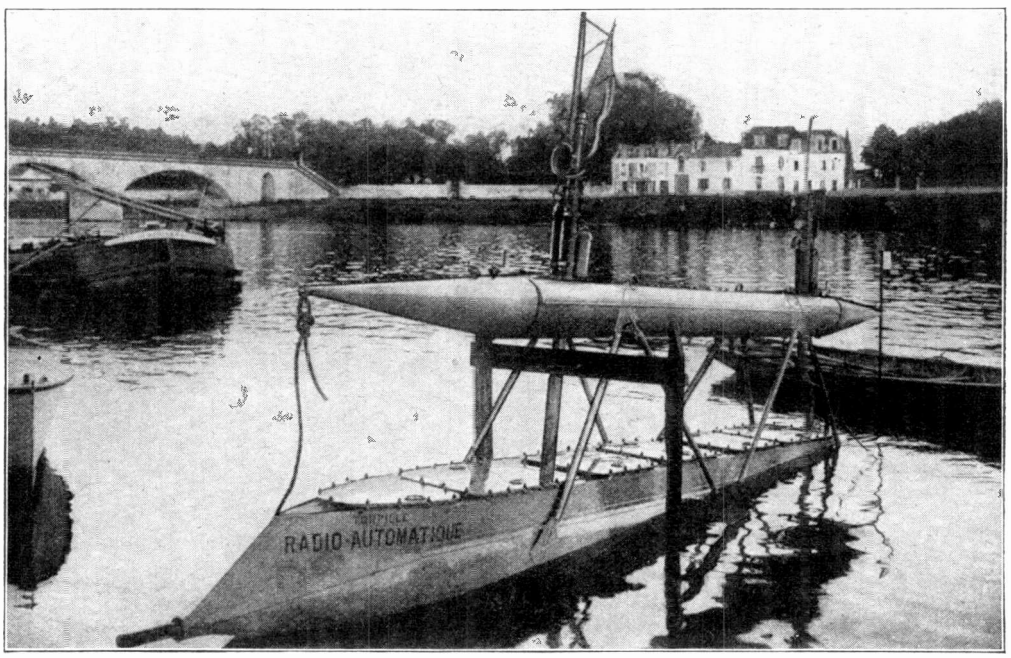


TOY SEMAPHORE

semaphore arm in place at the top of the post, fasten a string to it and pass the string through a screw-eye guide. To the lower end of the string attach a piece of soft iron which should be heavy enough so that when current passes through the electro-magnet the soft iron will be pulled down and the signal arm raised.

The Radio-Automatic Torpedo

The idea of controlling torpedos and small boats by means of wireless has engaged the attention of inventors for a number of years and particularly in foreign countries considerable success has attended the experiments. One of the most successful of this strange type of craft is known as the Radio-Automatic —a torpedo. It has been seen recently on the River Seine in France and the results attained with it are quite promising.

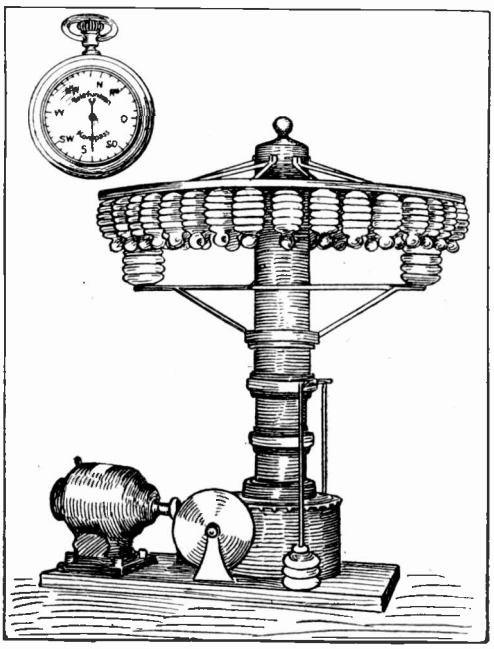


THE LATEST TYPE OF WIRELESS CONTROLLED TORPEDO

Ordinarily, the lower or torpedo part runs beneath the surface, and only the upper portion lies out of water. This part is a long, cigar-shaped cylinder, and it can even float on the surface, as it is water tight. It holds the electrical apparatus which receives the wireless signals and then sends the current in the proper way into the torpedo so as to work the propeller and rudder, raise or sink it or run it fast or slow. The wire which forms the antenna for receiving the waves is stretched between the two masts. On the rear mast is mounted a powerful acetylene lamp so as to send a beam back to the shore station and this beam has an electric shutter so as to make automatic signals and thus show how the apparatus is operating. Of course all the actual power for running the boat is supplied by batteries, the wireless waves simply controlling devices which turn on and off the current in the proper local circuits.

Telefunken Wireless Compass

With the new Telefunken wireless compass the direction of a distant wireless station may be found. To carry this out, the sending post is provided with a certain number of antennæ each of which sends out waves in a certain direction on the horizon, so that by connecting the apparatus onto antenna No. 1 the waves travel north, No. 2 to northeast, and so on. In reality there are used as many as sixteen different points of the compass.



THE WIRELESS COMPASS

To connect in each antenna in turn there is used a contact drum rotated by an electric motor. A separate antenna sends out a time signal in all directions. Just after the time signal is sent, the drum rotates so as to connect on one antenna after the other. At the distant station the operator has a watch device with a hand rotating around a dial at exactly the same rate as the drum. When he hears the time signal, he presses the watch button and the hand commences to rotate. At a given time, one of the signals comes in his direction and here the sound is loudest so that he stops the watch and now the hand points to the direction of the other station.

The time of each rotation is one-half minute and he can repeat the observations so as to arrive at an accurate result. It is said that the method is accurate to within three or four degrees.

Wireless Club Directory

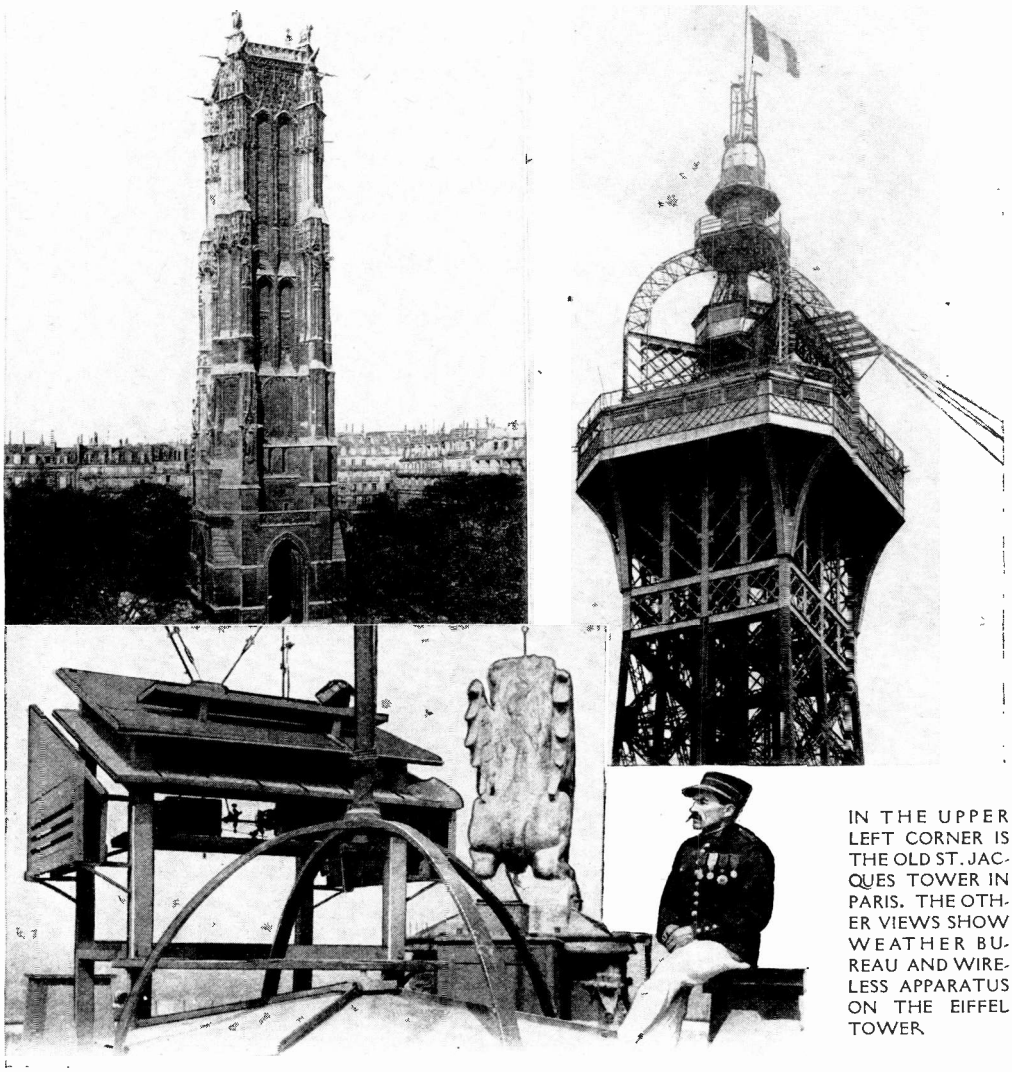
In the paragraph at the beginning of the Wireless Club Directory in last month's issue not all the readers of this department may have noticed that hereafter the directory will be published once a quarter instead of every issue. This directory is growing rapidly in size, and space cannot be devoted to it in every issue. As readers no doubt file their magazines there is really no necessity of running it oftener than once every three months, which permits of its being kept fairly up to date as to names and addresses of officers.

Correction

Referring to the article "How to Comply with the New Wireless Law" in the November issue, paragraph three states that experimenters having apparatus which is not powerful enough to transmit farther than the boundaries of the state in which the station is located need not take out a license. The Regulations require a station which can interfere with the reception of signals from outside the state in which it is located to have a license.

The fact conveyed in paragraph four should be that a receiving station only requires no license, no matter what its receiving radius may be.

On page 849 of the December issue the inductance of the "Standard Helix," should read "14.28 microhenrys," the inductance of a single turn is then approximately .29 mochrohenrys.



IN THE UPPER LEFT CORNER IS THE OLD ST. JACQUES TOWER IN PARIS. THE OTHER VIEWS SHOW WEATHER BUREAU AND WIRELESS APPARATUS ON THE EIFFEL TOWER.

WEATHER BULLETINS FOR FRENCH AIR PILOTS

In the future the air pilots will be able to fly under better conditions in France owing to the recent decision made by the war department in connection with the weather bureau. Weather bulletins and forecasts will now be received by telegraph in all the leading aviation centers which desire to have this news, and such news will naturally be received in the military aeroplane and airship headquarters above all in order to keep down the number of accidents to the officers. The weather news service has already started and the first bulletins were received at the Buc, Versailles, Rheims, St. Cyr, Pau and other headquarters during the latter part of October. The region of Paris is favored by having such a high point as the Eiffel Tower for making weather observations and at the extreme top there are mounted a number of instruments. The ancient St. Jacques Tower within the city is also one of the best equipped in this respect.

Aeroplane Wireless Experiments in France

During the recent French military maneuvers some interesting tests were made with improved wireless apparatus mounted on a Farman aeroplane. It kept up connection with a ground post when upon scouting flights, so that the enemy's movements could be observed and the distant post kept notified of the position of troops or batteries. The new Rouzet wireless apparatus was used on the aeroplane. While it is true that the other aeroplanes not equipped for wireless did some remarkable scouting work, the reports came in to headquarters much quicker when wireless was used.

As an example of what can be done under conditions of actual warfare, the Farman flyer started out on Sept. 16 towards the enemy's positions and observed all their movements in the region lying between Courcoue, Dange and St. Maure. The notes were sent back to the commanding general's headquarters at once after each observation without needing to wait until the aeroplane had made its whole flight. In this case the trip lasted for two hours, so that the first news came in one and three-quarters hours, sooner than it would have been delivered by an ordinary aeroplane.

The inventor mounted the aeroplane on some of the tests and states that the signals were good when flying as high as 5,000 feet and were not hindered by the fog. The apparatus was also installed by an under officer having but two months' training and he could handle it without any trouble, sending 900 words an hour. During the same maneuvers, signals were sent from airships to posts on the ground with great success.

PORTABLE GROUND STATION USED IN CONNECTION WITH AEROPLANE WIRELESS EXPERIMENTS

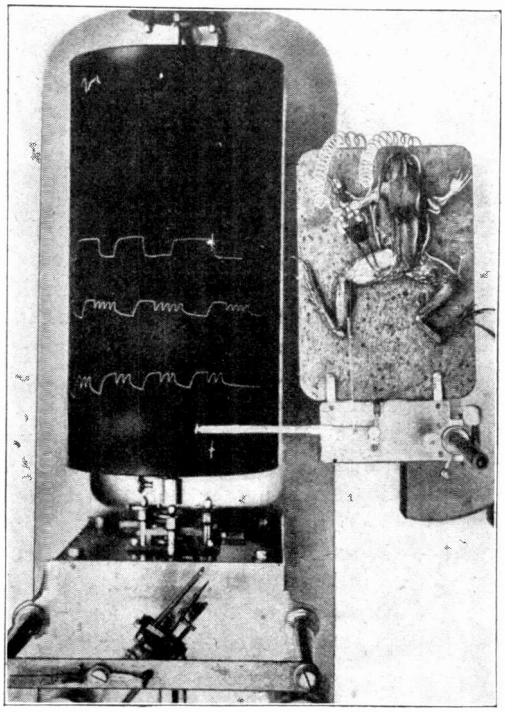
Setting Railroad Clocks by Wireless

Setting railroad clocks by wireless is a method which is likely to be quite useful in the future. It is beginning to be used by the Northern Railroad Company in France and the first wireless post is now installed at the station of St. Quentin, about 90 miles from Paris, so as to receive the time signals from the Eiffel Tower. A very simple antenna

is made up of two wires stretched upon the building and the whole plant did not cost more than $50. Once a day the telegraph operator receives the exact time from Paris and is thus able to set the clocks at the station.

The Frog Muscle Experiment

In the January issue we published a diagram and description of the interesting experiments made in the medical schools at Rennes with frog muscles and nerves, utilizing their sensitiveness to electrical impulses for receiving wireless signals. Since this was published we have received a photograph from Paris showing the apparatus in actual

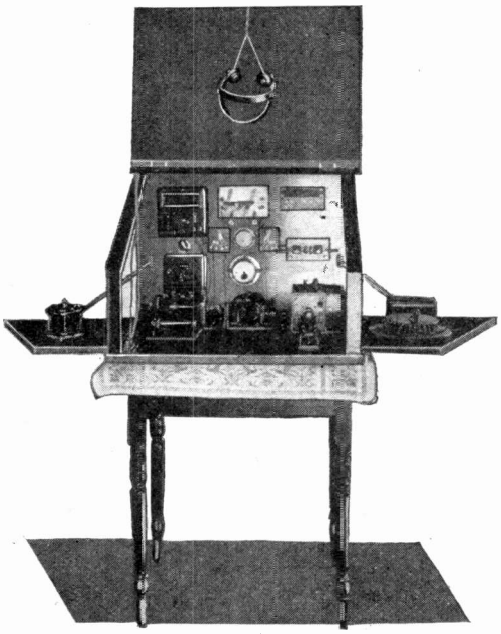


TIME SIGNALS EFFECTUALLY RECORDED THROUGH THE FROG'S MUSCLES

operation. In the picture is shown the smoked paper drum with messages recorded and at the right the mounted frog. At every spasmodic jerk of his leg the delicately mounted pointer is made to record the movement on the paper.

P. E. Wireless Club Member in South Africa

This picture of a cabinet enclosed wireless telegraph set was sent in by a member of Popular Electricity Wireless Club, Mr. R. Oxenhan, Durban, State of Natal,



WIRELESS SET OF A SOUTH AFRICAN CLUB MEMBER

South Africa. He writes: I have four friends who have installations and we have been experimenting together for years. The Postmaster General of South Africa will not allow us permits to continue our experiments. We have written off and on for the last year, and now are informed that we will have to do away with our installations on account of the interruption to the Durban Radio Station. I have been to see one of the prominent men in Durban, and he is going to help us with his influence in the Parliament, or from the Minister of Post and Telegraph. I might say we never had any intention to interfere with the above station. My mast is of bamboo, 62 feet high. My instruments are all home made except my receivers. At night I get signals from a 500 mile radius.

Questions and Answers in Wireless

By A. B. COLE

HELICES (CONCLUDED)

106. *In stations of what capacities should helices be used?*

The use of a helix is not advisable in stations where the power used is less than 25 watts. It is practically a necessity, however, where transformers or larger coils are employed.

107. *Give dimensions for a helix to be used in small stations.*

Diameter of winding—five inches; number of turns—10; size of wire—No. 10; kind of wire—copper or aluminum; distance between turns—one inch.

This helix is suitable for use with coils giving up to a one inch spark.

108. *What form of conductor is best for winding helices?*

Either a solid wire or a tube is to be preferred to metal ribbon as having no sharp edges from which brush discharge and consequent loss of energy can take place. Stranded wire is better than solid wire of the same outside diameter on account of having a greater surface and therefore less high frequency resistance.

CONDENSERS

109. *What is the purpose of a condenser?*

A condenser is used to vary the wave length of the circuit in which it is a part. In its action a condenser resembles a tuning coil, but the variation in the case of the former is one of capacity and in the case of the latter is one of inductance, both of these qualities affecting the wave length. The condenser and tuning coil differ, however, in that the condenser tends to advance the current with respect to the electromotive force and the tuning coil retards the current. This statement is true in dealing with alternating currents of commercial frequencies, and probably is also true in wireless circuits.

110. *What is a fixed condenser?*

A fixed condenser is one having a single capacity, that is, one whose capacity cannot be varied.

111. *What is the difference between an adjustable and a variable condenser?*

An adjustable condenser is arranged in sections, so that one or more sections can be used at will. A variable condenser is so made that gradual variation of capacity from one value (usually zero) to another value is possible. Fixed and variable condensers are generally used in receiving circuits and adjustable and fixed types are more often employed in transmitting circuits. Of the three above mentioned types of condensers, the variable is most desirable, but is used little in the transmitting station because of the difficulty of insulating movable plates carrying high tension currents.

112. *Describe the construction of a fixed condenser for receiving.*

A fixed receiving condenser may be made of a strip of good quality paper 3 by 45 inches and two strips of tinfoil each 2 by 40 inches. One strip of foil is placed on each side of the paper, leaving a margin of ½ inch on the edges. The three sheets are then rolled up tightly and secured in a roll. One wire is attached to each tinfoil sheet and these serve as terminals. Care must be taken that the foil sheets do not come in contact with each other as is very likely to happen if a poor grade of paper is used.

113. *Explain how to test a fixed receiving condenser for contact between the foil sheets.*

Connect the condenser in series with a battery lamp or a small battery motor and five or six cells of dry battery. If the lamp or motor operates, the foil sheets are in contact.

114. *How does alternating current pass through a condenser?*

Properly speaking, alternating current does not pass through a condenser. A condenser consists essentially of two con-

ducting surfaces separated by an insulating material, called a dielectric. If one of the conducting surfaces is connected to one wire of an alternating current circuit and the other surface is connected to the other wire, the one connected to the positive wire becomes positively charged as the voltage or potential of the wire rises, inducing a negative charge on the opposite surface. If the latter surface is large, considerable induced current will be required to raise it to the potential of the positive surface and consequently more current will flow to the positive surface as its potential rises. The current induced in the negative surface flows into the negative wire until the direction of the current reverses, when the same conditions take place in the reverse order.

It will therefore be understood that current does not really flow through a condenser connected to an alternating current circuit, but the transfer of current between the conducting surfaces is the result of induction. If the condenser were connected to a direct current circuit, practically no current would pass, for there are no variations of the potential of the direct current supply to speak of.

115. *Describe a fixed condenser for transmitting.*

Such condensers are generally in one of three forms: Leyden jars, molded sections and glass plate types.

The Leyden jar consists of a glass jar coated inside and outside with tinfoil to within two or three inches of the top. In the best forms the jars are electroplated with copper instead of tinfoil coated, as greater capacity is thereby obtained. The outer coating is one terminal of the jar and the inner coating the other. Connection is made with the inner coating by means of a metal chain fastened to a brass rod passing through the wooden top of the jar. Instead of coating the inner surface of the jar with foil, a solution of two ounces of common salt in one pint of water may be used, and in this event the chain dips into the solution.

Condensers for high tension currents are also made of metal sheets molded into a composition of high resistance and inductive capacity. The molding is done under hydraulic pressure of several tons. The Leyden jar and the molded type condenser are illustrated in Figs. 33 and 34 respectively.

Glass plate condensers for amateur use

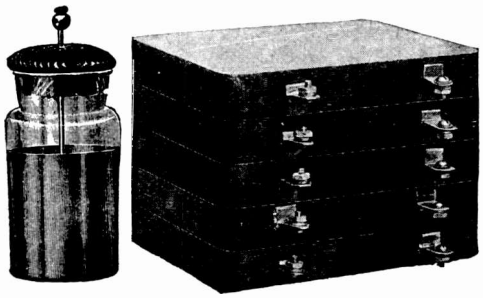


Fig. 33 LEYDEN JAR

Fig. 34 MOLDED CONDENSER

are made by pasting or otherwise securing tinfoil sheets on both sides of plates of window glass or photographic plates, previously cleaned. The plates thus formed are set up in a wooden rack and alternate plates are connected together to form a complete condenser. The glass plate condenser has the advantage that variation in capacity is easily obtained by using more or less of the plates, but the glass described above is of a poor quality for this purpose as it contains lead salts which act as conducting media for high tension currents. Considerable loss is therefore found in these condensers and is easily observed in the dark as brush discharge of a purple color.

116. *Upon what factors is the capacity of a condenser dependent?*

The capacity of a condenser consisting of two flat sheets of metal separated by a dielectric is directly proportional to the surface of metal, the distance between them and the dielectric constant of the dielectric.

117. *How is the capacity of condenser measured?*

The most generally used method is to

use a standard variable condenser in connection with a ballistic galvanometer for comparison. The unknown condenser is charged to a certain capacity by means of a battery and is then allowed to discharge through the galvanometer. The standard condenser is then charged to the same potential and allowed to discharge through the galvanometer, and the capacity of the standard condenser is varied until the deflection produced by it is equal to that produced by the unknown condenser. Under such circumstances the capacities are equal.

118. *What is the resulting capacity of several condensers connected in parallel?*

The resulting capacity is equal to the sum of the individual capacities of the condensers.

119. *What is the resulting capacity of a number of condensers connected in series?*

The resulting capacity is the reciprocal of the sum of the reciprocals of their capacities separately.

Thus if condensers of ½, ⅓ and ¼ M. F. respectively were connected in series, the resulting capacity would be $1 \div (2+3+4) = 1/9$ M. F.

The Brush Discharge

The term "brush discharge" to the wireless experimenter usually conveys the idea of the luminous electrical discharge so frequently seen at the edges of the tinfoil in the ordinary glass plate condensers. Of course this type of discharge is by no means only found in connection with condensers.

It is, in ordinary air, of a purplish violet color. To the unaided eye the discharge seems quite complicated, but those who have access to a Wheatstone rotating mirror will see not only one image of the brush, but several, arranged in succession and at regular intervals. Each interval corresponds to a single discharge. The complexity of these discharges is really due to the length of time taken for the retina of the eye to absorb their luminosity and for it to fade again.

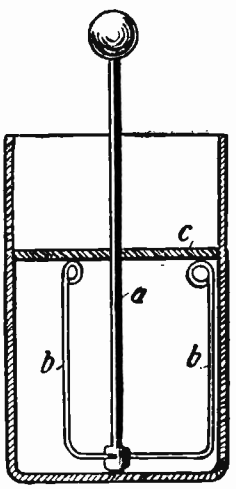
The brush is generally accompanied by a hissing or crackling sound, and in some cases a musical note. The tone or pitch of the discharge may be made to rise considerably if the hand or a conductor of fairly large surface be brought near.

An air current, if properly directed, will convert a brush into a glow. This glow is produced by the constant passage of electricity through a small portion of air in which the tension is very high so as to charge the surrounding particles of air, which are swept off by the "electric wind," which forms a most essential part of this phenomenon.

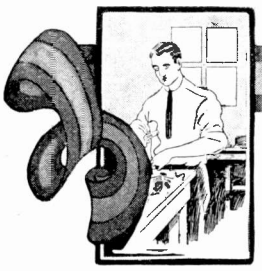
Increasing the power, diminishing the discharging surfaces and rarefaction of the air favor the production of the glow.

Improvement in Leyden Jars

An improvement in the way of fixing the metal rod of a Leyden jar has been brought out by a Berlin firm. In the usual methods, the rod runs through the cover of the jar which is of cork, wood or other material, but in the new design the rod (a) is held in place by a set of three springs (b) as will be noticed and the springs support the ebonite cover, being at the same time well pressed against the inside tinfoil coating of the jar. Thus the springs serve to give a good contact with the tinfoil and the rod is held upright in the middle and in a tight position. Owing to the new Blume method the rod can never fall over to one side, as is often the case where it is run through the cover of the jar.



NEW TYPE OF LEYDEN JAR



For Practical Electrical Workers

Motor Boat Ignition

By GEORGE MADISON

It is a well known fact that over 85 per cent of gasoline engine trouble originates in the ignition system. Motor boat owners who understand this very important part of their engines will fully appreciate how very necessary it is to keep their ignition systems always in perfect order and it is for the benefit of these as well as for their more advanced shipmates that I have undertaken to give a few ideas on the subject of ignition.

For those who are in doubt as to the value of correct ignition, I am going to tell of a few of the troubles which are due, sometimes if not always, to the ignition system, and many readers will doubtless recognize troubles for which they have "pulled" their long suffering carbureters, dismantled their circulating pumps and perhaps the entire engine, only to have the engine start off from no apparent cause and in due course of a few minutes stop again from the same cause.

Eight out of twelve of the principal causes why an engine fails to start are due to the ignition: (a) Weak batteries. (b) Short circuit on the wiring system. (c) Broken wire. (d) Broken down coil. (e) Corroded connections or switch. (f) Fouled spark plugs. (g) Switch not on or fails to make contact. (h) Timer out of time.

Five out of nine of the principal reasons of an engine missing explosions are due to ignition: (a) Defective or dirty spark plugs. (b) Loose connections. (c) Weak battery. (d) Sticky vibrator on coil. (e) Poor contact on timer. (Advancing the spark too far will also cause the engine to miss fire.)

Base explosions are due to two causes usually and the remedy is to turn on more gasoline and set the spark a little earlier. The ignition system is often to blame for the sudden stopping of the engine after running in good shape for some time. These troubles may be caused by: (a) The spark plug getting wet and short circuiting. (b) Some loose tool, tin funnel or measuring cup or water throwing a short circuit across the terminals of the coil. (c) Some object holding the vibrator. (d) The switch being accidentally kicked open. (e) The water in the bilge may have shorted or grounded a wire or wires. (f) The connection between battery cells may have been broken or pulled off. (g) The insulation on the spark plug may have broken down. (h) The ground wire on the engine may have been pulled or broken off.

WIRING.

When wiring up an ignition system on a motor boat, great care should be taken to obtain the best of material in accordance with the old saying that "The best is none too good." This holds particularly in this connection, as safety may some time depend upon the engine working without a kick when in a heavy seaway or swift current. In the matter of the selection of the spark coil it is best to purchase a standard piece of apparatus from

some reliable dealer whose advice may be depended upon even at a little higher price than is asked "by some fellow down the river" for a secondhand one "just as good as new." You are then nearly sure that the apparatus is right and in perfect condition; and if trouble ever does show up in the coil, you can get a new part or send it to its own factory to be repaired.

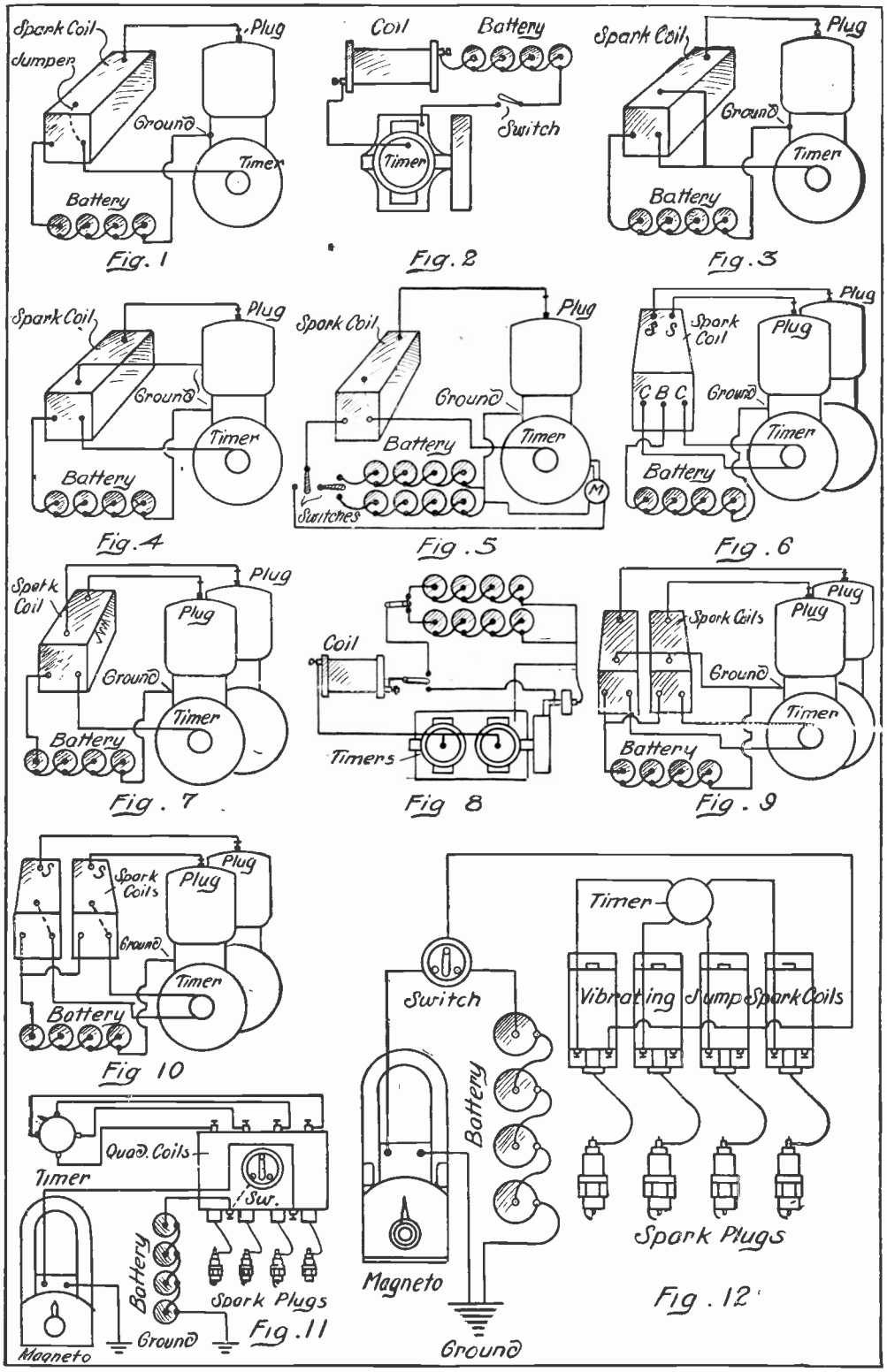
Spark plugs should also be purchased from a reliable dealer who will tell you the truth regarding them, as there are a great many of them on the market and all are claimed to be the best. Personally the writer likes a porcelain plug, as the mica plugs while less liable to mechanical damage are very apt in a comparatively short time, to soak up enough oil to short the plug through its insulation. I also like a plug having as few curves and angles as possible, as these do not foul up so quickly if too much lubricating oil is fed into the cylinders.

The switch may be of the knife type or a regular round, hard rubber, two or three point, battery switch. The two point will control two sets of battery or a battery and a magneto, while the three point will control two sets of battery and a magneto. The latter type is and has been giving me perfect satisfaction, as the switch points have little recesses, or cups, into which a little projection on the lever fits thereby insuring a perfect connection no matter how rough the sea. The knife type has one advantage, however, where appearance does not count and that is that it is impossible to throw the switch off unintentionally by brushing up against it. The switch is always cut into the ground wire of the circuit.

The wire itself should be the very best obtainable, as a poor insulation will harden and crack very quickly upon being exposed to the air, dampness, heat and oil to which all ignition cable is exposed. The insulation will break down and allow the current to escape to ground through other channels than the intended ones and thereby cause considerable trouble. The French make of solid rubber insulation is supposed to be the best but I have tried them all and have come back to the Packard. The insulation on this cable is not solid but is built up of insulated fabric and thick layers of black and white rubber. All wire should be run in the most direct manner possible; should be securely fastened up with little fibre cleats such as telephone wiremen use; should never lay on top of one another and must never run under the flooring where there is dampness to rot the rubber.

The current for the system may be obtained from several sources as follows: dry cells, wet cells, storage batteries and magnetos. The dry cell battery is without doubt the most popular and is usually used in sets of six cells. These cells make the most economical form of battery, as they are not only cheap in first cost but are long lived and on the whole dependable. They are also desirable on account of their comparatively light weight and the fact that they may be hung up or laid in any position and take up very little room. There is also a waterproof guaranteed battery on the market termed a multiple battery which is guaranteed for an entire season. The writer used one of these multiple batteries in connection with a six cell dry battery and did not call upon the dry cells to do any work last season except to try them out once in a while to see that they were in good working order. Wet batteries will give very good satisfaction if room, weight and dirt are not objectionable. There is, however, a wet battery on the market which gives good satisfaction. If you are going to use this as a source for your electric current, get the one that has a rubber top which prevents the liquid from slopping around when the boat is in a seaway, which retards the creeping of the battery salts, and which delays the evaporation of the liquid. But wet cells are cumbersome and troublesome at best.

The storage battery which has become


Spark Coil
Plug
Jumper
Ground
Timer
Battery
Fig. 1
Coil
Battery
Switch
Timer
Fig. 2
Spark Coil
Plug
Ground
Timer
Battery
Fig. 3
Spark Coil
Plug
Ground
Timer
Battery
Fig. 4
Spark Coil
Plug
Ground
Battery
Timer
Switches
M
Fig. 5
S S
Spark Coil
Plug
C B C
Ground
Timer
Battery
Fig. 6
Spark Coil
Plug
Ground
Timer
Battery
Fig. 7
Coil
Timers
Fig 8
Spark Coils
Plug
Ground
Timer
Battery
Fig. 9
S S
Spark Coils
Plug
Ground
Timer
Battery
Fig 10
Quad. Coils
Timer
Sw.
Battery
Spark Plugs
Ground
Magneto
Fig. 11
Switch
Battery
Magneto
Ground
Timer
Vibrating Jump Spark Coils
Spark Plugs
Fig. 12

so popular with autoists is not of so much value in a motor boat unless the boat is equipped with a charging dynamo, as the battery is exceedingly heavy and must be carried to a garage to be charged. I have run a single set of dry cells all season and have seen storage battery after storage battery play out in from one month to six weeks. This probably was due to carelessness or ignorance but it is a fact nevertheless. If the boat is to be used around home waters where the garage is ever handy, the storage battery is fairly good, but if you are going on a cruise get dry cells.

The magneto is a handy machine to have on any motor boat. The magneto should not be relied upon too much, however, in wet or stormy weather unless equipped with a hood to keep off the rain and spray. A low tension magneto will not only take care of the ignition with ease (a battery being required only to start the engine) but will also care for the lights as well. I have a friction driven magneto that not only supplies the lights and engine, but operates the electric horn as well.

In connecting up a set of dry cells care should always be taken to have the wire coiled between each cell so that there will be no trouble from broken connections.

CARE OF IGNITION OUTFIT.

The best way to take care of the battery, coil, etc., is to separate the individual cells with pieces of cardboard well shellaced (it will do no harm to shellac the cardboard cartons on the dry cells themselves). Everything should be securely fastened in a box or locker. This locker should have a good lock and be absolutely waterproof. If the boat is used but little it is well to place the ignition outfit in a box, so that it may be taken ashore when not in use, thereby insuring the outfit against dampness and damage.

In an open boat when bucking up against a heavy sea or when it is raining, a piece of oiled canvas should be stretched across between the combings and over the engine. This will protect the plugs from the water and also keep the dampness from the carbureter.

MAKE AND BREAK VERSUS JUMP SPARK.

When gasoline engines were first used they were equipped with the make and break system of ignition, but at the present time the jump spark system is the most generally used, although the make and break is much more simple and altogether better adapted to rough work.

The make and break ignition is especially adapted for open boats and fishing craft because the damaging elements of water, moisture and salt air which are so detrimental to the jump spark, have no terror for the make and break.

It is a recognized fact that the jump spark when properly installed and cared for is efficient and therefore it will be this style of ignition with which this article will deal principally.

There are various ways of wiring up an ignition system, as may be seen by the following illustrations. After selecting the diagram which meets your requirements, it would be a good plan to enlarge the drawing on heavy paper, or make an enlarged tracing and have it blue printed on cloth and fasten it on the inside of the cover of your ignition locker or box. This may save you considerable trouble until you get perfectly familiar with the various connections.

Fig. 1 illustrates a three terminal coil connected up for use on a one cylinder engine.

Fig. 2 explains a make and break connection for a one cylinder engine.

Figs 3 and 4 describe a method of wiring four terminal coils on a one cylinder engine.

Fig. 5 shows a wiring system for two sets of battery and a magneto on a one cylinder engine.

Fig. 6 illustrates a five terminal coil wired for use on a two cylinder engine.

Fig. 7 shows a single four terminal coil connected up to a two cylinder engine.

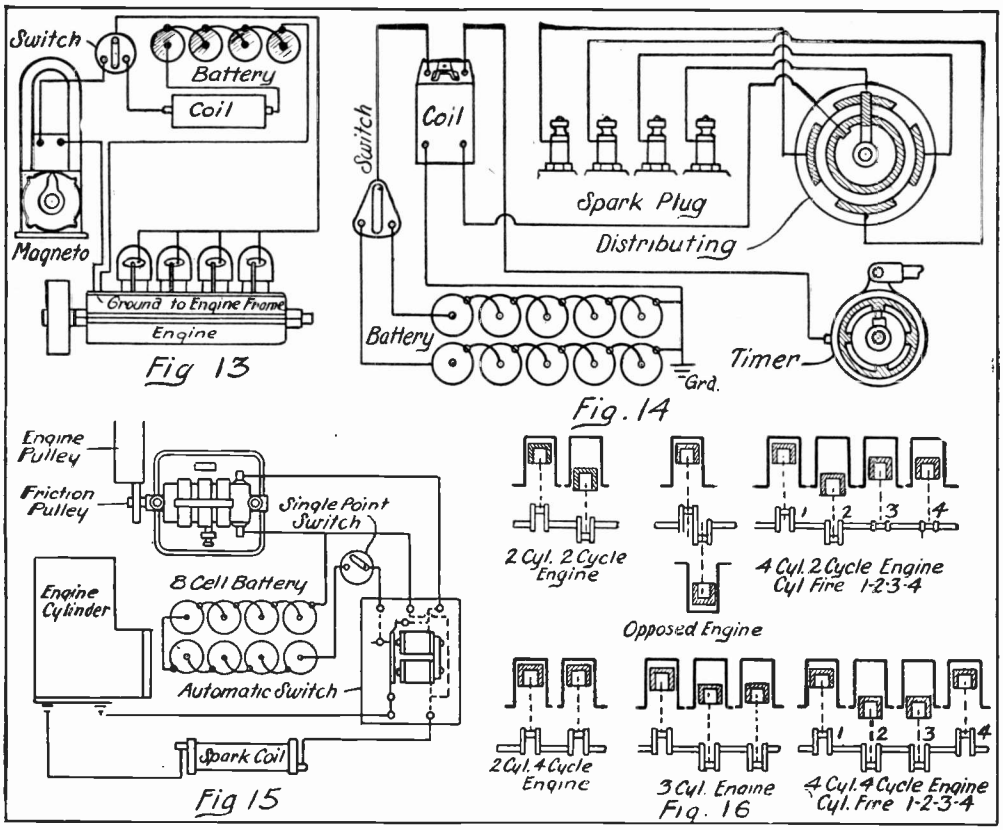


Fig. 8 describes a make and break system on a two cylinder engine.

Fig. 9 explains a two cylinder engine using a separate coil for each cylinder.

Fig. 10 illustrates two three terminal coils in use on a two cylinder engine.

Fig. 11 shows the connections of a four cylinder engine using a four unit coil, a timer, a magneto and a battery. This system may be used for any number of cylinders by using the proper coil.

Fig. 12 illustrates the connections of a four cylinder engine using a magneto, a battery and separate coils. This diagram is adaptable for any number of cylinders from one to a dozen.

Fig. 13 describes magneto, spark coil and battery connected up for a four cylinder make and break system. Any number of cylinders may be connected up in this way.

Fig. 14 illustrates a single coil connected up to a four cylinder engine and using a distributer. This system is known as the synchronized jump spark ignition.

Fig. 15 shows a primary spark ignition circuit containing a magneto generator, an eight cell chemical battery, and an automatic cut-off or relay.

On some two cycle marine engines there is an insulated button on the timer handle to which the ground wire is attached instead of to the frame. This is a handy rig as the engine may be stopped by pressing this button and breaking the circuit. This feature is especially appreciated when used on an engine which is without a reverse gear, as the spark can be retarded until the engine is nearly stalled, the button is pressed, the timer thrown quickly to the other side of the quadrant and the button released. The engine is now reversed. This method will not always work but the trick can be accomplished about once out

of three times if the operator is real expert at it. Don't let anyone talk you into running your boat without a reverse gear. Every time the engine is reversed on the spark it is a body blow to its health and a few times is liable to do so much damage that it will cost more than the price of a reverse gear to put the engine in shape again.

TROUBLES OF A JUMP SPARK SYSTEM.

If high tension ignition is used you can tell by the sound of the engine whether the missing appears to be confined to certain cylinders. If it is, the cylinders at fault may be quickly discovered by holding down the vibrator of one or more of the coils. If all but one of the vibrators are held down the engine will stop if this one cylinder is not working. When the faulty cylinder has been thus traced, open the pet cocks, retard the spark and turn the engine over slowly by hand until the desired vibrator buzzes and note if the buzz is clear. If the sound is not clear and steady adjust the contact screw by turning slightly. If the spark is much more feeble than that given by the other coils but there is no arcing at the contacts and the vibrator is adjusted as well as possible, the coil is probably short circuited and should be returned to the factory. It stands to reason that this method is not adaptable to a one cylinder engine.

If the vibrator and coil are all right, the spark plugs are probably sooted. With some engines and some plugs this is a very common occurence and the plug is the first thing to be examined. If the plug is clean it is still possible that the porcelain is cracked internally or that the mica has absorbed oil enough to throw a short across it. Try a new plug or exchange the plug from another cylinder. If the cylinder still misses look over the cable for leaks due to water or defective insulation.

If a synchronized jump spark is used, Fig. 14, the symptoms of the different possible troubles will be about as above with the exception that the local misfiring can only be due to leakage in the spark plugs or spark plug cables or to bad insulation in the distributer itself. The latter may be due to water or dirt or metal particles and would not appear if the distributer is kept clean. As the vibrator for all the cylinders is the same one, it requires considerable attention since it has from two to six times the work to do that the ordinary vibrator has in the other systems.

Much of the trouble with spark plug sooting may be avoided by not racing the engine when idle, as the high speed causes the oil in the crank case to splash up onto the cylinder walls and into the plug. This oil is then carbonized by the heat of the explosions, causing the short circuits in the plug and making the engine misfire.

TIMING AN ENGINE.

If there is one thing more than another which the average motor boat owner hesitates to tackle it is timing his engine. This is not the difficult job that it is generally supposed to be until it comes to a four cylinder, four cycle engine. The reason that the latter is complicated is because there are so many marks on the flywheel that it is hard to distinguish which is which.

If the engine is a single cylinder, two cycle affair the timing is comparatively easy. The spark plug is removed from the cylinder and the flywheel turned over until the piston is at the top of its stroke but has not gone over the center. A mark is then made on the flywheel and the timer set so that the explosion takes place at just that point of the stroke. The reason for setting the spark just before the piston goes over the center is because a charge of gasoline does not explode instantaneously but requires an appreciable length of time; therefore, if the piston has gone over the center before the explosion takes place the full effect of the charge is lost and only about one-half of the impluse goes into the power stroke.

If the engine is a two or more cylinder, two cycle machine the position of each piston is marked on the fly wheel and the timer contacts set accordingly and the cylinders explode in order.

In a four cycle engine, however, the job is more difficult, as not only is the position of each piston marked on the flywheel but also the position of each inlet and exhaust valve. This naturally makes a good many marks on the flywheel and brings many of them very close together. The timer is set in accordance with the pistons and the valves are set by changing the position of the cams on the cam shaft.

Fig. 15 shows the different arrangements of the crank shaft and the position of the pistons which will show very clearly how the timer should be set for each kind and size of engine.

IGNITION DON'TS FOR MOTOR BOATMEN

Don't try to start an engine with worn out batteries.

Don't try to run an engine with soot fouled spark plugs.

Don't let batteries get wet.

Don't run wires through bilge water.

Don't let wire connections get loose.

Don't stop the motor and leave the charging switch in contact.

Don't let bare wires come in contact with the motor.

Don't let wire terminals get loose or corrode.

Don't forget that 85 per cent of motor failures are due to electric trouble.

Don't fool with the spark coil. The vibrator is adjusted at the factory and seldom needs readjustment.

Don't screw the vibrator contact too tight or it will burn out the contact points. Get a new battery.

Don't expect satisfactory results from a poor or worn out battery.

Don't try to start the engine without making sure that the spark lever, commutator or timer is retarded.

Don't try to start an engine without closing the switch.

Don't put a wrench on the upper nut on the spark plug when the plug is in the engine. You may ruin the plug.

Don't screw a spark plug tightly into a cylinder when the latter is hot. You may not be able to get it out when the engine cools off.

Don't forget to throw out the switch or pull the button and put it in your pocket when not running.

Don't expect the engine to run with loose wire connections, weak batteries, dirty spark plugs or poorly insulated wire.

Don't think it a waste of time to clean off the ignition points occasionally.

Don't adjust the carbureter as soon as the engine works badly. Look at the ignition system first.

Don't pile anything on the batteries or coil.

Don't conceal wiring under the floor.

Don't have a leaky battery box and don't keep it in an exposed place.

Don't use a single set of batteries; series multiple last longer.

Don't forget the ammeter if dry cells are used.

Don't forget to carry an extra spark plug, a vibrator for your spark coil, some extra ignition wire, a small piece of fine emery cloth for cleaning your plugs, a fresh set of battery and a large quantity of common sense when going any distance from home in a motor boat.

From the foregoing article it will be seen that the electrical end of the gasoline engine has much to do with the actual smooth working of the engine, and when a motor boatman conquers the electrical part of his engine he may go cruising without fear or favor, providing, of course, that his gasoline tanks are full and the lubricating oil is running right.

Protectors of the Network

Electric current for light and power is almost universally distributed as alternating current. This current at a high voltage or pressure is sent out from the power plant to distributing points in the various localities served. Here the current is passed through transformers which "step down," that is, reduce the voltage sufficiently to make it safe to be used for household and ordinary power purposes. A transformer is capable of serving a group of customers, the lines running out in all directions from the low voltage winding. All of these transformers in a given district are interconnected to form a network, both the low voltage and the high voltage mains which are entirely separated and distinct from each other, being so interconnected. A network will then form the source of supply for all the customers in the district, the transformers dividing the load among themselves.

This system takes advantage of what is called the "diversity factor" of the customers' demands. That is to say, since the customers will never all demand their maximum of current at the same time, the total capacity of the interconnected transformers need not be as great as would be the case if each customer required an individual transformer as was once common practice.

But even the interconnected system has a disadvantage. In case of one transformer burning out or in any other way causing a short circuit on the line the primary fuse on that particular transformer is at once blown, dropping that unit out of the network. The load which this transformer was carrying must now be carried by the other transformers. And in addition these transformers must take care of what is called a "short circuit current" which the crippled transformer will draw from the network.

On account of the resistance of the various cables connecting all the transformers, the drop on the line, as engineers would say, the transformer nearest the disabled one will now take up most of the additional load and its fuse in turn is likely to let go. Therefore, it is quite possible that all of the transformers in the district will one after another blow their fuses after the first one has been disabled.

This is one of the hundred and one things which may happen to a distribution system which the general public seldom takes into consideration in passing judgment on the company's service. But let it be remembered, however, that there are a great many things like this that might happen and that no sooner does the possibility arise than someone must set to work to design a remedy in anticipation.

In this case a remedy has been devised which is called a network protector, designed by the Metropolitan Engineering Company of Brooklyn, N. Y. It is beyond the province of an article in a non-technical magazine to explain the details of its operation. Suffice it to say that the protector is in itself a little transformer so connected to the primary and secondary distributing mains that it acts as a delicate electrical balance. When everything goes all right the protector plays no part, but as soon as the transformer to which it applies gets into trouble the protector "gets busy" and cuts the transformer out of the network instantly, and by reversing the polarity of certain coils actually gets electrical pressures within the sick transformer to opposing the destructive short circuit current above alluded to from rushing into it out of the surrounding network. With this short circuit current killed even before it can start the other transformers on the system can safely take on the work which the disabled one has dropped and continuity of service is preserved.

Advantages worthy of note are that the protector is entirely electrical, positive in action, free from moving parts and requires no attention or adjustment.

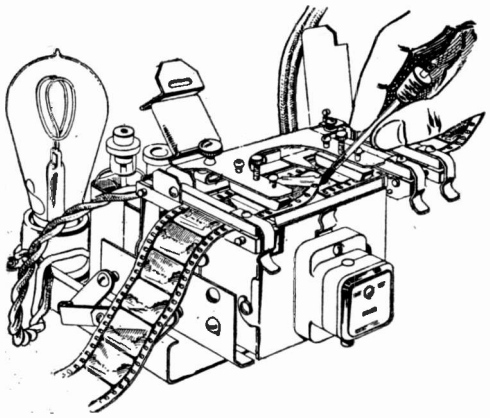
This is but one example of scores and scores of wonderfully designed and constructed protective devices found in every

nook and corner of an electrical generation and distributing system, and all designed to do away with the human element in every way possible.

We all insist on continuous service. We are apt, many of us, to raise an outcry if our lamps flicker for a moment or if for two seconds they should go out all together even if that were to happen but once a year. But is it not well at the same time to give a thought to what might the state of affairs have been if millions of money and the best engineering brains of the country had not been expended in developing these intricate, automatic devices which hold the electric force in check and control it to a nicety?

Film Mending Machine

Every moving picture operator knows from experience under what trying conditions a film sometimes becomes torn or broken and how the film must be scraped and the torn edges trimmed down evenly so that a perfect joint and perfect registration of the perforations along the edges may be obtained in mending it.

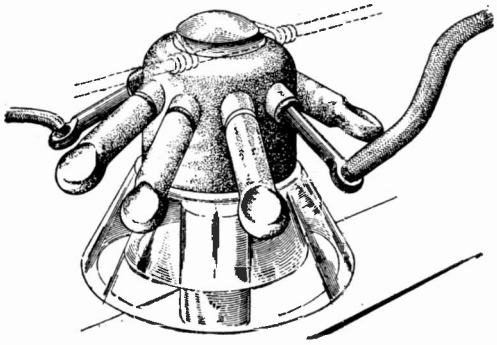


FILM MENDING MACHINE

The invention of Edward J. Schafer, Seaside, Oregon, provides for a repairing machine attachable to any rewinding machine and arranged to swing out into the film's path when needed. A transparent plate with a light under it clamps the scraping and cutting mechanism.

Odd Current Distributing Insulator

This illustration, looking something like the picture of an octopus, is a petticoat insulator made so that wires may be connected to it for branch circuits. The insulator has a threaded top upon which



OCTOPUS INSULATOR

may be placed a metallic ring having a number of projecting insulated arms to which wires are connected by soldering, screwing or riveting into the eyes. A patent on the device has been granted to Ernest H. Knutz, Arcata, Cal.

The Electrician's Stationery

Any man in the electrical business should pay attention to the quality of his stationery and the printing of the same, for the character of an electrician's workmanship and his standing are judged to a considerable extent by the writing materials he uses. A good crisp bond paper, either white or tinted, of the regulation typewriter size, is the best material for practical use.

Heed particularly the letterhead. Here is an opening for originality in the arrangement and wording of the printed matter. Try to simplify the wording so that it shall be neat in appearance, concise and comprehensive.

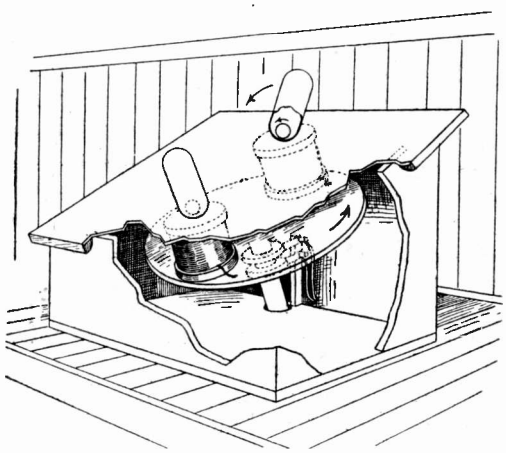
Whatever the style of the letterhead may be, the envelopes must be of the same paper and the return address printed in the manner characteristic of the letterhead, though on a reduced scale.

area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is expressed in depth in inches.

The "miner's inch," the unit used in connection with placer mining, also expresses a rate of flow and is applied to water flowing through an orifice of a given size with a given head. The head and size of the orifice differ in different localities, thus making it a most indefinite and unsatisfactory unit. Owing to the confusion arising from its use, it has been defined by law in several States. The California miner's inch is in most common use in the United States and was defined by an act approved March 23, 1901, as follows: "The standard miner's inch of water shall be equivalent or equal to 1½ cubic feet of water per minute, measured through any aperture or orifice."

The Tumbler Boxes

A dealer in talking machines and phonograph records emphasized his advertising argument that his records were entertaining, by a show window display.



THE BOXES EXECUTE A SUCCESSION OF SOMERSAULTS

Two cylindrical record boxes were provided with round ends and placed upon a table, the top of which was inclined. Passers-by saw these boxes executing a succession of somersaults in a circle upon the table top. The peculiar action of the tumbler boxes is due to two electro-magnets made to rotate under the table top and to their attraction for a soft iron ball in each box.

Photo-Electric Cells

The thermopile and photo-electric or light cell have much in common. In the thermopile a bundle of wires or strips of different metals are joined at the ends and the two ends of the bundle kept at different temperatures. This maintains a difference of potential or electrical pressure between the two ends and a current may be obtained.

In the light cells two plates of metal or compounds immersed in a suitable solution are so arranged that one metal sheet is in darkness and the other exposed to light. A current flows from one pole to the other with a voltage depending somewhat on the substances used.

Becquerel, Grove and Sabine observed the effect of light falling on the platinum electrodes of a voltmeter, but Minchin was the first to make a real photo-electric cell. This was in 1880. His device was exceedingly simple. Two sheets of metal, possibly tinfoil, were separated by blotting paper and so placed that only one plate was illuminated. Minchin experimented with sunlight and the light from burning magnesium. By means of a delicate galvanometer in circuit he detected an appreciable current as a result of the unequal illumination.

Fleming's modification was a natural developement. Instead of using two flat plates, he made the cell of two concentric cylinders with the cylinder of blotting paper between. As in Minchin's cell the metal sheets were immersed in pure water. Of course the inner cylinder was in darkness and a difference in potential easily observed.

Kitching's cell, invented in 1882, was more complex. He used silver plates for the poles and could of course have de-

tected a current had they been placed in pure water and one plate illuminated strongly. But Kitching varied the plan somewhat by coating the silver plates with freshly made silver chloride and acidulating the water in the cell with a little hydrochloric acid. This proved to be a decided improvement, and when one plate received much more light than the other a current flowed from the light plate to the shaded one. In explanation it may be suggested that since light decomposes silver chloride—as in photography—a difference in concentration at the two poles results and the light cell then becomes a simple concentration cell setting up an electric current until the concentrations at the poles again become equal.

Sauer's photo-electric cell (1882) and others of its type and delicacy may prove of great value in weather observations. A porous cup containing a little mercury in which dips a platinum electrode is set inside a square glass vessel which contains a solution of 100 parts water, fifteen parts common salt and seven parts copper sulphate. An electrode of silver sulphide is hung in this outer glass jar. The whole contrivance is set in a box of wood or other opaque material with a door at the side. When the box is dark a slight current is noted, the platinum being the positive element. If now the side of the box is opened, the current increases in proportion to the intensity of the light. In fact it is abnormally sensitive to a very slight change in the intensity of light received. If in circuit with a galvanometer, an unrolling band of paper and a tracing pen it could record the variations in sunlight for an indefinite period. It is supposed that the copper sulphate acting upon the salt forms copper chloride, or cupric chloride, to be exact. This is then reduced to cuprous chloride by the mercury and finally this cuprous chloride acts upon the silver sulphide to form silver chloride. However, this last reaction does not occur without the aid of light, hence the sensitiveness of the cell to variation in light. Another light cell of value in measuring candle power is the Rigollet and Randall type. The poles are two copper oxide plates immersed in pure water. If one of these plates receives strong light while the other is in darkness a current of the order of millivolts is set up. The increase in electrical pressure is directly proportional to the light up to a certain point, hence it is possible to measure small candle power by this device. The electrical pressure is also proportional to the number of cells in series. A very interesting point in this connection is that coloring the copper oxide plates with various dyes, such as eosin, malachite green, naphtol yellow and other organic dyes, gives a notable increase in pressure or voltage. Very different effects are also observed if the cell is moved along the spectrum from red to violet light.

In all probability this suggests the real explanation of the action of all photo-electric cells. Ultra violet light whose waves are shorter and more rapid in vibration than the visible violet rays has a marked reducing action on many chemicals in solution. For example, nitrates are reduced, in water solution, to nitrites. Now oxidation or reduction at either pole in any solution will produce a current of electricity, so the reducing action of light in particular ultra violet light, exerted on one pole only will just as surely produce a current. Furthermore it has been found quite recently that some metals when immersed in water and exposed to strong ultra violet light, throw off minute charged particles in what is called the colloidal condition. This cannot be done without leaving an opposite and equal charge on the metal plates and a passage of electricity to the other pole not so exposed to the light results. Further investigation of metallic colloids may add considerable to our knowledge of photo-electric cells.—HARRY. N. HOLMES.

What is an Electrolier?

What is an electrolier? This question may sound simple inasmuch as it has been customary to call a chandelier for holding electric lamps as distinguished from a chandelier for holding gaslights, an "electrolier." Recently, however, various manufacturers of cut-glass electric portables, and even manufacturers of street lighting standards, have been calling their products "electroliers." Evidently, therefore, we must fall back on the general definition given in most dictionaries—that an electrolier is a support for electric lamps.—*Electrical Record.*

Flashing Election Returns

On the night of the recent national election, the Oregon Power Company, in conjunction with the Bell Telephone Company, transmitted election returns to every electrically lighted home in the city of Albany, Ore., by switching the lighting circuits on and off according to a system of flashes as follows: One dash (five seconds darkness) indicating Taft's election; two dashes (two intervals of darkness of five seconds each) indicating Wilson's election; three dashes (three intervals of darkness of five seconds each) indicating Roosevelt's election; four dashes indicating result as doubtful. The Bell Telephone received returns over its telegraph wires and transmitted them to the Oregon Power Company.

Electricity, Brandy and Champagne

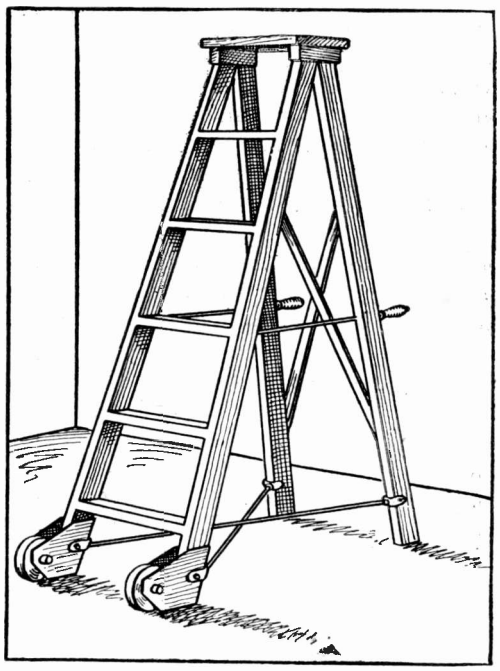
It is reported from abroad that, fanciful as the idea may appear, some success is attending the use of a wireless telegraph station to "age" and clarify wines.

It has been some years since chemists first conceived the notion of utilizing the action of electric currents of high frequency in the perfume industry. A kind of electrolysis, not yet fully explained, unites and compounds the diverse essences.

This phenomenon inspired some curious experiments in France. An electric generator of high frequency was installed in the storerooms, warehouses and wine vaults in order that Hertzian waves might be communicated to the spaces about the bottles. By this means, it is claimed, two widely differing results are to be expected—the aging of the cognac and the drawing out of the deposit which the fermentation process causes about the cork.

Ladder for Lamp Tending

Where a large number of incandescent lamps on the same floor and out of reach in fixtures are regularly cleaned it necessitates the lifting about of a step ladder. To transform a step ladder into an easily movable affair, wheels may be attached to metal shoes into which two legs of the



LAMP TENDER'S LADDER

ladder set. When all four standards of the ladder are on the floor it is firm. By raising the rear legs a trifle the whole structure can be pushed about on the wheels.

Electrical Securities

By "CONTANGO"

As suggested in the last issue of this magazine further mention will now be made of some of the large consolidated electrical undertakings which illustrate the points brought out in previous articles as to capitalization, bonded indebtedness, yield at the price at which you can purchase with other details briefly told. Such organizations present excellent opportunities for the investor's money and while the object is not specially to pass on the merits of the corporations named, yet the facts presented are set forth as worthy your consideration. Before investing your money in the securities of a company you will of course expect to inform yourself on the financial condition of that company—its capitalization, indebtedness, earnings, etc. To enable you to do this reliable companies issue at regular intervals financial statements. It will be well then to analyze quite carefully the few examples which follow so as to be able to judge of others that may come to your notice from time to time, as this is precisely the kind of information you should ask for and obtain in connection with any investment of similar nature which you may contemplate.

Pennsylvania Water, Light and Power Company

The Pennsylvania Water & Power Company is a Pennsylvania corporation, the development being located at Holtwood, Pa., on the Susquehanna River, about 20 miles from tidewater of Chesapeake Bay. The company has in operation about 73,000 horsepower, the ultimate capacity of the plant being estimated at about 120,000 horsepower.

The company owns a right of way 100 feet wide and 40 miles long from its plant to the City of Baltimore, carrying six aluminum transmission lines upon 400 steel towers, ranging in height from 58 to 120 feet; these towers also carry private telephone lines. There is also a handsome substation in Baltimore with a capacity of 65,000 horsepower, with space for the addition of 13,000 horsepower when needed. Power has been delivered in large quantities to the Consolidated Gas & Electric Light & Power Company and the United Railways & Electric Company of Baltimore.

The company's surplus earnings after paying the bond interest for the year ended December 31, 1911, were $66,-200. As this was the company's first year of operation, the above earnings may be considered satisfactory. The price of the bonds at the close of 1912 was 92 to 94, which means a yield considerably better than five per cent; the price of the stock at the end of the year ranged from 69 to 71.

United Light and Railways Company.

The United Light and Railways Company was organized in July, 1910, for the purpose of acquiring, financing and

Pennsylvania Water & Power Co. (Incorporated January, 1910, in Pennsylvania)

BONDED INDEBTEDNESS

	Authorized	Issued
Penna. Water & Power 1st Mtge. Sinking Fund Fives, J &. J.....	$12,500,000	*$7,930,000

Issued in $1,000 denominations; bonds may be registered as to principal and mature January 1, 1940. The Sinking Fund Provisions, for the purchase of bonds at not over 105, are 1915 to 1919 $50,000 per annum; 1920 to 1924, $75,000 per annum, thereafter $100,000 per annum.

CAPITALIZATION

	Authorized	Issued
Capital Stock (par 100).....	$8,500,000	$8,495,000

*Including $250,000 set aside to cover plant extensions during 1912.

operating public utility properties and has acquired and now owns directly, or through ownership of all or a very large majority of the stock, the following properties: Chattanooga Gas Company; Cedar Rapids Gas Light Company; Cedar Rapids and Marion City Railway Company; Ottumwa Gas Light, Heat and Power Company; Fort Dodge Light and Power Company; Citizens Railway and Light Company; Laporte Electric Company; Laporte Gas Light Company; Cadillac Gas Light Company; Grand Rapids, Grand Haven and Muskegon Railway Company, and the Tri-City Railway and Light Company. The last named company serves Davenport, Ia., Rock Island, Moline, East Moline, Ill., and adjoining towns including an interurban railway between Davenport and Muscatine, Ia.

The United Light and Railways Com-

CAPITALIZATION	Authorized	Outstanding
First Preferred Stock, 6% Cumulative	$12,500,000	$5,000,000
*Second Preferred Stock, 3% Cumulative	5,000,000	3,000,000
Common Stock	12,500,000	5,287,500
First and Refunding 5% Bonds	.....	4,375,000
One year 5% Note due June 10, 1913	.....	750,000

The first and second preferred stocks of the company pay quarterly dividends January, April, July and October.

*Of the outstanding $3,000,000 of second preferred stock, $775.000 is convertible at the option of the owner into either first preferred or common stock of the company, share for share, on October 1, 1913. The remaining $2,225,000 second preferred is convertible at the option of the owner into either first preferred or common stock of the company, share for share, on June 15, 1915.

The company has no floating debt, nor have any of the subsidiary companies. The United Light & Railways Company will advance to the underlying companies, as needed, the necessary funds for extensions and betterments to property.

The $750,000 one year note above mentioned was issued on account of purchase price of a recently acquired property and will be refunded before due date from the cash balances of the company or from the sale of additional preferred stock.

The company has a large amount of cash working capital.

ESTIMATED EARNINGS AND CAPITALIZATION STATEMENT

For 12 Months Ending	July 1, 1913	July 1, 1914	July 1, 1915	July 1, 1916
First Preferred Stock	$5,000,000	$6,775,000	$7,000,000	$7,000,000
Second Preferred Stock	3,000,000	2,225,000	2,225,000	2,225,000
Common Stock	5,287,500	5,537,500	5,537,500	5,537,500
United Light & Ry's Co. 1st 5's	5,750,000	6,250,000	6,750,000	7,250,000
Gross Earnings	$4,950,000	$5,425,000	$5,925,000	$6,425,000
Operating Expense, including taxes, maintenance, etc	2,895,000	3,165,000	3,445,000	3,705,000
Net Earnings	$2,055,000	$2,260,000	$2,480,000	$2,720,000
Interest and dividend charges of subsidiary companies	894,722	894,722	894,722	894,722
Balance	$1,160,278	$1,365,278	$1,585,278	$1,825,278
Interest on United Light & Railway Co's 5's	287,500	312,500	337,500	362,500
Balance	$872,778	$1,052,778	$1,247,778	$1,462,778
Interest on $750,000 1 year note	37,500	.....	.....	.....
Balance	$835,278	.....	.....	.....
Dividend 6% on 1st Preferred Stock	300,000	394,875	420,000	420,000
Balance	$535,278	$657,903	$827,778	$1,042,778
Dividend 3% on 2nd Perferred Stock	90,000	72,563	66,750	133,500–6%
Balance available for dividends on the common stock, depreciation, etc	$445,278	$585,340	$761,028	$909,278
Equal to	8.5%	10.5%	13.75%	16%

pany's operations as noted are conducted in the States of Iowa, Illinois, Indiana, Michigan and Tennessee, a large portion of them, however, being in the States of Illinois and Iowa. In all of this territory the franchise situation as a whole is stated to be good, the majority of the rights extending to 1929, 1930 and later dates and some are perpetual. The percentage of gross earning capacity of properties operating under shorter franchises than mentioned is less than thirteen per cent of the total.

Finally it may be mentioned the new money requirements are almost entirely for extensions and betterments necessitated by the rapid growth of the business.

At the close of 1912 the common stock was selling 77 to 80; the first preferred 84 to 86 and the second preferred 74 to 76 which means a yield on the first preferred of 6.97 per cent and on the second preferred of 3.94 per cent at the prices mentioned.

The table of estimated earnings just set forth shows that the estimated earnings for the first fiscal year's operations of the company under the present management were equal to four times the interest charges on United Light and Railways Company bonds—that the dividends on the first preferred stock after all prior charges should have been earned were nearly three times and that the dividends on the second preferred stock after all prior charges should have been earned were nearly six times, leaving the balance of more than eight per cent for the common stock on that basis of estimate.

Public Service Company of Northern Illinois.

The Public Service Company of Northern Illinois was organized under the laws of Illinois in 1911. It has acquired and now owns in fee all the properties formerly belonging to the following companies: North Shore Electric Company; Economy Light and Power Company; Chicago Suburban Light and Power Company; Illinois Valley Gas and Electric Company and the Kankakee Gas and Electric Company.

The company operates in thirteen counties in the northeastern part of the State of Illinois practically surrounding Chicago, serving a territory with a combined population approaching 500,000. The service rendered includes the supplying of electricity, gas, heating, domestic water and the operation of one street railway. The territory has grown rapidly and is likely to continue to grow equally rapidly.

CAPITALIZATION

Common Stock—	
Authorized	$15,000,000
Outstanding	9,062,500
Six Per Cent Cumulative Preferred Stock—	
Authorized	10,000,000
Outstanding as of Dec. 31, 1912	7,588,075

In considering the earning power of this company it is well to realize that in exchanging securities of the Public Service Company of Northern Illinois for those of the combined companies only $763,000 of the preferred stock was issued in exchange, the balance of the exchange of stock being in the common, and that the additional preferred stock issued for cash was to provide funds to pay for property acquired and the current needs of the company.

The amount of underlying bonds outstanding in the hands of the public has been reduced $2,012,500 in the period of ten months mentioned. At the close of 1912 the preferred stock sold from 99 to 99½ which being practically at par yields almost exactly six per cent. The five per cent bonds were quoted at the close of the year at 97 to 97½ which means a yield of little better than 5⅛ per cent.

These five per cent coupon bonds of the denomination of $1,000 dated October 1, 1911, and due October 1, 1956, are redeemable October 1, 1921, or on any interest payment date thereafter at 110 and interest.

EARNINGS

(As Officially Reported)

Ten months ending August 31st	1912	1911
Gross Earnings	$2,831,682.73	$2,567,067.68
Operating Expenses, including taxes	1,726,387.84	1,680,614.26
Net Earnings	$1,105,294.89	$ 886,453.42
Bond Interest	507,698.42	450,489.35
Balance	$ 597,596.47	$ 435,964.07

BONDED DEBT

Public Service Company First and Refunding 5's		
Issued	$8,734,000.00	
In Treasury	534,000.00	
Outstanding in the hands of the public		$8,200,000.00
Underlying bonds on portion of property (to retire which a sufficient amount of Public Service Company First and Refunding bonds are reserved with the Trustee) outstanding in the hands of the public		$5,916,500.00

SECURITY OF BONDS

These bonds are secured by a mortgage covering as a direct lien all fixed property now owned or hereafter acquired by the company. The mortgage is now a first lien on that portion of the company's properties formerly belonging to the Illinois Valley Gas & Electric Company, and to the Chicago Suburban Light & Power Company. These two properties produce about 30 per cent of the gross earnings of the combined properties acquired by the company. The bonds are further secured by the deposit with the trustee of $3,198,000 par value of underlying bonds as follows: $2,069,000 North Shore Electric Company first and refunding 5's; $222,000 North Shore Electric Company first mortgage 5's; $421,000 Econom / Light & Power Company first mortgage 5's; $408,000 Kankakee Gas & Electric Company first and refunding 5's, and $78,000 Citizens' Gas Company first mortgage 5's. The first and refunding bonds, therefore, are not only a direct first lien on properties producing approximately 30 per cent of the total gross earnings of the company, but in addition share in the lien represented by the deposited bonds.

STANDARD GAS AND ELECTRIC COMPANY.

The Standard Gas and Electric Company was incorporated April 28, 1910, under the laws of the State of Delaware and controls companies located in Minnesota, North Dakota, Wisconsin, Illinois, Iowa, Arkansas, Alabama, Oklahoma, Colorado, Montana, Idaho, Washington, Oregon, California and Kentucky. The service consists of supplying gas, electric light and power, steam heat, telephone and street railway service. This company is controlled by H. M. Byllesby and Company, the well known public utility financing and operating engineers of Chicago, who in this case operate the subsidiary companies and who have a country-wide reputation in succesful operation of properties of this character.

As showing the amounts of bonds, preferred and common stock of the subsidiary companies taken over and absorbed in the issues of the holding company the table on the following page is interesting. It moreover gives a very good example of the methods pursued:

CAPITALIZATION

	Authorized	Outstanding
Preferred Stock, 8% (cumulative from June, 1912), Par $50	$30,000,000	$10,977,950
Dividends payable March 15th, June 15th, Sept. 15th and Dec. 15th.		
Common Stock, Par $50	15,000,000	9,343,150

BONDS

	Authorized	Outstanding
In this case there is a funded debt of Convertible, Sinking Fund, Gold 6's	$30,000,000	$10,300,000

These bonds are dated December 1, 1911, and are due December 1, 1926. Subject to call at 105 and interest, but convertible at the option of the holders into preferred stock on the basis of $110 bonds for $100 of stock.

HOLDINGS

As of 1912	Bonds	Preferred Stock	Common Stock
Arkansas Valley Railway, Light & Power Co. 5s	$3,510,000	.....	$3,499,400
Consumers Power Co. (of Minn.) 5s	1,970,000	.....	.....
Enid Electric & Gas Co. 6s	20,000	$439,300	499,500
Everett Gas Co. 5s	915,000	124,200	628,400
Ft. Smith Light & Traction Co. 5s	150,000	798,700	949,900
Louisville Gas Co	.....	.....	99,800
Mississippi Valley Gas & Elec. Co	.....	1,000,000	1,248,500
Mobile Electric Co. 5s	241,000	277,500	864,200
Muskogee Gas & Electric Co. 5s	218,000	541,500	765,000
Northern Idaho & Montana Power Co. 6s	1,465,000	25,000	1,000,000
Northern States Power Co	.....	498,200	759,500
Oklahoma Gas & Electric Co	.....	1,294,300	1,150,000
Olympia Gas Co. 5s	70,000	.....	.....
Ottumwa Railway & Light Co. 5s	218,000	234,500	630,200
San Diego Cons. Gas & Electric Co	.....	.....	2,715,000
Southwestern General Gas Co. 6s	528,000	25,000	1,000,000
Tacoma Gas Co. 5s	755,000	306,800	875,500
Tacoma Gas Light Co. 5s	683,000	.....	.....
Western States Gas & Electric Co	.....	149,600	3,145,700
Sundry Notes	121,000	.....	.....
Totals	$10,864,000	$5,714,600	$19,830,600

At the close of 1912 the common stock sold from 22 to 23½ and the preferred at 50 to 51½, making the yield on the preferred 7.92 per cent or practically the guaranteed eight per cent.

The company's earnings in the first fiscal year presented were as follows:

STATEMENT OF EARNINGS

	Year ended June 30, 1912
Gross Earnings	$1,919,052.07
Expenses	37,698.96
Net Earnings	$1,881,353.11
Interest Charges	469,557.92
Available for Dividends	$1,411,795.19
Preferred Stock Dividends	684,894.72
Surplus	$ 726,900.47

By way of explanation it may be said that when a holding company finances through a bond issue, it is usually secured by the deposit of the securities of the subsidiary corporations or, in other words, the issue becomes a collateral trust mortgage. It is usually attempted to determine the amount of such bond issues by the value of the underlying properties as applicable to the securities actually obtained by the holding corporation which in turn bears direct relationship to the cost of acquiring these securities. Quite obviously such a process is largely a matter of appraisal.

Very often, however, preferred stocks will be the senior issue of the holding company and more than in the case of bonds, are inclined to bear relationship to the earning power of the properties acquired. These bonds, therefore, underlying or second in security, seldom represent new capitalization in the full sense of the word, because they are usually devoted to acquiring the securities of the subsidiary properties. Their further issue is to provide other tangible values acquired by the company, and the adequacy of these values determines the conservatism of the issue—the relation of tangible and physical assets to the mortgage. And finally the primary test of the financial success of any company is the stability of the underlying bond and preferred stock issues.

CITIES SERVICE COMPANY.

This company controls, through ownership of their capital stocks, the Denver Gas and Electric Light Company, Spokane Gas and Fuel Company, Empire District Electric Company and the Brush Light and Power Company. It serves a growing population of about 450,000 with light, fuel, and power.

CAPITALIZATION

	Authorized	Outstanding
Preferred Stock (6% Cumulative)	$30,000,000	$10,195,360
Common Stock	20,000,000	5,499,430

STATEMENT OF EARNINGS

Gross earnings for 12 months ending September 30, 1912	$1,152,252.87
Expenses	82,596.86
Net Earnings	$1,069,656.01
Dividends on Preferred Stock	586,932.28
Balance for Common Stock	$482,723.73
Dividends on Common Stock	200,855.32
Surplus for 12 months	$281,868.41
Total Surplus to September 30, 1912	$503,797.11

Twelve months ending	Net Earnings.	Ratio of net earnings to dividends paid and accrued on average amount of Preferred Stock outstanding for the year.	Per cent earned on average amount of Common Stock outstanding for the year.
Mar. 29, 1912	$ 974,186.79	180.00	8.61
Apr. 30, 1912	990,780.26	180.30	8.69
May 31, 1912	1,007,640.06	180.60	8.75
June 30, 1912	1,023,436.52	180.86	8.81
July 31, 1912	1,040,137.51	181.19	8.89
Aug. 31, 1912	1,053,225.61	181.82	8.95
Sept. 30, 1912	1,069,656.01	182.25	9.03

Dividends are paid monthly at the rate of six per cent per annum on the preferred stock and four per cent per annum on the common stock. This company has paid dividends continuously since its organization in September, 1910, at the rate of six per cent on its preferred stock. On the common stock dividends were paid at the rate of three per cent per annum up to January 1, 1912, since which time the common stock dividend rate has been four per cent. In addition to paying these dividends the company has accumulated a surplus since its organization of $503,797.11.

It is the plan of the company to increase the dividends on the common stock one per cent each year until six per cent is reached, and thereafter to pay on that issue larger cash dividends and, in addition, to distribute annually to common stockholders a portion of the common stock of the company which is reserved for that purpose.

Cumulative Preferred Stock

This represents stock issued and sold to the public on which payment of a certain set rate of interest is assured. Thus it may be six, seven or eight per cent, as the case may be, and after the set dividend has been declared and paid the balance of the earnings may be applied to dividends on the common stock, or if there is a second preferred to the dividend on that.

The term "cumulative" is an additional guarantee, in that it means that if the set dividend or part of it remains unpaid in any year it has to be made up and paid in the next year, or in the first year in which the earnings are sufficient, and before any other dividend is paid, whether on second preferred or common stock or anything else. The preferred stock does not of course come before the bonded indebtedness if there be any, or of the sinking fund bonds forming a funded debt which may, as in the case of the Standard Gas and Electric Company, be convertible into preferred stock.

Bonds as an Investment

Public utility company bonds, as a type of investment, combine the highest degree of security with a constant and increasing earning power based on the fact that public utility companies furnish services which are absolutely necessary to any modern, civilized community.

Public utility concerns are not subject to the influence of bad financial conditions, but continue through periods of prosperity and depression to show, not only a constant earning power, but earnings increasing even in larger proportion than the increase in population.

The urban population of the United States is constantly increasing and each new inhabitant of a community means just that much more use of electricity, gas and transportation.

The introduction of public service commissions in the various states has also done much to place various corporations on a firm footing, inasmuch as under the public service commissions the corporations are not heckled by petty local politicians or forced to pay tribute to an organization under threat of competition.

The concentration and control of the various public utility companies throughout the country in the hands of strong holding companies is resulting in increased efficiency and economy. It is very certain that it will not be long before the bonds of most smaller public utility companies will be the underlying securities of large companies, as for example is the case with the companies treated of in the first part of this article. Thus the Kankakee Gas and Electric Company's bonds are now a constituent part of the securities of the Public Service Company of Northern Illinois.

While security and earning power rightly make the bonds of public utility companies grow in favor with the public, yet the yield as pointed out in the preceding pages by several striking illustrations has a great deal to do with it. Public utility bonds usually pay five per cent and are brought out as a general rule at a discount, that is, below par, so that the investor is able to secure returns from five to 5¾ and at the same time know that his money is conservatively invested.

Curious Uses of the X-ray

Many physicians, especially those of France, in the production by X-ray photography of an apparently solid image of such an object as a broken bone or a foreign substance embedded in the flesh, cause the tube producing the X-rays to oscillate by means of a cam revolving 300 times per minute.

Two radiographic images of the same object, as seen from different points, are thus formed on the viewing screen and by means of shutters electro-magnetically controlled by the oscillating apparatus. The right eye sees one image and the left eye the other, vision being cut off while the tube is changing its position. The result is that the image appears solid. In other words, the effect is stereoscopic.

Among the achievements of practical science is the development of a plant for radiographing pearl oysters to ascertain not only the existence but the stage of development of the pearls without killing the animals or opening their shells.

As many as 500 oysters have been submitted to examination in one minute, hundreds of shells spread on a tray being exposed at one time. Oysters showing no pearls are returned to their beds; those showing partially developed pearls are sent into "hospital" to be nursed, while those whose pearls are full grown suffer the fate that attends all things which possess something that man wants. It is said that radiography is not injurious to the oysters.

SCIENCE EXTRACTS FROM FOREIGN JOURNALS

Blast Firing with Wireless.—In the course of a paper read before a London meeting of the Association of Mining Electrical Engineers, Mr. E. Kilburn Scott referred to the future possibility of firing mine and quarry explosives by the wireless methods, thus securing greater safety for those who are carrying on such work. Shot firing is a risky business at the best, and the farther one can get from the explosion the better one is situated to avoid accident. The adoption of wireless methods for this kind of work would of course extend the possible range of the firing point almost indefinitely. The question is a most interesting one and it only remains to carry out the method in a practical way.—*The Marconigraph, London.*

White Light from the Mercury Lamp.—A German inventor has succeeded in getting a very good white light from a mercury vapor lamp, and should his experiments be upheld in practice this will mean a much wider use for lamps of this kind. Great results were expected from them at first on account of the cheapness of the light, but unfortunately the color of the light is very bad owing to the lack of the red rays. The inventor, Wolfke of Breslau, now finds that the metal cadmium is excellent for this kind of a lamp, when mixed with a small percentage of mercury, and as the cadmium melts at a low heat, he is able to produce a vapor lamp which glows with a brilliant white light. This shows up objects in their natural colors about as well as an arc light, so that the new lamp will be very good for use in stores where the natural colors and shades of goods need to be well shown up. Inventors have long been looking for a solution of this problem, as it is a most practical one from the fact that a really good lamp would be soon taken up by the public.—*Revue Electrique, Paris.*

The Speaking Incandescent Lamp.—After the speaking arc which awakened so much interest, we are now to have the speaking incandescent lamp, and this will be no less remarkable. In fact, it is found that a lamp can be made to act as a telephone receiver, and to do this we need to use a metallic filament such as an Osram lamp of 100 candle power. It is connected on a 120 volt, direct current circuit, with the use of a self-induction coil. In shunt on the lamp is a condenser and also the secondary winding of a telephone transformer. On the primary end of the transformer is a five cell storage battery and a microphone transmitter. Words spoken into the transmitter are reproduced by the lamp, thus giving a most novel effect. To explain this, we may suppose that the telephone currents are added upon the direct current so a to give waves which cause the lamp to burn more or less brightly according to the strength of the waves. This causes small changes of heat in the lamp which act on the glass and the air, so that a sound is heard. Thick glass stops the action, and it is best to use a 500 to 1,000 candle power lamp with thin glass, as this is most sensitive and gives the best sounds.—*Cosmos, Paris.*

Across the Alps by Electric Auto.—An enjoyable trip across the Alps in an electric automobile can be had as soon as the new Swiss scheme is organized, which will be before long. Electric auto-cars are to make the 25 mile trip between Airolo and Ulrichen over a very picturesque country in about two hours, not counting the stops. The road between these two points runs in the mountain region by way of Bedretto Valley and the Nufnen Pass. However, it will take a great deal of work to enlarge the roads and make them suitable for running the heavy automobiles, and a bridge will need to be built over the

Tessin River. The cost of the undertaking which includes roads and automobile plant will be about $500,000. It is proposed to make three trips a day each way and all the year round except when snow hinders the running of the cars.—*Revue Polytechnique, Geneva.*

Engaging Servants by Wireless.—The idea of engaging servants by wireless is a new one, but it was the latest expedient of the ladies in New Zealand. It seems that this serious domestic problem meets with as little solution in the antipodes as in the home country, but the brighter spirits among the mistresses of New Zealand have cut the Gordian knot of their own difficulties in a most ingenious way. News reached Wellington that the *"Turakina"* which was shortly to arrive from London, had on board between 20 and 30 girls willing to enter the domestic service. That was satisfactory as far as it went, but the demand was far ahead of such a small supply. When the vessel landed, a number of anxious matrons were waiting, but they were doomed to disappointment, for the majority of the girls had been booked long before the end of the trip. To their chagrin they learned that their more wide awake neighbors had sent Marconigrams to the ship.—*The Marconigraph, London.*

Introducing Sewing Machine Motors in Strasburg.—Current for running sewing machines is sold on a very satisfactory plan at Strasburg, Germany, at present. The subscriber uses a one-sixteenth horse power, three phase motor and pays about 60 cents a month to the company. At the end of five years he owns the motor and the wiring. He pays for the current itself at another rate this being about two cents per kilowatt-hour, and the motor rent on the ordinary plan without sale is six cents a month. Should this be not paid, the company shuts off the current. It is found that a sewing machine motor of this small size does not cost over two cents per day for current, and beside, the work is done one-third faster by the use of the motor, also a more regular result is obtained as to the quality of the work. Motors are mounted either upon the machine or underneath and one German firm is bringing out a new method for belt stretching by a simple device so as to slow the speed of the motor, doing this by a foot pedal. A brake on the flywheel also brings the machine to a stop very quickly.—*Elektr. Zeitschrift, Berlin.*

Electric Food.—We already referred to the remarkable experiments made in France by Prof. Bergonié in the way of treating the human body by high frequency currents. In this way he was able to add to the heat contained in the body, and this means that the person absorbs a certain amount of energy and therefore needs to take in less food in order to keep up the system. Since then he has been making experiments which are almost of a sensational character. Using the current, he proves conclusively that he can supply heat to the human body and this replaces the heat which would need to come by consuming food or in reality burning it in the human system. We will give an example in order to show what can be done. He took a man of five feet ten inches in height and in very run down condition, as he weighed only 110 pounds. Although eating a great deal of meat, he was quite feeble and could not walk 300 feet without needing aid. Naturally he was not able to work, and was also very sensitive to cold. After a series of treatments by the electric bath lasting for 40 minutes each and corresponding to quite an amount of heat absorbed each time, his weight increased and he now weighs 140 pounds. He eats less food and is able to walk for hours without fatigue, and Dr. Bergonié states that he is almost in usual health and in bright condition. This example speaks volumes and we may expect some surprising results in the future from the new method. It is no

longer to be doubted that electricity replaces food to quite an extent.—*Le-Matin, Paris (daily).*

"Duraluminum."—Seeing that aluminum is largely used in the electrical industries, it will be of interest to speak of the new metal known as "duraluminum" which is brought out by A. Wilm of Berlin. It contains 90 per cent of the pure metal and the rest of various other metals, the exact composition not being given at present, and it is claimed to be much superior to the usual metal. It is strong as well as hard and when used as electric wire for running on poles, it does not need to be handled with as much care to avoid breakage. A span of six miles of steel wire breaks by its own weight, and of aluminum four miles, but the new metal shows as high as 11 miles, so that it is even tougher than steel. Again, when used in 300 foot spans the new wire shows the least amount of sag. By a tempering process, metal pieces can be made quite hard and this will be another good point. It is not much attacked by acid and unlike aluminium it does not corrode in the air. Probably much of the breaking accidents from the pure metal are caused by internal corrosion of cables.—*Revue Electrique, Paris.*

Wireless in the Balkan War.—It is said that the Turkish wireless station at Smyrna was destroyed by the Italian battleship *Pisa* last spring, and a spectator states that as many as 200 shots were fired. Thus there is no wireless post on the coast in the hands of Turkey at the present time but the Turkish vessels are fitted with an old type of Marconi apparatus. Shortly before the outbreak of the war the government secured two portable German sets and at once dispatched them to the scene of war. On the other hand, the Balkan states provided themselves with a good number of portable stations of different makes. The wireless plants at Athens and Varna, which have the latest Marconi apparatus, are able to connect with each other, and their range extends over all the scenes of war. It is stated that these two land posts are of great importance for the co-operation of the land and naval forces, seeing that thirteen vessels of the Greek Navy have new types of wireless apparatus, and these are also mounted on Greek and Bulgarian merchant steamers. The posts on the vessels have a good range and can make connection with the land stations at Athens and Varna at any time.—*Electrical Review, London.*

Wave Motors.—Millions of horsepower are going to waste which the sea could furnish us if only some practical way of running a tidal plant could be found. The idea is in the air at present and there are several projects in hand which are likely to be taken up before long. One of these is brought out by Engineer Pein, of Hamburg, and he proposes to lay out two large basins on the sea coast in Schleswig-Holstein. Two tidal basins connected by a narrow space are used, and the water takes a swift flow between the basins on somewhat the same plan as has been used in old times, but this has never been used on a modern scale and for running as large a plant as the 5,000 horsepower one which he is now designing. Part of the work is already done by a one and one-half mile jetty in the sea connecting with Nordstrand island. The basins will have 2,500 and 1,600 acres surface and the height of the water fall between them is four or five feet, so that with a great volume of water it is possible to run a set of 500 horsepower turbines, ten in number, so as to have 5,000 horsepower. This is only a trial plant, and should it succeed, a much greater amount of power can be obtained in this way by using larger basins and in greater number, as the sea will give an unlimited amount of power.—*Revue Polytechnique,* Geneva.

Electro-Magnetic Velocity

Experiments by Blondot on the rate of propagation of an electro-magnetic disturbance along a wire showed, according to one series of tests, a velocity of 184,183 miles per second, and according to another series, in which the distance traversed was nearly twice as great, 185,177 miles per second. The velocity of light is about 186,300 miles per second.

Electricity from the Sea

At first glance there seems to be no connection between the breaking of sea waves and the electrical condition of the air. Recent investigations, however, show that the shattering of the waves and the scattering of the spray have the effect of imparting positive electricity to the atmosphere. Visitors to the seashore experience a stimulation from the ozone contained in the air, and the presence of this is ascribed to the electrifying action of the spray from the breaking waves.

NEW BOOKS

QUESTIONS AND ANSWERS ON THE NATIONAL ELECTRICAL CODE. By T. S. McLaughlin. New York: McGraw-Hill Book Company. 1912. 210 pages. Price, $1.00.

This is a key and index to the National Electrical Code and classifies and interprets the requirements of the Code in a way to make the information more easily accessible and more readily understood. It recognizes the Code as the established authority, and undertakes to explain its method, purpose and influence.

MOTION PICTURE WORK. By David S. Hulfish. Chicago: American School of Correspondence. 1912. 564 pages with 278 illustrations. Price, $4.00.

The motion picture field comprises two industries, the manufacturing and the exhibiting of film pictures. Both fields are covered in this volume. Drawings, diagrams and numerous photographs are used to present instruction and aid the text. The subject matter is presented in two parts: Part I, The Optical Lantern, Motion Head; Part II, Photography, Motography or Motion Photography, Motion Picture Theater, Electrical Principles.

EXPERIMENTAL WIRELESS STATIONS. By Philip E. Edelman. Minneapolis: Philip E. Edelman. 1912. 219 pages with 80 illustrations. Price, $2.00.

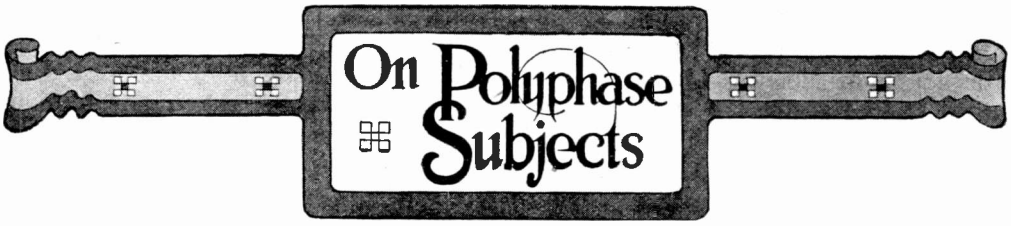
One of the main objects of the book is to provide a standard design for so-called amateur stations which will take the place of the many varieties of hit and miss apparatus constructed by experimenters. It is intended as a guide to a rational, worthwhile study of the art and only matter which directly contributes to the practical has been presented.

ELECTRICITY, ITS HISTORY AND DEVELOPMENT. By William A. Durgin. Chicago: A. C. McClurg and Company. 1912. 171 pages with 57 illustrations. Price, $1.00.

This book is intended for the man who desires a fair understanding of present day electricity, but who finds the statements of textbooks and manuals more detailed than he needs and a bit too dry to hold his interest. It considers the main events in the development of electricity preserving at the same time the romance of the work of the pioneers, past and present.

PRACTICAL MATHEMATICS. By Claude I. Palmer. New York: McGraw-Hill Company. 1912. 136 pages with 20 illustrations. Price, Part I, 75 cents; Part II, 75 cents.

These comprise two of a series of books which are the direct outgrowth of a course in practical mathematics given by the author during the past eight years in the evening classes of the Armour Institute of Technology, Chicago. The students in these classes have ranged in age up to 55 years and have been for the most part practical men who have come to realize the need of a knowledge of elementary mathematics.



From the Land of the Sultan of Sulu

Jolo is the southernmost port of any size in the Philippine Islands. The old and perhaps most familiar name is Sulu (the scene of the play of the Sultan of Sulu is supposed to have been located at this place).

A garrison of two infantry companies is now located at Jolo. Major George A. Skinner of the Medical Corps, United States Army is attached to this garrison and as a subscriber to the magazine he writes an interesting letter concerning conditions there, and one which might be well considered by some of our American manufacturers. Some extracts from the letter follow.

"Through the advertising columns of your magazine I found an engine such as I have long wished, the 'Baby' gas engine of the Elgin Wheel and Engine Company. I have one of these with me, an Edison 40 ampere hour storage battery and a number of six volt tungsten lamps. So we have the only electric lighted house in the island of this group. My little outfit has attracted a great deal of attention and I presume others will put in similar or larger outfits. There is of course no development along this line yet, but undoubtedly there will be.

"The greatest need of the town is an ice machine and when there is sufficient interest in this and electricity I presume some enterprising citizens will construct a plant and combine the commodities.

"We have a moving picture show, rather two of them, and of course each of these has its own engine and produces its arc for the machine. So the people are getting interested in electricity. I also have my Ford car here, electric lighted, and it's better than a circus parade when I take it out as I do from time to time. It is the first one that most of the people have seen. When I leave it for a moment or so there is a crowded street, for the people come from every direction to look at the strange beast.

"I wish you might interest some manufacturer to send out literature of small portable ice machines. They would sell like hot cakes at a county fair. Such machines are made, I know, and recently I saw an extensive description of them in the *Sc. Am. Supplement* of June 15th, but unfortunately the article does not state where they are made or their price. I saw something about a German machine of this character that retailed for about $75.00 that would make 20 or 25 lbs. of ice per day. Such a machine, if it depended upon heat for its action, like the one described in the article referred to, would undoubtedly find a large sale among the residents both here and on the isolated plantations; also on the small and sailing vessels that do not carry ice machines. Of course, here the Government maintains an ice plant of considerable size, but it cannot make nearly enough ice to supply this place alone. So the great need is a small, simple, portable ice machine such as I have suggested.

"Maybe you can hustle up some battery maker to put out a small pocket light of the storage type. The little flash lamps are fine, but by the time we get the dry cells over here they are about half run down and the lamp is out of business too much. If I had a small storage battery to take the place of the dry cells, I could keep it loaded all the time and all ready

for business. But it has got to be good, and not spill its contents, and be fairly strong. There would be a big sale for this class of pocket light. One with a battery capacity of maybe two to four ampere-hours at two to four volts would give great results.

Possibilities of Trade With India

One of the subscribers to this magazine is Mr. J. K. Kripalani of the firm of Gidvani & Co., Ramkrishna Mills, West Katcha, Hyderabad Sind, India. This firm does a general engineering and contracting business acting also as agents for foreign manufacturers. In a recent letter he made some suggestions for the development of business relations between our country and his. Over there they are very favorably inclined toward American products of all kinds, and especially electrical goods; but it is difficult to get them. To quote from his letter:

"The field for general engineering being vast, as I told you, it is ready for exploitation by all business people. The first among those are the English manufacturers and they are reaping a good harvest, first because they are helped by their own English Government as all the Government contracts generally go to them; secondly, because the English manufacturers are nearer to India than others, the mails being only fifteen days and with other countries like America and Germany it takes a month. The goods arrive within a month of order from England while from America it takes three to four months.

Knowing well that time means money no attempt is even made to order in the United States or Germany for the most part. This is a very great handicap. If by any means your government causes direct mail services between your country and ours I am certain business would develop to an undreamt of degree. If this cannot be done then the only other alternative is to send floating museums of your products to our country and finally to establish such museums at all the principal places of our country under the direct superintendence of your consuls.

"These are only a few suggestions to develop real business between your country and ours, for which I am very anxious, for I feel that American machinery and other goods are just the articles most suited to our needs.

"Besides the American manufactures being very adaptable to our requirements we don't experience much difficulty in ordering a variation in designs in our articles, should we so desire them.

"I shall be very glad if my firm comes into more intimate contact with manufacturers on your side and if you could help it in any way I shall feel much obliged.

"The foremost thing will be for me to be in possession of complete literature on the subjects of each manufacturer. The price lists and the discount sheets must accompany the catalogues. Blocks for illustrating their wares and advertising them in our local papers should also be sent. Cable words for all possible enquirers must never be omitted and when possible samples should be sent without hesitation. If the articles are too bulky, small models if in stock may also accompany.

"I feel this you can do very well, by making a special mention of my firm in your magazine for some time you could bring me in touch with most of your manufacturers. Suggest to me some bold enterprising men who would take some risk and venture in sending a few of their articles for donation purposes. All articles in electrical engineering interest me."

Hotel Clerk—I found the "Not to be used except in case of fire" placard those college boys stole out of the corridor.

Manager—Where?

Clerk—They had nailed it over the coal-bin.

* * *

The artist and his young wife had just returned from their honeymoon, when a friend dropped in and found them laughing over something.

"What are you two laughing over?" said the visitor.

"O, it was jolly," said the wife. "My husband painted and I cooked, and then we both guessed what the things were meant for."

* * *

The other day a dairy company's complaint clerk was called to the telephone. "This is Mrs. Mixin," she said. "I want to know if your cows are contented?" "Wha-a-at?" asked the amazed clerk. She repeated her question. "I see that your rivals advertise that their cows are all contented," said she. "I will begin to take their milk unless I am assured that your cows are all happy." The clerk begged her to hold the 'phone a moment. Then he went away and gnawed a corner off his desk. When he got his voice under control he returned to the 'phone. "I've just been looking up the books, madam," said he, "and I am happy to say that we have not received a complaint from a single one of our cows."

* * *

Manager—Where is Jones?

Office Boy—He isn't in. His wife sent him word that the baby was asleep and he's gone home to see what it looks like.

* * *

A teacher gave her pupils an exercise to write on the blackboard.

In the midst of the exercise an urchin began to laugh. She asked him why he was laughing and he answered:

"Joe's put putten where he should have putten put."

* * *

Kid—"I want to ask you a question.

Sister's beau—"What is it?"

Kid—"When you were a little boy and fellers called on your sister did they ever give you a nickel to go out and play?"

The traveling salesman had four minutes in which to catch his train.

"Can't you go faster than this?" he asked the street car conductor.

"Yes," the bell ringer answered, "but I have to stay with my car."

* * *

"Oh, Willie! Willie!" cried a teacher to a hopelessly dull pupil, "whatever do you think your head is for?"

"Well," he replied at last, "to keep my collar on."

* * *

"Oh, mother, why are the men in the front rows baldheaded?"

"They bought their tickets from the scalper, my child."

* * *

"Waitah," said Colonel Clay, as he glanced around the dining room of the big hotel, "you all kin bring me a Kentucky breakfast."

"And what is that, sir?" asked the waiter.

"Bring me a big steak, a bulldog and a quart of bourbon whisky."

"But why do you order a bulldog?" asked the waiter.

"To eat the steak, suh," replied the colonel.

* * *

She—"If you could have only one wish, what would it be?"

He—"It would be that—that—Oh, if I only dared to tell you what it would be."

She—"Well, go on. Why do you suppose I brought up the wishing subject?"

* * *

Never ask leading questions when examining your pupils. Do not hint at the answers. Make the learner find them unassisted."

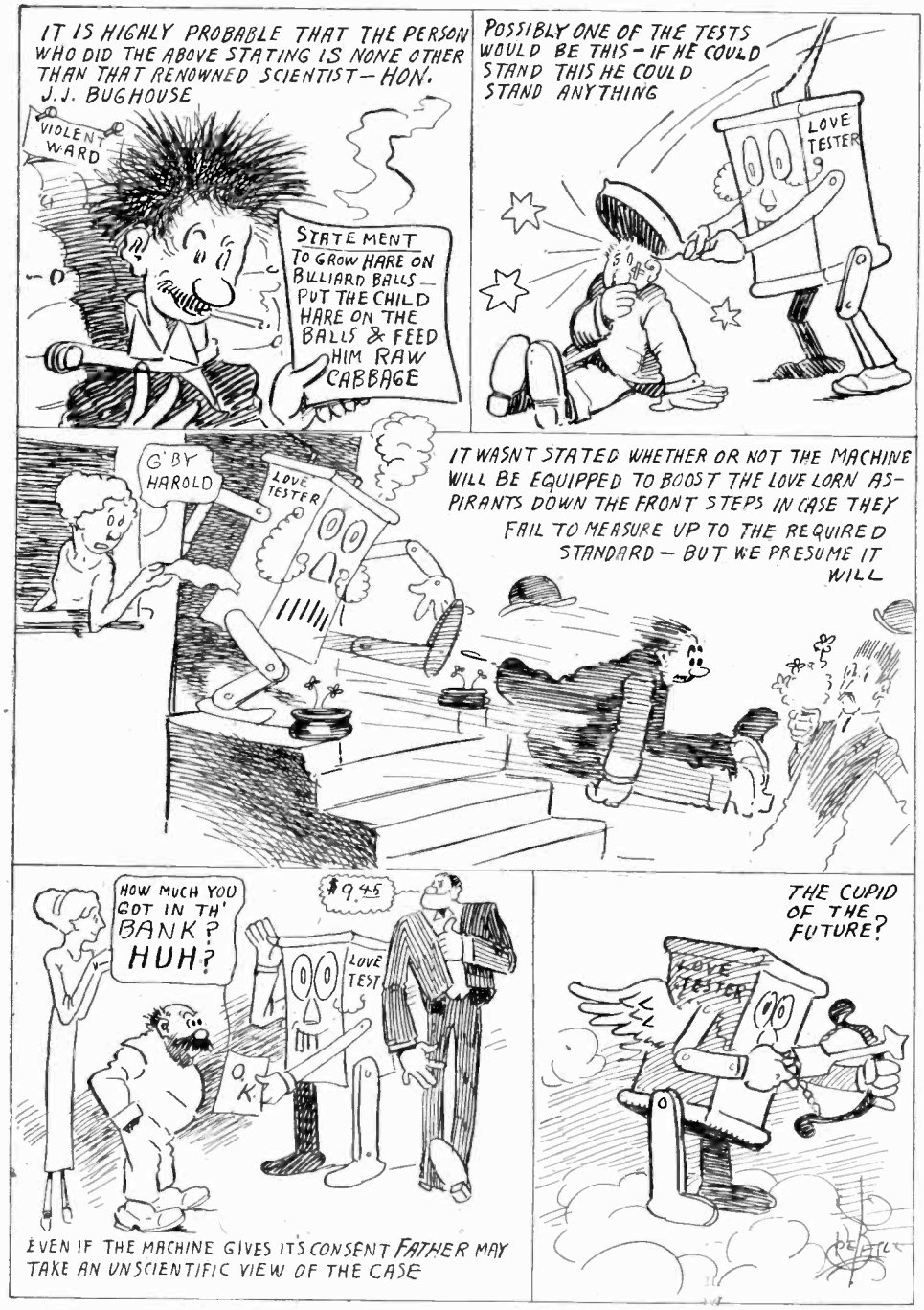
This is how the young lady teaching Greek history obeyed the rule.

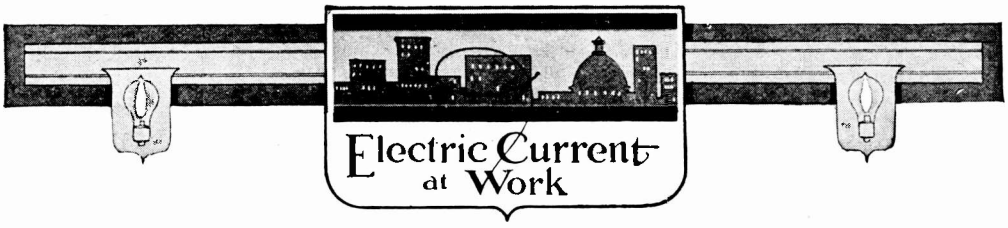
"Willie, who dragged whom how many times around the walls of what?"

* * *

A teacher in a lower grade was instructing her pupils in the use of a hyphen. Among the examples given by the children was the word bird-cage. "That's right," encouragingly remarked the teacher. "Now, Paul, tell me why we put a hyphen in bird-cage?" "It's for the bird to sit on," was the startling rejoinder."

ACCORDING TO PRESS REPORTS MEN OF THE FUTURE WILL CHOOSE THEIR WIVES BY THE AID OF ELECTRICITY. WITH THE AID OF THE LOVE TESTER SWEETHEARTS WILL BE ABLE TO TELL WHETHER THEY ARE REALLY FITTED FOR ONE ANOTHER OR NOT

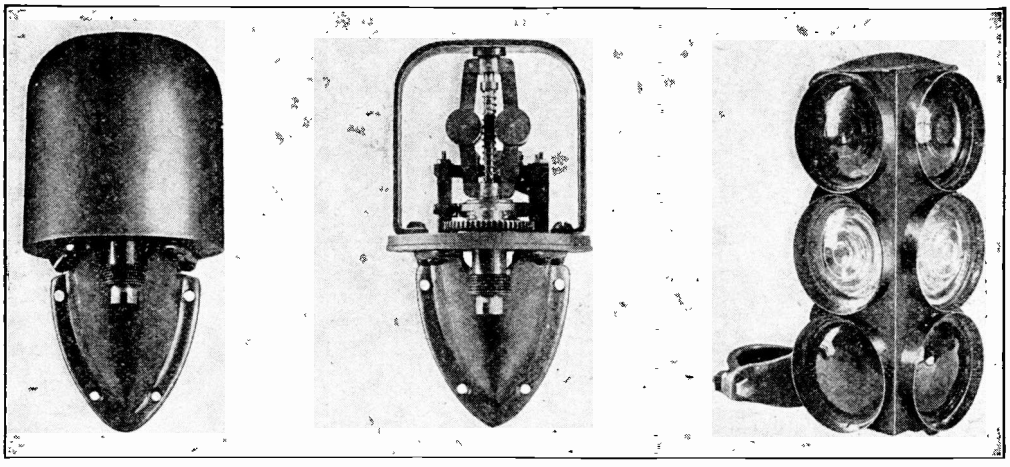




Warning to Motor Speeders

Motorists who exceed the speed laws are to advertise the fact for the benefit of public and police, if the voters of Los Angeles pass an ordinance for which initiative petitions are now being circulated. The proposed law will make it compulsory for all motor driven vehicles to carry an electrical speed indicating device, which is equipped with three lights placed one above the other. This triple lamp is set on the hood of the car or over the handle bars of a motor cycle and as the speed progresses, a variety of colored light combinations are shown. In this way, an observer can tell whether the vehicle approaching him at night is going at the legal speed or is breaking the regulations, and if so to what extent. The latter is an important point, for when a culprit is brought before the judge; he may escape with a fine if he is not going more than 30 miles an hour, while for speed above that he must receive a straight jail sentence.

The mechanism of the device is very clearly indicated in the series of photographs, the governor being connected with the speedometer shaft which as it whirls faster and faster, throws the current on the white the green and the red lamps and finally on combinations of the three, registering different speeds up to 60 miles an hour. Going ten to fifteen miles an hour a white light is flashed; from 15 to 20, a green light; from 20 to 25, a red light; from 25 to 30 a red and white, and so on. The lights show from in front and from both sides through a 2½ inch pane, while from the rear, visible from the chauffeur's seat, they show as little points of light. The rear lights thus serve to warn the driver if he inadvertantly exceeds the speed limits, which vary in different parts of town and in the country. Of course it is necessary to provide for a system of

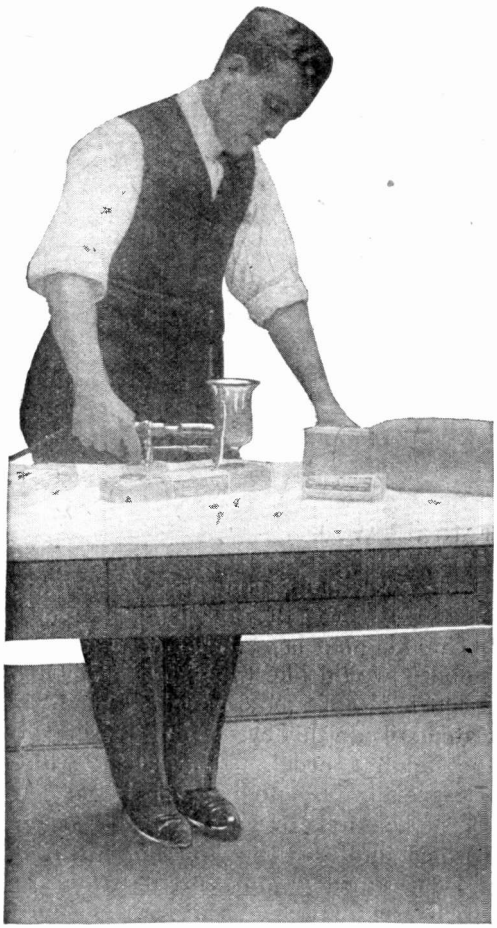


CASING FOR THE GOVERNOR THE GOVERNING MECHANISM TRIPLE LAMP TO BE MOUNTED ON THE CAR HOOD

sealing and locking the case containing the mechanism and this should be done by a city official, who should also test the device at certain intervals to see that it is working properly. Any tampering with the seal or mechanism should be punishable by law.

An Office Convenience

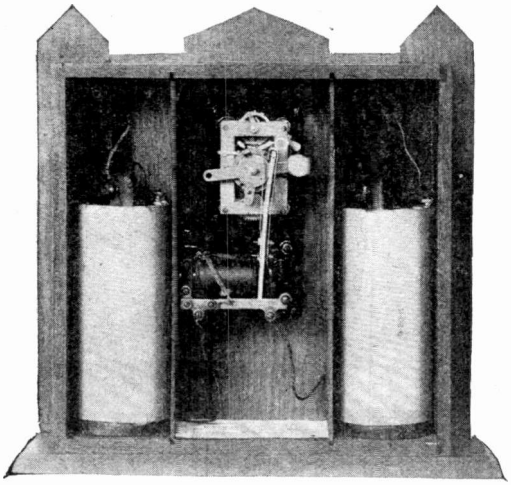
There is no more reason to-day for the use of the old fashioned stick of sealing wax and flame than there is for the wax candle or kerosene lamp. The electrical wax melter and dropper is one of the most useful productions in the line of office conveniences. The apparatus consists of a melting pot to hold the wax and this is attached to an electrical heating device that offers sufficient resistance when the current passes through to generate enough heat to melt the wax. The operator by the pressure of a finger can release the molten sealer in as small or as great quantities as may be expedient.



WAX MELTER AND DROPPER

Battery Wound Clock

A clock that needs attention not oftener than once a year and perhaps at longer periods is to be had in the self-winding clock which obtains its energy from electric current. In the picture the interior of the American clock of this type is shown with two dry cells to supply current. The clock is run by the action of a weight at the end of a lever arm attached to the clock mechanism. When gravity carries this weighted arm to a certain point in its downward travel, a contact is closed which allows the batteries to energize an electro-magnet. The armature of the magnet almost instantly raises the weight to its upper position ready to again turn the wheels. The weight is lifted practically once every minute. This frequent rewinding keeps the same pressure upon the clock train all the time, making it a good timekeeper. The batteries need renewing once a year.

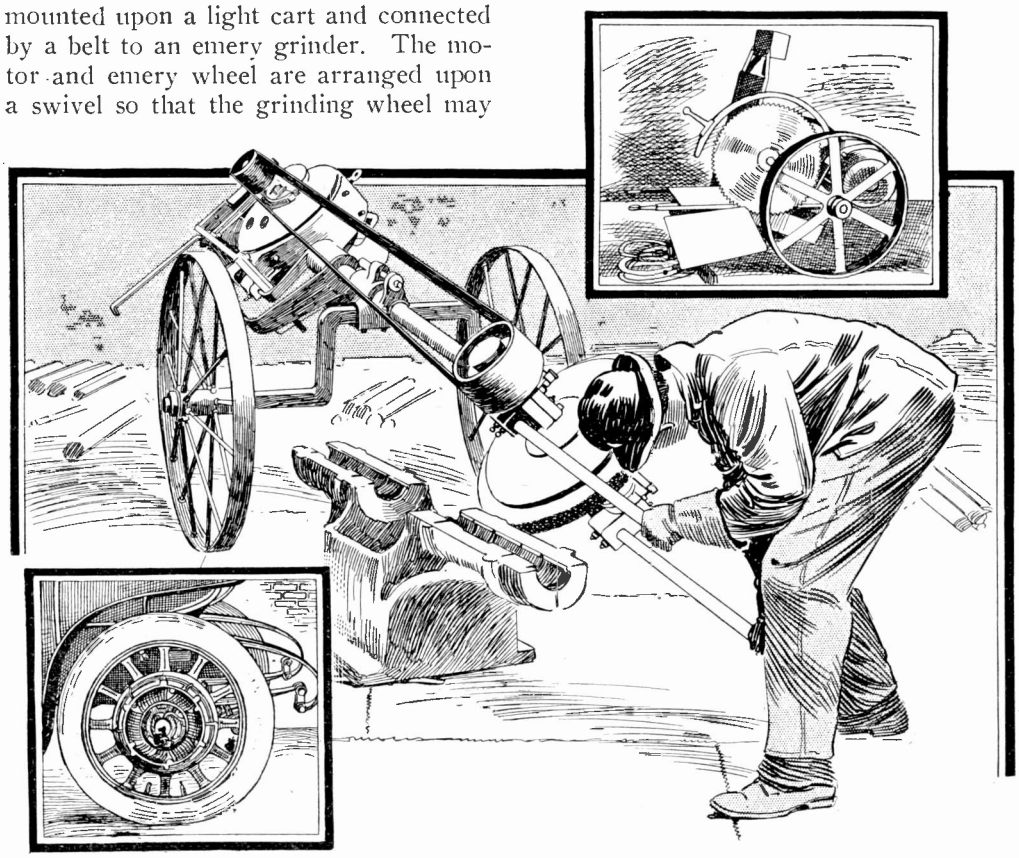


THE "WORKS" OF A BATTERY WOUND CLOCK

Taking the Motor to the Work

One of the most decided advantages of the electric motor is in being able to take it, with the machine it drives, to the work.

In the illustration a motor is shown mounted upon a light cart and connected by a belt to an emery grinder. The motor and emery wheel are arranged upon a swivel so that the grinding wheel may be played upon the work. A single workman can thus take care of castings that would require the services of several men to handle if they had to be carried to grinding machines.



BRINGING THE MOTOR TO THE WORK

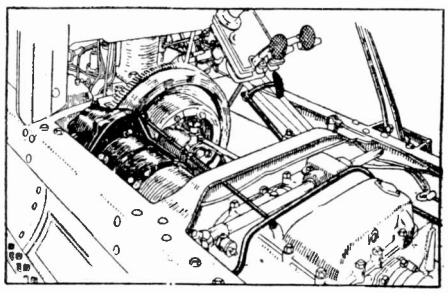
An unusual application of placing the motor close to the work is found in some storage battery trucks in which the motor is built into the hub of the drive wheel as shown, thus doing away with the usual mechanical transmission.

The large number of bad spots in wooden block street pavement are due to poor fitting of the blocks, the shaping of these blocks being done with an ordinary hand hatchet. A portable circular saw operated by a motor now replaces the hatchet, with the result that saw fitted blocks make a more solid and lasting roadway.

Automobile Electric Starter

Cranking up is labor that every automobilist would like to avoid. The Gray & Davis electric motor starter here illustrated will do this by simply pressing the foot upon a pedal. This motor, which is especially built for starting a gasoline engine, connects by gears with the engine flywheel and each time the motor is used it keeps turning until the engine picks up. The motor then automatically ceases to operate.

It has shown its strength on test by turning a six cylinder engine for an hour and a half. One feature of the equipment is the absence of any drag upon the engine after the motor has per-



AUTOMOBILE SELF-STARTER

formed its labor. Another feature is the absence of hand operated switches, the control of the starting operation being obtained by pedal action.

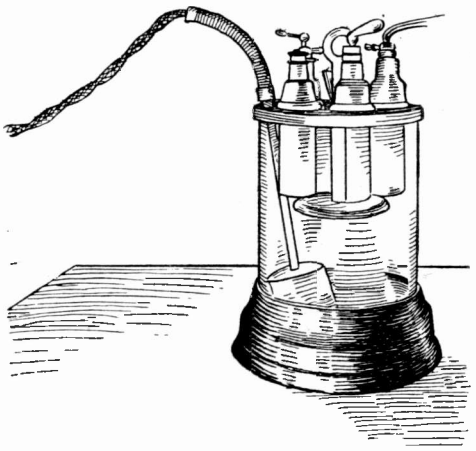
One of the greatest advantages of this system is safety. If the automobile should become stalled on a railroad crossing or in some traffic congested street, the motor may be applied to the engine and will propel the car until the engine picks up.

The motor is operated from a six volt battery, the same one that is used for ignition and according to investigations the average time during which it really takes current from the battery amounts to a total of not more than 24 hours a year.

Instrument Sterilizer

The progressive surgeon or dentist is alive to the advantage of creating a favorable impression upon his patient. Most people nowadays know more or less about germs and of the necessity of absolutely antiseptic conditions. Therefore, if the dentist or surgeon can sterilize his instruments in full view of the patient the latter is put in a better frame of mind.

The use of the Monarch sterilizer furnishes an example to illustrate this point. The instrument is a little metal affair composed of a cylindrical heating unit on a short handle. The wires from the lighting circuit pass down through the handle and connect with the resistance wires inside the heater. When current is turned on the latter is brought quickly to a high temperature. This device is plunged into the glass container for the

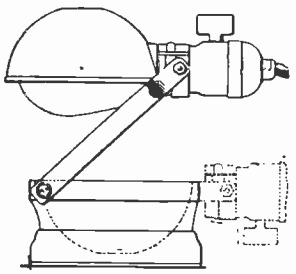


DENTISTS' INSTRUMENT STERILIZER

instruments right in front of the patient and he can see the water steam and even boil.

Collapsible Electric Light Holder and Stand

A lamp which the traveling man and tourist will appreciate has been patented by Jefferson F. Pierce, Tampa, Florida. It consists of an electric light bulb and

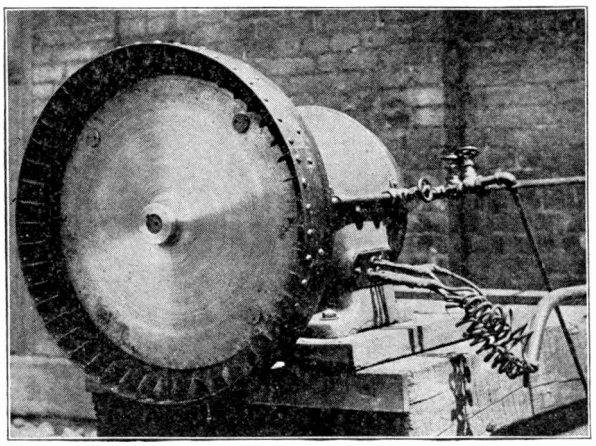


COLLAPSIBLE LAMP HOLDER

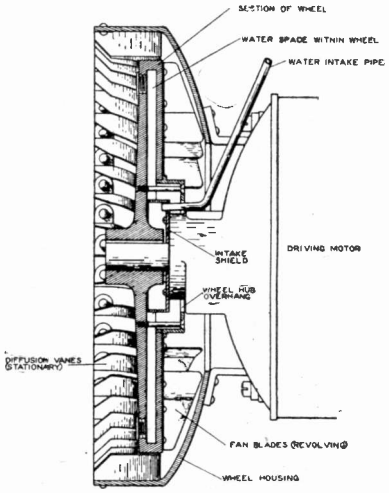
socket upon pivoted arms fastened to a concave base and so constructed that when collapsed the lamp, shade and arms nest within the base. The devise thus occupies little space in a trunk or traveling bag.

Air Humidifier for Mines

That miners may work with greater safety to life and health the United States Bureau of Mines at its Pittsburgh station recently tested a big motor driven air humidifier for throwing into the air myriads of tiny particles of water. It was designed by one of the engineers of the Bureau.



AIR HUMIDIFIER FOR MINES



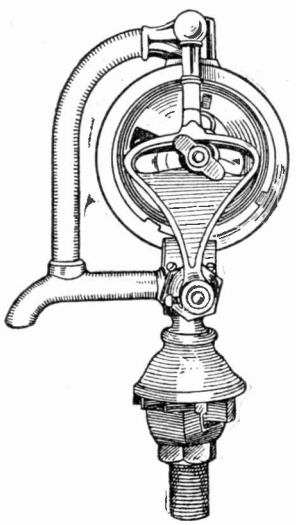
The humidifier consists of a hollow wheel mounted upon the shaft of an electric motor, the wheel being provided at its periphery with spray nozzles and at its hub with an opening for the admission of water, while on its back are arranged a series of fan blades.

It will be noted that the back and rim of the wheel are enclosed in a steel housing that serves as a casing for the fan and as a support for the air diffusing vanes as well as a shield for the revolving parts. When the wheel is rotated at normal speed by the electric motor and water is admitted under practically no pressure to the opening in the hub, the centrifugal force developed at the nozzles in the wheel's periphery gives to the water a hydraulic pressure of more than 200 pounds per square inch. This pressure drives the water through the nozzles in the form of a fine spray which is carried away by the blast of air from the fan blades on the back part of the wheel.

It is held that the diffusion vanes cause the air to be discharged in the form of a cylinder whose axis is coincident with the fan shaft and the mist produced is extremely fine. There is practically no dripping of solid water.

Heats Water as Used

A little electric water heater made so that it is a part of the faucet causes us to say, "What next?" For cold water, turn on the faucet; for hot water turn on the faucet, then turn the switch.

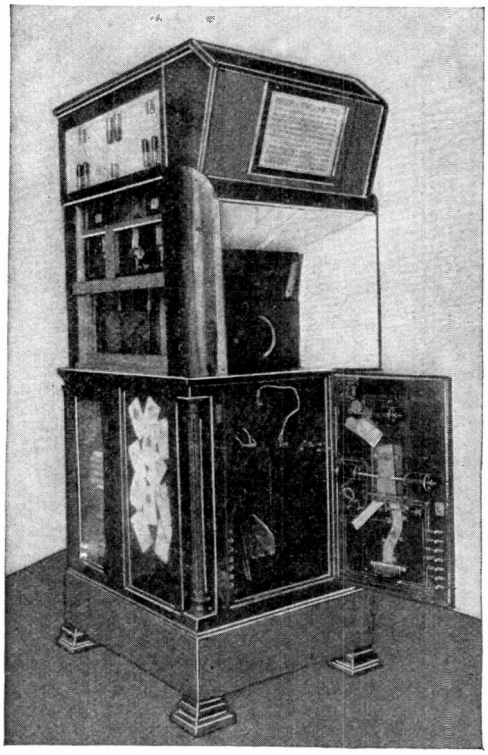


WATER HEATER

Upon the inside of the Sterling heater is a coil of wire in a porcelain cup through which the water flows. Electric current heats this wire which imparts its heat to the water. No more water is heated than is actually used and the heat shuts off with the water.

Coin Operated Photographing Machine

A recent French, coin operated, photographing machine is operated entirely by electricity, producing instead of the old tintype, a handsome portrait on a platino bromide postal card, so that it is likely to



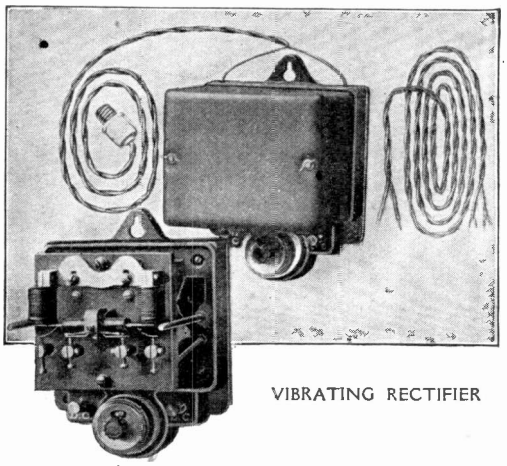
COIN OPERATED PHOTOGRAPHING MACHINE

prove a favorite with the public. The sitter drops in the coin and then a brilliant flash of light comes on so as to take a practically instantaneous portrait. The card is put through different chemical baths in a closed vessel or dish, each of the solutions being held in upper containing vessels and fed down by an electric valve which measures off the right amount in a small glass bulb and then feeds it into the dish. Water for washing the print is let into the dish in the same way, the dish being automatically filled and emptied by the electric valves. Then the card drops into an electric motor driven centrifugal dryer which dries it in fifteen seconds and it is then delivered to the sitter. A circular switch with an arm going around a contact disk is used to operate all the electric circuits in turn, the arm being driven by a small motor. The machine finishes the picture in 4½ minutes and is a marvel of ingenious work.

Vibrating Rectifier

For charging the small three cell storage batteries used for ignition and lighting purposes on automobiles a new type of alternating current rectifier has been developed by the Westinghouse company. It is not intended, however, to charge the large batteries for electric vehicles.

It operates on the vibrating principle not hitherto extensively employed for changing alternating to direct current. A technical description of the working of the apparatus is not possible here. It is sufficient to say that the device is very



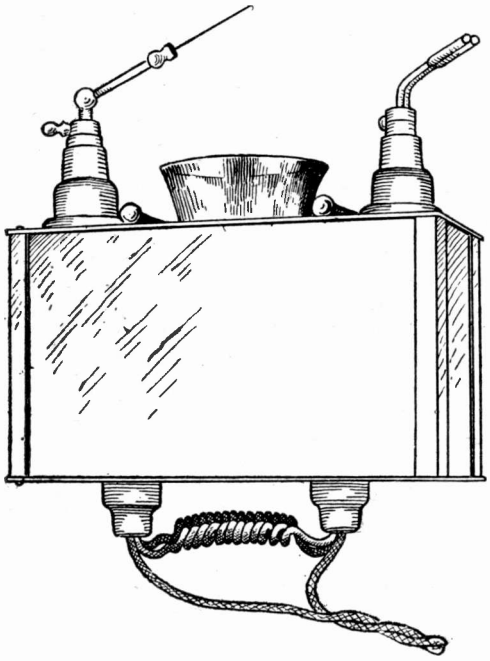
VIBRATING RECTIFIER

compact in size and to charge a battery all that is required is to connect the attachment plug to a lamp socket and the lower binding posts to the battery.

No care need be taken as to which pole of the battery is connected to which binding post, as it is immaterial. Should the supply circuit be interrupted temporarily the rectifier will start again as soon as power is restored to the line.

Spray Bottle Warmer

An example of one of the services that electricity performs for the dentist is illustrated in the accompanying picture of the Shoenberg spray bottle warmer. The



SPRAY BOTTLE WARMER FOR DENTISTS

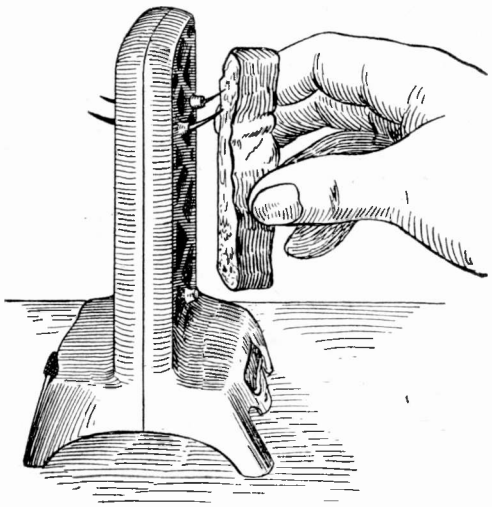
neat case encloses electric lamps which furnish the heat. Besides the two spray bottles there is room for a water glass.

Cord Adjuster

The accompanying illustration shows the Ideal cord adjuster which relieves the drop cord of wear. The adjusting cord is fastened to the socket and extends to the ceiling and is run through a slotted porcelain cleat. The end of the cord is weighted with an iron ball which is just heavy enough to keep the lamp and shade in place and in whatever position desired. The lamp can be pushed up or down with one hand without interfering with any work the operator is doing, and the lamp will stay in just that position. The adjusting cord is fastened to the socket by either a collar or a knot in the cord under the bushing.

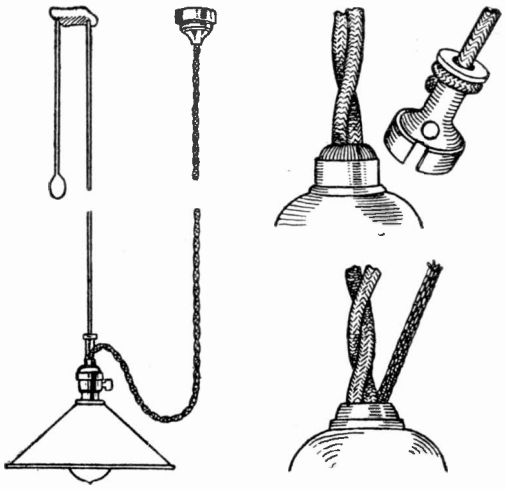
Hanging the Bread on the Toaster

There is a new electric toaster on the market, known as the Monarch, which embodies a very simple method for holding the bread in place. Four little pins

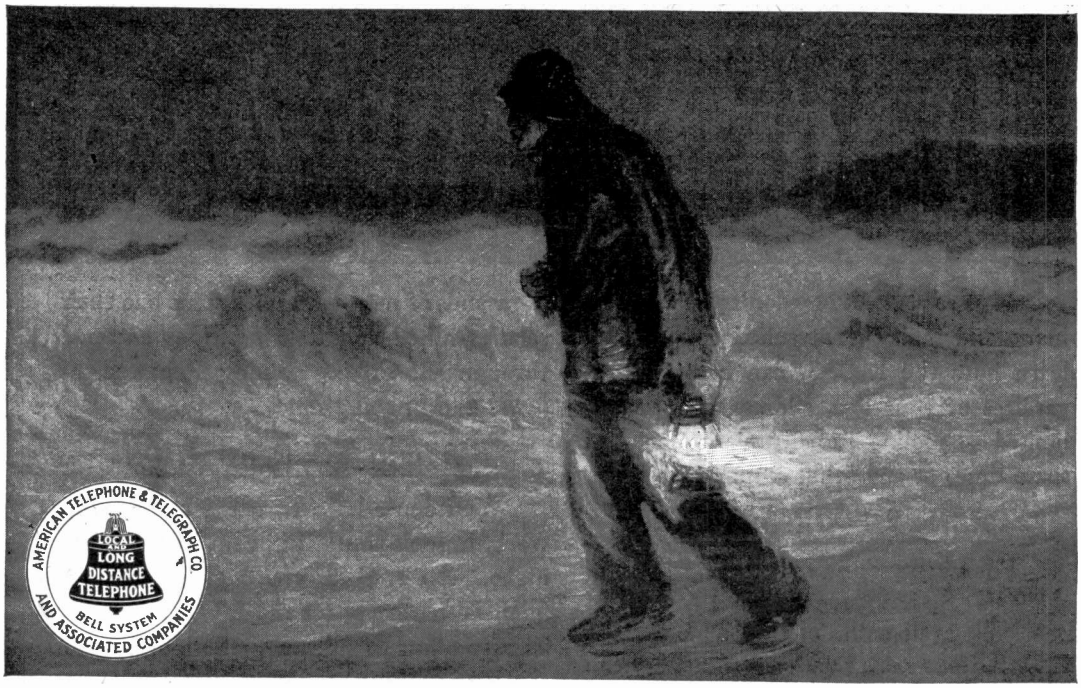


ELECTRIC TOASTER

or brads, two on each side of the upright frame, hold the slices in place. Two slices should be toasted at a time, as the heat is then more confined and the toasting done more evenly and quickly. The heating wires are mounted on suitable insulators inside the frame and glow red hot under the influence of the current.



ADJUSTER WHICH RELIEVES THE DROP CORD OF WEAR



Always on Guard

No matter where a ship may be along the American coast; no matter how dark, or cold, or stormy the night, the coast guard is on watch, patrolling the nearest beach or rocky cliffs.

This man, always on guard, could, by his own unsupported efforts, do little to save life, or to guide ships away from perilous points.

As a unit in an efficient system and able, at a moment's notice, to command the service of his nearby station, he becomes a power to whom all ship owners and passengers are indebted.

In the same way, the Bell Telephone in your home and office is always on guard.

By itself, it is only an ingenious instrument; but as a vital unit in the Bell System, which links together seven million other telephones in all parts of this country, that single telephone instrument becomes a power to help you at any moment of any hour, day or night.

It costs unwearying effort and millions of dollars to keep the Bell System always on guard, but this is the only kind of service that can adequately take care of the social and commercial needs of all the people of a Nation.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

Every Bell Telephone is the Center of the System.

YOUR family washing done for about two cents a week! Done quicker, easier, cleaner, and without bother or muss. That is what a FEDERAL ELECTRIC WASHING MACHINE will do for you. If your home is equipped for electricity, you really owe it to your own pocketbook to learn all about this wonderful family laundry machine.

The FEDERAL Electric Washing Machine

saves time—labor—money—clothing

Think of it—just a short hour with a FEDERAL—at a cost of about 2c for electricity—instead of a whole morning's drudgery. No need for a laundress. The frailest woman can do her own washing with a FEDERAL. The machine *does the work.* Washes the heaviest blankets or most delicate laces clean, white and undamaged.

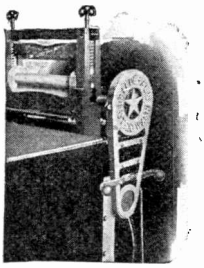
So Easy to Operate

Simply place the soiled clothes, soap and hot water in the machine, turn on the electricity and the FEDERAL does the rest. In just a few minutes the entire tubful is washed and wrung spotlessly clean—ready to hang on the line.

More Than Pays for Itself in a Year

The average family washing costs $2 a week or $104 a year, The purchase price of the FEDERAL being only $85, you can easily see how it pays for itself and more the first year.

Unique Lever Control



Among the most notable of the FEDERAL'S exclusive features are its absolutely protected gears, all on one side of the machine, and its unique automatic starting and stopping device—a convenient lever which starts or stops the entire operation in an instant. No danger of accidents to fingers or clothes. No other machine has this feature.

We will ship the FEDERAL fully equipped, f. o. b., Chicago for $85. State whether you use alternating or direct current and the voltage. Write for handsome free descriptive circular today. Address, Washing Machine Dept.

FEDERAL SIGN SYSTEM (ELECTRIC) Lake and Desplaines Sts. **CHICAGO**

CLASSIFIED ADVERTISEMENTS

THE COST OF ADVERTISING IN THIS SECTION IS 5 CENTS PER WORD

Remittance must accompany order, or advertisement will not be inserted.

Forms for the March issue close February 1st.

AERONAUTICS

TWO FOOT, MODEL AEROPLANES. BLERIOT, $1.00. Wright, $2.00. Antoinette, $1.00. Curtiss, $2.00. Demoiselle, $1.00. Farman, $2.00. In knock down form with blue print and instructions for building. Will send post-paid. Yale Mfg. Co., Dept. D 4, Newark, N. J.

COMPLETE PLANS DRAWN TO SCALE, accompanied by clear, concise building instructions: WRIGHT 3 ft. Biplane, 25c; BLERIOT 3 ft. Monoplane, 15c; "CECIL PEOLI" Champion Racer (official record 1,691 feet), 25c; "IDEAL" three foot Racer (new), 15c. Send 5c for most complete 40 pp. illustrated catalog including rules for contests. IDEAL AERO, PLANE & SUPPLY CO., 86B West Broadway New York.

AGENTS WANTED

SMALLEST ALARM CLOCK, BIBLE AND Telescope, 10c each prepaid. W. H. GARNER, B-1408 W. 22nd St., Los Angeles, California.

AGENTS MAKE BIG MONEY WITH OUR Flexible Sign Letters. Send 10c for outfit. Paul Jacobs, 25 Third Avenue, New York.

AGENTS AND CANVASSERS FOR BOOKS. Never sold before. Write for particulars. Also other propositions. Kirk A., Box 3002, Phila., Pa.

PERFECTION POCKET ADDING MAchine—Lightning seller; agents wanted. Cincinnati Specialty Co., Dept. E, Cincinnati, Ohio.

AGENTS—TO SELL OUR FAST SELLING books and post cards. Catalogue free. Curtis Co., Dept. PE, Englewood, Chicago.

AGENTS:—MY TWELVE MONEYMAKERS bring repeat orders. Easy selling plans. Big profits. G. Rolfe, 923 N. Alder, Philadelphia, Pa.

AGENTS—COST 2c, SELL 25c. SIGN LETters put on with roller. Samples free. Embossed Letter Co., 232 West Illinois, Chicago.

DON'T ACCEPT AN AGENCY UNTIL YOU get my samples and particulars. Money makers. Address SAYMAN, 706 Sayman Bldg., St. Louis, Mo.

AGENTS WANTED FOR ORIENTAL novelties, never before seen in America. Quick sellers. Repeaters. Immense profits. Joseph Kanematz, Box 529, Portland, Oregon.

HUSTLING AGENTS, EITHER SEX, SELL Usoline Polishing Cloths; every demonstration sells; big profits. Glenside Galenical Co., Glenside, Pa. Box 40.

AGENTS WANTED

SEE DISPLAY AD, PAGE 55. DOUD LIGHTing Co., Chicago.

SEE WHAT I SAY UNDER "TYPEwriters." ATCHISON.

AGENTS WANTED TO SELL ARTICLE which can be used in every home and schoolhouse. Non-Draft Ventilator Co., Frankfort, Ind.

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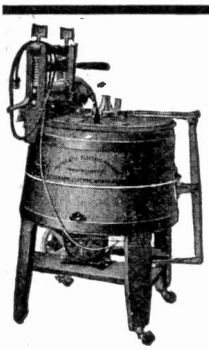

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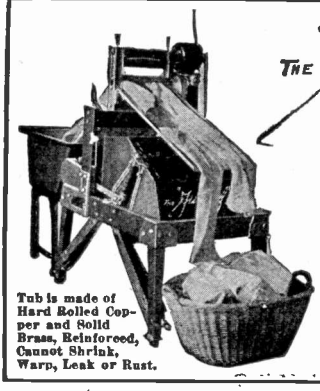

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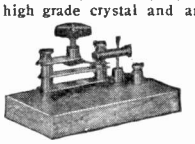

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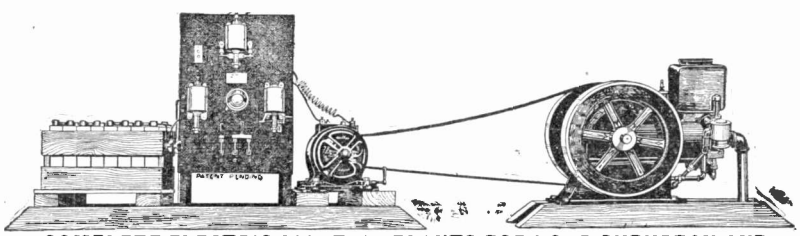

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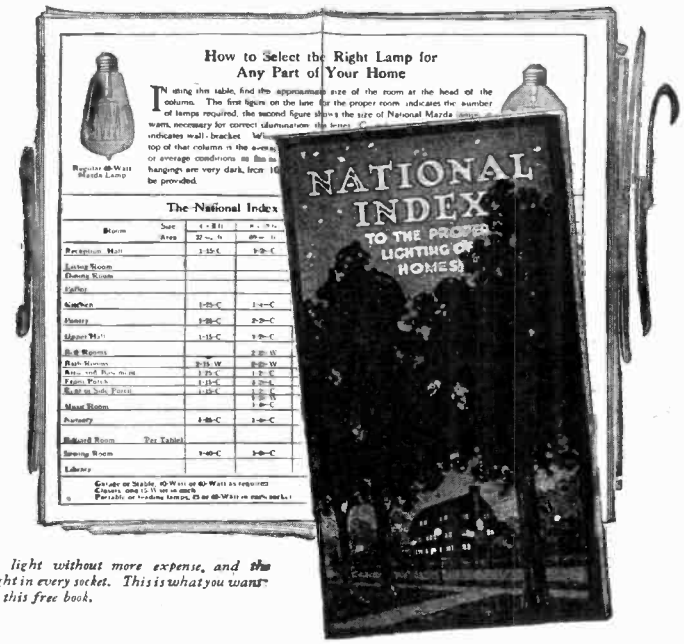

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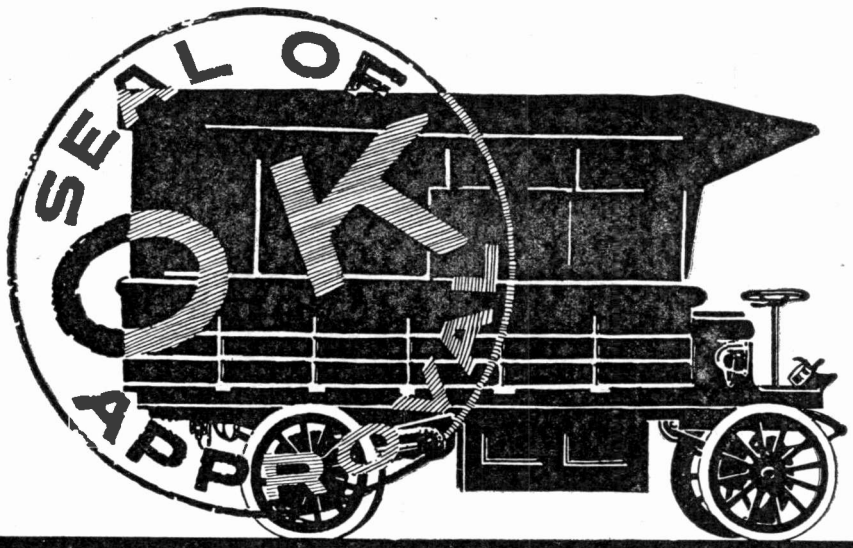

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