Popular Electricity
In Plain English
Henry Walter Young, Editor

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MINING CAMP IN THE MOUNTAINS—BEGINNING OF THE DESERT TELEPHONE LINE

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Running a Telephone Line Across the Desert

By C. L. EDHOLM

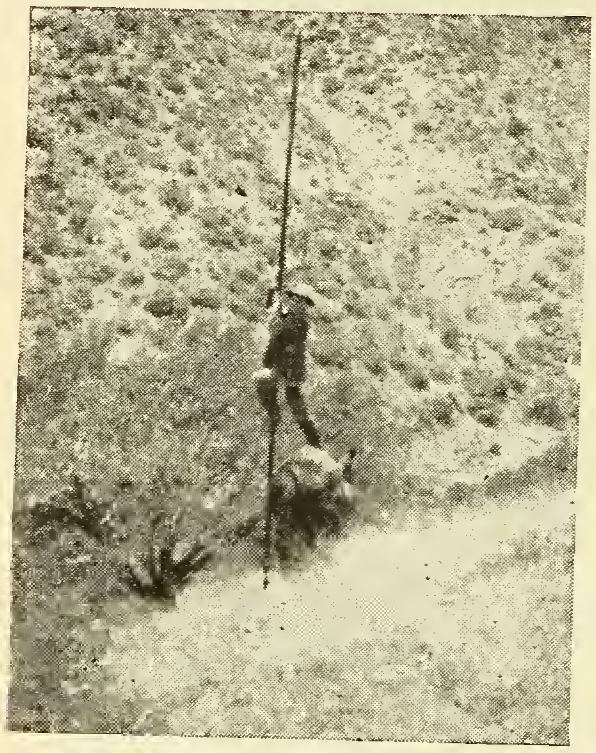
FOR THE telephone lineman whose work is done in the cities and the settled parts of the country the work has a general sameness and monotony, but to the men who are called upon to do the rough work on the fringe of civilization, even the commonplace work of setting up poles and stringing up wire, is rather picturesque.

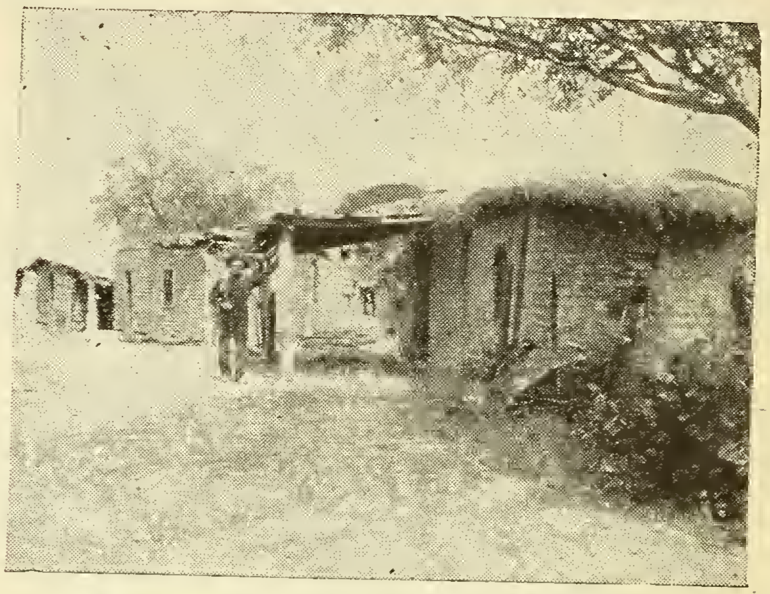
A few years ago I was given such a job, to superintend the construction of a telephone line from an obscure mining camp in the mountains to the nearest town, and although I did not know the first thing about telephones I accepted the commission promptly, as it was part of my duties to do anything that needed to be done and learn how while I was doing it.

The camp was high up in the Galiuros and the nearest town was far down in the bed of the San Pedro River, a distance of about eighteen miles, which led through every variety of rough and rocky mountain country and a stretch of mesa bristling with cactus and hot as a sizzling frying pan under the Arizona sun.

The general manager had bought an old government telephone line used in early days to connect the San Carlos Apache reservation and the adjacent settlements with Old Fort Grant, so that in case of outbreaks among the savages the troops could be called out promptly. The coiled wire and the poles, 20 foot lengths of two inch pipe, were stacked by the construction gang at the head of a sand wash, a place called Dry Camp, and when I took the job my first errand was to an Apache rancher up the canon to engage his burro train. This murderous looking old bandit had every appearance of being one of the original band of Geronimo, who used to keep things interesting in those parts, and it was odd to speculate on whether the line he was to help reconstruct had once flashed messages of his deviltry and brought out the cavalrymen to run him out of the country.

The old Indian was at home in a thatched hut of adobe, before which extended an awning of ocotillo branches. Under this pleasant shade the family table was set and the old brave, surrounded by his family, welcomed me to a dinner of chicken and chili, frijoles,

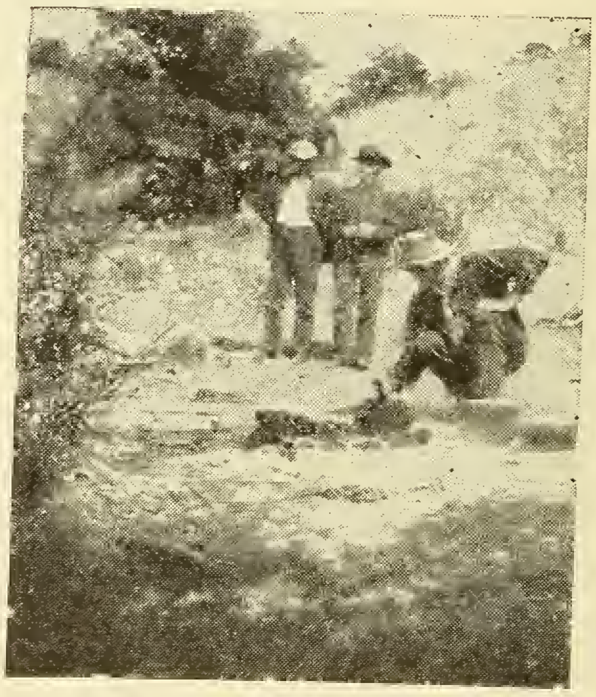




My assistant in picturesque surroundings

By standing on the saddle we could get a good start up the pole

One of the Apache boys on his cayuse



Back to camp and a dinner of coffee and frijoles

Digging pole holes in the rocky hillside

Burros loaded with poles

tortillas and black coffee. He had married a Mexican woman and their union had been blessed with a dozen brown-skinned boys and girls, the lads active and clean limbed, clever with the rope and excellent horsemen, the girls, liquid-eyed, languid; tropical in their sensuous movements as they moved about waiting on the table.

The contract was settled after dinner, with just enough dickering to satisfy the bargaining instinct of the old man. The pact was sealed with a hand clasp and the boys mounted their ponies and scurried over the range to round up the grazing burros.

Next day I rode with the general manager of the mine, across the long, hot ridge of the mesa, overgrown with giant cactus and cholla, a vicious long-spined variety that the cowboys declare will jump at you if you ride close enough. We had no surveying instruments, but got along well enough without them, tracing the general course of the line with banners of newspaper tied on sharp sticks and jabbed into the trunks of the suhuaros. By keeping several of these signals in sight at a time we were able to run a fairly straight line along the crooked ridge.

Our course lay directly through a ruined fortification, constructed of unmortared rock walls on the point of a steep promontory over the river. The ground was covered with fragments of pottery of various colors and patterns, and occasional mounds of stones indicated that excavation would reveal buried remains of an ancient village. Two or three of these mounds had been opened and disclosed the walls of houses. One of three rooms with plastered walls was the largest; doubtless the home of the chief. Who were they? The builders of these fortified villages along the San Pedro? A wierd feeling comes to one in walking over the grave of a race that has perished with no record of its rise and fall, leaving only the mute witnesses of its daily life to baffle us in our guessing. We planted a pole squarely in the middle of the forgotten village.

Our gang of workmen was to meet the other telephone gang working down the canon from the mine in the mountains. After we left the mesa we descended into the wash and from here the poles were to be set on the high points of the bank and shorten the winding course of the arroyo as much as possible.

Our clever ponies picked their way along walls that were precipitous enough to make the knees of a valley horse knock together with fear.

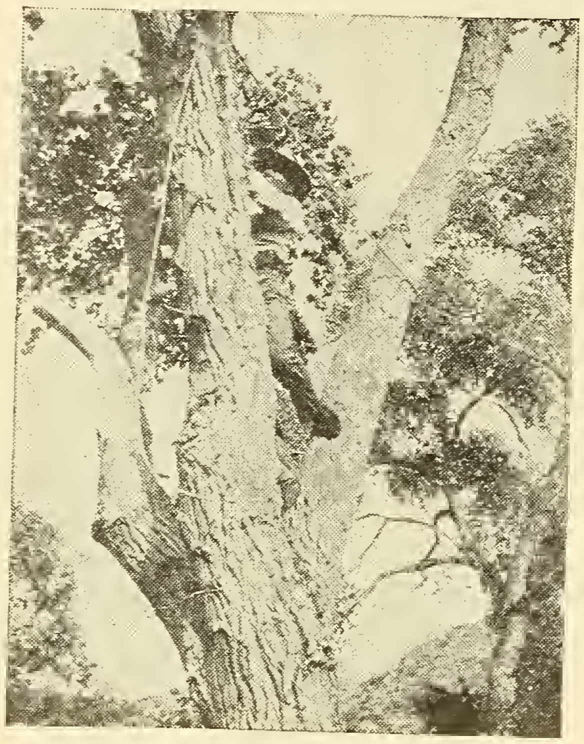
At this point the formation was conglomerate, a sort of petrified plum pudding with stone "plums" from the size of real plums to the dimension of a man's fist. The cement that bound them into a solid mass was as tough as the stones embedded in it. Higher up in the mountains the formation changed to granite and porphyry; jagged cliffs that formed box canons through which the little stream rushed and brawled impatiently.

When I returned to town the Indian had arrived with his first load of poles and wire. With his train of a dozen burros he could carry on each little animal two coils of wire and two iron poles, the ends of the latter dragging on the ground.

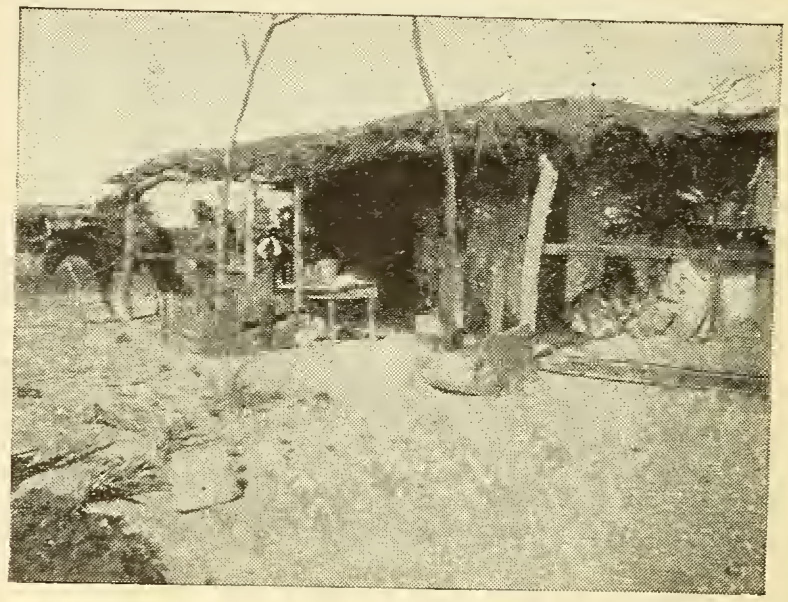
I was told that in the early days when the line was first built by the Government they would simply lay a pole and a coil of wire across the shoulders of two big, black cavalrymen and make them tote the load across the mesa, so you see our method of using a burro team was quite a step forward after all.

A lineman had been sent to help me and I found him at the primitive little hotel that evening. His job was to superintend the Mexicans who dug the holes, while I rode ahead on the line and showed the burro drivers where to drop the poles and wire.

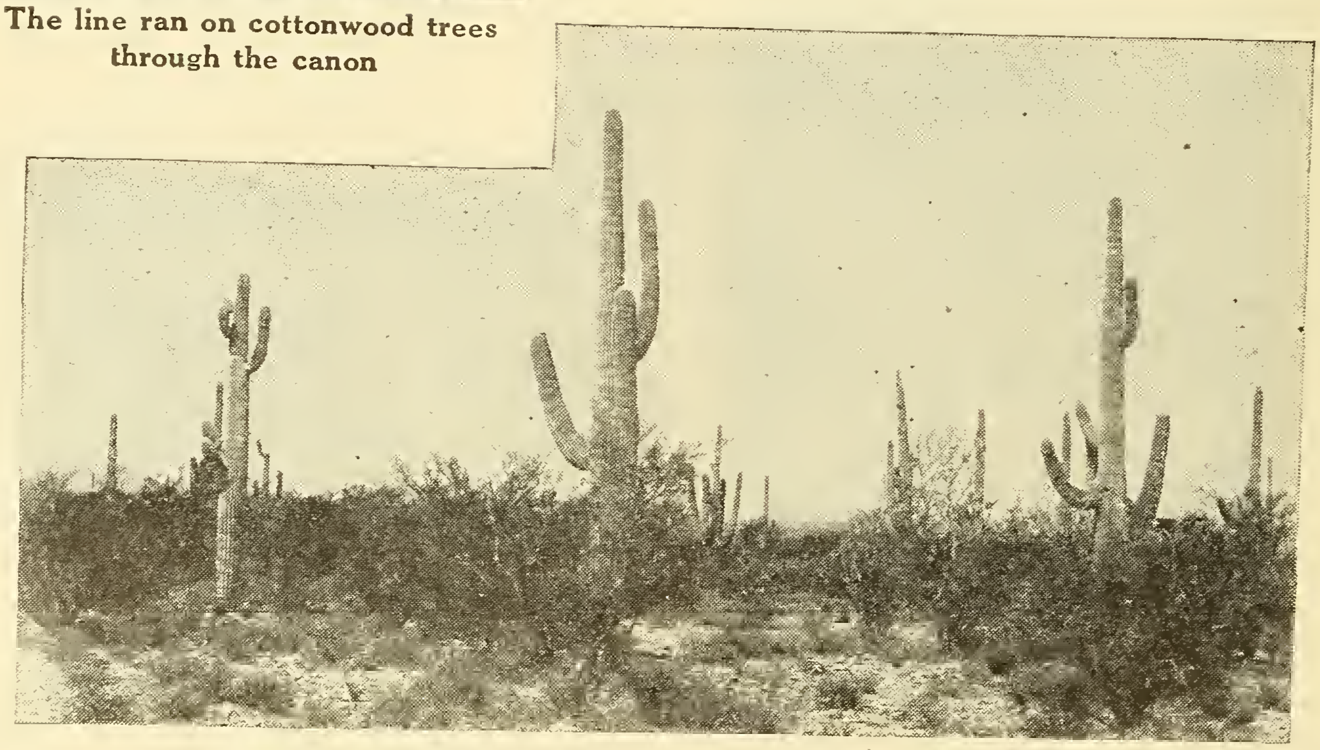
The days passed delightfully at that kind of work. The torrid sun of the Arizona summer was tempered by the



The line ran on cottonwood trees through the canon



The old Apache's home where the burros were obtained



Giant cactii—The survey was run by attaching newspaper banners to the tall plants

Stringing the wire

All that is left of old Fort Grant—End of the old government telephone line breeze of the mesa and our small gang made a mile and more a day easily.

Then as we were getting well toward the point where we were to meet the other gang we made a horrible discovery, we were running short of poles. Here was where my ability as construction superintendent had a chance to shine. I went through that district with a fine tooth comb, while the lineman and the gang of Indians and cowboys were starting in to set the poles, and it was surprising to find stray poles in the most unexpected places. Three or four were found half buried as they stood upright in the river bed, the tailings of an old stamp mill having been poured over them. I set a couple of Indians to digging them out and kept on skirmishing around and found a couple more, one of them used as a fence post by an enterprising farmer, while another had been annexed by the storekeeper, laid flat over a couple of wooden posts and utilized for hitching horses. Still we were half a dozen poles shy, and I was telling my troubles to the local justice of the peace, who was also the barber and the watchman of an abandoned mine. The justice of the peace came nobly to the rescue. "I don't suppose wooden poles would do?" he queried.

"They wouldn't? Well, I should say yes. If we have to sit around here waiting for half a dozen poles to be shipped in while the men's pay goes on——"

"Well, I didn't know whether iron poles and wooden poles would go on the same line, but if wooden poles won't interfere with the iron ones, you can have the old 6 by 6's running from town to the stamp mill. There are only about half a dozen. Will they do?"

But I was already out of my chair and had armed an Indian with an axe and we made an onslaught on those poles that made the chips fly.

They are still in use and in no way interfere with the iron poles which form the balance of the line.

The poles were just about all up when I was confronted with a new trouble. We were well fixed with insulators, for there was a barrel of new ones and only

THE LINE RAN DOWN THIS RUGGED CANON

half of the old ones had been shot away by wandering cowboys, but most of the pins were broken off or lost, and the barrel of new ones which was supposed to be in town had failed to arrive. Here again it was a case of finding a makeshift in a hurry or else let the men sit around in idleness while their pay went on. An idea struck me and it was a good one. I had one of the cowboys sharpen up a couple of hatchets and two of us foraged in the back yards of every shack in town. The odds and ends of hardwood we unearthed would have fitted out an old curiosity shop. Fragments of walnut bedsteads, broken pick handles, wagon spokes, worn out rocking chairs, anything that was made of hardwood and could be begged, borrowed or "lifted" was our meat and we took the whole collection of stuff behind the hotel and chopped out pins with our sharp hatchets that will probably do service for many a year. Of course they weren't threaded, but we simply tapered them so that the insulators could be jammed down good and hard, and we found that the pieces of old bedsteads were just as good to help carry telephone messages as any machine made pin.

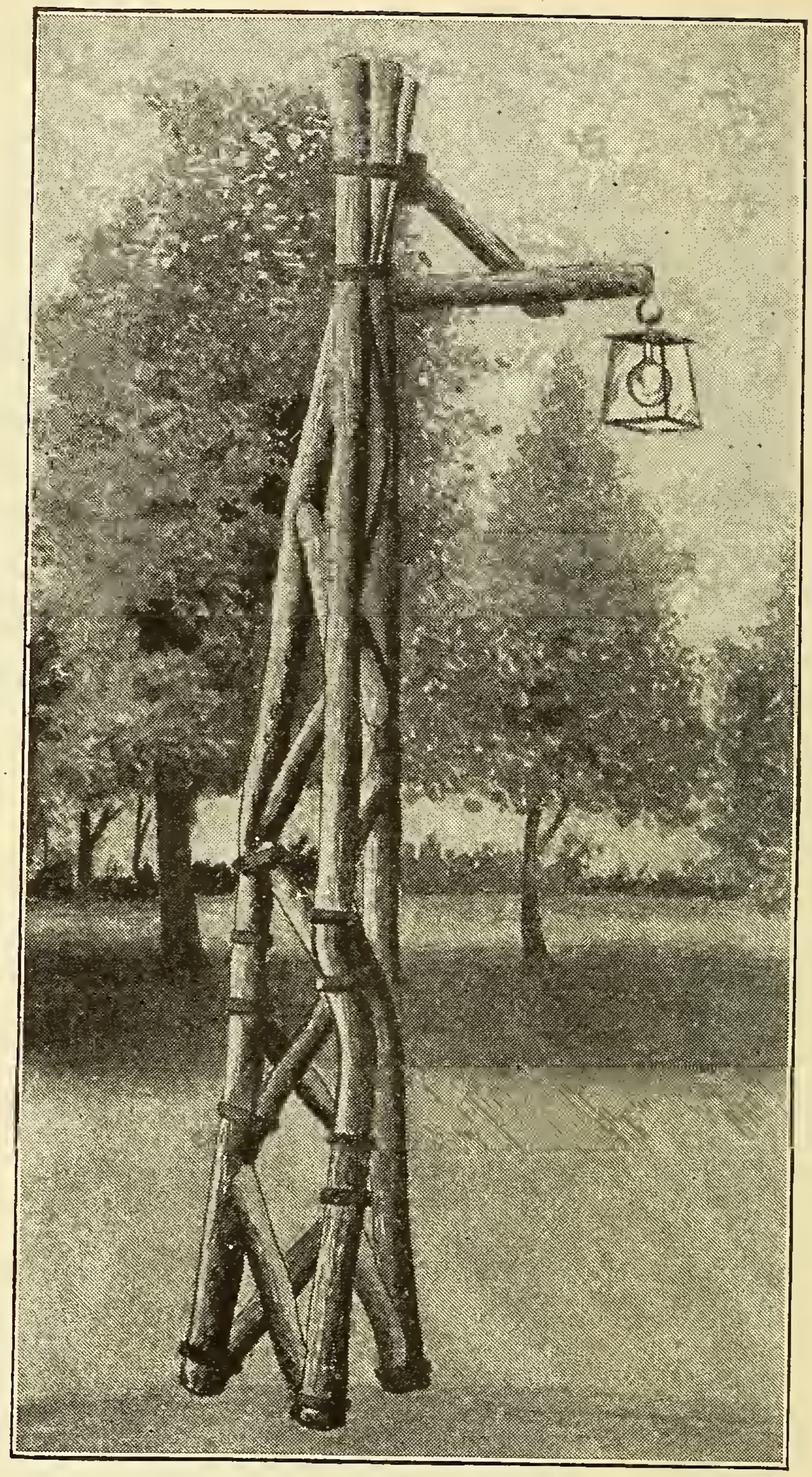
We had to make use of pretty nearly every makeshift to finish that old line, and I think we strung together nearly every weight of wire that is manufactured. The only place where we drew the line was robbing the ranchers of their barb wire to piece out.

Those were great days, riding up and down the line across the simmering mesa to see that the Indians and cowboys were not "soldiering," clambering up and down the rough sides of the mountains on a sure footed little cayuse and coming home to a dinner of frijoles and black coffee that tasted like food of the gods.

Finally the last insulator was in place, the last length of wire strung (part of it from tree to tree in a canon full of cottonwoods), and then the batteries were connected up in town and we tried to get the mine. I never heard a pleasanter sound than the answer from the superintendent's office. It meant that the long, hot days on the mesa had been put to a good purpose and that I had done the job and done it right.

A Rustic Lamp Post

This unusual rustic lamp post is one of a number designed and built for Roath Park, in Cardiff, England. The park committee came to the conclusion that the money spent by the promoters of galas and similar festivities on Chinese lanterns and like decorations would willingly be given for much more effective electrical lighting. A scheme was therefore prepared which provided for 30 pillars in the different walks, the lighting of the bandstand, strip lighting amongst the trees, etc., all designed along the odd and artistic lines shown in the picture.

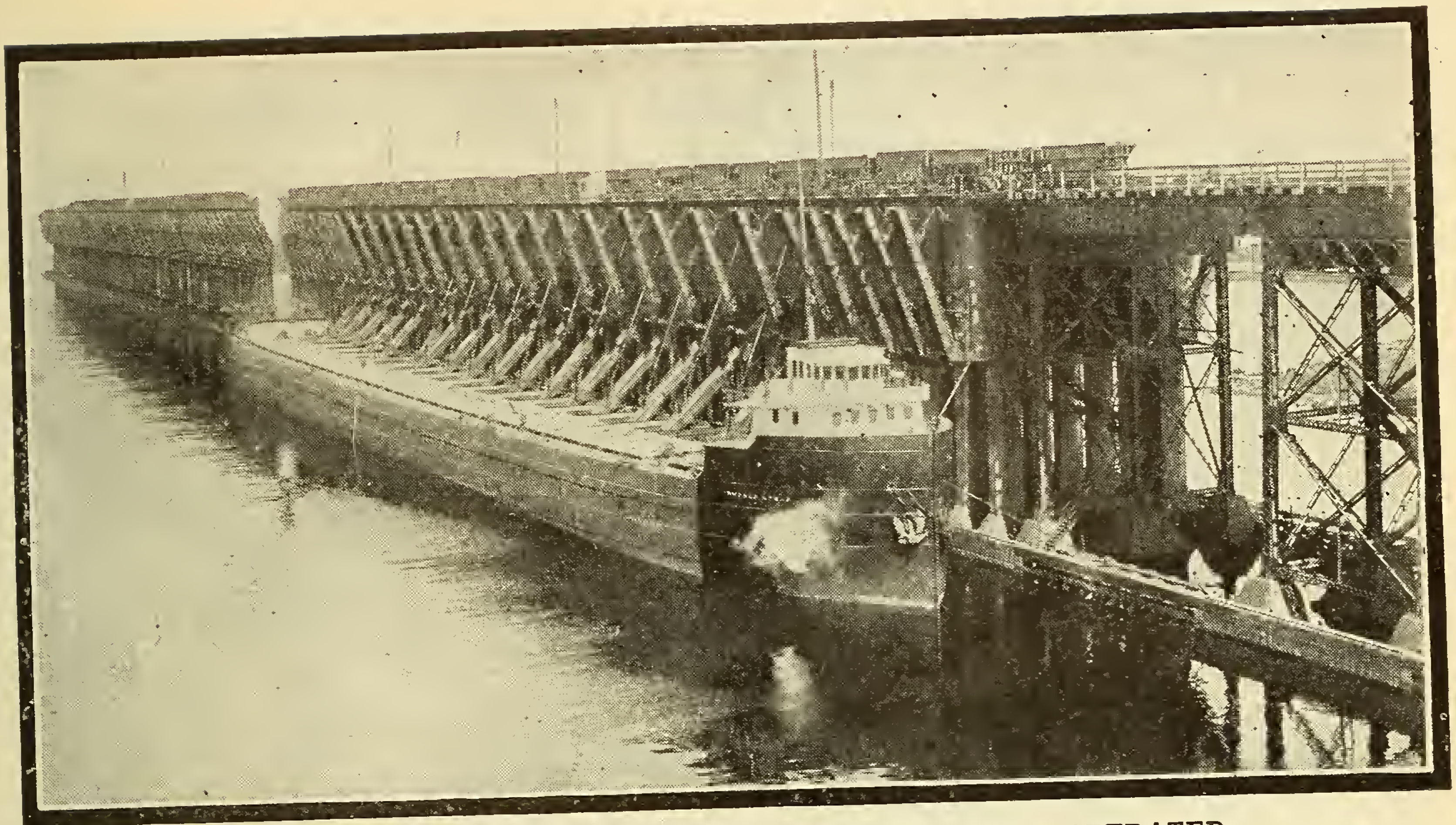


RUSTIC LAMP POST IN AN ENGLISH PARK

Largest Ore Dock in the World

This big ore handling dock along side of which a boat may anchor and receive its load is the only one of its kind in the world, and is a part of the Great Northern ore docks located at Superior, Wis.

This dock is one-third of a mile long, 65 feet wide and 75 feet high. The heavy concrete pillars shown in the picture are 40 feet high and support large pockets or bins into which the ore is dropped from the ore cars on the tracks above.



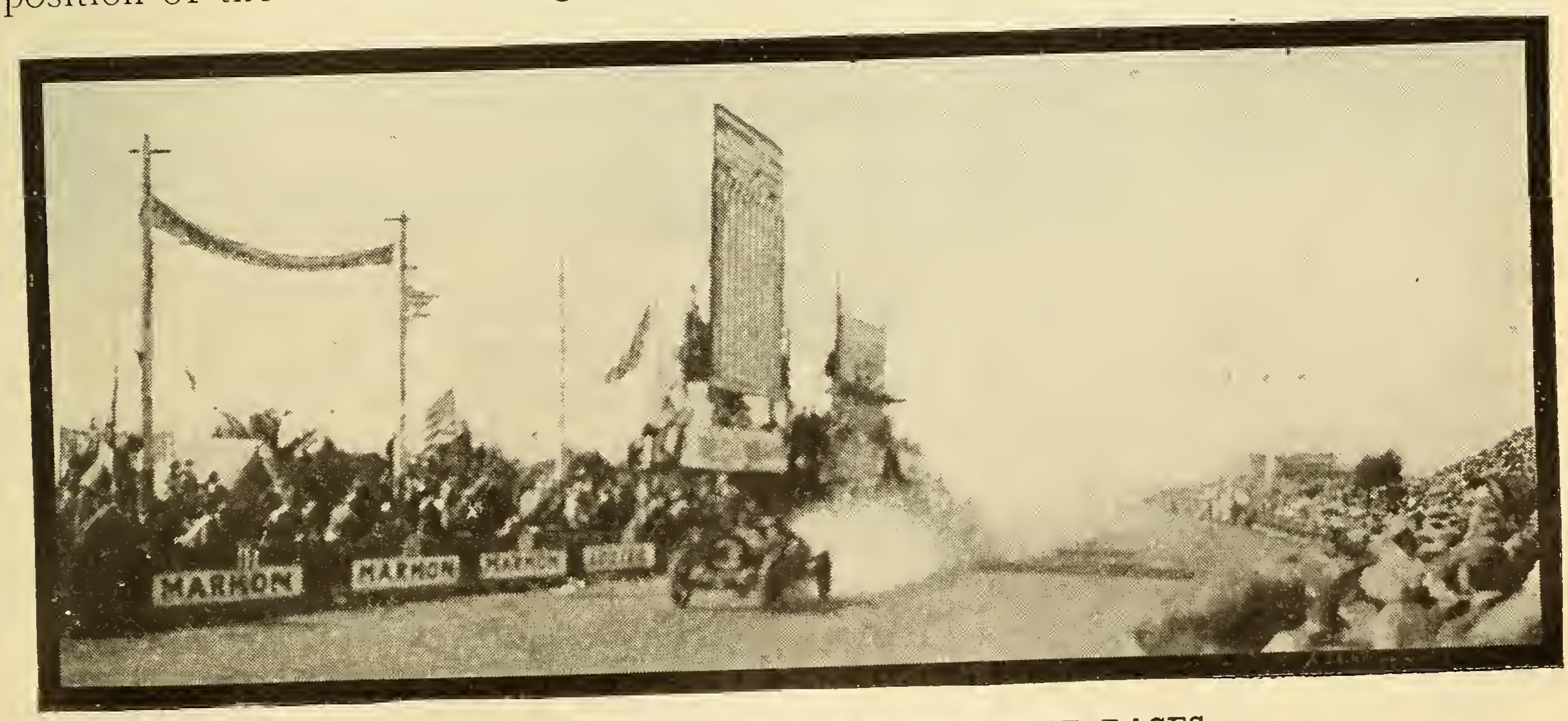
LARGEST ORE DOCK IN THE WORLD—ELECTRICALLY OPERATED

There are 151 of these pockets built of steel on each side, and to them are connected heavy metal spouts through which the ore runs into the boat. Electric motors lower and raise the spouts with rapidity.

Score Board Is Unique

An electrically operated score board was used for the first time in the history of auto road racing at Santa Monica, Oct. 14. By means of this device, the grand stand was kept informed as to the position of the racers all along the eight mile course, as each car number was painted on a sheet of metal which was moved along the score board upon divisions that represented miles and half miles.

The operator of the board was informed as to the position of the cars by means of telephones, temporary stations having been erected at half mile intervals. An operator was placed at each station, and in addition to reports on progress of cars, he sent in notification of tire or engine trouble, of cars that dropped out of the race, and most important of all, of accidents.



UNIQUE SCORE BOARD FOR AUTOMOBILE RACES

Turbines of Today and Yesterday

In December, 1901, a contract was closed by the General Electric Company with the Commonwealth Edison Company of Chicago, to install three 5,000 kilowatt (6,710 horsepower) turbine units in the new generating station at Fisk Street, which was then contemplated. Previous to the placing of this contract there was not a generating turbine in the world larger than 1,000 kilowatts and no commercial Curtis turbines had been built.

As a result of recommendations made by the General Electric Company's engineers and of experimental demonstrations of results made in Schenectady, the officers and engineers of the Commonwealth Edison Company decided to discard the plans for a large reciprocating engine station which they had drawn up, and to base the very large investment contemplated on the belief that the vertical shaft turbines proposed would prove to be commercially successful and desirable.

When this contract was made the oil supported step bearing had never been operated except on a very small experimental scale, and in certain trials with vertical shaft water wheels which had proved unsuccessful and were supposed to indicate inherent instability, and practically every detail of mechanical and electrical arrangements of this turbine and generator was completely new in type and in method of manufacture.

The machine was first put in operation October 2, 1903, and remained in continuous service until May 29, 1909, when it was replaced by a new and larger machine which the development of the art had produced and which now operates in the same space occupied by this first unit and from the same battery of boilers originally assigned to it.

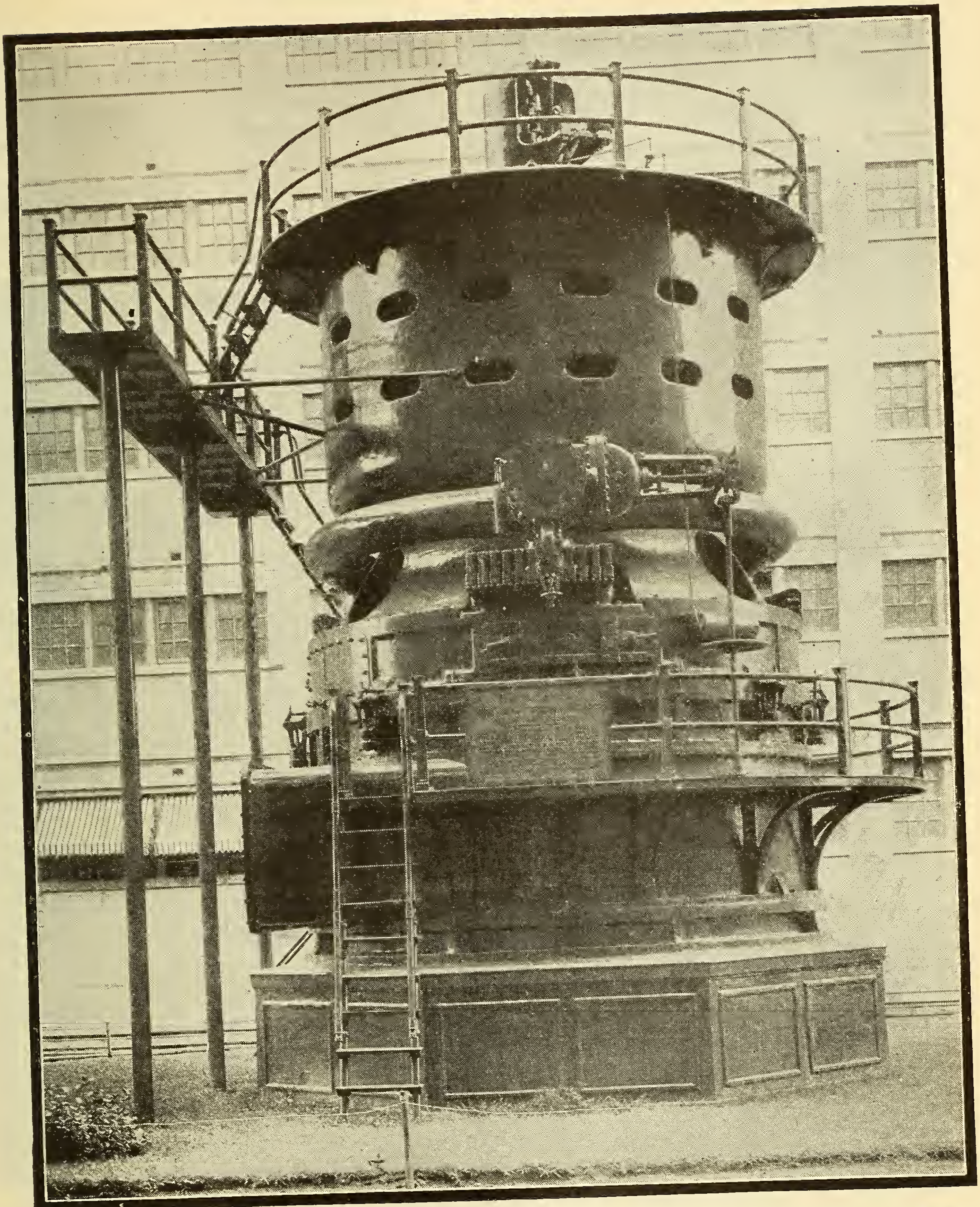
When the advancement of the art had justified the replacement of this original unit and a contract was made to cover the exchange, Mr. Samuel Insull, president of the Commonwealth Edison Company, specified in that contract that the first of these three original units should be set up as a monument with a suitable tablet to commemorate the great step in engineering which its installation marked. The machine now stands with its original stairways and galleries as shown in the photograph, in the middle of a grass plot, in front of the turbine department of the General Electric Company at Schenectady, N. Y.

Turning now to the latest development in the steam turbine art, the most powerful machine in the world for the generating of electricity was placed in service on November 3rd, by Mr. George B. Cortelyou at the Waterside generating station of the New York Edison Company.

The greatest of playwrights could not have conjured up a more dramatic and spectacular setting for the starting of this electrical monster than the one which really existed at Waterside. Opposite the new machine stood seven huge vertical engines, an older type of generating apparatus, working might and main. At the time appointed for the starting the guests ranged themselves about the giant turbine.

Suddenly the first of the line of vertical engines came to a stop and the turbine got under way. Then one by one the other vertical engines were stopped and their entire "load" transferred to the great turbine.

From a state of idleness the grim monster leaped into roaring activity, assuming the whole work of the seven vertical engines, all of which were brought to a dead stop. Several years ago these vertical engines represented the highest efficiency in current production and now comes a single machine in comparison with which they are but as toys. The



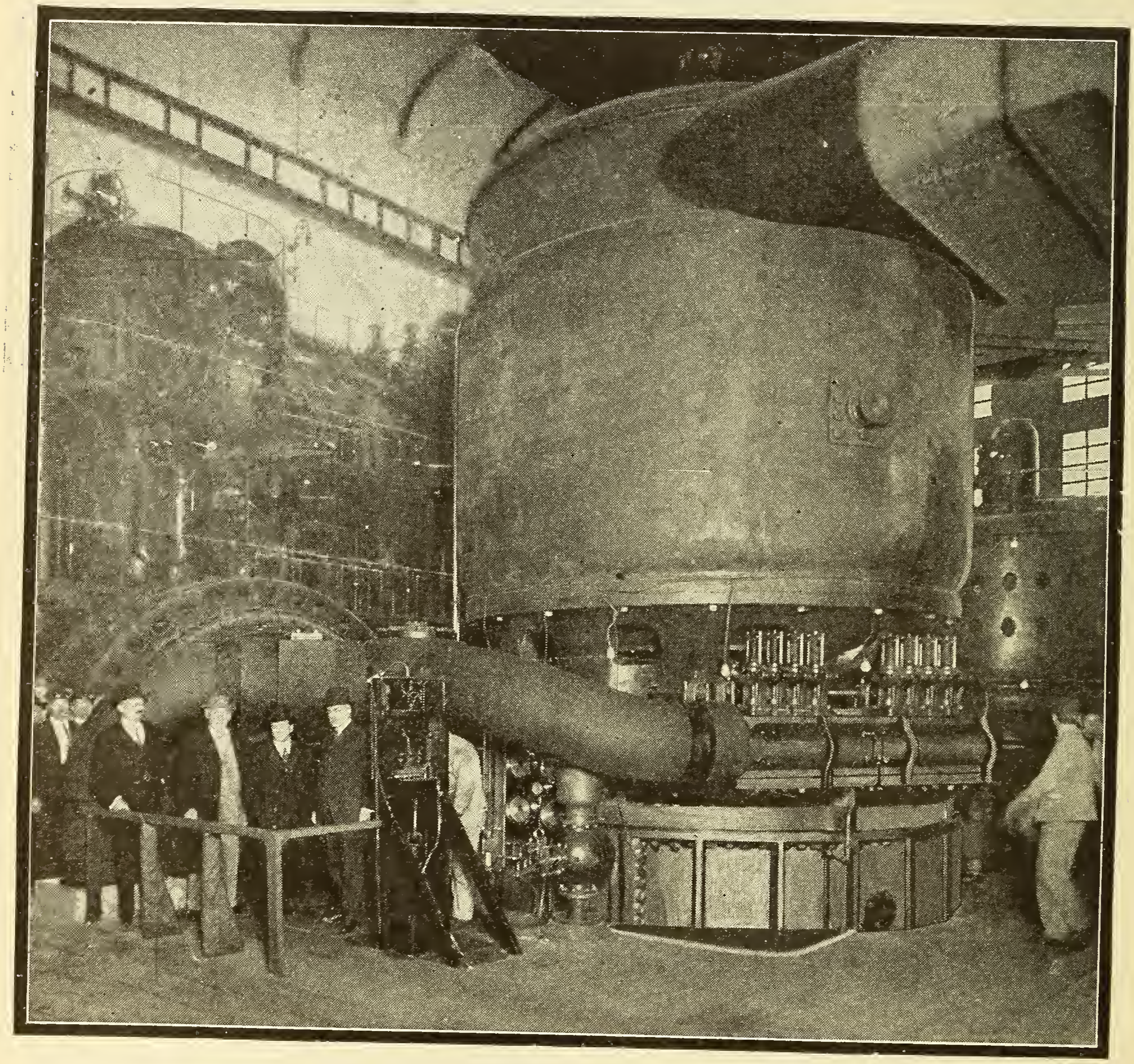
FIRST COMMERCIAL CURTIS STEAM TURBINE—PUT IN OPERATION IN 1903 IN THE FISK STREET STATION, CHICAGO. ADVANCEMENT IN THE ART HAS RESULTED IN THE REPLACEMENT OF THIS UNIT, WHICH HAS BEEN SET UP AS A MONUMENT IN SCHENECTADY, N. Y.

turbine, it must also be remembered, occupied but slightly more floor space than one of the vertical engines.

This great generator has a capacity of 30,000 horsepower, sufficient to supply all the current for the city of Providence, R. I., or any city of about 250,000 population. Alone it would supply a chain of cities such as Albany, Syracuse and Utica. Its power is equal to that of the largest ocean liner, 30 of the largest express locomotives, or a line of horses six abreast and ten miles long. Unaided it could light 1,000,000 incandescent lamps, each of sixteen candlepower.

The New York Edison Company is the successor to the Edison Electrical Illuminating Company, the first corporation ever organized to do incandescent lighting on a permanent basis. The first district station and distributing system were developed by Mr. Thomas A. Edison personally. For many months, day and night, the work had his constant and direct supervision. That which is today the best in the generation and distribution of electric current is proceeding on lines which he then discovered and utilized—the direct connected unit, the underground systems, the meter, the addition to the high resistance incandescent lamp, the foundation of all.

The site of the old Pearl Street station, a lot 50 by 100 feet, was purchased in May, 1881. The original station was four stories high and when started contained sixteen units, the historical "Jumbos" and supplied current to an underground system of less than fifteen miles in mains and feeders, occupying a territory from Wall Street to Spruce Street, and from Nassau Street to the



PLACING IN OPERATION THE NEW TURBINE GENERATOR IN WATERSIDE STATION, NEW YORK. IT HAS A CAPACITY OF 30,000 HORSEPOWER—ENOUGH FOR THE ORDINARY CITY OF 250,000 INHABITANTS

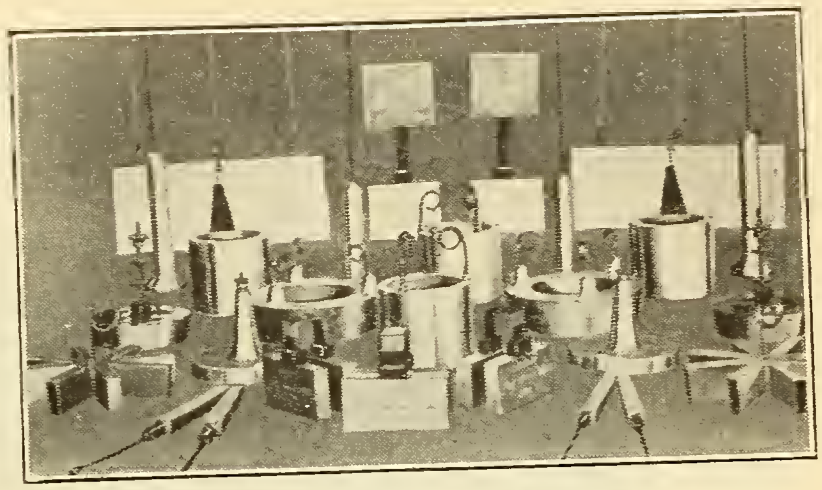
East River, about a mile square. The underground system was connected and tested during July, 1882, and September 4, 1882, at three o'clock in the afternoon, the station was placed in permanent operation. It ran continuously with but one break of about three hours in 1883 until the fire of January 2, 1890. The interruption to service after the fire did not last more than half a day; thus, since three o'clock of the afternoon of Septemebr 4, 1882, until the present time, Edison service on Manhattan Island has been fully interrupted only twice and the aggregate of these interruptions has been less than twelve hours.

The main generating or Waterside stations occupy two city blocks, and have a capacity of 500,000 horsepower. They are the largest of their kind in the world. At the present time there are 1,114 miles of mains, feeders and cables in the underground system. Through these is supplied current for practically the entire island of Manhattan, containing 21,093 square miles, and the Borough of the Bronx, having 4,065 square miles. More than 100,000 customers are supplied through 122,000 meters. The installations aggregate 4,341,000 incandescent lamps, and 40,200 arc lamps, 263,500 horsepower in motors. On December 31, 1910, the aggregate of these was 572,000 horsepower.

New Battery Zincs

All users of batteries know how much trouble is given by the zincs, which are often eaten away irregularly or else become covered with a deposit. Sometimes the amalgam gives way and then there is no protection for the zinc so that the acid or other solution attacks it and it is likely to be dissolved in a short time.

The new Bamber zincs which have appeared in England are intended to meet this difficulty. When tested against ordinary zincs in dilute acid for a number of hours, the ordinary zinc lost 61 per cent of its weight, while the Bamber zinc lost but nineteen per cent, which is a remarkable showing. After 65 hours there was considerable local action on the ordinary zinc and the amalgam seemed to have given out so that the zinc was much attacked. The surface was deeply scored, and a "waist" had already formed below the level of the acid. On the other hand, the new zinc had a good surface and was but little attacked. With bichromate batteries very good results are obtained, and the life is much longer. The illustration shows a variety of shapes of zincs for different kinds of batteries.



SHOWING A VARIETY OF BATTERY ZINCS

Skeleton Hands

In X-ray work it is important to have the tube adjusted to send out rays of ample power before trying them on the patient, for otherwise the skin of the latter might be burnt by the rays while the apparatus is being adjusted to give the necessary penetration.

One way of testing the adjustment consists in trying it on spare bones; as for instance, on a skeleton hand mounted within a radioscope. Imitation skeleton hands are now sold for this purpose. They are made of paper pulp or other compositions that are about as opaque to the X-rays as an actual hand would be.

Recently the ministry of public works advertised for bids on concessions for electric tramways and electric light plants in Adrianople, Adana, Aleppo and Jerusalem.

The Founders of the Electrical Industry

The Two Great Companies Finally Evolved from the Pioneer Efforts

By GEORGE FREDERIC STRATTON

We have seen that, of the companies which originated the manufacture of electrical machinery, three, viz: the Edison, the Brush, and the Thomson-Houston companies, after having themselves absorbed a number of smaller concerns, became merged into one great corporation—the General Electric Company.

The fourth—the Westinghouse Electric and Manufacturing Company—true to the character of its founder, remained sturdily independent, and so remains. As the combined output of the new General Electric Company in 1892 amounted to twenty-one million dollars, and its capital and surplus was thirty-three millions, it appeared then as if the Westinghouse Company was outclassed and would so remain. But the annual reports for 1906 show that its sales had reached a total of forty millions against an output of sixty millions by the General Electric Company, and its capital had increased to fifty millions against an increase to eighty millions by the other company.

GEORGE WESTINGHOUSE AND THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY.

George Westinghouse has never been left far behind in any enterprise in which he engaged. Possessing, as he does, the perseverance of Edison, combined with much of the inventive genius of Thomson, and the great financial ability of C. A. Coffin—the president of the General Electric Company—Westinghouse towers as a gigantic figure in the electrical industry. And though his energies, his genius and his time are divided among his other great interests he is a leader in that industry.

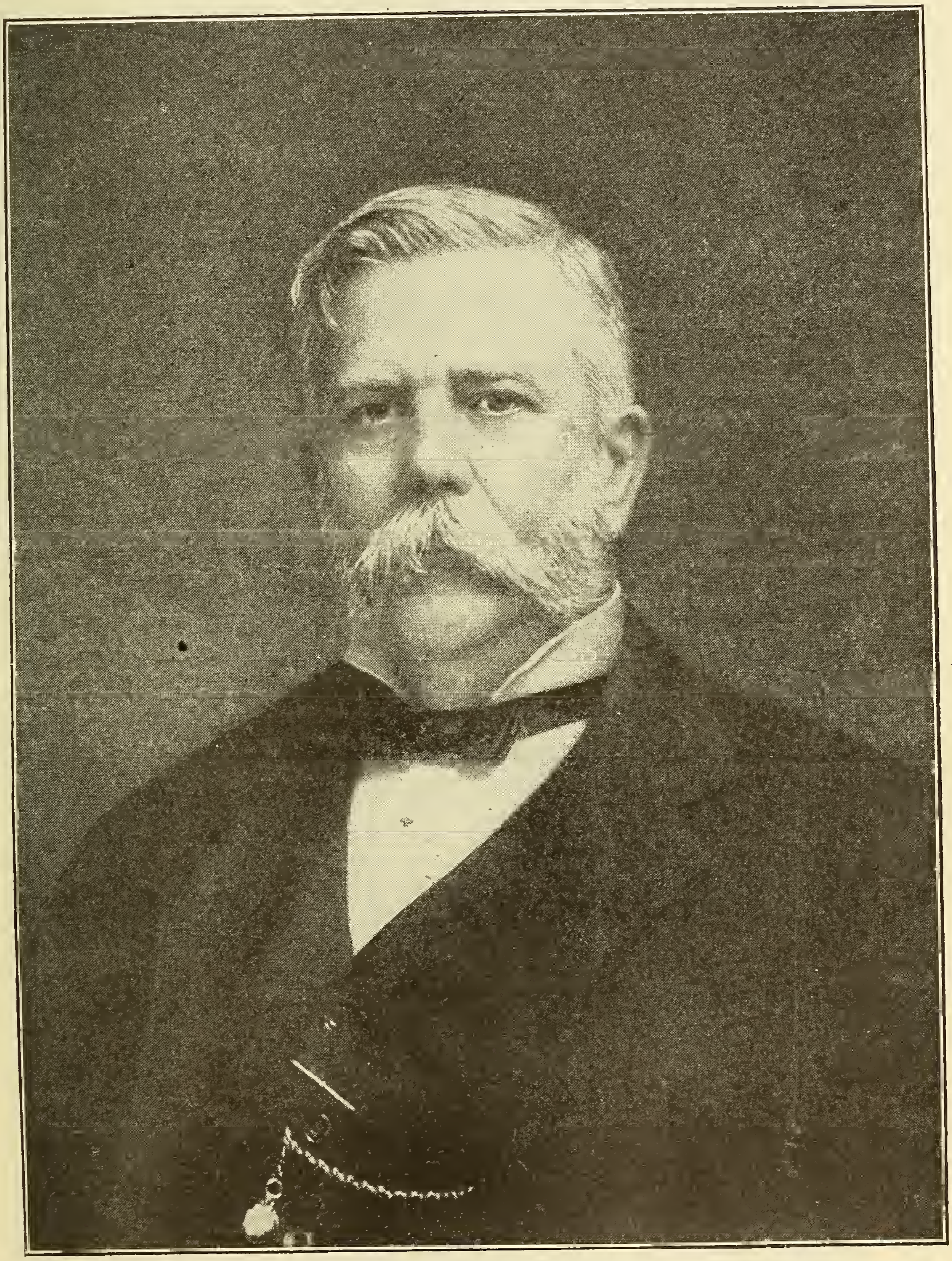
He is president of thirty corporations engaged in different manufacturing lines. He is directing the employment of two hundred million dollars of capital, and fifty thousand employees. He has branch factories in England, France, Germany and Russia; usually spending a portion of each year in those countries. He has secured patents on over two hundred of his own inventions, many of which are in active operation.

He is always a pioneer, and his career in the manufacturing of electrical apparatus has always been marked by leadership. In the early days of the industry the direct current only was used, but Westinghouse saw, with shrewd estimating judgment, the even greater possibilities of the alternating current; and in spite of the difficulties then attending its use—the opposition of scientific men and the denunciation of the press of the day at the supposed danger from its high voltage—the great industrial captain was not turned from his purpose. Undoubtedly this prejudice and opposition kept his company behind at the first, but it is certainly owing to the great success of its alternating current developments that the company has forged ahead so remarkably in the last decade.

Again, when starting on the manufacture of car motors and equipment, Mr. Westinghouse purchased the Lackawanna and Wyoming Valley Railroad—42 miles from Scranton to Wilkesbarre—for the sole purpose of developing, himself, his system of electrically equipping a railroad in the most efficient manner.

Then, when the steam turbine was first adopted by the English Government as motive power for the speediest torpedo boat destroyers, Westinghouse at once saw its value as a prime mover for electric generators and dynamos. He hastened to England, purchased the American rights of the Parsons patents, and before his idea was taken seriously by engineers in this country, he had fitted up a manufacturing plant and was setting up the machines.

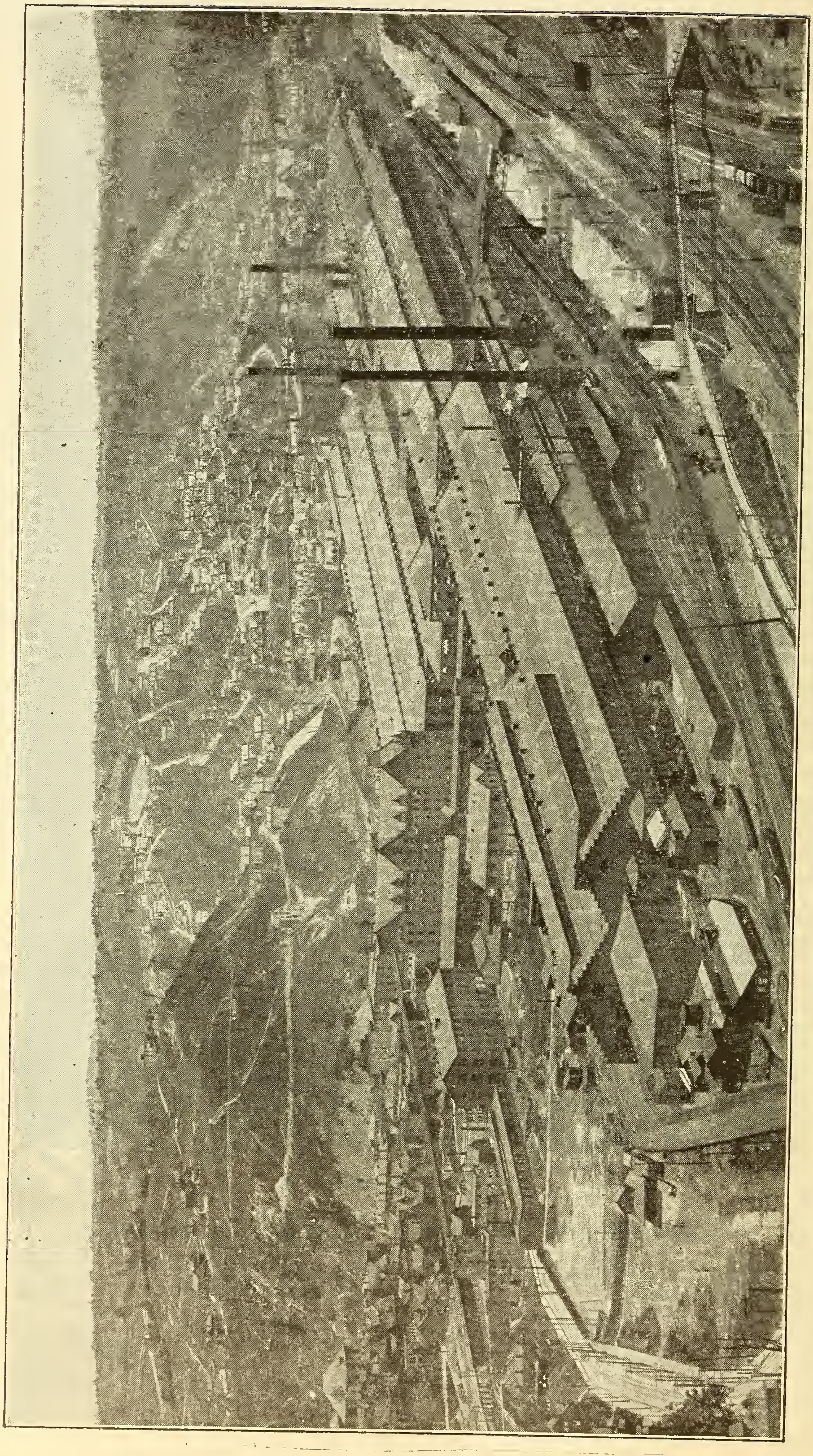
He was born at Central Bridge, N. Y., in 1846; fought with the Union forces in '63-64, and then re-enlisted in the navy as an assistant engineer, in which capacity he served until the end of 1865. He then took a two years' course at Union College, and the year after graduating invented the air brake.



GEORGE WESTINGHOUSE

A director in several of the Westinghouse companies gives the following terse and comprehensive review of Mr. Westinghouse's personality:

"He is big, bluff, hearty; a giant in body and mind; reasonable, but impatient of opposition. His brain works so quickly that he sees the essential point



WESTINGHOUSE COMPANY'S WORKS AT PITTSBURG, PA.

in a complicated situation even before the story can be fully told, and his decision comes as quick."

Like the other founders of the industry, he is as well known in European countries as in his own, and as highly esteemed. He has received the Cross of the Legion of Honor from the French government, the Order of Leopold from the King of Belgium, and other minor decorations.

THE GENERAL ELECTRIC COMPANY.

We now arrive at a review of this great company, with its eighty millions of working capital, its miles of buildings, 40,000 employes, and a staff of mathematicians, scientists, practical engineers and business managers such as has probably never been assembled by any other single industrial corporation.

A short time after its organization the General Electric Company experienced the only dark days known in its history. Its capital was fixed at fifty millions, ten of which were bonds, the remainder in stock. The combined capital of the two consolidating companies was twenty-five million of stock and in exchange for that the forty millions of new stock was turned over—the patents, franchises and good wills being estimated as worth fifteen millions. Although savoring slightly of the high finance operations of the present day, this capitalization cannot be considered in any degree excessive, or even unreasonable.

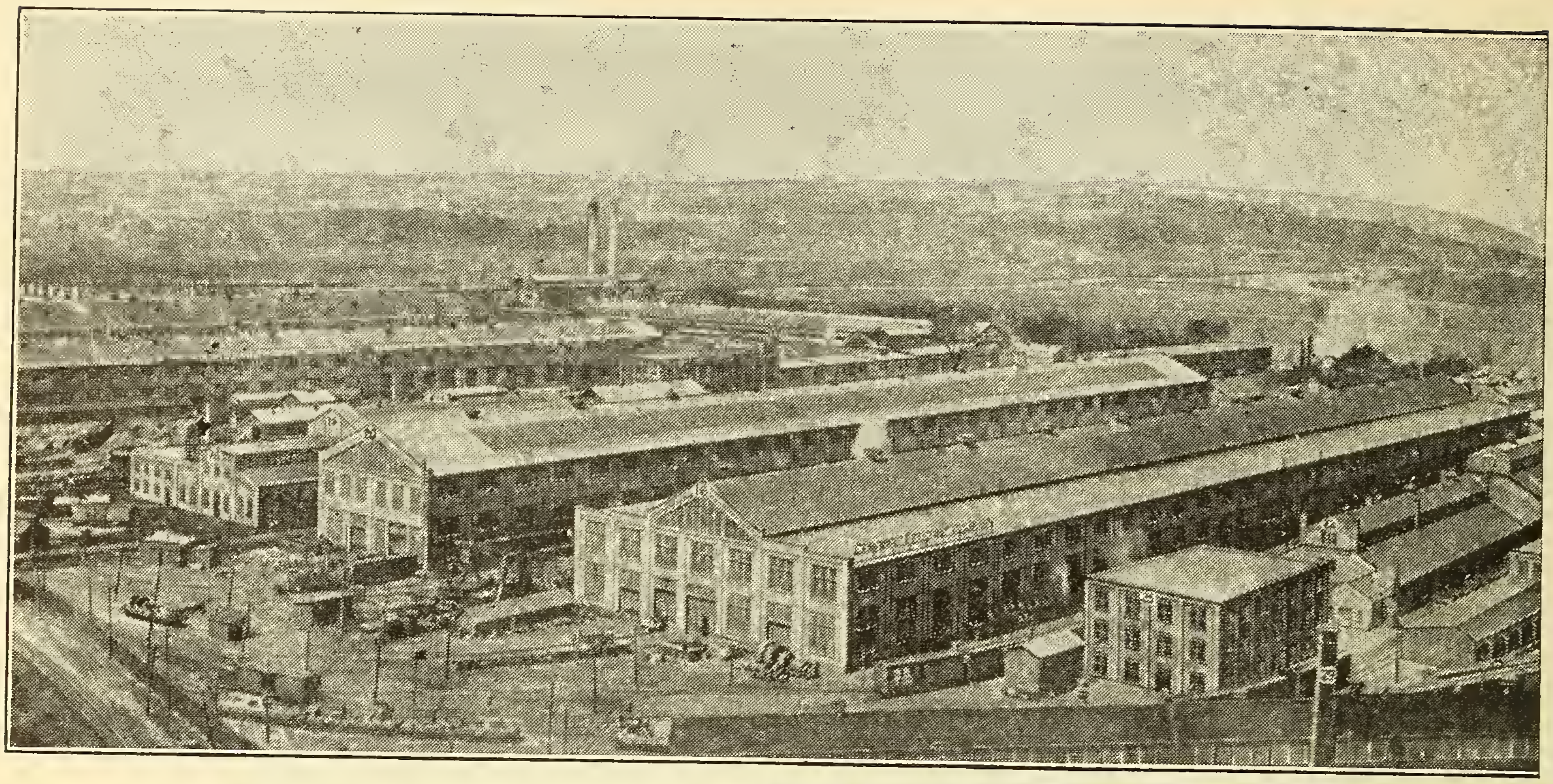
In 1898, the president, Mr. Coffin, presented a plan for reorganization. It was, to reduce the par value of all stock from 100 to 60, and after a meeting of stockholders this was agreed to. Thus the capital stock was reduced from forty millions to twenty-four millions—or about the amount of the original stock exchanged. In announcing this reduction the officials frankly stated that the original valuation of the patents and good wills had been over estimated.

Matters improved at once. Business was on the up-turn and within a year the company resumed dividends. In 1902 so large a surplus had accumulated that a stock dividend of fourteen millions was declared, thus restoring to the shareholders the amount they had relinquished four years before.

The great success of this company, interrupted only by the temporary loss, which as we have seen was fully regained, is due to a splendid policy of comprehensive and liberal experimentation. In this policy the company is imbued with the spirit of Edison. The spirit which impelled him to devote the first large sum which came into his possession—$40,000 received for the stock ticker patents—to the installation of a workshop for purely experimental purposes, found a fitting development and exposition in the later expenditure, by the General Electric Company, of over two millions in the acquisition of the patents and the experimental development of the Curtis steam turbine, an expenditure which was freely incurred before a single order was obtained, or even solicited. As far as the writer knows, no such large sum was ever before expended by an industrial corporation in a like manner upon a single type of machine. It was a magnificent demonstration of courage and progressive exploitation.

Outside of this, the company has, for some years past, spent annually, nearly as large a sum in experimenting upon new appliances and improvements, and in investigating outside inventions. It keeps a force of three expert patent attorneys, with 25 office assistants, constantly under salary.

In the '90s the company built and equipped the Schenectady Street Railway from Albany and Troy to Schenectady—a trackage of 35 miles. This was for the same purpose as that which Westinghouse had in view in the purchase of the Lackawanna and Wyoming Valley Railroad, viz.: the development, under their own eyes and management, of the electrical equipment of street car lines.



MAIN FACTORY OF THE GENERAL ELECTRIC

It is a wonderful plant—that of the General Electric Company—or rather plants, for there are no less than seven separate establishments; one at Schenectady, N. Y.; others at Lynn, Mass., Harrison, N. J., Fort Wayne, Ind., Pittsfield, Mass., Toledo, O., and at Erie, Pa. Seven hundred acres have been purchased upon which another great plant is now being installed.

Then there are factories in Canada, in England, and on the Mediterranean. In all, the total number of hands employed reaches upward of 40,000.

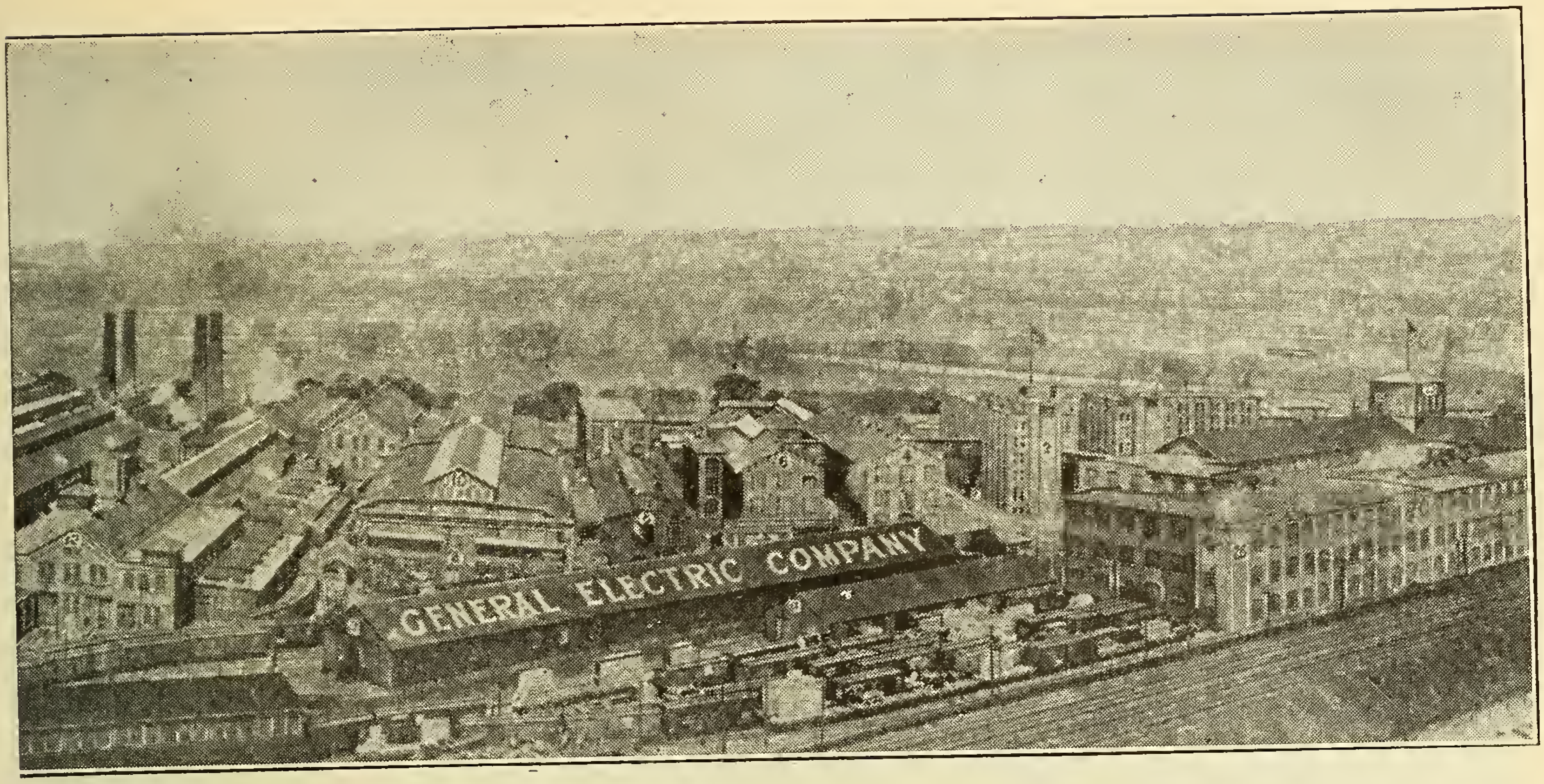
CHARLES A. COFFIN, THE PRESIDENT OF THE GENERAL ELECTRIC CO.

The president of this corporation is Charles A. Coffin, who had been treasurer and manager of the Thomson-Houston Company for some time previous to the consolidation with the Edison Electric Company, and who was then made president of the new company.

Although Mr. Coffin cannot strictly be regarded as a founder of the industry his connection with it from so early a period, and the large share he has had in building it up to its present proportions, identify him very closely with the founders. He occupies a distinct position in the commercialism of the industry. While both Brush and Westinghouse have displayed high organizing and financial abilities, Brush dropped out during the first decade of electrical exploitation, and Westinghouse has always divided his time and able energies among his other large enterprises.

But Coffin has devoted every moment of his time and every impulse of his financial genius, since 1892, to the development of the manufacture of electrical machinery. He is not a scientist or an inventor. He is purely a financier and organizer.

He was born in Maine in 1844, and in his early manhood became interested in the shoe manufacturing business in Lynn, Mass. He is one of the few capitalists who were instrumental in removing the old Thomson-Houston Company from New Britain to Lynn, and shortly afterwards he sold out his shoe factory and devoted his fortune and his energies to the infant industry. His splendid success is signalized in the monumental establishments at his home town and at Schenectady. Like the other founders he is still on deck planning and directing, as enthusiastic and energetic over the latest undeveloped discoveries of electrical possibilities as he is over the tremendous output and reliable achievements of standard apparatus.



COMPANY AT SCHENECTADY, NEW YORK

THE PRESENT AND THE FUTURE.

At the last census the total annual production of dynamos, generators, motors and all appliances for the equipment of railroads and light and power plants, was valued at about $140,000,000. Of this amount the two companies—the General Electric and the Westinghouse turned out a little over one hundred million dollars worth. The remaining production was divided up among nearly 200 smaller manufacturers.

Those figures are not, in themselves, insignificant; but they are small compared with the immense development of industries and public service which the equipment and appliances invented by the founders of the industry and manufactured in their plants, have made possible. The street railways of the country are capitalized at over three billion dollars.

The light and power companies are capitalized at nearly one billion dollars, and their earnings last year were over one hundred million dollars. That industry rests upon the foundations laid by Edison, Brush, Westinghouse and Thomson; and others whose inventions have been developed and made practicable by the leading manufacturers of today.

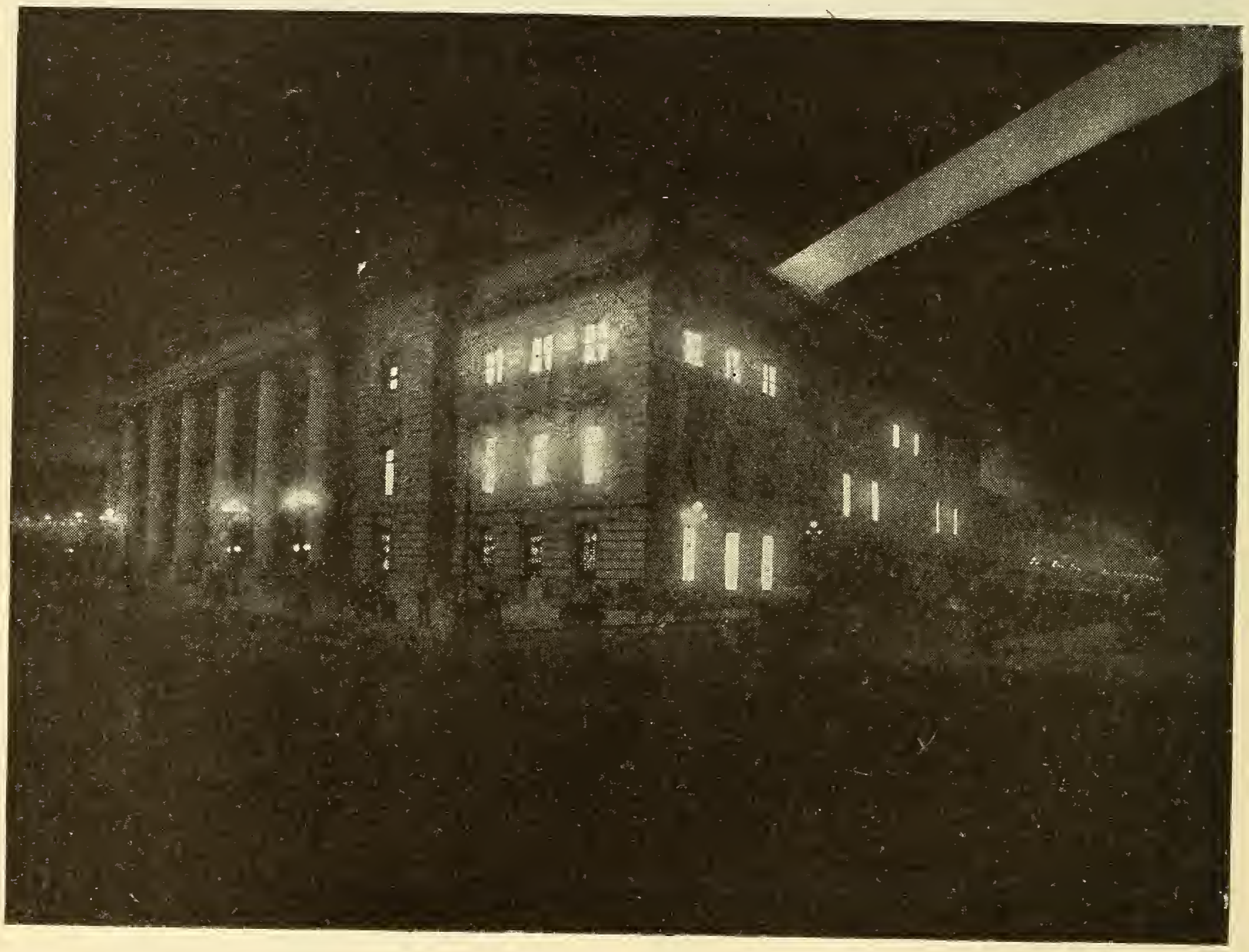
These founders had even a more direct influence upon the establishment of electric railways and lighting plants than that of inventing and manufacturing the necessary apparatus. In the early days it was not always sufficient to make the machines which would do the work. It was also necessary to brush away the clouds of doubt and cynicism with which such new and astounding results were viewed. Those fathers of the lamp and the dynamo had to show their own abiding faith in their work. They made possible the formation of many of the street railway and lighting projects by furnishing the electrical apparatus and taking their pay in stocks or bonds of the projected companies. The Edison electric and the Brush electric companies themselves formed many companies for lighting various cities; and the old Thomson-Houston and the Westinghouse companies did the same for the development of street car lines.

Nor is this all. The utilization of water power in regions inaccessible for manufacturing purposes is being enormously developed through the use of electrical transmission, a development made possible only by the use of the inventions and apparatus comprised in electrical machinery. In addition to the hydro-electric plants to be found now, in almost every canyon of our great mountains, and beside the gigantic dams of wild and secluded rivers in the South and West, the manufacturing companies are continually shipping such apparatus to South America, India, Africa, and to countries where the lighting equipment has a six months' night to illuminate.

Nor is the end yet, or even in sight. The most pessimistic observer will not declare that it is. Edison, Brush, Westinghouse and Thomson still live, and have not ceased to labor. The oldest is still in possession of his keenest faculties and strong determination; the youngest is well this side of Dr. Osler's—beg pardon, Sir Dr. Osler's—celebrated assertion of inanity at three score years. Mighty things may yet come from these men, and from the scores of younger men who, enthused by their example and influence, and emulating their successes, will continue the work.

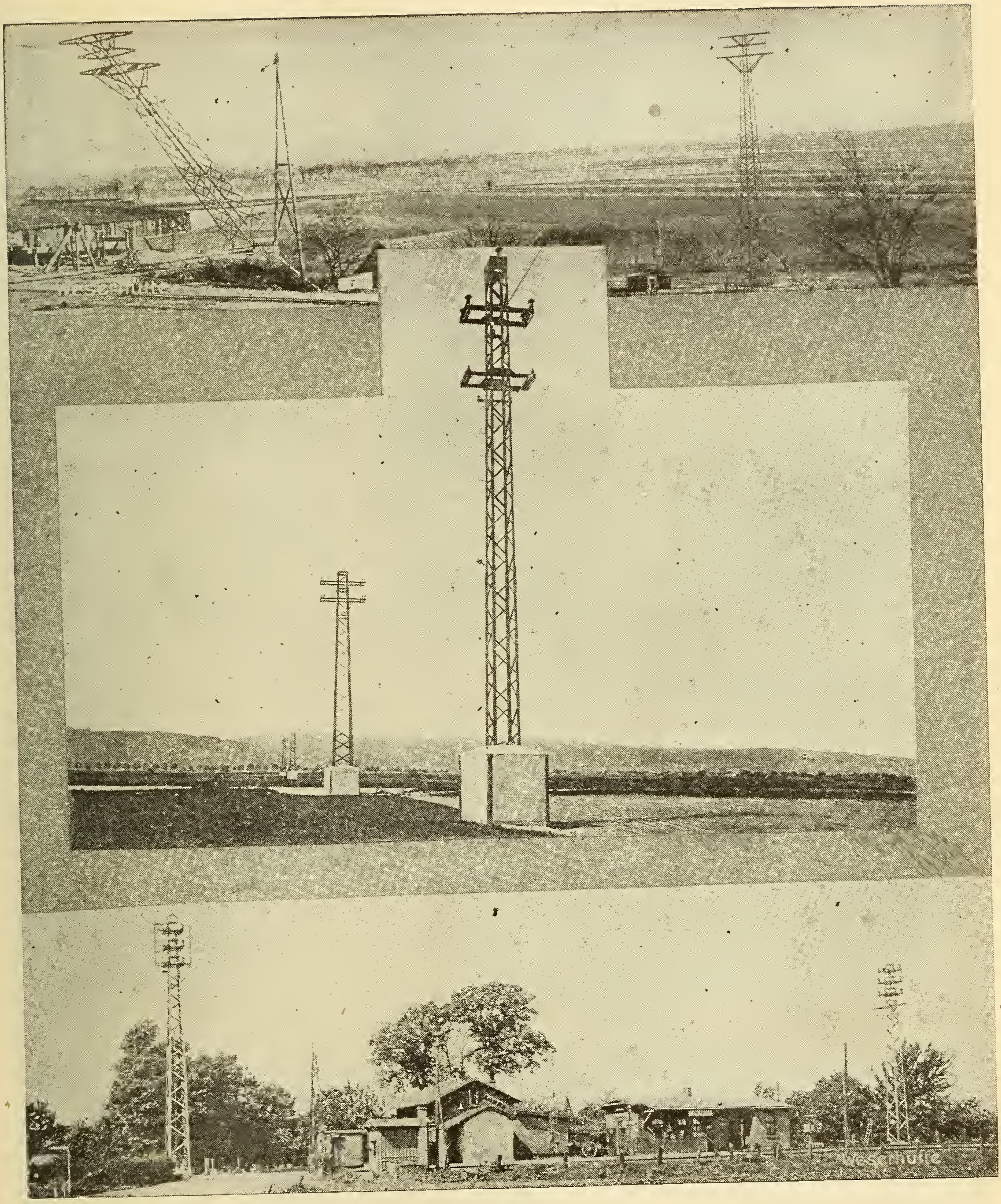
Powerful Searchlight on Railway Station

Pedestrians traveling from the "loop district" to Chicago's West Side in the evening have their attention called skyward by a big ray of light which shoots far into the sky from the roof of the new Chicago and Northwestern Railway station.



STRIKING PHOTOGRAPH OF A SEARCHLIGHT BEAM

A powerful searchlight of the "Navy" type has been installed on the clock tower of the station on the Clinton street side. Set on an oscillating device, it is moved about by electrical apparatus designed by the railway's engineers. The lamp is in operation from 5:30 p. m. to 10:30 p. m. and shoots its powerful ray over the loop district. When the light is directed east the ray can be followed for six or seven miles out over Lake Michigan. The beam of light where it leaves the lamp is 30 inches in diameter.



PICTURESQUE TRANSMISSION TOWERS OF GERMANY

The great steel towers on which German power companies as a rule carry their transmission lines, far from being eyesores, are real ornaments to the landscape. The upper illustration shows a line near Freienwale, Germany, in course of construction. The middle picture shows the transmission line of the Bayerische Uberland Centrale-Actiengesellschaft of Regensburg at the point where it crosses the Donan. The bottom view shows the towers of the Moers-Uerdinger line. The country through which the lines pass is a veritable garden and there is something picturesque about the rows of tall sentinels that guard it.

Electric Submarine Signals

Submarine signals as at present developed serve as an accurate and reliable coast warning and in thick weather give the same service that lights and marks give in clear weather. Take as an example all trans-Atlantic liners bound for New York. They try to pick up Nantucket light vessel for this is where they make their turn and is the point of departure from which they lay their course for Fire Island and Ambrose Channel light vessels. If they pick up Nantucket they can lay their course with absolute certainty and be sure of making Fire Island. If not, the run to New York is full of anxiety and danger, which might be done away with if such a system were installed.

Submarine bells in the English channel and in the North and Irish Seas enable liners to run from point to point with confidence, and do away with the dreadful uncertainty in the fog. It is of interest to note that the Cherbourg tenders equipped with bells steam outside the harbor and act as guides for the liners coming in, thus saving much valuable time and avoiding the danger of a close and uncertain approach to the coast in fog. The service that submarine signals render is not confined to saving life and property. Their value for saving time also was well illustrated by an incident at Bremerhaven some years ago when the Kaiser Wilhelm II reached the mouth of the Weser together with several other vessels which were not equipped with submarine signals. By means of her submarine signal apparatus she was able to pick up the Weser lightship, enter the harbor where she found the fog lifted and discharge her passengers and cargo. It was 22 hours before the weather cleared outside and the other vessels could make port.

For deep sea work the electric apparatus consists of an electric bell with tripod, connecting cable and power plant. The tripod is used for supporting a submarine bell. The submarine cable leads from bell to the shore station, and there is a marking buoy with an anchor chain for marking the location of the bell.

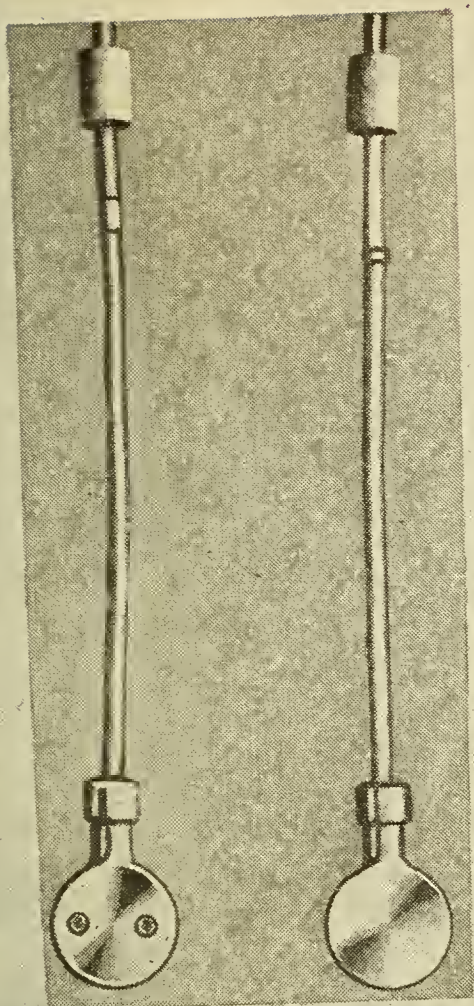
A small gas engine power plant usually supplies the necessary electricity. The electric bell consists of a 220 pound bell about fifteen inches in diameter, attached to a case containing the actuating mechanism. The mechanism is very simple in construction. A large electromagnet having six posts attracts a disk-shaped armature which is attached directly to a rod which moves the hammer of the bell. The bell mechanism and case together weigh about 900 pounds and measure over-all nineteen inches in diameter by 50 inches high.

The bell is suspended from a tripod which rests on the bottom of the ocean. This tripod is made of steel channel irons and is about 21 feet high and weighs 5,000 pounds. It must be placed in water sufficiently deep to enable vessels to pass over it without striking.

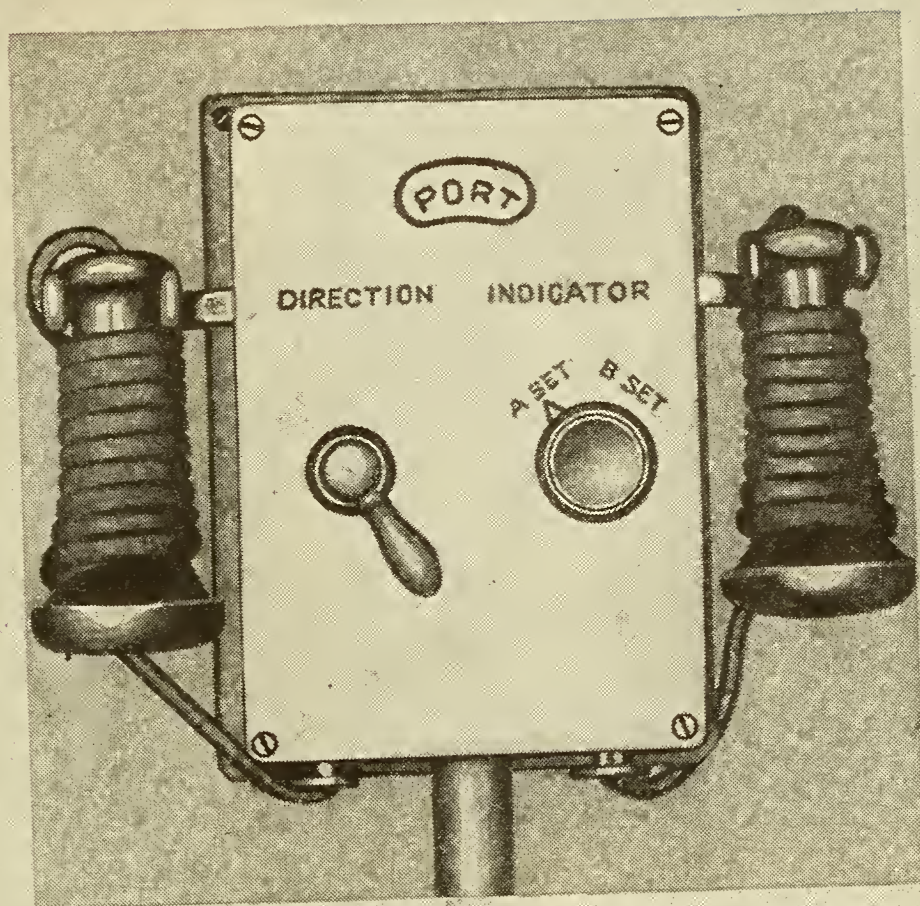
There is an electric controller driven by the engine which contains an electric switch operated by dogs on a wheel passing over it. Each time a dog strikes the switch an electric circuit through the dynamo and bell mechanism is closed, thus ringing the bell. The dogs are so placed on the wheel that any desired code may be rung by the bell.

On the switchboard there is also a telephone receiver connected with the two telephone wires in the cable, which in turn are connected with a microphone in the bell case. By this means the engineer in the shore station can hear whether the bell is ringing properly.

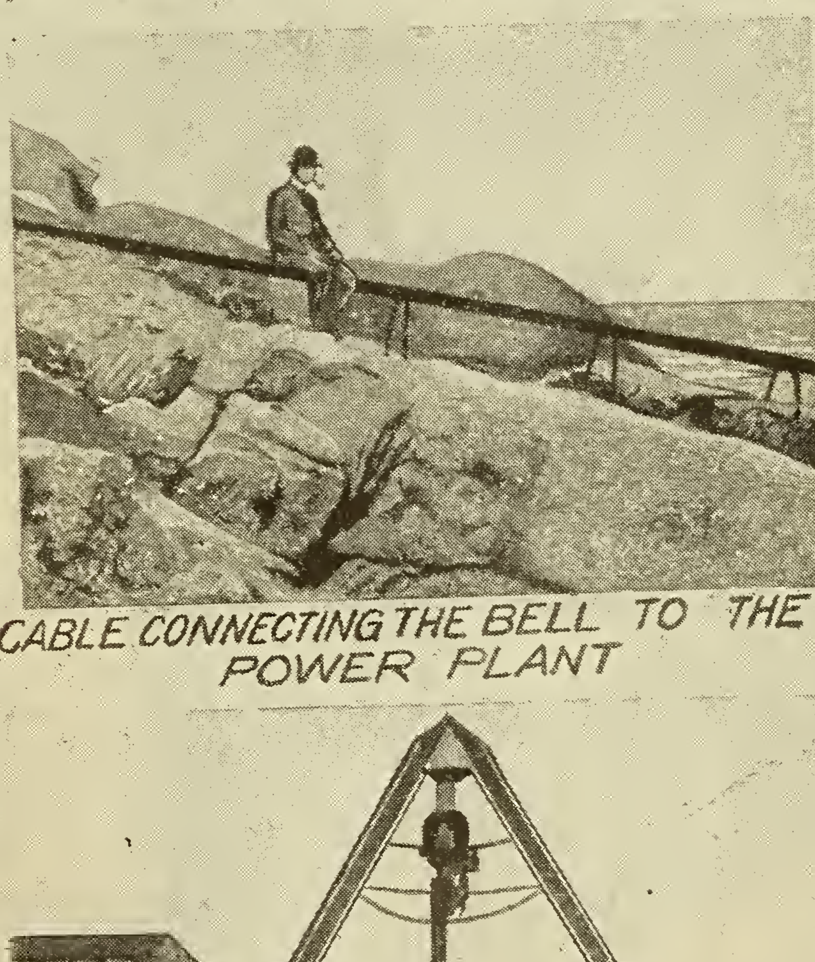
The receiving apparatus of a submarine signal equipment is most interesting. It consists of an indicator box which contains switches for connect-



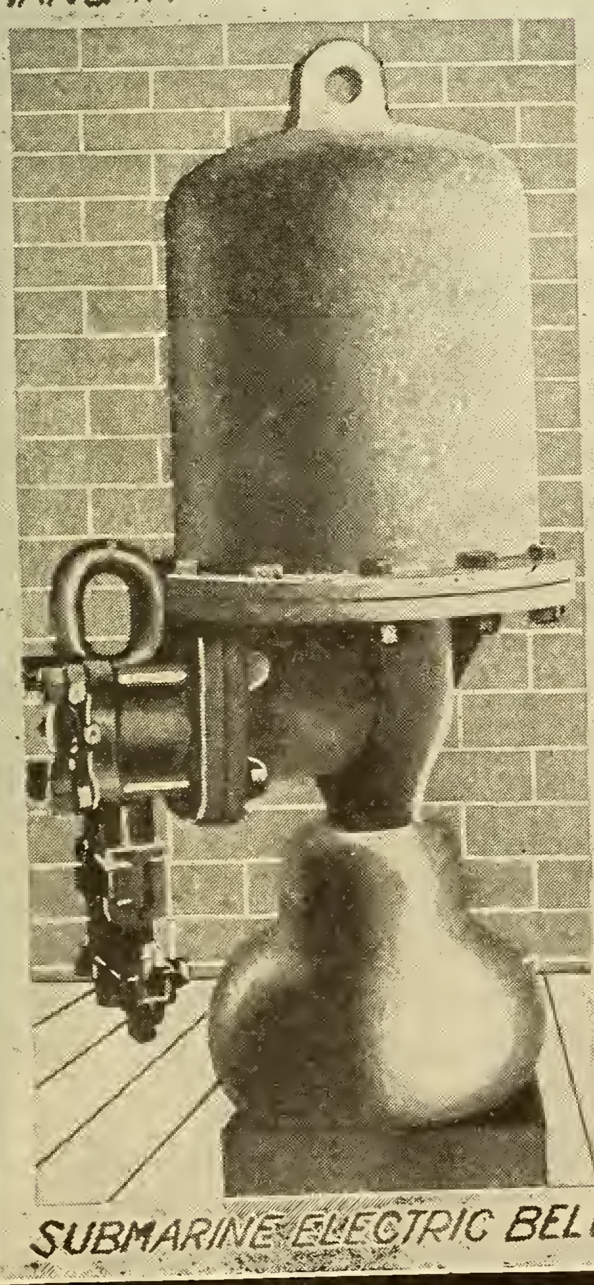
MICROPHONES WHICH HANG IN THE SEA



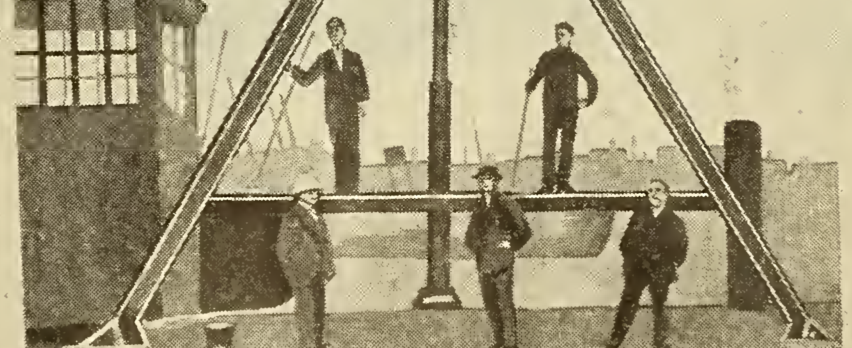
INDICATOR OF SUBMARINE SIGNAL



CABLE CONNECTING THE BELL TO THE POWER PLANT



SUBMARINE ELECTRIC BELL



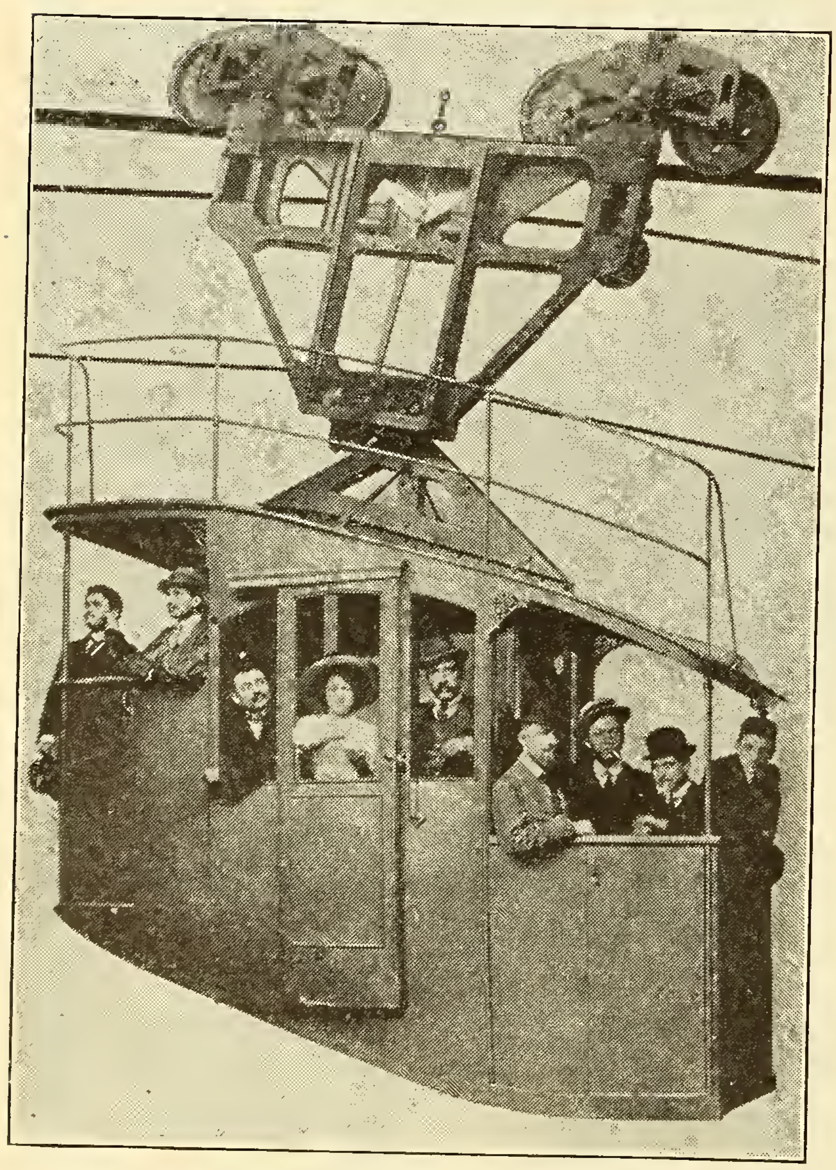
FRAME SUPPORT FOR ELECTRIC BELL

ing alternately the microphones of the system with the telephone receivers. Dry batteries are used for supplying an electric current for the telephones.

The microphones, two in number, are suspended in the water and transmit the bell sounds to the telephones. The indicator box is provided with telephone receivers and switches which enable the officer on duty to listen to the microphone on either side of the ship as desired, the better to determine from which direction the sounds are coming.

Electric Cableway Up Mt. Blanc

A suspended, electrically driven cableway is being built upon the slope of Mount Blanc so as to reach a point near



OFF FOR THE TOP OF THE ALPS

the summit of the mountain. The first cableway of the kind is now running upon the Wetterhorn, also in the Alpine region, and it proved to be a decided success. Instead of traveling by rail, tourists will now have the sensation of an aerial voyage among the glaciers and snow covered peaks. Before this a difficult climb was needed in order to reach the high peak known as the Aiguille du Midi, but when the cableway is finished, the ascent will become an easy matter.

The car is hung from a permanent steel cable which is stretched along between trellis work steel towers. There is an upgoing and a downcoming car, each upon its own cable, and the two cars run close together upon the parallel cables, the two main cables being carried upon the upper expanded part of the towers. The two cars are drawn along at the same time by a lighter cable, which is endless, and runs in the usual way upon cable drums placed in the upper and lower stations. An electric motor in the upper station serves to drive the cable drums. A third cable, which is just under the track cable, is used for safety, and serves as a standby in case the drawing cable should break. Then the safety cable becomes attached to the car by an automatic device.

An Electric Advertisement

An electric light company in a western town recently made a hard campaign for new users of electricity. A street car furnished the advertising and it was such good advertising that the number of contracts coming in has doubled.

Light wood signboards were built up around the sides and back of a single truck street car. These signboards were framed by reflector troughs containing 30 100 watt tungsten lights. Various arguments for the use of electricity were painted on the signboards, the legends being changed from time to time. The front of the car was equipped with a powerful interurban headlight, while inside was an equally powerful electric player piano. When this car is sent down a quiet residence street, with its headlight blazing and its sides flashing, and with its piano playing, it naturally gets considerable attention.

Electric Car for Bridal Parties

The London United Tramways Company has built a luxurious car for the special use of wedding parties, theater parties, etc. It is beautifully fitted up within and adorned on the outside in various ways, even including jars of ferns on the roof. The members of the crew appear to enter into the spirit of the occasion, judging from their smiling countenances.

THE MOST MODERN WAY OF STARTING A HONEYMOON—ON A LONDON BRIDAL CAR

Lights in a Hindu Temple

After a long series of arguments, it has at last been decided to install electric lights in the famous temple of Kali, at Kalighat, India.

A large number of pilgrims visit this temple every day, and they have always been greatly inconvenienced in their worship by the defective lighting arrangements. When the proposal was made to install electric lights, the orthodox Hindus were bitterly opposed, for they felt that it would be sacrilege to introduce anything modern into their religion.

However, after several sessions and many lengthy discussions, the controlling body decided that there was nothing objectionable in such an installation, so the Calcutta Electric Supply Corporation was given a hurry-up order. This is looked upon as one of the greatest victories modern electrical progress has won in India, for up to a very short time ago, no one believed it possible to obtain permission to use such a modern appliance as the electric light in one of the old temples.

Platinum Production Small

The entire production of crude platinum from placer mines in the United States for last year, as well as for 1909, came from the States of California and Oregon. This production in 1910, according to Waldemar Lindgren, of the United States Geological Survey, was 390 troy ounces, valued at $9,507, a decrease of 282 ounces and $3,296 compared with the figures for 1909.

"Unit No. 8"

By HERBERT ALDEN SEYMOUR

"He's 2,000 years old—and he's brand new," said Holroy to MacHugh, patting the shell of the great steam turbine electric generator in the erection of which he and his crew had been working night and day.

"Too new," grumbled old MacHugh, the chief engineer of the Citizens Light and Power Company. "You'll be all today balancing it, and the 'green' armature has to be dried out before it'll do us any good."

He looked at the bronze tablet newly attached to the mighty girth, and grunted as he read thereon: "Licensed....to be used for all purposes except as a prime mover for....aerial craft." The tablet also bore data relative to capacity, 10,000 kilowatts; speed 750 revolutions per minute; and various other items, including many patent numbers and dates.

"You're in an awful rush, for a man who didn't want a turbine at all," said Holroy, good naturedly, a few minutes later. "You've hounded me for two weeks about it."

"Unit No. 8," they called it, the powerhouse containing seven other engines and generators of 1,000 to 2,500 kilowatts each. These were all vertical Corliss engines and MacHugh was justly proud of them. He had been reared to the reciprocating type to which they belonged, and to that type he was stubbornly inclined to pin all his faith.

He loved the straightforward mechanical simplicity of cylinder, piston, connecting rod and crank; and the swing of the big generators and flywheels, and the steady whirling of the governors were obeisances and symbols of his mastery. Steam pressure and expansion were tangible ideas; but to use these forces kinetically in a turbine with thousands of little vanes or buckets—that was difficult for him to feel, in terms of thousands of horsepower in the compass of a few cubic feet. And MacHugh had never yet seen a steam turbine in operation.

General Manager Walker, discussing MacHugh's attitude with his wife, as he had discussed all the principal moves he had made since assuming his responsible position with this company, had said, "Mack is a good engineer, and he knows turbine theory; but he has no love for it. However, I know he will come around to it when the time comes."

"Well," answered pretty, young Mrs. Walker, who had all the faith of a bride in her energetic husband, and loved to be included in his managerial confidence, "well, he won't play any tricks with it, anyway. He is too staid and reliable for that. You can trust him. And that is very fortunate, because your success is much in his hands."

Walker, visiting the power station that gray December morning, paused at the door, casting an apprehensive glance at the sky.

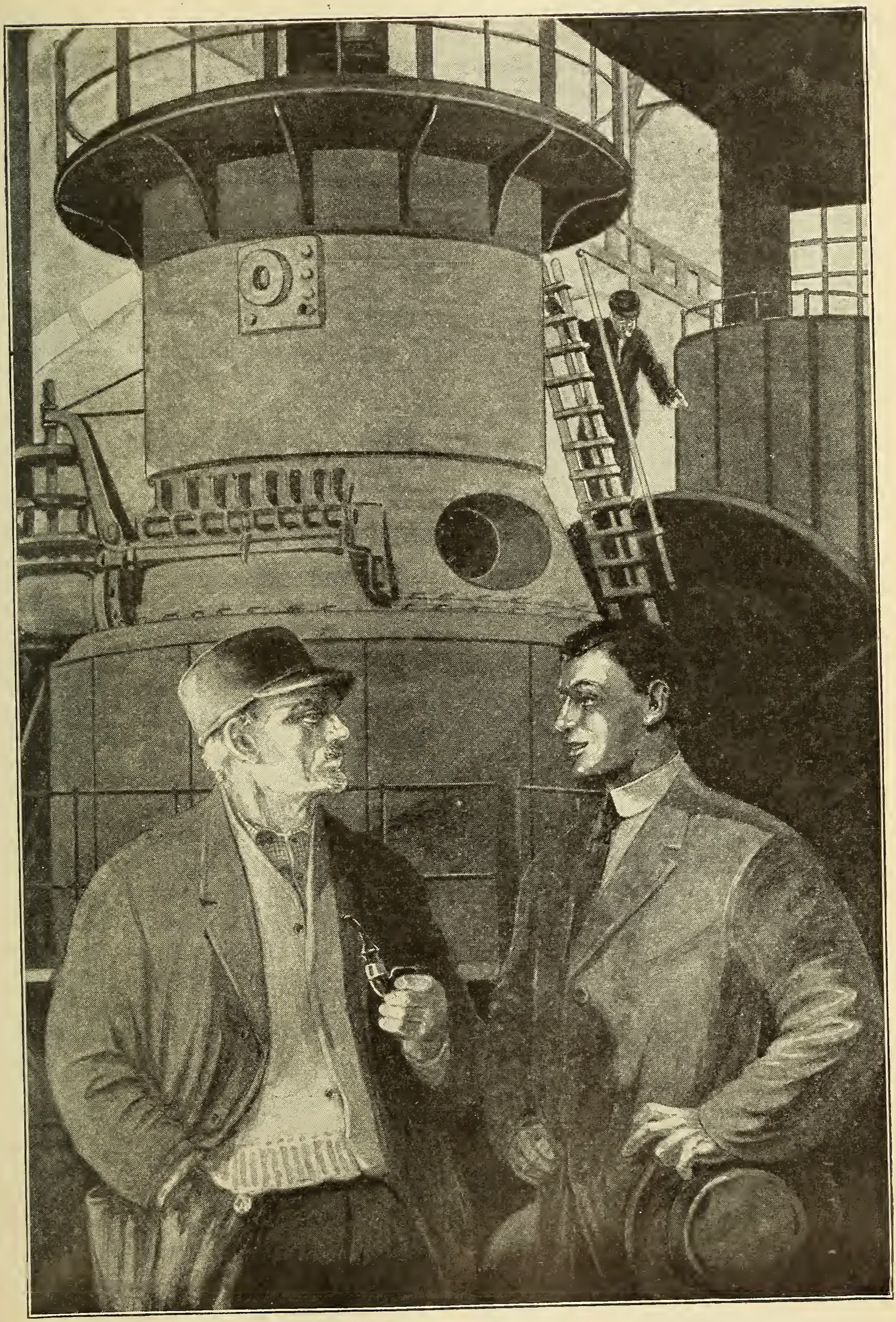
"Snow," he said to himself, "snow, sure as a gun. And I know just what it will do to us with that traction load."

He scowled at the black smoke issuing from the stack of the Adamson furniture factory on the opposite corner. There was a steam power plant there in spite of its proximity to the electric station, and it always angered the general manager to see evidences of the fact. His own stacks smoked less for 5,000 horsepower than theirs did for 50. The fuel was the factory refuse, eked out by an abominable grade of soft coal.

"I'll stop that some day," said he, entering the station.

Holroy, erecting engineer for the manufacturers, waved a hand to him from the top of the new unit.

"Will you finish today?" enquired the general manager.



"You're in an awful rush for a man who didn't want a turbine at all."

"I hope so. This double shift work has lasted quite long enough for me. I'll be glad to get the machine off my hands."

"Not half so glad as I'll be to get it on the system," declared Walker.

"Mack," he continued, "we're likely to have snow; perhaps a blizzard; and if so a peak load away above anything we've ever carried. Watch everything very carefully. The new franchise ordinance that we have been fighting so long to secure is just about settled in committee. At a meeting this afternoon I shall try to wind up the tedious business and get it all cut and dried for recommendation to the Council tonight. Things are at a critical stage, and we can't let a storm bother us now."

The situation, with the great heedless public likely to call for 2,000 horsepower or more in excess of the capacity of the station, the turbine not being ready to operate, and the franchise in the balance, was a ticklish one, and very much of Walker's own engineering, as he himself knew. His wife knew it too; knew also that a freak of wintry weather might be enough to turn the scale the wrong way.

II.

A half dozen men were seated on top of the turbine, pushing on the field poles with their feet, and even under this puny impulse the 75 tons of metal in the revolving portion turned willingly on the big step bearing. Meanwhile other men listened for sounds of internal rubbing, standing on the lower platform with long wedge shaped steel clearance gauges held to their ears, points against the turbine's shell.

"All clear," was the word. So Holroy opened the throttle a little and Unit No. 8 came slowly up to a speed of 200 revolutions per minute. There was no rubbing, but a faint tremor could be felt.

Holroy turned a satisfied countenance to the chief engineer.

"Pretty steady at low speed."

"Very good," admitted MacHugh grudgingly.

"Let's see what 300 shows," said Holroy, admitting more steam.

And now the whole structure trembled with the whip of the upper portion. Chalk in hand Holroy climbed up and marked the heavy side of the shaft at the governor on top. Steam was shut off, and the artificial load, secured by short-circuiting the "green" armature for drying out and testing, presently brought the machine to a stop.

From a variety of weights prepared for the purpose, Holroy selected two small ones which were now screwed into holes in the motor frame opposite the chalk mark.

Again the test was made and yet again. Small weights were added and shifted. Holroy was patiently careful. Gradually the balance was improved as the morning wore on. MacHugh watched the operations and finally became somewhat bored. A few pounds of unbalance in his slow-moving Corlisses had never mattered, but in a machine of comparatively high speed, the periphery of the bucket wheels running about five miles a minute, a few ounces are all-important.

"Eleven-fifty," said Holroy at length, glancing at his watch. "I'm due to meet Walker for lunch."

He departed, and MacHugh moodily wandered back into the old portion of the engine room, where his eye could find constant satisfaction in the throw of the big cranks, and the slow, ponderous turning of the giant fly-wheels of his pets, the reciprocating engines.

The station men knew that he had been irritable ever since the subject of the turbine was first broached.

Walker's daring moves during the past year, when he was fighting for his new franchise under the disturbed conditions of a mayoralty campaign, had precipitated difficult conditions. The general manager had taken advantage of an opportunity to contract with the street railway people for about 3,000 horsepower of their load. This had absorbed the station reserve, and so the installation of additional capacity had been rushed to take care of this and the rapidly growing lighting and power load. Operating costs had been improved a little, however, and under these conditions Walker had forestalled the Council committee by voluntarily reducing rates for service, at the same time jacking things up all around to a most rigid level of economy. He scrutinized every detail constantly and demanded the utmost efficiency throughout. Then he had insisted on a single large turbine instead of the reciprocating units MacHugh had wanted, and had persuaded the directors to authorize it. Well, the responsibility was all his.

MacHugh, standing on the switchboard gallery which overlooked the old machines and brooding thus, listened to their familiar sounds. Each engine was personified in his mind and he could almost think them discussing the situation. Triple expansion Corliss No. 7 seemed to be saying:

"They're testing out that new tub full of wheels today."

And No. 6 replied: "Yes, there's something doing, all right, at last. I wish you weren't in the way, so I could see that big milk bottle when they put a load on him. He'll throw solder all over the engine room if he tries to come up to rating. Ten thousand kilowatts—not!"

"Upstart!" exclaimed No. 4. "Why, it overheated all seven of us to carry the winter peak last year, and that only went to 10,000 just before Christmas. Walker must be going dotty."

"Thunder. My flywheel alone weighs almost as much as all of this duck's moving parts," returned No. 7. "I hope MacHugh won't fall down on his account some fine day."

"Talking about peak loads, it has begun to snow," remarked No. 6, "and the cars will pull heavy."

The station clock struck the hour and MacHugh started from his reverie and went into his little den to wash up for dinner.

III.

Back from his luncheon, Holroy settled to his task again vigorously.

"Here goes for 400," he said, turning steam into the turbine, "and—there it is again; that confounded vibration; but not very bad now. Go up and mark it, Sam. Well," to MacHugh, "the snow has come, hasn't it? Regular blizzard."

"Bad," said MacHugh, "very bad. See what the load has risen to," indicating the bulletin at the switchboard.

Holroy whistled. "They *are* using juice. Well, the day is very dark for this hour. Perhaps it won't rise so much from now on."

Walker came into the station shortly afterward wearing a distinctly worried look. He and MacHugh held a council of war and then MacHugh called up the traction people.

"No use," he reported. "They are doing their best now at their own power house. The cars are crowded with women and children all loaded with packages. The storm is so bad that all the plows and sweepers are out, and they take a devil of a lot of power."

"Well, Mack, watch yourself. I've got to go to the City Hall now. The service must be A1, that's all there is to it."

As he turned to go, the assistant engineer summoned him to the telephone. Mrs. Walker was on the wire.

"Oh, Tom!" she said, "I just wanted to speak to you before you went to the committee meeting. I called your office but you weren't there, so I had them switch me onto the station 'phone. I do so hope you'll be successful, dear. It means so much to you, I know. Mr. Norton says the load is very heavy and growing. Well, let Mr. MacHugh do all the worrying about that. Your mind must be free from distraction. Call me up when you get through at the City Hall. I'm going to have a splendid supper for you. Now not a word more except 'good luck' and 'good bye!' "

Fifteen minutes later the boiler room foreman entered hastily and, catching MacHugh by the arm, whispered hoarsely in his ear, "the Adamson furniture factory's afire!"

Norton, MacHugh's assistant, had seen it from the window. "It's going to be a bad one," said he, running up. "A matchbox in a gale of wind. I'll start the fire pump and send a gang to our roof to fight the flying embers."

As Norton ran to the signal board, MacHugh hurried out onto the street to see for himself. Black smoke crawled out at every joint of the second story windows of the factory, and a red gleam flashed angrily within.

"The varnish room," volunteered one of the shivering employes who lined the sidewalk. "It's all off."

MacHugh's anxious eye measured the scant 60 feet between the two buildings. Engines and leads of hose were rapidly filling the street. Pipemen clambered up the fire escapes of the doomed building.

The blizzard buffeted him. Streams of water now rose against the burning factory and swished through the windows, glass disappearing out of the sash as though by magic. But the entrance of more air was what the fire wanted. With a roar the flames burst forth, driving the smoke far outward and the battle was on.

The grizzled chief of the fire department whirled up, with a clang, behind his tall, rangy bay, and strode to a box with just one glance at the fire. As the chief turned Mack stood beside him. They had known each other for years.

"Mack," said the chief, noting the station brigade wetting down the roof and wall, "I want to send some pipemen up there on your roof. I'll run two leads up there and hit that blaze from above."

"Good!" replied the other; and the chief was gone.

MacHugh ran back into the station, relieved by the presence of the veteran fire-fighter. Holroy was coming down the turbine steps.

"Only a slight vibration now," said he. "An ounce or so in the right place will do the business, I think. Does that fire worry you?"

"I think we are safe enough," replied MacHugh, "but the blizzard is a bad one. That worries me more," glancing at the load bulletin. "The demand is excessive for this time of day."

There was a tremendous contrast between the warm engine room and the treacherous, icy roof where Norton's crew and the department men were at work. And as more and more water and snow froze on it the footing became worse and worse. Underneath them MacHugh roamed about, his nervous eye alternately on the load bulletin and the turbine job. How he wished that machine was in operation. He wondered how things were going with Walker at the Council committee meeting, and was reflecting, for the hundredth time, that his good old Corlisses were standing the strain well and were in shape to do their utmost when there was a sudden crash of breaking glass overhead, hoarse shouts from the firemen on the roof, and a big twin nozzle attached to two leads of hose, and strapped to a steel "jack," came through the skylight switching this way and that, throwing 1,600 gallons of water per minute in erratic curves over one entire end of the engine room.

(*To be concluded.*)

Power Station at the Mouth of a Mine

The Northern Colorado Power Company has carried out the novel plan of building a power station at the mouth of a coal mine in order to use lignite, a form of coal which very rapidly deteriorates with exposure to the air in shipping. As this fuel costs from 70 to 90 cents a ton at the mine, the price of current to consumers who use it principally for running feed grinders, threshing machines and pumps is proportionately low.

KYLEMORE PASS AND LAKE—SITE OF MARCONI'S UNIQUE WIRELESS STATION

A New Marconi Project

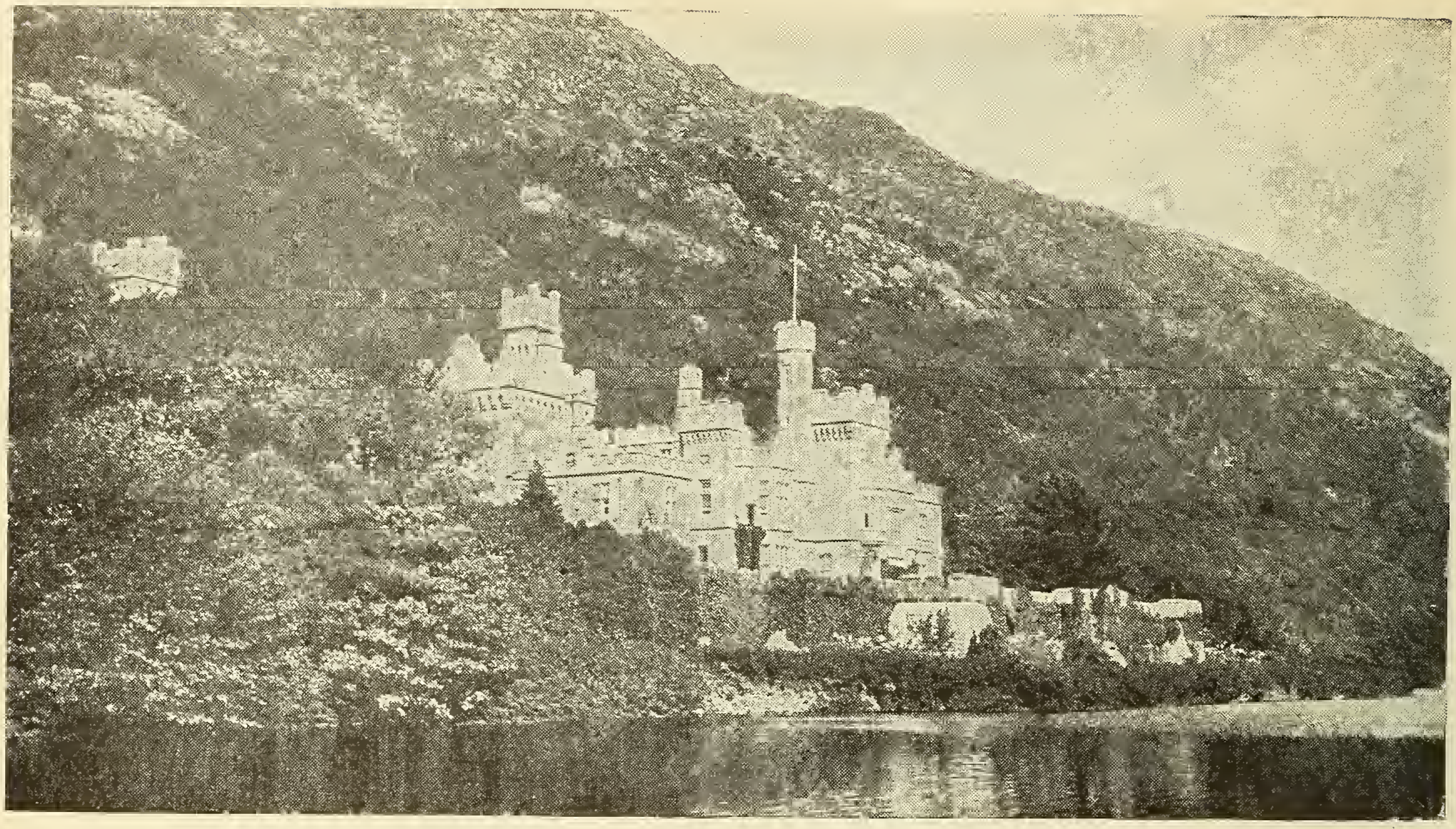
By WALDON FAWCETT

It has just become known, through no fault of his own, that Marconi, the Italian wizard, is planning important new applications of the principle of wireless transmission. Indeed, it would not prove very surprising if the prospective advance in the science turns out to be as long a step forward as any which has heretofore marked the progress of the Twentieth Century mode of communication.

The public had its first hint of Marconi's fresh ambitions when the inventor recently paid an extended visit to the island of Newfoundland, and news dispatches from St. John's carried the announcement that this outpost of the continent had been chosen as the site of a larger and more elaborate wireless station than the Marconi interests have heretofore had on this side of the Atlantic. However, the most interesting part of the story remains to be told. It concerns Marconi's cherished project for a new station in Ireland—one that will realize ideals over which he has long dreamed.

It may be explained just here that Marconi has decided to make the Emerald Isle the chief scene and center of his operations and experiments. As our readers know, the eastern terminus of the Marconi trans-Atlantic service has been located for some years past on the Irish coast and the existence of favorable natural conditions has combined with sentiment to influence the pioneer in the wireless field to concentrate his efforts here. In explanation of the sentimental factor it may be recalled that Marconi married an Irish beauty and following the example of the invaders of old who married Irish women, he bids fair to become more Irish than the Irish themselves.

The new Marconi station will not only present important innovations in equipment—regarding the exact nature of which the inventor will disclose nothing—but it will constitute a novelty in that it will be perched on a mountain peak, or, perhaps it would be more correct to say on top of a mountain range. In other words Marconi has induced Nature to



KYLEMORE CASTLE AND MOUNTAIN IN THE WEST OF IRELAND. HERE POWER WILL BE GENERATED FOR MARCONI'S NEW PROJECT

give him at slight cost, the advantage of an elevation several times as great as that which the United States government will attain at heavy expense through the erection of lofty steel towers for its principal wireless station located near Washington, D. C. In this provision of a natural situation Ireland gives the inventor a unique advantage, for in no other equally good location on either side of the Atlantic can there be found lofty mountains at the very edge of the open sea.

The sending and receiving station which, since the establishment of trans-Atlantic wireless communication has handled the Marconigrams passing between the two continents, is located a short distance from the little city of Clifden which occupies an almost central location on the west coast of Ireland.

EUGENE ZIMMERMAN, MARCONI'S AMERICAN PARTNER

Clifden, the capital of County Connemara and the terminus of the railway, is advantageously situated at the head of and well above Clifden Bay, itself an inlet of Ardbear Bay, and the Marconi station would seem to have every possible advantage of site except great altitude above sea level.

This latter Mr. Marconi now proposes to secure by making a new base of operations in the heart of the mountains of Connemara some dozen miles from Clifden. According to the present tentative plan the plant at Clifden will not be abandoned, but will be continued as a sending station. A receiving station will be established on top of the mountains at the Pass of Kylemore. The mountains here appear as solid masses of marble and granite, but scantily covered with earth in many places and with but a meagre vegetation. They rise to a maximum height of 2,700 feet.

A most spectacular phase of the project is Mr. Marconi's scheme for arranging his antennæ. The aerial will not be supported on a pole in the usual manner, but will be suspended in a far flung span between two of the mountain peaks. A person who has had any opportunity to observe the wild gales that sweep along this exposed and rocky coast cannot but marvel at the suggestion that so extended a span will stand up in the face of the buffetings of the wind, but Mr. Marconi and his engineers have already conducted extensive experiments with such a wire system stretched between Diamond Mountain and its neighbor at Kylemore and the results are said to have been such as to confirm their confidence in the feasibility of the undertaking.

From the standpoint of Americans one of the most interesting features of the enterprise is that Mr. Marconi is, in effect, to have an American partner—none other than Mr. Eugene Zimmerman of Cincinnati, the Standard Oil and railroad magnate. Mr. Zimmerman some years ago purchased for his only daughter, the Duchess of Manchester, Kylemore castle and estate, one of the most famous estates in the United Kingdom, and upon which the previous owner had expended $25,000,000. Since acquiring the property Mr. Zimmerman has spent a considerable portion of each year at Kylemore, and with the instinct of an American business man has set about developing the dormant resources of the great holding which aggregates thousands of acres.

A notable outcome of the new policy at the Kylemore estate is the arrangement whereby Mr. Zimmerman undertakes to develop electrical power for the Marconi installations. Current will be supplied not only for the new receiving station atop the mountains opposite Kylemore castle, but also for the sending station at Clifden, where coal—and coal obtained at no low price—is now used in the generation of power. Water power will generate electricity at Kylemore—indeed is already doing so on a small scale. On top the mountain which rises in a sheer wall of rock directly behind Kylemore castle are located two lakes which yield a never failing and virtually limitless supply of water with a possible height of fall by comparison with which that at Niagara appears a pigmy. It is the plan of Mr. Zimmerman to carry a 24-inch pipe up the face of this mountain—in itself no slight chore—and to construct an electric power plant that will be as exceptional in its way as will the Marconi station on the neighboring ridge.

Tampering with Lock Gives Alarm

A lock, the invention of Louis Nagy, New York City, is so made that any attempt to turn the knob or use a key to throw back the bolt causes an electric bell to ring, the circuit being closed by springs in the lock. Wires from the lock run to contact buttons on the edge of the door, these buttons pressing against springs on the door jam, which place the alarm in service when the door is closed.

A Novel Condenser

The superintendent of a mill was putting on his rubber boots to make an inspection of the water wheel as the treasurer of the company came in to look about.

After standing under a large belt for a few minutes in conversation with the visitor, the superintendent unintentionally touched the treasurer's shoulder giving him an electric shock, which nearly overturned the man of money. The earth, the rubber boots and the man inside formed a leyden jar, the discharge of which was very severe, especially to a person expecting nothing of the kind.

A Swiss Doctor's Eye Magnet

A Swiss oculist, Dr. O. Haab, professor at Zurich University, uses in his work one of the most powerful eye magnets

OPERATING WITH THE EYE MAGNET

ever constructed. It is what is known as a bell magnet, only one pole being used to extract fragments of magnetic substances from the eyeball.

The magnet becomes strongly attractive only when a current of electricity is passed through the coils of wire surrounding its core. The pedal arrangement opens and closes the circuit to this magnetizing current, and thus, being operated by the foot, leaves the doctor's hands free for manipulation of the patient's head. Of even more importance, this arrangement dispenses with the necessity of removing the magnet from the eye for discontinuing its action. Even with the best suspension imaginable, the heavy mass formed by the magnet and its windings cannot possibly be removed quickly enough to avoid unvoluntary displacements of fragments enclosed in the eye, and, with a large fragment strongly embedded, the eye might be almost pulled from the socket if some means were not provided for quickly turning off the current.

Illuminated Millinery

Flowers have ever been one of woman's means of adding to her attractiveness and their employment upon millinery creations is more or less common according to the prevailing style.

Showing real genius in adaptation a milliner has suggested and carried out the idea of trimming bonnets or hats for evening wear with illuminated flowers. These artificial designs of flowers and foliage with tiny electric bulbs hidden within are as true to Nature as skill can

ILLUMINATED MILLINERY

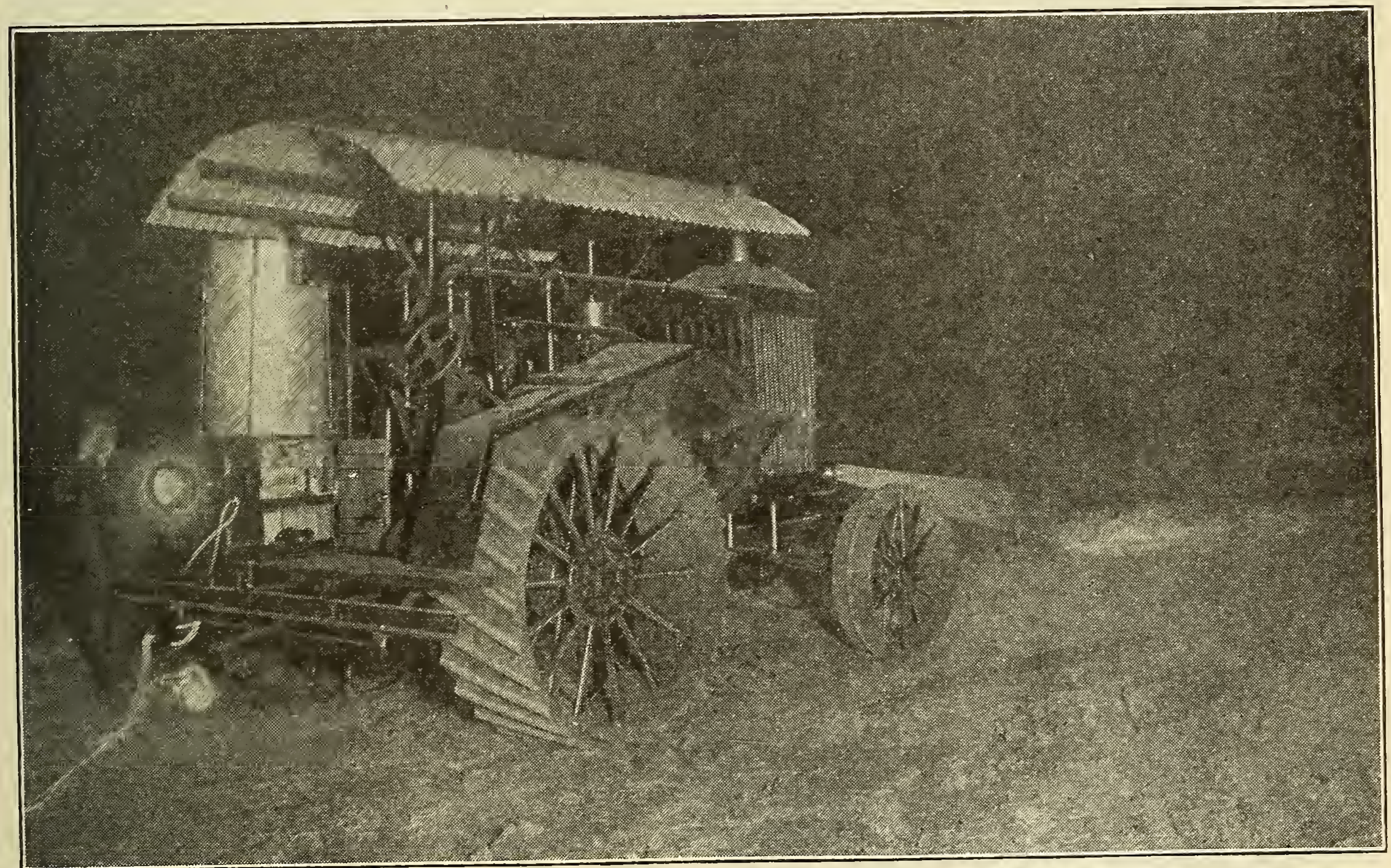
make them and are readily applied to this novel use. An electric battery concealed in the crown of the hat, and a small hidden switch enable the wearer to display at pleasure her sensational though by no means flashy head covering.

Quick Catch by a Burglar Alarm

Catching a burglar two minutes after he breaks into a building is quick work. The fellow in this story might have had the rest of the night to gather his "swag" and get away had not the store which was next to an alley been guarded by the burglar alarm system of the Chicago Electric Protective Company.

The house breaker used a jimmy on the door in the alley. No sooner had he opened the door and kicked aside an apparently useless gate of very light wooden strips than drop No. 53 on the Protective Company's board a block away fell with a click, a green lamp lighted up and an electric bell rang. "Hey! Boulter," called the attendant to the dozing patrolman, "Hustle down to 125 LaSalle! Something's wrong!" True to his name the patrolman grabbed his gun, ran to the store and slid down the alley. Finding the door partially open he entered in true western style, gun in hand, when a noise in the front window indicated the bad man's hiding place. "Come out of there with your hands up," suggested the patrolman. The thief obeyed while Boulter reached back to a little switch on the door and signalled, "Send police." When these officers arrived they found the intruder with hands still up at Boulter's request. A 38. caliber loaded revolver and 26 cartridges were found in the fellow's pockets.

By kicking the wooden door gate and breaking a fine wire laid in its bars, Mr. Burglar kicked himself into jail. His kick sent in the alarm at 10:45 and at 10:47 he was "pinched." Time, two minutes.



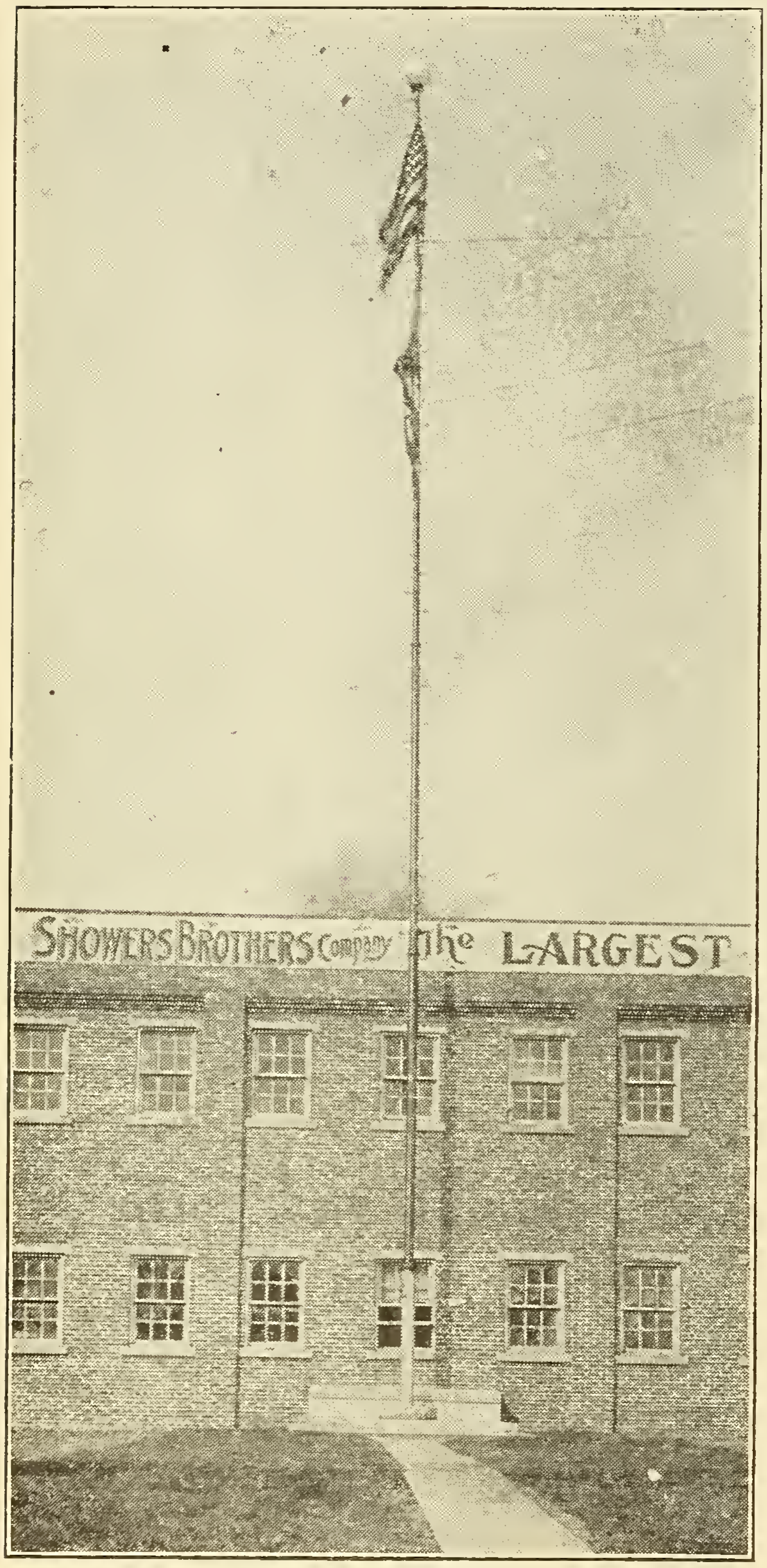
FARM TRACTOR FITTED WITH ELECTRIC SEARCHLIGHTS

Searchlights for Farm Tractors

The use of powerful electric searchlights is a decided advantage in guiding farm tractors after dusk. Our illustration shows a typical 45 horsepower tractor thus equipped with a small dynamo feeding two electric searchlights. These light up the surroundings when the machine furnishes power for threshing machines and the like, or allow it to be driven with safety at night across fields and along roads.

Marking the Center of Population

Some time ago the census department announced that the population center of the United States at the time of last year's census was in the vicinity of



POLE AND ARC LAMP WHICH MARKS THE CENTER OF POPULATION

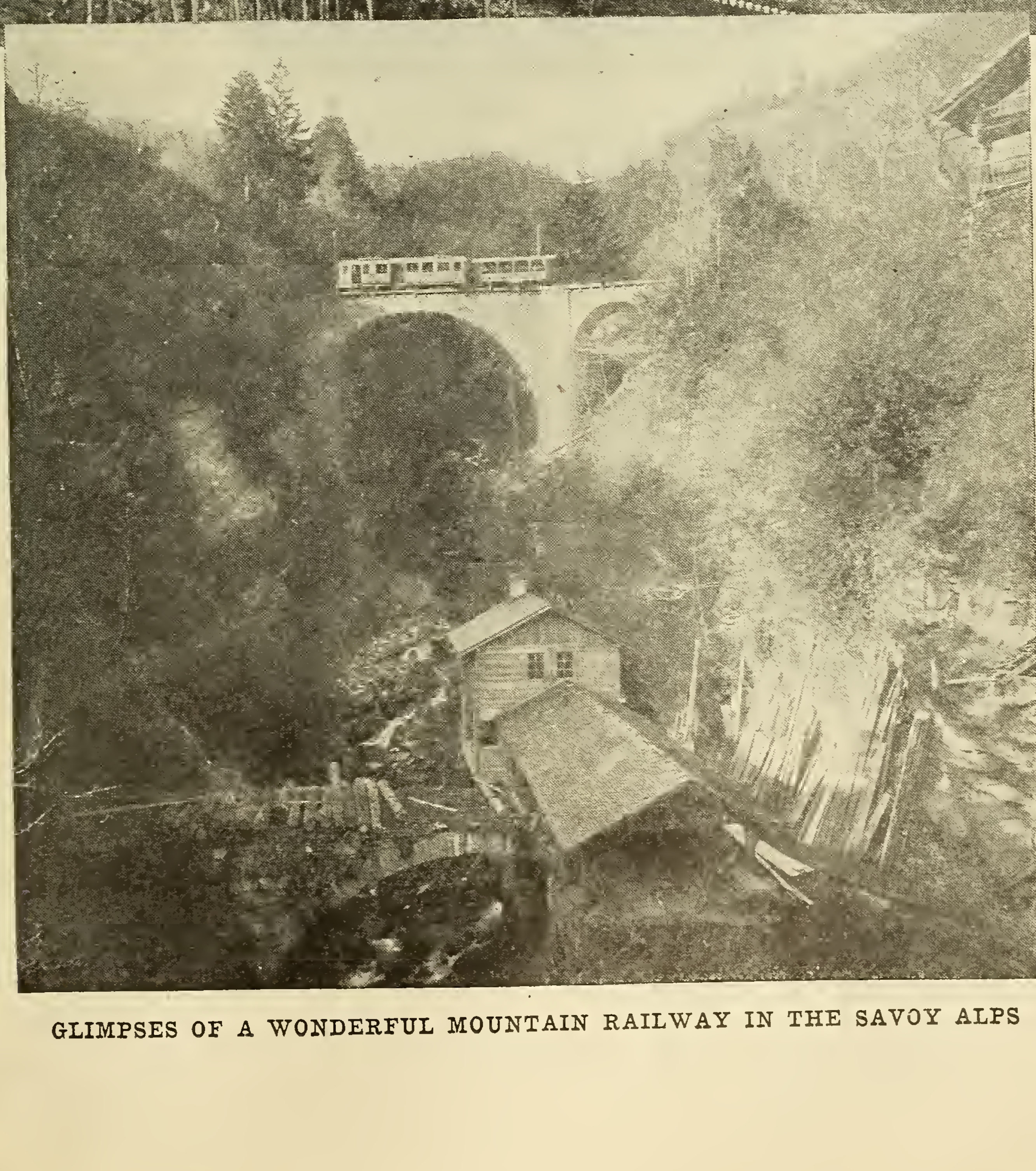
Bloomington, Ind. Last fall more exact calculations were made public, and with their aid Prof. W. A. Coggshall, chief astronomer of Indiana University, located the spot on the grounds of a furniture factory in Bloomington. When the spot had been staked out, the furniture manufacturer promptly ordered a memorial flag pole erected on it, with a suitably inscribed stone base and an artistic stone seat behind it. The pole is of steel, 70 feet high, and capped with an electric light which shines high above the city at night.

A Railway in the Savoy Alps

Winding its way through the Illiez Valley of the Savoy Alps between Monthey and Champery, and affording a splendid view of their imposing scenery is one of the most novel railroads ever constructed. The line is of the combined adhesion and rack type.

The course of the line is from the steam railroad station in Monthey through the village streets, thence over the tracks of a local steam line until it reaches a height of 1,258 feet above sea level. At this point it enters on the first rack section which is 1.4 miles long. After a run of 1.6 miles, including the 33 foot stone viaduct illustrated, Chemed is reached, at an elevation of 2,120 feet. Then follows a section of ordinary construction 1.4 miles long, which ends at a height of 2,375 feet after passing through a tunnel 300 feet long. The next 1.6 miles is of ordinary construction, but is followed by 0.37 mile of rack section which ends at Val d'Alliez, 2,917 feet elevation. The line then descends some 70 feet in the 0.8 mile to La Cour. The third and last rack section begins 0.7 mile from Monthey and extends 0.45 mile. The terminal, Champery, is 3,232 feet above the sea.

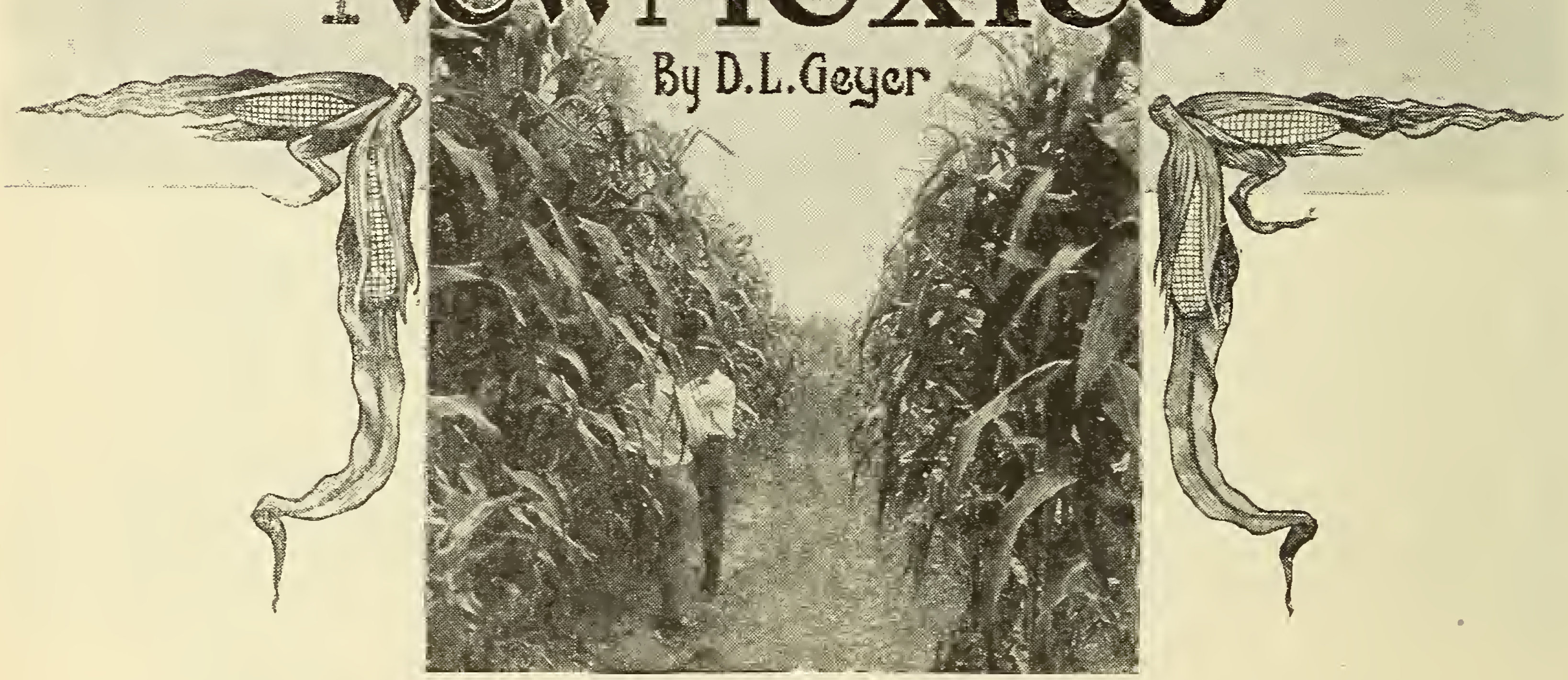
The standard train on this line accommodates 70 passengers. Each of the four motors on the motor car, which hauls one trailer, develops 75 horsepower and enables the trains to attain a speed of six miles an hour on the thirteen per cent grade. The motor cars are about 46 feet long and over seven feet wide. They are divided into second and third class compartments with a central entrance platform.



GLIMPSES OF A WONDERFUL MOUNTAIN RAILWAY IN THE SAVOY ALPS

Electricity's Miracle in New Mexico

By D. L. Geyer



A desert New Mexico has been called for ages, ever since we got it from Old Mexico. A desert much of it remains still. While irrigation has in places reclaimed tracts as large even as a whole eastern state — for saying nothing of Rhode Island, New Mexico could mark out four complete states as large as Ohio —still the enormous size of the new commonwealth always leaves plenty of room for new projects. A belt of flowing artesian wells has put into cultivation an area larger than Maryland. But artesian districts are very sharply limited. There is a slope-line—usually marking off the region that is tillable—beyond which the water will not rise above the ground and flow.

Now here is where the pump enters. If the water, though abundant, will not come clear to the surface, pumps will raise it the last few feet. And since pumps cannot be driven at a loss, the problem of irrigation then comes down to this; can we find a power that will bring up this water cheaply enough to be paid for by the resulting crop.

Electricity is furnishing such a power in southeastern New Mexico, and furnishing it on coal brought all the way from Colorado. From Colorado because, although New Mexico is said to have unlimited deposits of coal, somebody is seeing to it that very little shall be mined at present. With the cheaper coal that is certain to be released in time the only limit to the amount of land that can be brought under cultivation is the capacity of the wells. But the greatness of the reclamation is not so wonderful as its quickness.

Just a little more than a year ago a company of eastern capitalists bought a section of the old Milne-Bush ranch, or hacienda, near the town of Roswell. The land was simply grazing range—prairie with a little bunch grass on it, dry as a country road after a month's drought. The company made a longtime contract with the local electric people for power. This contract caused the rebuilding of the light plant with a capacity which was doubled, and which could be doubled again should the demand necessitate it.

The ultimate capacity of the finished plant was planned to be not less than 15,000 horsepower.

Then the company began putting down artesian wells. It obtained a surveyor and parcelled the wide-flung 12,000 acres of cattle lands into the small plots demanded by an intensive system of farming—from 40 acres for orchards down to ten acres for vegetable raising. It located the well on the highest point of each plot, that the water might flow easily over it all. Over each well it installed a 20 or 25 horsepower motor, and direct connected to it, from ten to 45 feet below, was placed a centrifugal pump. Both were suspended from steel trusses. A cement lined pit six feet square was constructed to hold the machines, and a square cement house a little bigger covered it all.

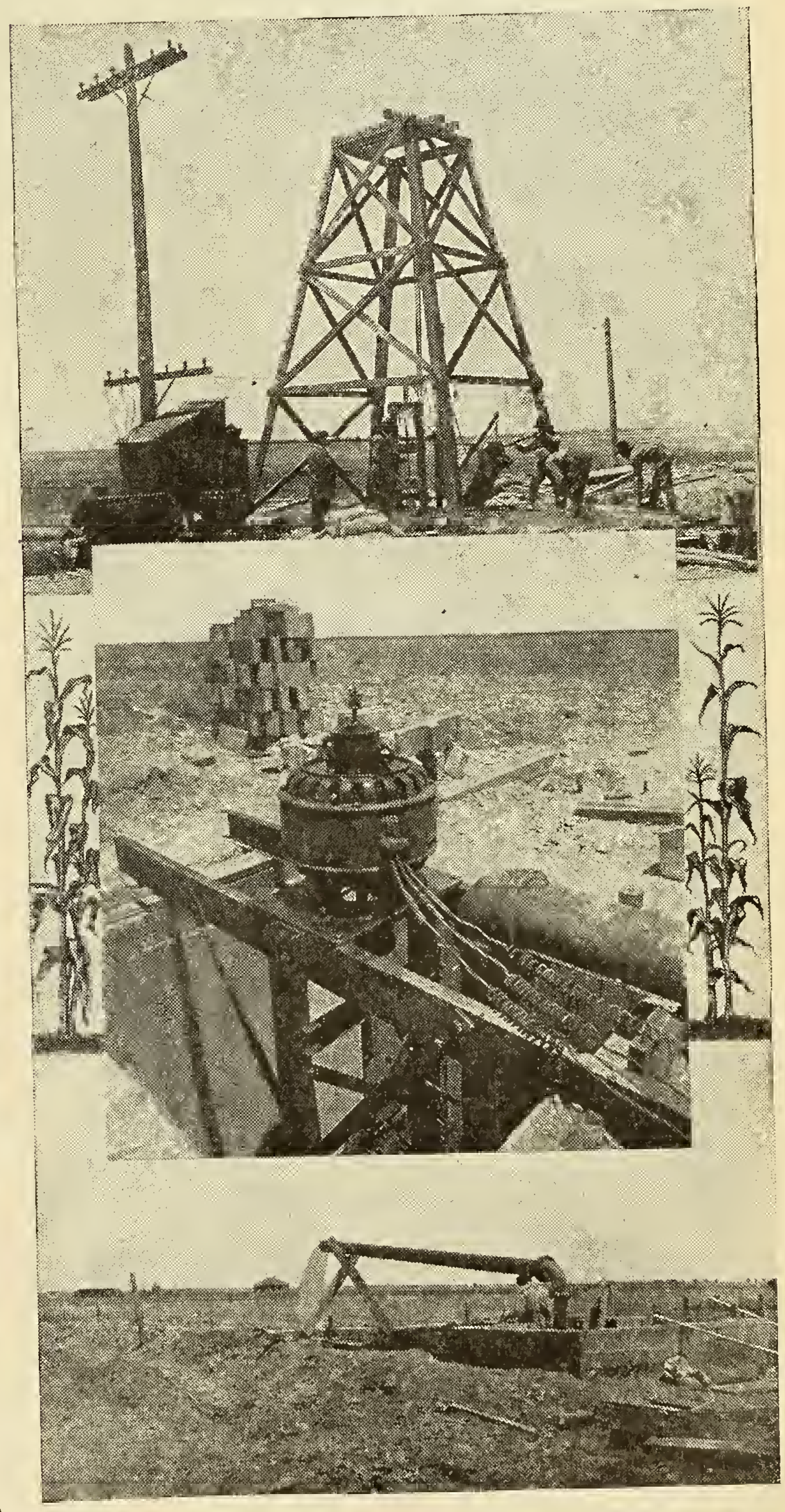
It then remained to connect up with the central plant. Out across the dust blown "farms"—advanced by this time from unfenced prairie to fenced prairie—were built 60 miles of transmission lines. These were for the larger part distributing lines, for the lands begin hardly beyond the city limits. Sixty-six hundred volts were to be carried on the primary lines, and 550 on the secondary. Frozen ground being a rare impediment in such a latitude, this work could all be done during the first winter.

With raised ditches built along the higher sides of each plot, in which the opening of gates at regular intervals would allow the water to flow out across the imperceptible slope of the farm, the preliminary work of the company was done. Then it turned on the steam at the power plant, turned on the current at the little pumping stations, turned on the water at the ditch gates, and the miracle began.

New Mexico soil welcomes water as a born inebriate his first stein. Plants spring up and grow at a rate which to a resident of the colder cloudier states seems impossible.

Just a walk across the new farms, one year now since ground was broken, is enough to convince the most hardened of doubters. Here, suppose, is a fence running back at right angles to the road. On one side lies the prairie, dust-yellow, as dry and sterile as it lay a century ago; on the other side there fairly bursts on one's eyes the intense dark green of a thickly covered alfalfa field. The slender wires of the fence mark the dividing line between barrenness and prosperity.

The cost of putting water on the land is about $2.50 per acre. Rather, this is the cost of pumping water into the main



PUTTING IN THE PUMPING EQUIPMENT, THE MOTOR READY FOR WORK AND THE FIRST VISIBLE RESULTS

ON THE LEFT IS THE UNBROKEN PRAIRIE, ON THE RIGHT THE BEGINNINGS OF AN ORCHARD TO WHICH ELECTRICITY HAS BROUGHT THE WATER

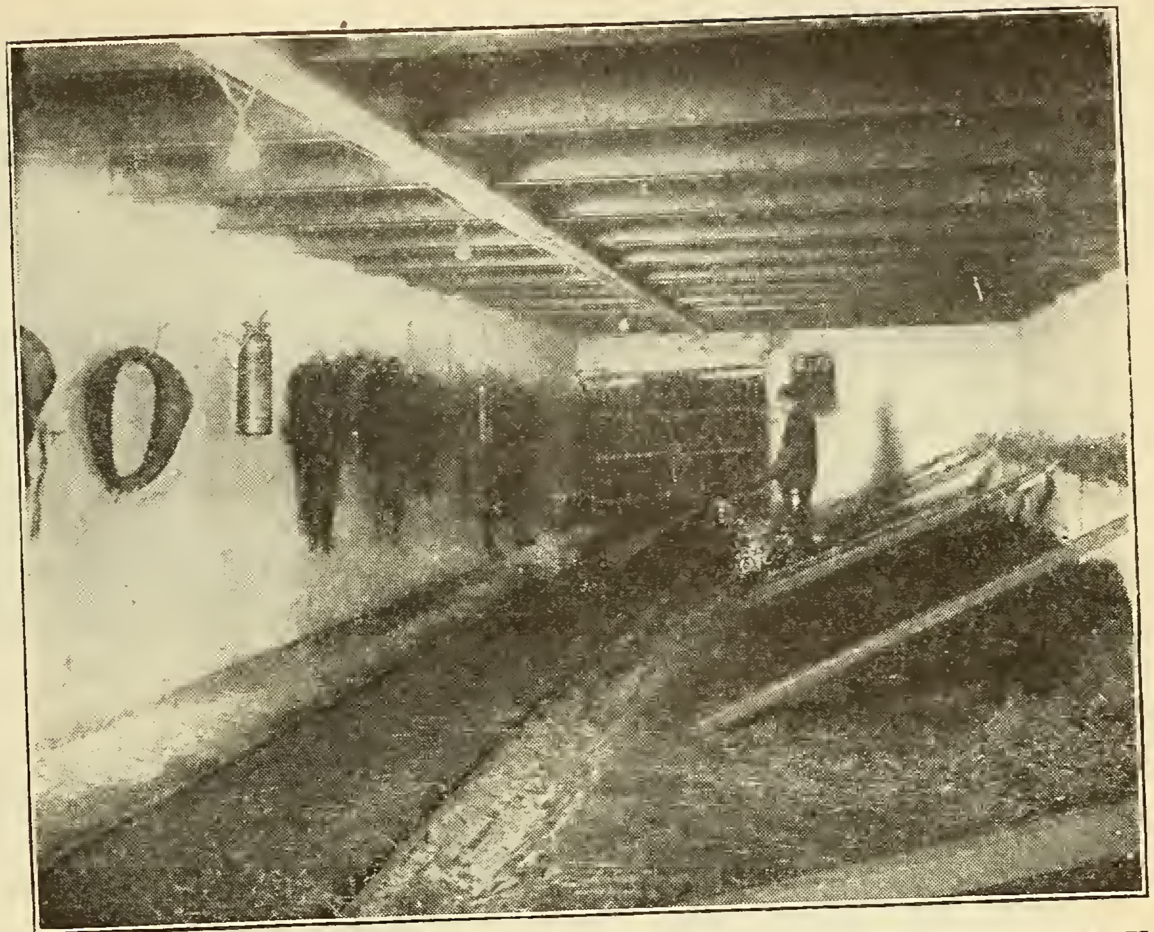
ditch. The wages of a man to distribute it over the land, through the various branch channels, will be something less than $1.00 an acre. Calling the water cost $3.00 per acre, and allowing a fair amount for first seeding, one needs only to be told that the average crop of eight tons will bring $10.00 a ton, or $80.00 an acre, to see that these men are not farming for their health alone. They are men who are just a little ahead of the procession because they are applying what others only theorize about.

Indeed the farmers on this property are of a most surprising sort. One would look a long time for a specimen with the traditional chin whiskers and hickory shirt. One farm was pointed out which is operated by a young graduate of Yale. Another is being run by a leave-of-absence clergyman from one of the largest churches of Chicago. The kind of men by whom southern California was reclaimed from similar aridness 30 years ago are beginning to see something in the deserts of New Mexico. They are men of long vision, young capitalists usually who want a place to work where their money will work too, and where at the same time they can enjoy the maximum of outdoor life. Many of them seem to think they have found it in a place where they can bring to their aid the marvels of electricity.

Lighting Underground Stables

A stable without windows and yet with ample light and good ventilation is that of the Continental No. 1 mine of the H. C. Frick Coke Company. Most of the hauling in this mine is done by electric trolley cars, but for a small part of the work horses are still used. As these horses are accustomed to working in the dark, nothing would be gained by bringing them into the open when not at work, provided that proper food and ventilation can be given them in underground stables.

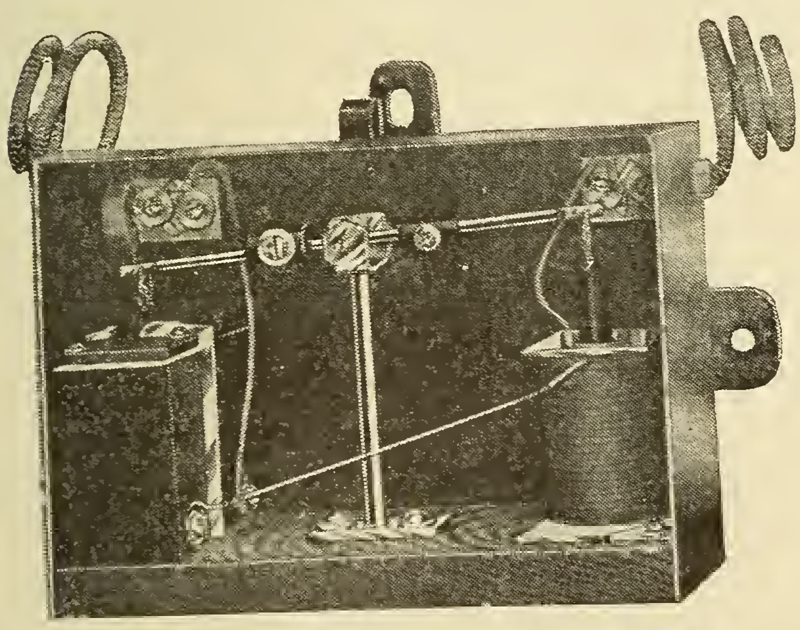
This has been done by making one part of the mine into a stable lined with concrete and steel, with a brick floor sloping to a drain. Incandescent lamps strung along the rafters light this and also the adjoining stall in which the horses are washed off with a hose when they come from their work covered with coal dust. The good supply of fresh air for which the mine is noted, makes this a well ventilated stable in spite of the absence of windows. However, the horses are unaccustomed to bright light and would have been badly scared by a flashlight, hence this is the reason our picture had to be taken when they were not in the stable.



AN UNDERGROUND STABLE WHERE THE HORSES KNOW ONLY ELECTRIC LIGHT

Selling Electric Current "By Weight"

A novel electric light meter, which might almost be said to sell current "by weight," is being built by a Montreal concern. It is designed for customers'



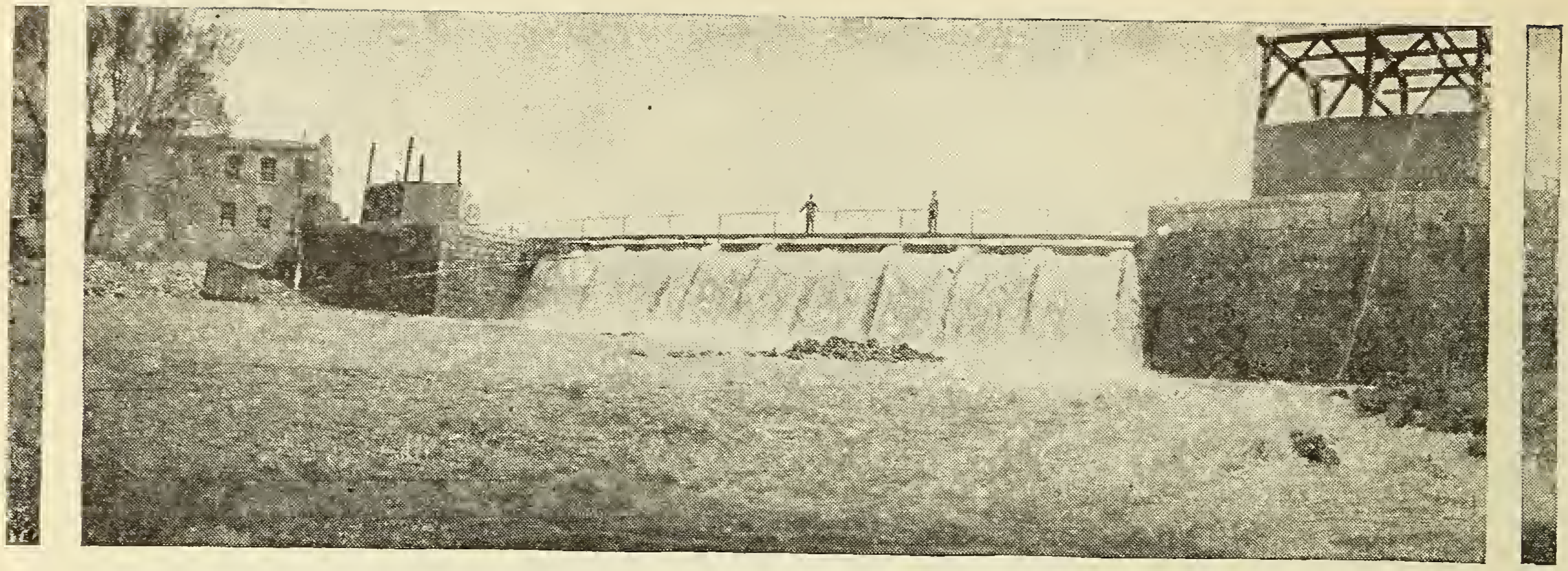
A NOVEL ELECTRIC LIGHT METER

circuits which are on the flat rate system, but from which current must not be taken above a certain maximum.

At the left in the picture are two cans containing mercury. A U-shaped piece of iron floats in the mercury with one leg of the U in each can. This member closes the circuit to the customer's lights. It is connected by a chain to a balanced arm. The right end of this arm is connected by a chain to the plunger in a solenoid coil, the current on its way to the lamps passing through this coil. There are also regulating weights on the balanced arm.

As current passes through the coil, by a well known principle of electricity, a pull is exerted on the plunger. This pull is directly proportional to the amount of current flowing. Therefore, if the maximum number of amperes which the customer is allowed to use, is say, ten amperes, the weights are adjusted so that ten amperes will just pull down the plunger and lift the U out of the mercury and break the circuit. The U immediately falls back and closes the circuit again. Thus, when the customer starts to use more current than the allowed maximum, all the lights are set winking, which continues until a light is turned off, bringing the current down within the limit.

A five per cent increase of voltage above normal changes the candlepower of a carbon lamp by 30 per cent; of a tungsten lamp by 20 per cent.



DAM NO. 1 AT MAMMOTH SPRING

Story of an Ozark Spring

By GRACE T. HADLEY

For countless years I was merely a drinking place for the deer. The old settlers in the foothills of the Ozarks called me Head of the River. I am big enough to be the head of Spring River, for I am the largest spring in the world, so I was finally christened Mammoth Spring. My surface area is eighteen acres, as big as ten city blocks. My origin is still something of a mystery. My source is in subterranean waters. My depth has been sounded 96 feet with an anvil and then the force of the rushing, underground current was so strong, the plummet could go no further. I deliver 500,000 gallons of pure, cold water per minute and I never go dry. My flow of water is uniformly regular and constant.

In the early days old man Deadrick retarded my flow with a four foot obstruction which he called a dam, in order to get a little fall to grind a grist of corn. He put up a wooden structure called Deadrick's Mill, which was very quaint and old fashioned. This was in 1867, and for fifteen years all the work I did was to grind a grist of corn now and then. In 1876 something very important happened. The Kansas City, Ft. Scott & Memphis railroad came through. It passed quite near me. My, but I was scared when the first locomotive came puffing along. It seemed so strong, so powerful, and I seemed almost insignificant beside it. I felt strange stirrings within my inmost depths. I was a big spring and I wanted to do big things.

In 1881 the Mammoth Spring Improvement and Water Power Company purchased me. They built a dam of cut stone across my outlet and planned a little city. I now began to prove what I could do, and I promptly developed 800 horsepower, a portion of which was used to run a cotton mill. In the following year the Mammoth Spring flour mill was erected with a capacity of 500 barrels daily. I was quite puffed up and I was stimulated to do more, and sure enough, bigger things were in store for me. In 1896 an eight foot dam was built farther down stream and below the first dam. This second dam was a plain wooden structure, but power was developed by this dam sufficient to light up the village. This was all A. C. stuff and so satisfactory that I was soon called upon to illuminate a town in a sister state—Thayer, Missouri.

In 1907 E. C. Belamy took charge of me. He was my Opportunity. Yes, I think he is related to the famous Mr. Bellamy who wrote "Looking Backward," but this Mr. Bellamy is always looking forward. He is brisk, energetic and a ceaseless worker. Moreover, he

AT THE U. S. FISH CULTURE STATION

has ideas; better still, he has the faculty of putting these ideas into practical operation. He says there is nothing in that old adage, "The mill will never grind with the water that is passed," for he found out from actual measurement that the fall of Spring River is 10.4 feet per mile for the first sixteen miles down stream. So he got an idea of building a new dam below number two, a real modern dam of reinforced concrete to develop enough power to be transmitted to distant points. Mr. Frank F. Hill, of Memphis, furnished the means to build this dam and install the necessary hydroelectric equipment. Does that look like a new and unfamiliar word? Well, it is the keynote to all future development along electrical lines in the rural districts. This dam was begun in 1908 and is now completed. It is 610 feet long with a 24 foot head and a net working head of nineteen feet and six inches. It has Leffel waterwheels belted to Westinghouse generators, 500 kilowatts in two units which admit of constant service. This dam is so constructed that there is space for increased installation when the power is needed. Now, the first dam developed 800 horsepower, the second 600 horsepower, the third 1,200 horsepower, a total of 2,600 horsepower. Mr. Bellamy says that the possibilities of power in Spring River are practically unlimited, as he can build a dam every two miles and get a 20 foot eight inch head, until he has 20,000 horsepower at his command. You see he has taken me into his confidence and has told me what he expects me to do, and I never fail him, so we work together in perfect harmony.

Now I will tell you what I am going to do for the 'Frisco Lines at Thayer, Mo. This town is just over the state line about two miles distant. I expect to pump water for engines into tanks, and to do a lot of work in the 'Frisco shops at Thayer, such as driving drills and riveters; but best of all, I shall operate the electric block signals between Thayer, Mo., and Black Rock, Ark. I shall do some very important work on the operation of a generator set to charge batteries for the purpose of dispatching trains by telephone at Thayer.

I am already lighting the town of Mammoth Spring and pumping water by means of hydraulic rams into homes and hotels. I supply 1,200 gallons of pure spring water to the United States Fish Commission, which has a station just across the track.

Beyond doubt I will furnish power to be transmitted into Howell County, Missouri, as far north as West Plains, the county seat, and a thriving town of 3,800 inhabitants. I expect to light up Koshkonong, Mo., in Oregon County, and do a lot of work for the farmers along the way. Howell and Oregon counties are the prize winning fruit counties of Missouri. At Koshkonong Mr. W. C. Paynter has a display of products that he has raised on his model farm, and it is truly wonderful what can be raised in this region.

At Brandsville, Mo., is that interesting Swiss colony, secured through the efforts of W. R. Haight, who is developing a model farm and peach orchard. I expect to furnish power to Mr. Haight for heating, lighting and farming purposes. Not far away is the 100 acre tract which Governor Hadley purchased, and where his peach orchard is being developed.

Now you can easily see how much work I expect to do for these farmers when Mr. Bellamy gets his transmission lines through Howell County, Mo., as far north as West Plains.

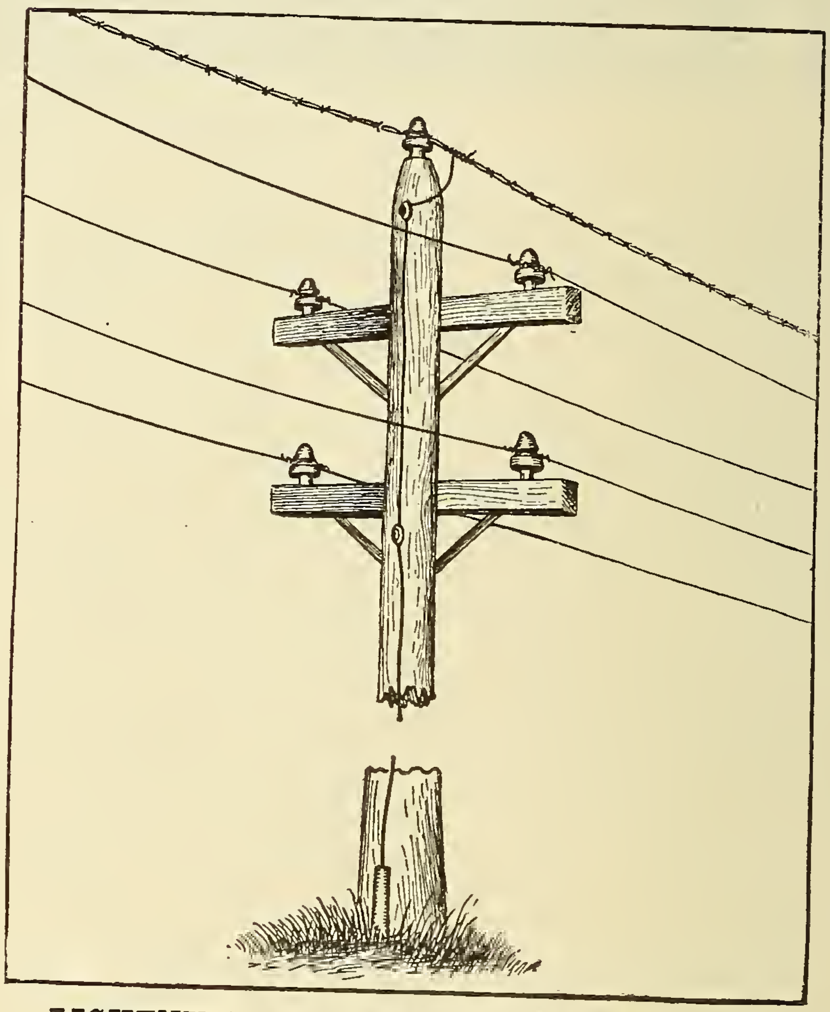
A City of a Million Without Telephones

Constantinople is a city estimated to contain about 1,000,000 inhabitants, half of which are non-Moslem races—Greeks, Armenians and Jews. But as yet no telephone service exists. Think of it, one million people with only the most primitive means of communication! American industry has, however, scored a success by having secured, with English and French colleagues, a concession for furnishing telephone service to the city.

A staff of engineers (British) has already arrived at Constantinople and is actively engaged on the preparation of the plans. The work the engineers have in hand is one of many difficulties, as Constantinople is one of the most peculiarly situated of all European capitals. The city is divided by the Bosphorus, which is deep and has variable currents; moreover, it is extensively used as an anchorage. The European center is again divided by the Golden Horn, over which there is no permanent bridge. In all parts of the city the streets are extremely narrow, winding and ill-paved, and many of them are precipitous hills. As no telephone service yet exists in Turkey, there are no available data whereby to gauge the probable use of the service or the probable traffic which the system will be called upon to carry.

A Novel Lightning Arrester

There are few lightning arresters which are as simple as the one used by an electric railway and power company in Virginia. They have a 2,200 volt alternating current transmission line running along their road which furnishes current for lighting purposes to private parties in the suburbs. In protecting this line from lightning they have strung an ordinary barbed wire, such as is used for fences, on insulators on the extreme tops of the poles, running parallel with the line wires, as shown in the illustration. This barbed wire is then grounded at every other pole. The numerous sharp points on the wire act the same as those on a lightning rod, and gradually "draw off" the static in the atmosphere all along the line. There can be no question as to the efficiency of this method, because the line wires have never been bothered with lightning since this barbed wire "fence" has been put up to keep out undesirable charges of electricity.

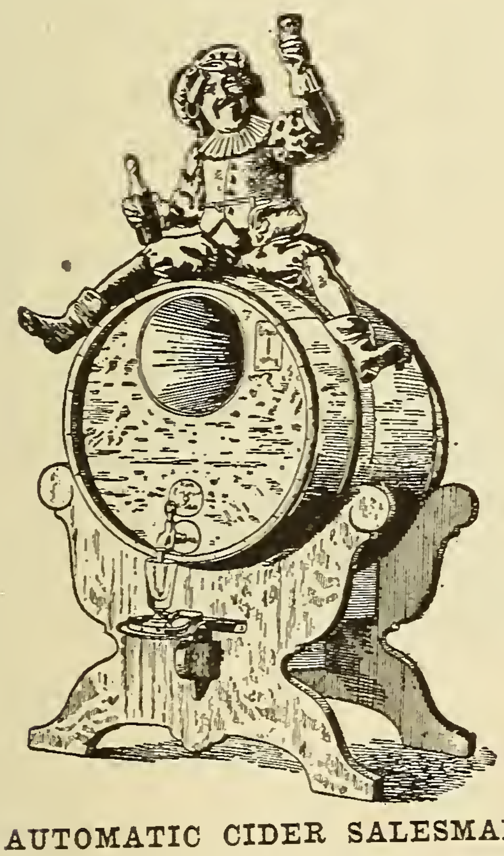


LIGHTNING ARRESTER OF BARBED WIRE

An Automatic Cider Salesman

The average man enjoys getting a little more than he pays for. While perfectly willing to pay a fair price for what he buys, he likes to receive a bonus—some unearned increment to make him feel that he is getting something of a bargain.

In catering to this trait of human nature, many a coin operated device has been equipped with a music box which plays a tune when the coin is dropped, the music being offered in addition to what the machine delivers as value for the coin. The latest of these musical slot machines is an automatic cask in which the coin does triple duty. On dropping it into the slot in one end of the cask, the faucet automatically fills the glass and a motor driven phonograph



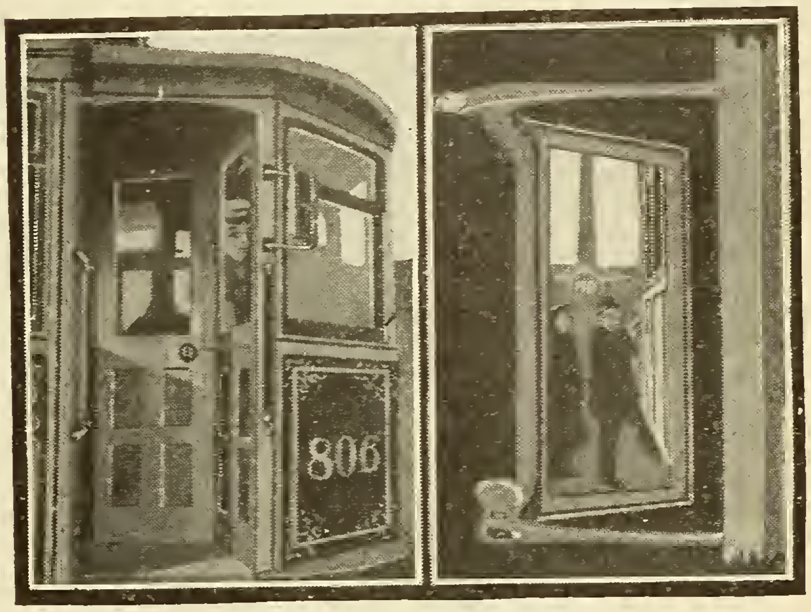
AUTOMATIC CIDER SALESMAN

within the barrel reproduces a "good fellow" song, while a lamp lights up the goblet which the figure on the cask is holding aloft.

When the tune has been played clear through the light goes out automatically; but as long as it is burning, additional coins may be used in filling other glasses without interrupting the tune. The apparatus takes its current supply through a flexible cord connected to an ordinary lamp socket.

Mirror Assists Motorman

A clever adaptation of the mirror to prevent accidents and assist the street car motorman is here illustrated. The



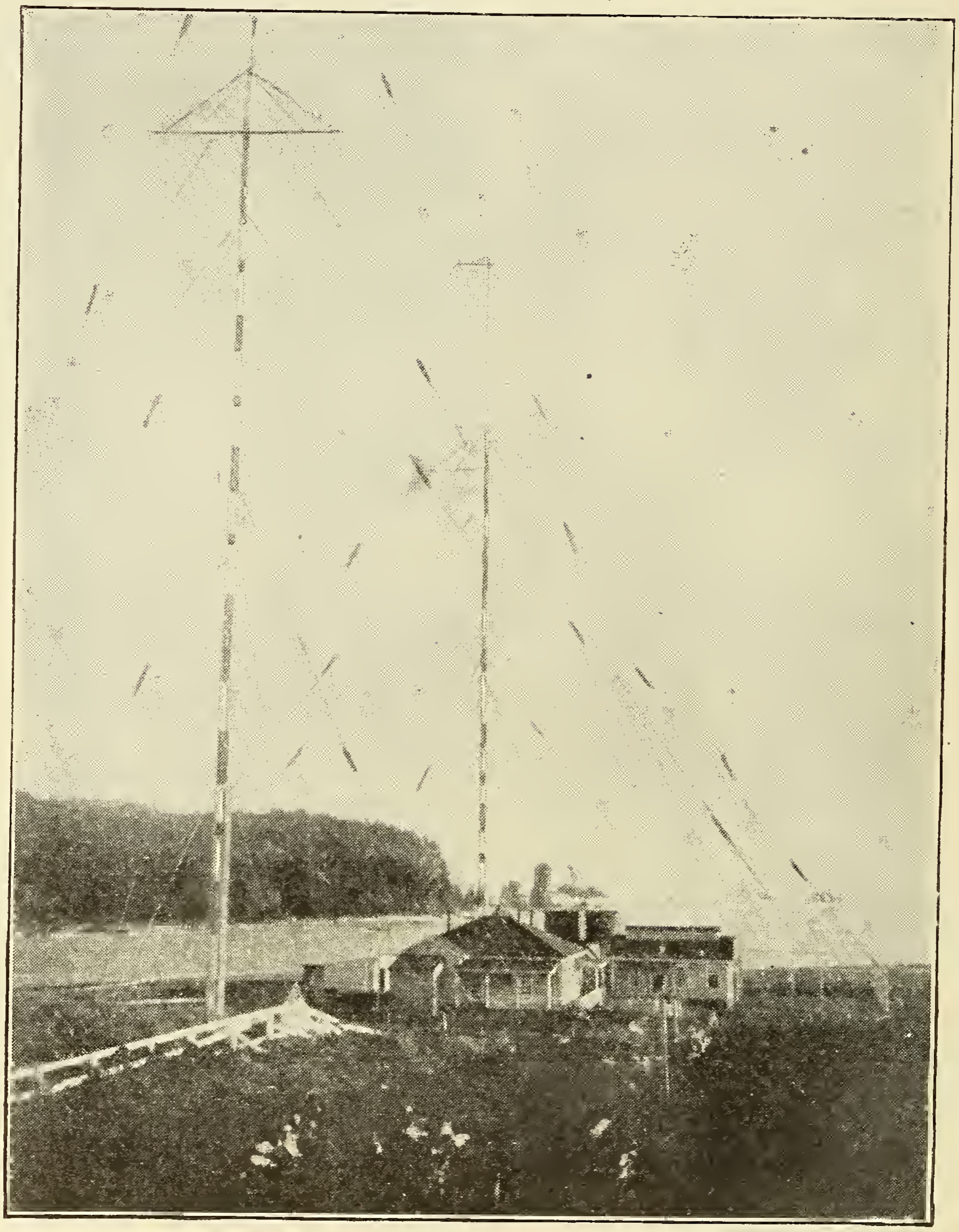
MOTORMAN'S MIRROR

mirror in a strong metal frame is attached to the front corner of the car at such an angle that the motorman can see passengers boarding and getting off the car.

A Telephone Drama

William C. De Mille's new play, "The Woman," which is to be produced in Washington by David Belasco on Easter Monday, has for its heroine a telephone girl, and the object of the play is to show how the telephone dominates the destinies of modern men and women. Wanda Kelly outlines the theme of the play thus: "One of the big central telephone stations is the world, all boiled down and spread out on the switchboard, and right there on that board thousands of people are meeting, their thoughts are crossing each other, and the Hello Girl is perched on top of a high mountain looking at them. That's the real world—what people are thinking—and it's all on the board, good and bad, winners and losers, rich and poor, all mixed up together, all going on at once, and the operator is a sort of Fate who sees that the right people get each other, and—like Fate—she has to let them work out their own affairs."

Wireless Men Who Live on Tatoosh Island



THE STATION ON TATOOSH ISLAND

At the western entrance of the Juan De Fuca straits, off Cape Flattery, Washington, is eighteen acres of volcanic rock known as Tatoosh Island. This island is a government reservation and is the most westerly point in the United States proper. The inhabitants of the island are government employees and their families, totaling 23. The twelve male inhabitants represent the working force of the lighthouse establishment, the U. S. Weather Bureau and the U. S. Navy wireless station.

The island itself is quite curious as it appears to have been thrown up a molten mass from the sea and suddenly cooled. The constant washing and beating of heavy seas have cut deep caves and fissures into its very heart. One cave or tunnel penetrates the island through and through, and in very rough weather huge seas wash in with a force that shakes the entire island and its buildings.

The wireless station on Tatoosh is one of the principal and most efficient Navy stations on the west coast, being the wireless connecting link between Alaska and the United States.

Every day at 8 a. m., 12 noon and 6 p. m., weather and shipping reports are sent. The weather report gives the cloud conditions, wind velocity and direction, barometer and temperature readings. The shipping report gives the vessels passing in the straits bound for Sound ports and outbound for coast or foreign ports. Hydrographic information is kept on file and sent to ships on request.

With a few exceptions all Navy wireless stations handle commercial messages under the following conditions: that no commercial station is able to do the work; that no expense is incurred by the government thereby; that the handling of commercial messages shall not interfere with government business.

It might give some idea how these affect the Navy stations when it is said that 85 per cent of the business handled at Tatoosh station is for commercial companies. Of course the stations are of considerable aid to navigation.

Navy wireless stations are required to work in harmony with other stations; particularly they should set good examples in regard to prompt dispatch of business on hand, and forbearance when communications with which they would interfere are going on among other stations. Government messages are handled during the first half of each hour and commercial messages during the second half as far as practicable, having due regard for any schedules in force.

Messages are sent and received from a concrete, sound proof room that adjoins the living bungalow. Inside this room no fog signals or other sounds can interfere with the receiving. The station force consists of five Navy electricians who are qualified wireless men and operators, and a cook. One man is on duty with receiving phones on at all times waiting for a call. The station work is divided up between the men so that each one has his part to look after and keep in order.

One sending set is of five kilowatts capacity and is used for distances up to 600 miles. In addition there is a giant set of fifteen kilowatts capacity, requiring a fifteen horsepower gasoline engine to run it which is used for long distance work.

Summer visitors to the island usually think Tatoosh would be an awful place in which to live during the winter. But it is doubtful if any of the wireless men would care to leave; they have everything for comfort. The living quarters or bungalow is as comfortable and modern as one could wish for. The men off duty can fish, hunt on the main land, or play a game of ball or tennis. The winter nights are spent playing cards and other games. Last winter the men had a chess tournament that lasted several months. The wireless station is well supplied with musical talent, and instruments from a piano down to a harmonica. Of course the orchestra meets quite often, much to the displeasure of the man on watch and the man who is trying to get a little sleep before the mid-watch. Meals are the most important event each day, and no expense is spared to make them first-class. The boys have their own vegetable garden and raise all kinds of fancy vegetables. They have their chicken ranch, so they will be sure the breakfast eggs are fresh. All holidays and Sundays are celebrated with a big chicken dinner.

Unusual Post Office Sign

Probably the only post office in the United States to boast of an electric sign is the reinstated post office at New Decatur, Ala. Recently the post offices in the two Decaturs were consolidated by order of the Post Office Department. The people of New Decatur strenuously objected to this, with the result that the order from Washington was rescinded. In honor of the restoration the people of New Decatur installed a sign reading "New Decatur Post Office, Alabama."

Experiments in Radio-activity

By FELIX J. KOCH

Some recent experiments with radium salts and other radio-active substances, designed or modified by M. Daune, Mme. Curie's assistant, at Sorbonne, the great Paris University, are interesting even to the layman. The four about to be described illustrate but a few of the many properties of this wonderful element.

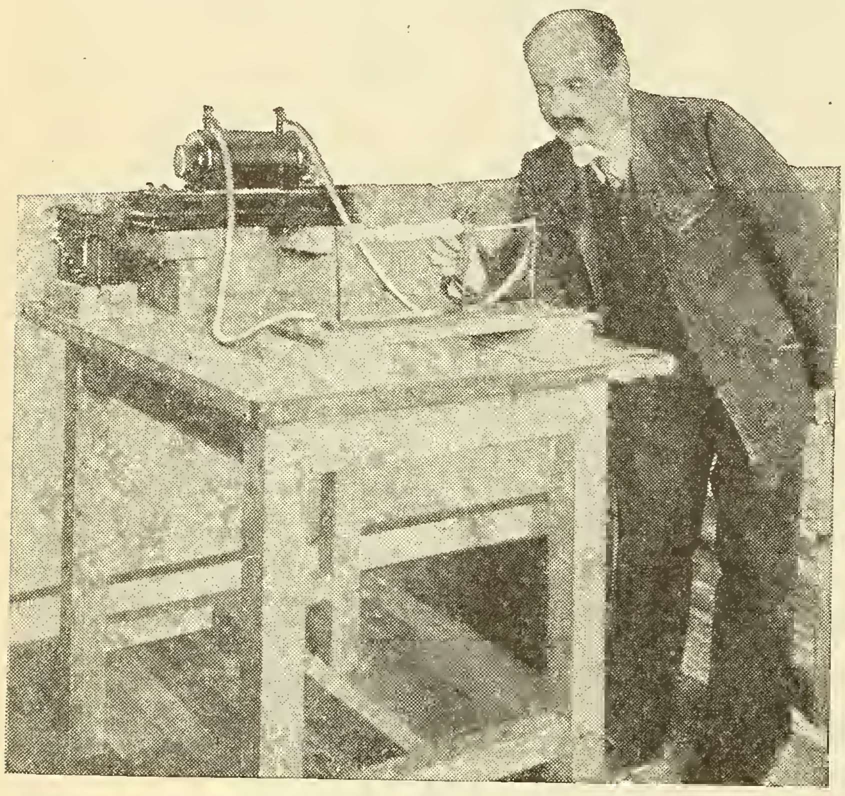


FIG. 1. DEMONSTRATING THE CONDUCTIVITY OF AIR UNDER THE INFLUENCE OF RADIUM

Air is, under ordinary conditions, almost a perfect insulator, yet in the presence of radium rays it will conduct electricity fairly well. In Fig. 1 an experimenter is demonstrating this fact, employing a spark coil and what is known as a Geissler tube. The spark gap of the coil is not used in the ordinary way. A wire is connected from one pole of the gap to one terminal of the Geissler tube. The other terminal of the tube, at the right, is connected to one of the balls of a secondary spark gap which is adjustable. The other terminal of the secondary gap is connected to the second terminal of the main gap. Then the coil is set in operation. When the balls of the secondary gap are moved sufficiently close to each other for sparks to jump across, the tube lights up with its characteristic weird glow, showing that there is a passage of current through it. When the balls are drawn apart, however, so that no spark passes, the tube ceases to glow. Now the experimenter brings a little tube containing some radium salts near to the secondary spark gap. Instantly the sparks begin to jump across once more, and the Geissler tube lights up. This shows beyond doubt that the radium rays have affected the air in the gap to cause it to become the conductor of an electric discharge.

The apparatus for the study of the radio-activity of mineral waters is shown in Fig. 2. It is composed of an electroscope surmounted by a glass cylinder, which contains a central electrode connected with the rod of the electroscope.

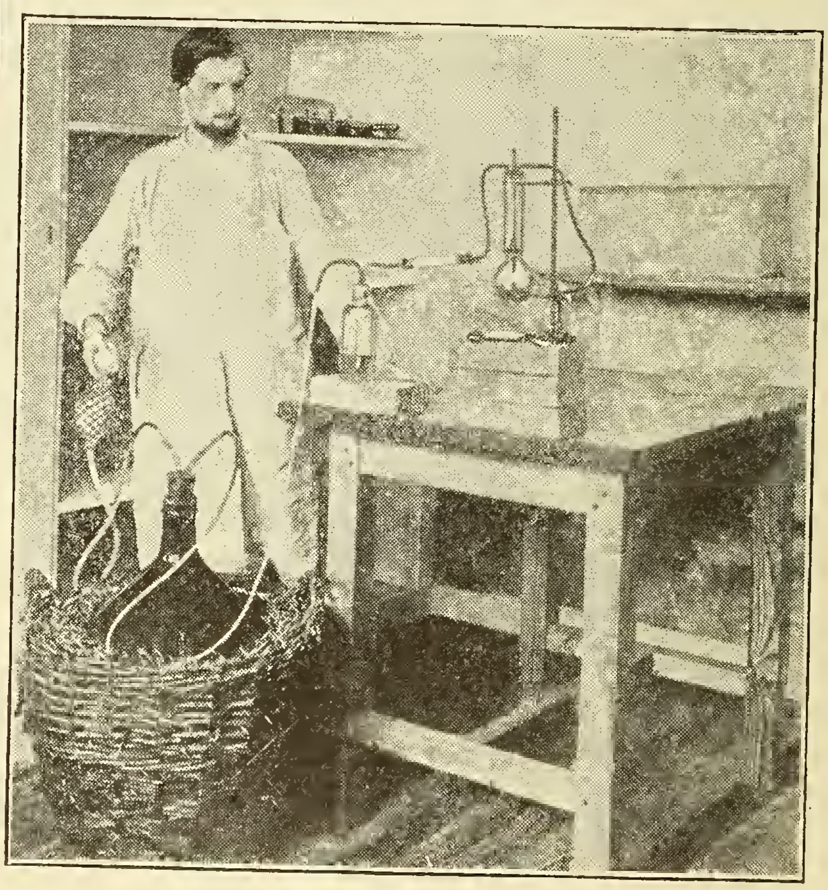


FIG. 2. TESTING MINERAL WATER FOR THE PRESENCE OF RADIUM EMANATIONS

The latter contains two gold leaves which have previously been given a static charge and repel each other due to this charge, until they hang at a widely divergent angle. The gas dissolved in

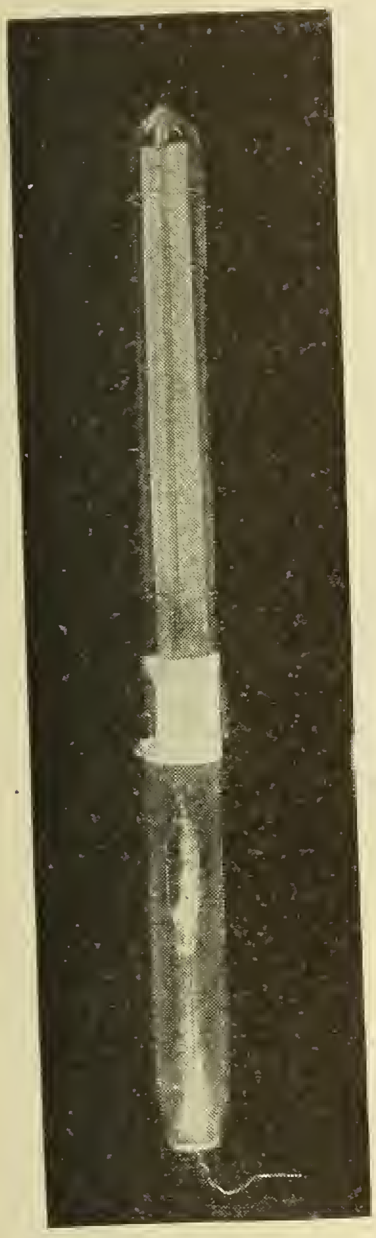


FIG. 3. DEVICE TO SHOW EVOLUTION OF HEAT BY RADIUM

the mineral water contained in the large bottle is expelled by a current of air which is forced through the container by compressing a rubber bulb. The gas traverses drying tubes containing sulphuric acid and phosphoric anhydride, and then enters the tube that surmounts the electroscope. If the gas possesses radio-active properties due to the presence of radium emanation it will conduct electricity and carry away the charge until the leaves fall together again, the electroscope being discharged.

In the laboratory of the De Lisle establishment at Nogent is a remarkable apparatus for the demonstration of the evolution of heat by radium. This apparatus, Fig. 3, consists of a very sensitive thermometer, the bulb of which is hollow and surrounds a thin walled glass tube which is prolonged beyond the bulb opposite the stem. The thermometer is inclosed in a wide glass tube which is exhausted of air to a "Crookes vacuum," and is sealed around, but not over the end of the little tube that penetrates the thermometer bulb. If a bit of radium is introduced into this little tube and pushed up into the bulb, the heat evolved by the radium will cause the mercury to expand.

The vacuum between the thermometer and the outer tube almost prevents loss of heat by direct thermal radiation from the thermometer itself, but a certain quantity of heat is conducted from the thermometer by the walls of the outer vessel, and thence radiated or conducted away. The rate of this loss of heat increases with the elevation of temperature and when it becomes equal to the constant flow of heat received from the radium the end of the column of mercury ceases to advance. One decigramme (1.4 grains) of radium produces a movement of about four inches, and if the instrument is standardized it may be used as a calorimeter for the measurement of the heat evolved by radium.

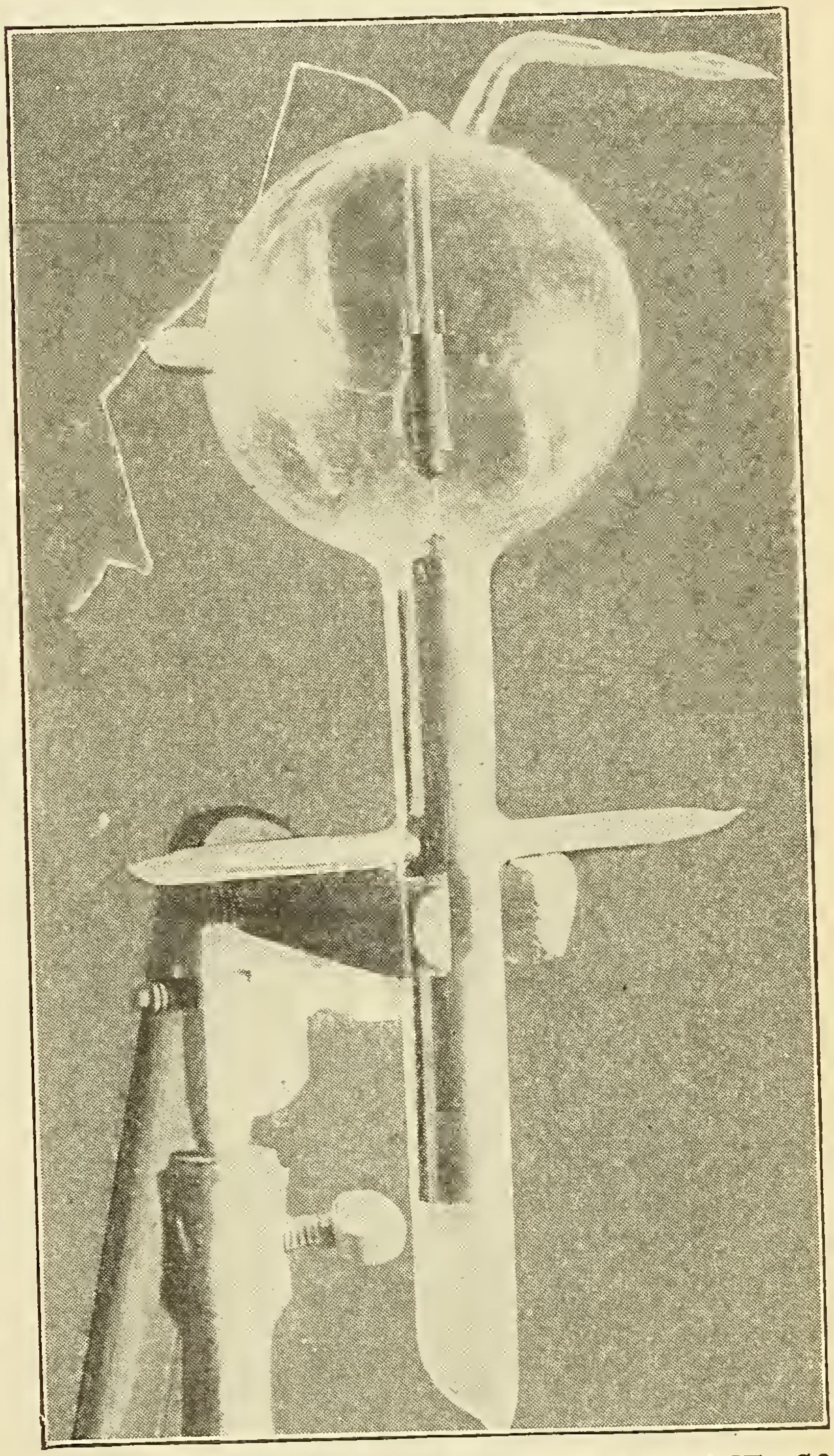


FIG. 4. "PERPETUAL MOTION" MACHINE—SO CALLED

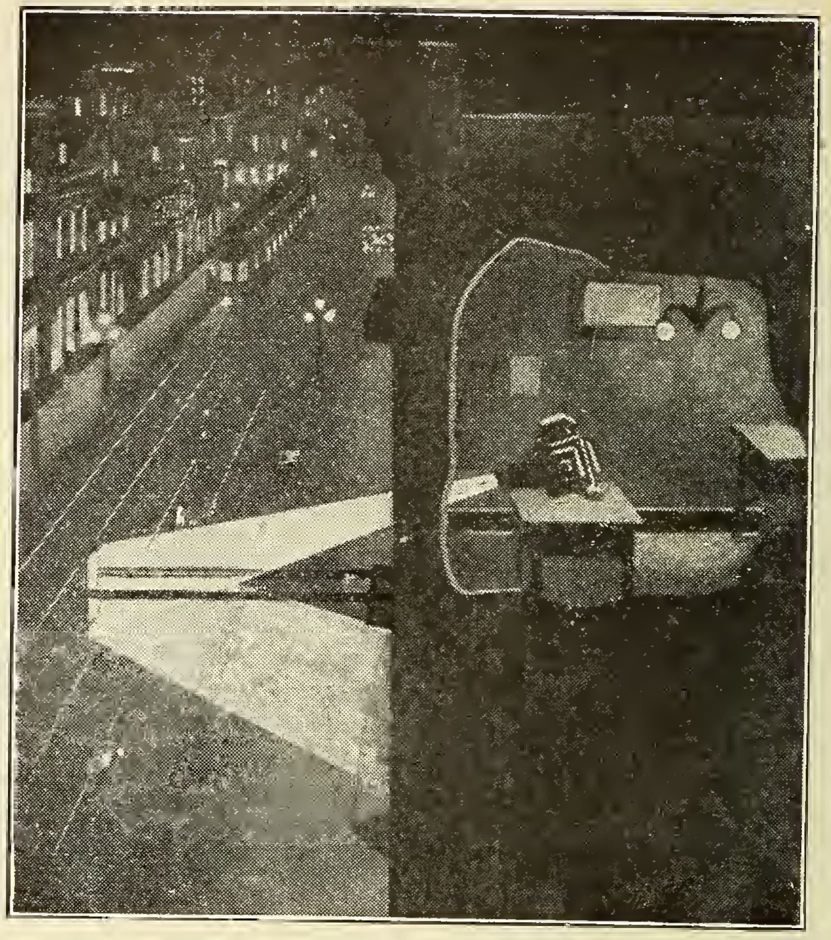
The most curious of M. Daune's devices seems at first sight to produce perpetual motion. It does not in reality do this, for the energy of a quantity of radium must eventually "run down." The apparatus, Fig. 4, consists of a glass globe containing a small axial glass tube, closed at the bottom and open to the outer air at the top, which is fused to the wall of the globe. The lower part of the tube is surrounded by a tube of brass which rests on an insulating post of quartz, supported by a brass rod below. The brass tube bears a gold leaf which forms an electroscope.

If a Crookes vacuum is produced in the globe, and a little tube containing radium is dropped into the open mouth of the central tube, the negative rays emitted by the radium traverse the two thin glass tubes and communicate their charge to the enveloping brass tube. The gold leaf diverges until it touches a platinum wire connected to earth, which discharges it and the brass tube to which it is attached. But a new negative charge at once begins to accumulate and when it has attained a certain value the gold leaf again touches the platinum wire and a second discharge takes place. These alternate charges and discharges and to-and-fro movements of the gold leaf are repeated indefinitely under the influence of a very small quantity of radium.

Stereopticon with Mirror Reflector

Stereopticon views thrown on screens which can be seen from the street are always popular with those who are out after dark, not only because of the pictures, but also because people like to see something going on. So true is this latter trait that in cases where the lantern is placed in a window on the opposite side of the street, part of the crowd usually watches the man at the lantern.

But what if the buildings on the other side of the street are dark and have their shades drawn so that the lantern can not be there? Then the puzzling question as to the whereabouts of the lantern may interest the spectators all the more and may add to the advertising value of the pictures. The explanation lies in having the lantern in the same building directly over the screen, the light being reflected by a mirror supported out over the side-



STEREOPTICON WITH MIRROR REFLECTOR

walk. If a projection in the building hides the lantern from ready view, the effect is all the more mystifying, and by keeping the mirror bright the pictures can be shown quite clearly.

Army Drinking Water Sterilized by Ultra-Violet Rays

Drinking water for the regular army will be sterilized by electricity as a result of experiments by the tropical board of the Medical Corps. Like many other valuable discoveries which have been made by army medical officers, this latest system of treating drinking water is apt to be adopted in civil life.

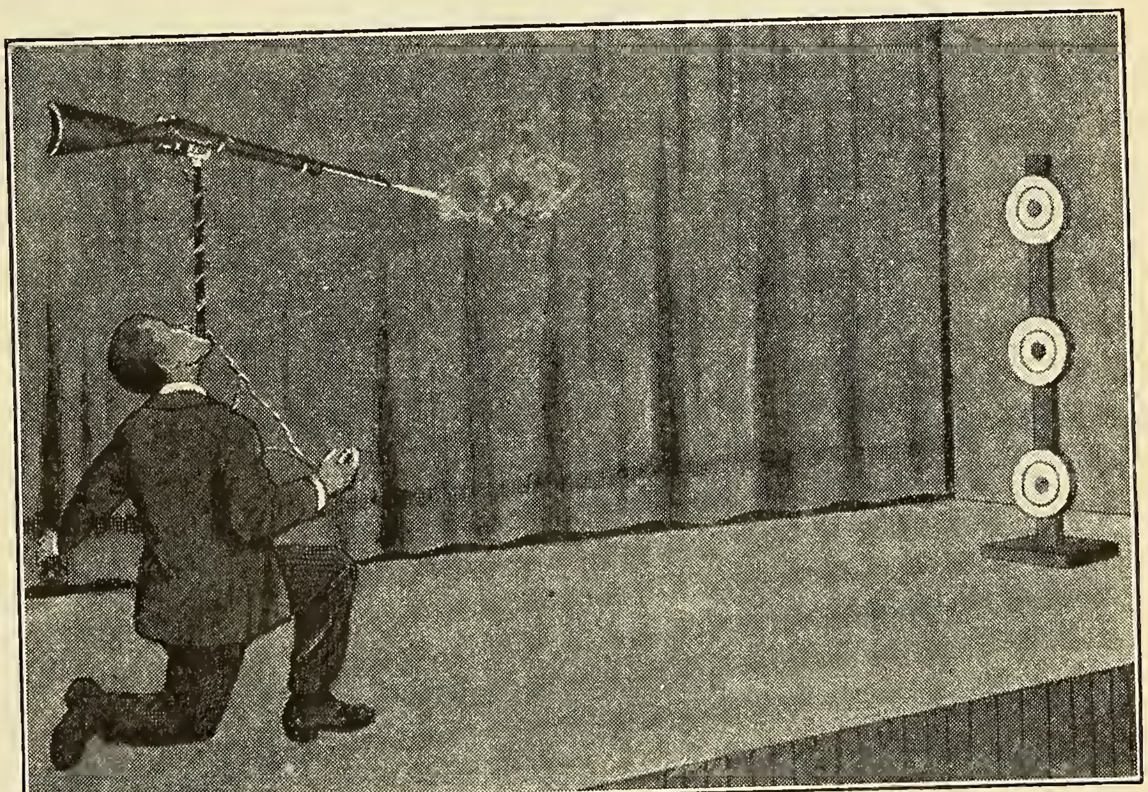
Strange as it may seem, drinking water can be purified more cheaply by electricity than by the universal method of boiling. At the same time the "live" taste of drinking water will be retained. All the microbes and death dealing animalculae, according to the report of the tropical board, can be destroyed by a single flash of the rays from an electric bulb.

These rays are known technically as "ultra-violet" rays. The board has been experimenting in the Philippines with ultra-violet rays for over a year. In the islands more soldiers have been killed by impure drinking water than by Filipinos' bullets. It has been found almost impossible to induce the soldiers to boil their drinking water, and they have too often preferred to take chances of impurities of the surface water in the islands rather than drink the flat boiled liquid.

At last the Medical Corps officers believe that they have solved this important problem for the army serving in tropical stations. The work of producing ultra-violet rays will be a very simple one at the posts, most of which have electrical plants. For troops in the field it is proposed to furnish a small gasoline engine to run a miniature electric plant.

Clever Trick Shooting

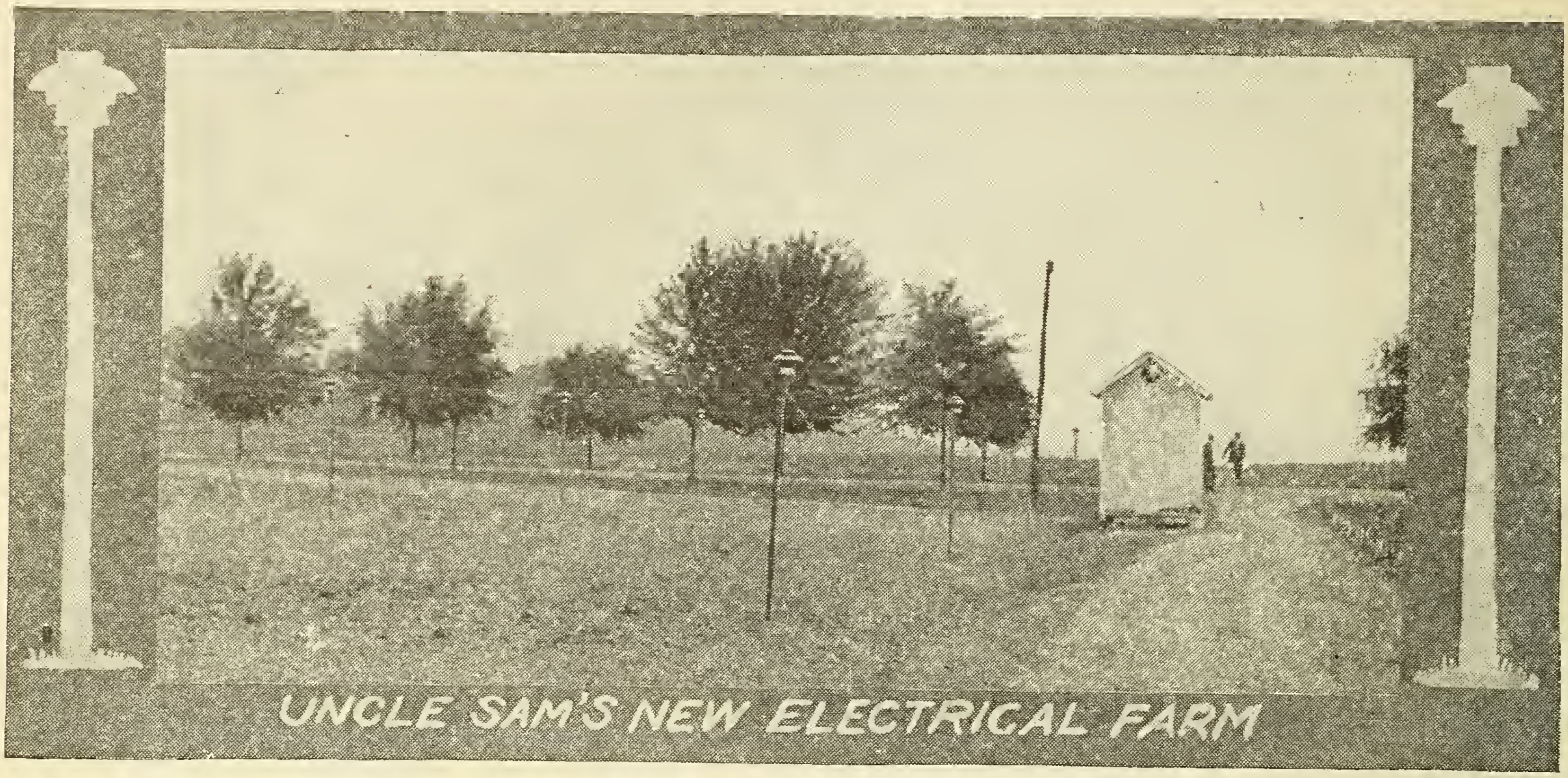
The only apparent limitation to the range of extraordinary firing positions assumed by stage marksmen is that of keeping the trigger in reach of the hand. Now a western professional has gone a step farther by letting electricity do this reaching while he manipulates the rifle and does accurate firing with it when no part of it is even within arm's length of him; as, for instance, when he has the gun balanced on the top of a notched broom stick. For this purpose, he has a magnet (taken from an annunciator) fastened to the stock of a rifle with the ends of the magnet cores near those of a piece of soft iron riveted to the trigger. Then a flexible cord running to a pocket battery and a pear-shaped pushbutton held in his hand completed the outfit. Of course, the mechanism on the rifle had to be so placed that the motion of the trigger armature would not disturb the normal balance of the gun when poised on the stick. Then all the performer had to do was carefully to note the direction and tilt of the rifle so as to press the button at the right moment. By standing, kneeling and lying on the floor at a distance of about 20 feet, he was able to hit three bulls-eyes at different heights.



CLEVER TRICK SHOOTING

Locomotive Electric Headlights

The decided advantages of an electric headlight are now so well established that the eventual replacement of all oil headlights is practically a certainty. There are today in the United States about 60,000 steam locomotives, of which about 15,000 or one-fourth, are equipped with electric headlights. Several large railways which have hitherto shunned electric headlights or used it only on their fast trains, are now experimenting with a view to adopting it for all their locomotives. In making this investigation they consider not only the turbo-generator arc headlight with reflector, which is the type almost exclusively used so far, but also the arc lamp with a bull's eye lens and no reflector and the incandescent lamp operated by storage batteries. The double base incandescent lamp with two filaments arranged in parallel in the same bulb is especially adapted to the latter type.



Uncle Sam's Experiments in Electro-culture

By WALDON FAWCETT

To test the practical value of electricity as a stimulus to plant growth is the object of interesting experiments just undertaken by the United States Department of Agriculture. The government experts are anxious to ascertain to what extent the magic current may be made to serve as a substitute for sunlight and these investigations may possibly point the way to means whereby the farmers and gardeners of the future may be made in a measure independent of climate. The scene of this unique line of research is Uncle Sam's greatest agricultural experiment farm, at Arlington, Virginia—across the Potomac from the city of Washington, D. C.—and it is expected that the investigation will occupy a period of many months.

Not the least important factor in making this American enterprise distinctive is the determination of the Federal scientists to carry on all their experiments under conditions that closely approximate those which govern the average farmer or truck gardener in his everyday operations. On the other hand many of the experiments carried out abroad in the past have been confined mainly to laboratory work or have been restricted to cultivation under glass or in greenhouses where conditions are more or less abnormal. To be sure, it is not the thought of Dr. Lyman J. Briggs of the Bureau of Plant Industry, who is in charge of the present experiments for the Department of Agriculture, that any present day farmer would at this juncture be justified in duplicating the governmental installation. That would necessitate an investment of $600 to $800 on what is, as yet, an uncertainty. At the same time it is realized that the value of any findings that may follow the government experiments will be greatly enhanced if this applying of the spur to Nature has been done under the normal, outdoor conditions of an ordinary agricultural community.

In another and even more important respect does the American project differ from most of the attempts at "electric farming" abroad. The vast majority of the experiments on the other side of the Atlantic have sought to promote plant growth by means of electric light. The "electrically grown" strawberries which were the pride of Sir William Siemens were brought to perfection under the rays of an electric arc light and the experiments that continued for six months in Paris at a later date were on the same basis. Yet later there were similar experiments with market garden plants at Cornell University, the progress and yield of the lettuce, radishes, beets, etc., that were cultivated with electric light as a supplement to sunlight being compared with those grown in an adjacent compartment, not thus lighted.

The present effort of Dr. Briggs and his associates involves no use whatever of electric illumination but concerns itself with an attempt to stimulate plant growth by means of electricity when applied in the form of static current to soil and air. This is a branch of investigation which may be said to be yet in its infancy although it has been clearly established that plants are very susceptible to such influence. Indeed, the influence of electric discharges is seemingly proven by the flourishing development of plants in the Arctic regions (until cut down by frost) where the sunlight is weak but where the atmosphere is naturally highly charged with electricity. In other words the theory of the scientists who have faith in this innovation is that high tension electricity supplied to the air above plants simply amplifies the natural atmospheric electrification.

The tract at the Arlington experiment farm which at the outset is being devoted to this initial venture in electro-culture has an area of one and one-half acres and this is apportioned in fourteen plots, each containing a little more than one-tenth of an acre. Seven of these beds are subject to the electrical influence while the other seven are not and they are so arranged that adjoining each plot upon which the magic current is brought to bear is a "check portion" of like area and physical characteristics which is devoid of electrical aid. The entire area is in the same crop, a selected grade of wheat, so that the experts can gauge accurately the impetus imparted to the plant growth by the electricity whereas the subdivision of the tract will, through the comparison of yields, enable the scientists to discount the minor differences due to soil, etc., which are sometimes manifest in the products of cultivated tracts lying side by side.

For distributing the high tension current to the area under observation there is a network of wires supported on poles and embracing the entire area in its meshes. To a person having any knowl-

TOYING WITH 100,000 VOLTS
DR. LYMAN J. BRIGGS ELECTRO-CULTURE EXPERT

CONNECTING UP THE WIRES FOR ELECTRO-CULTURE

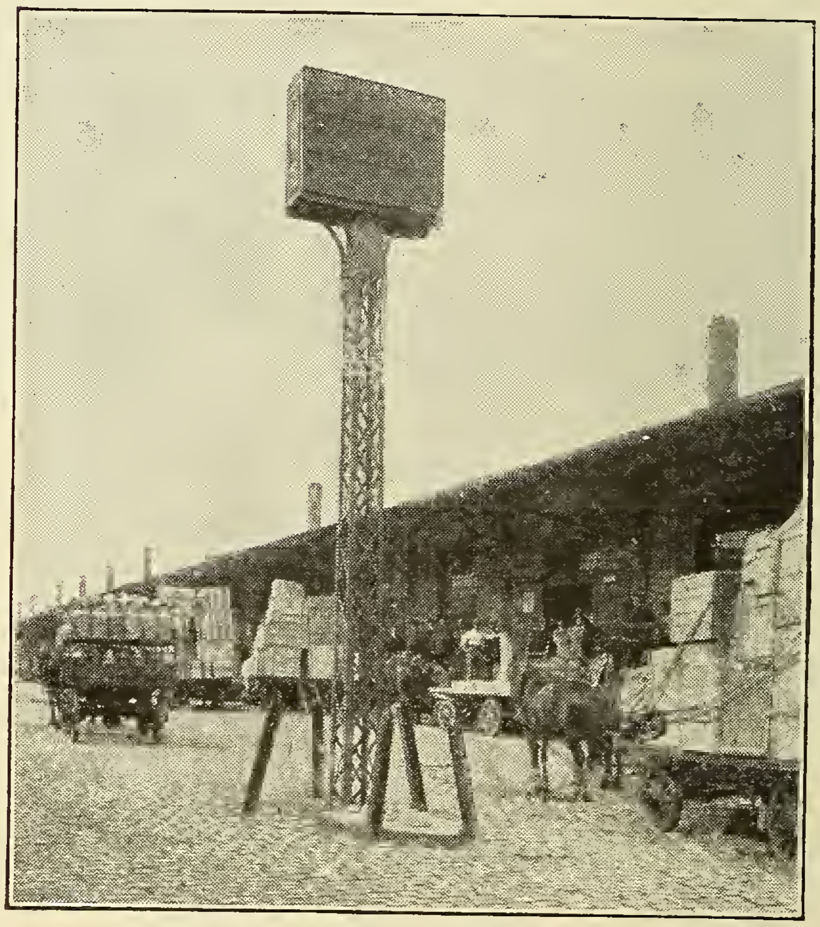
LITTLE POWER HOUSE AT UNCLE SAM'S NEW ELECTRIC FARM edge of ordinary electrical installations this system of overhead discharge wires must indeed appear a novelty by reason of the rather startling contrasts. For instance we see the galvanized iron wire carried by elaborate high tension insulators of the pattern usually employed only on high power transmission lines and these insulators are supported on very slender poles—the unusual combination being emphasized in its effect by the fact that these poles are only about seven feet in height. The poles are placed about two rods apart and each span of the heavy wire is crossed by six lines of finer wire, the effect being, of course, to provide what might be denominated a rather close mesh in this network of electric wires.

At one corner of the cultivated tract is located a small wooden building which might be dubbed the power house of this electric farm and near at hand is the point where the network of overhead wires is connected with the source of electricity at a potential of 100,000 volts.

Dr. Briggs who is conducting the American invasion of this interesting field has not been under the necessity of generating current at Arlington farm, having the benefit of commercial current supplied by the company operating an interurban trolley line. After exhaustive experiment he equipped his little plant with apparatus that is identical save in minor details with the regulation models provided for the most powerful X-Ray work in hospitals, etc. Electricity in its new function, supplementary to sunlight, is destined for use, presumably, only during the autumn, winter and spring when there is a deficiency of this natural heat. At the government farm on the Potomac it is not contemplated that the current will be on for more than eight hours out of the 24, and the plan is to apply the electricity during the late afternoon and early morning and to shut off the current at mid-day.

Doorway Indicator for Freight Stations

The Berlin Administration of Royal Railways recently ordered an electrical signaling plant to be installed at one of its busiest freight stations to designate the entrance ways which might be open at any particular moment for the passage



DOORWAY INDICATOR AT A BERLIN FREIGHT STATION

of trucks, saving much delay and confusion.

A signaling device was constructed in the form of an iron lattice pole about 20 feet in height carrying at its top a casing for receiving a set of transparent figures. Each figure was constituted by a sheet metal box, containing in its interior the socket of a 50 candle-power metal filament lamp and covered on both sides with red glass panes. An iron structure combined these figure boxes into a compact system.

As the loadway is extremely extensive, while the warehouse comprises as many as 27 openings, two such signaling poles were installed.

As soon as a warehouse opening has become disengaged for receiving goods, the corresponding lamp is lighted by an ordinary contact switch located inside beside the door, thus causing the number of the door immediately to appear in the transparent case. Comprehensive tests have shown luminous figures of red color to be equally suitable by day and night. Any figure can be read from both sides, thus allowing the driver after passing the pole to make sure of the correctness of his reading.

Sir William H. Preece Opening the Olympia Exhibition

Standing in the midst of a display demonstrating the progress made in electricity and surrounded by scientists, engineers of the day and exhibitors, Sir William Henry Preece opened the 1911 Olympia Electrical Exhibition in England, September last.

This venerable man who has given 60 well-spent years to scientific work and research, was honored by being chosen president of the Exhibition, the opening of which he attended in opposition to the advice of his physician.

In his address he referred to the fact that on January 1, 1912, he would celebrate his sixtieth anniversary as an engineer—30 years in private work and 30 years in the service of the State; that during his life time he had witnessed the berth of many things in industrial electricity and had taken an active part with reference to many of them. Following the address three cheers were given for Sir William and the Exhibition was open to the public.

Sir William Preece was born in Wales, February 15, 1834. His school training was obtained in King's College, London. His first practical experience he sought in the telegraph field, entering the post-office service in 1870, where he became 22 years later the State's chief electrician, his work extending to the Colonies.

SIR WILLIAM H. PREECE OPENING THE OLYMPIA EXHIBITION

His wide experience and research work have made him a writer of many important papers on submarine telegraphy and telephony and with Sivewright he brought out a "Text Book of Telegraphy." Two of his contributions to engineering literature published in this country are "Incandescent Lamps and the Grading of Voltages" and "Signaling Through Space Without Wires."

His "Recreations — Yachting and Shooting" point to his diversions.

Besides having conferred upon him the title of LL. D., he is a Fellow of the Royal Society and a member of many clubs and associations. He served with special distinction as president of the British Institution of Civil Engineers.

Night Blooming Cereus Photographed by Electric Light

It will be noticed that all parts of the accompanying photograph, with the exception of the opening flowers, are sharp and clear, the flowers only showing a fuzzy, blurred appearance. During an exposure of 30 minutes under a strong electric light the buds slowly unfolded. A double motion was observed at this time as the flowers turned away from the strong light. One little bud, indicated by the arrow, refused to open, but on the following night, under the starlit sky, developed into a large and beautiful flower. A. D. Dart.

UNIQUE PHOTOGRAPH BY ELECTRIC LIGHT

Rats Trained to Thread Wires in Conduits

Because the system of jointed rods and pulleys for drawing wires through conduits is slow, unsatisfactory and often a failure, the foreman of the San Diego, California, Gas and Electric Company, so the story goes, has trained four large rats, which he got from aboard ship to do the work. He taught the rats to crawl through stove-pipe in response to his whistling and always rewarded them with pieces of cheese.

A short time ago he tried them out in the city conduits with light strings fastened to their tails, and the scheme worked admirably. The string was tied to the wire and the wire promptly drawn through the long stretch of vitrified pipe.

Portable Electric Sign

The first portable electric sign displayed in St. Louis and perhaps in the United States was carried through St. Louis streets Tuesday evening by one of the big automobiles used by the circulation department of the *St. Louis Times.* The letters T-I-M-E-S were spelled out in tiny electric globes arranged on a three foot signboard and lighted by a storage battery.

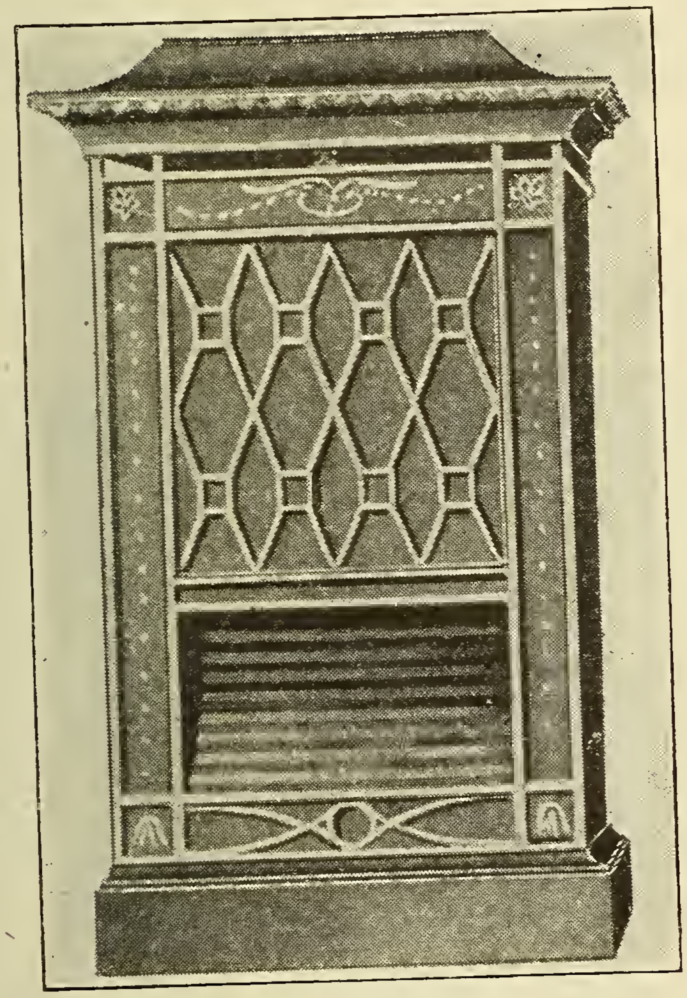
Advertising men, electric sign experts and novelty men from all over the city called at the *Times* office to see the innovation. Pedestrians on down-town streets turned to get a good look as the big automobile carrying the blazing sign rolled along.

Royal Quarters on the Durbar Ship

For the first time in history the King and Queen of England are visiting the far away colony of the British Empire, India.

In accordance with the custom long followed in India in great governmental events their visit is the occasion of the ceremonial, the Durbar, in this case proclaiming them Emperor and Empress of India.

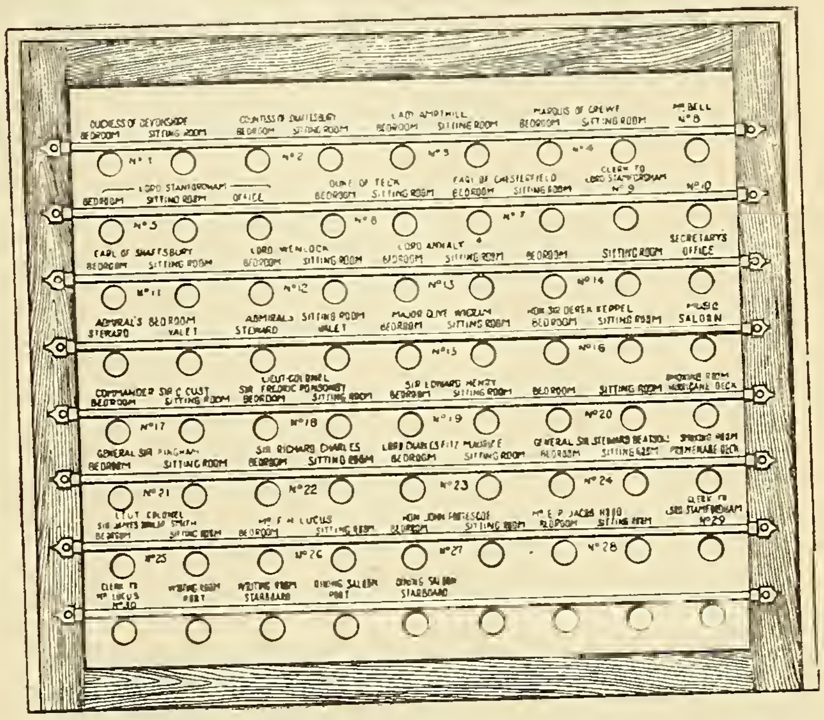
The voyage of King George and Queen Mary was made on the ocean liner Medina, in which special apartments were fitted up for their use, and electricity in a large measure contributed to the convenience and comfort of the royal party.



TYPE OF ELECTRIC HEATER USED IN THE ROYAL SUITE ON BOARD THE MEDINA

Because of the decided advantage over steam as well as the ease of control, electric heaters of the type shown were installed in their Majesties' suites. The heater, manufactured by an English firm, is made open at its lower front portion to give the cheery glow and real heat of an open fireplace, while the metal work is richly finished in oxidized silver.

In connection with the electric lighting, reading lamps were also provided, the Queen, by her special request, having a bookcase at the head of her bed, upon which was an adjustable electric reading lamp.



THE ELECTRIC INDICATOR BOARD SHOWS THE LARGE NUMBER OF PEOPLE IN THE ROYAL PARTY

To facilitate the calling of any of the officials or attendants of the party to the royal quarters, an electric bell indicator board with names and numbers was installed in the office. The furnishings, heating and lighting throughout were made to conform to the wishes of the King and Queen.

Electricity Reduces Copper Production Cost

The copper mines of Butte, Mont., are today producing copper cheaper than at any time in their history. This has been brought about by the introduction of many economies in operation.

Compressed air in the hoisting operations, electricity being the power employed, has made a material reduction in costs, while electric haulage underground and the substitution of electric power for steam in the operation of the pumps has effected other economies. The saving effected in this way, as against steam has been placed by local authorities at 35 per cent.

Electric Current at Work

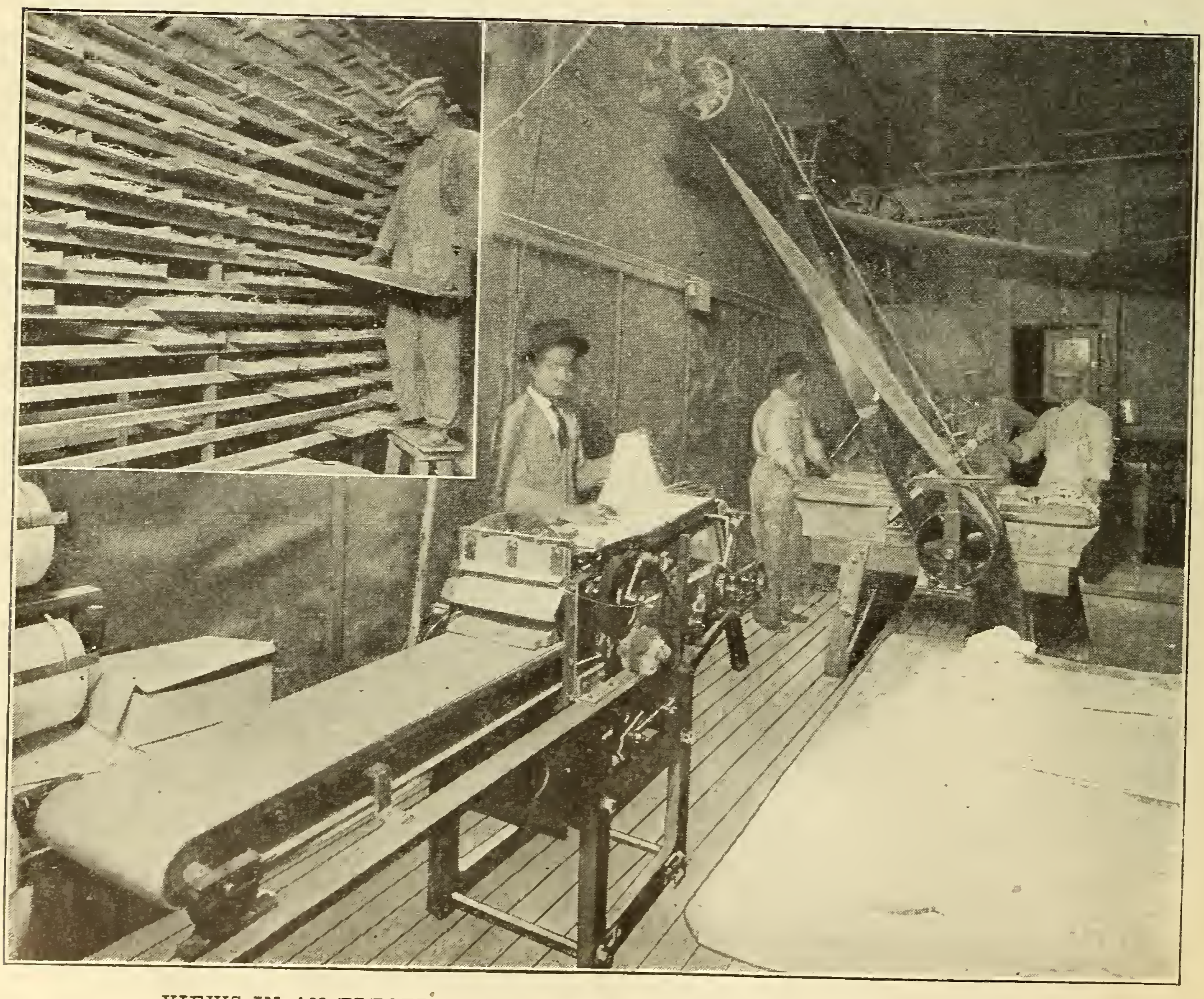
ELECTRICITY IN A CHINESE NOODLE FACTORY

Order a dish of "chicken chow mein," which will cost about six times "two bits" at the average Chicago chop sooy restaurant, and note the long, stringy fried threads of dough. "Chow mein" signifies "fried noodles," and the thready things are Chinese egg noodles which enter into the preparation of a score and more Chinese dishes.

Close upon the border of Chicago's Chinatown is a noodle factory, operated by electric power, lighted by electric lights and run by Chinese.

Contrary to the general belief that these people do not take kindly to being photographed, the accompanying pictures were made while the factory was in operation.

The flour, eggs and water are prepared for the mixer which turns out the dough in a mass. This dough is then taken to the rolling machine, where it is fed back



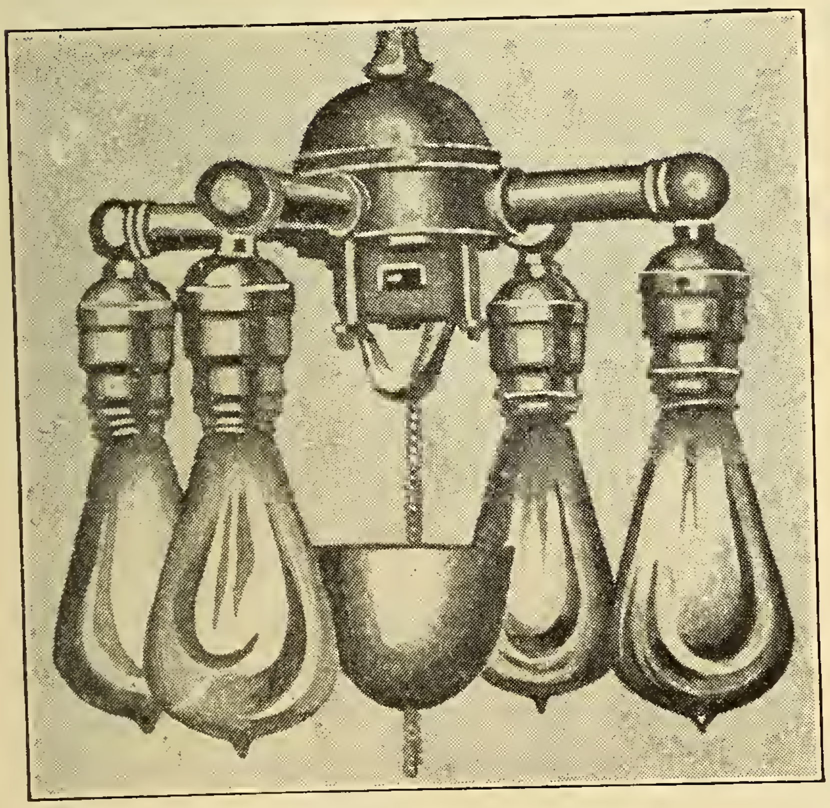
VIEWS IN AN ELECTRICALLY OPERATED CHINESE NOODLE FACTORY and forth between two rollers which are set closer and closer together until the mass of dough becomes a thin sheet about two feet wide and from 70 to 90 feet long. This sheet is cut up into ten or twelve foot lengths and folded up just as the dry goods clerk folds up a bolt of silk.

The folds are placed on the conveyor of the cutting machine and a turn of the switch starts the rapid clip, clip of the knife as it chops off fine strips of dough, which fall upon the tray beneath.

The trays when full are placed upon racks from which the noodles are taken when dry and placed in pasteboard boxes for delivery.

One Light at a Time

The illustration shows a switch somewhat out of the ordinary, made to turn on one light after another in a fixture



A NEW CANOPY SWITCH

until all are on, and then by successive pulls of the chain to turn off one light at a time until all are out.

The switch is arranged so that it may be attached to any fixture in which canopy space is available. The lowered canopy shows the switch fastened at the center of the fixture, the chain passing through to within easy reach.

Welding Sash Pulleys

Ten or twelve years ago the little pulley wheels over which the cords run in the sashes of our windows were all made either of cast iron or of wood. Then some enterprising firms began making both lighter and stronger forms out of pressed steel, punching the wheels in two halves and riveting these together. The result was a great improvement over the old practice, but depended on slow and careful riveting for its real strength.

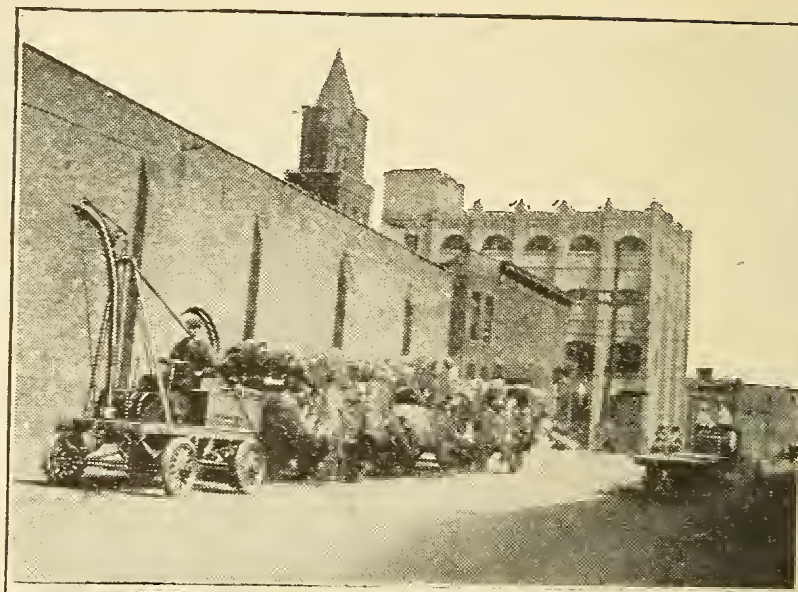
Now at least one manufacturer has gone a step farther by welding the parts into an integral whole, making both a neater and a uniformly stronger product. Each side of the wheel is stamped out

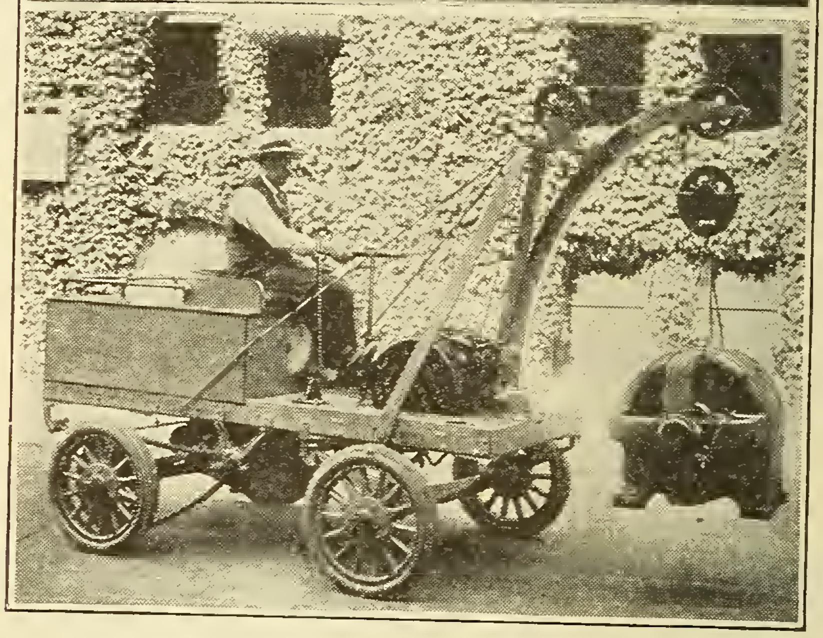
WELDING SASH PULLEYS

separately and when the two parts are slipped together in a special welding press, they are quickly welded into a firm whole. By using electricity for the welding there is no danger of overheating, or burning the parts, as is so often the case with other methods of welding. The operator's foot moves a plunger which presses the parts tightly together, while a hand lever controls the current which is needed only for a small fraction of a minute.

Battery Truck Crane

What is known as the battery truck crane is coming into extensive use about freight stations and factories. It consists of a stout platform truck carrying on the rear a storage battery. On the front is mounted a small crane operated by an electric motor taking its power from the battery. The truck itself is also motor driven. In the upper illustration the crane has been used to load bales of cotton onto a train of trucks and is now operating as a small locomotive to draw the train. In the lower picture the crane is transporting a one-ton motor from one part of the factory to another. As will be seen the heavy battery on the rear of the truck acts as a counter weight to keep the crane load from tilting the truck.

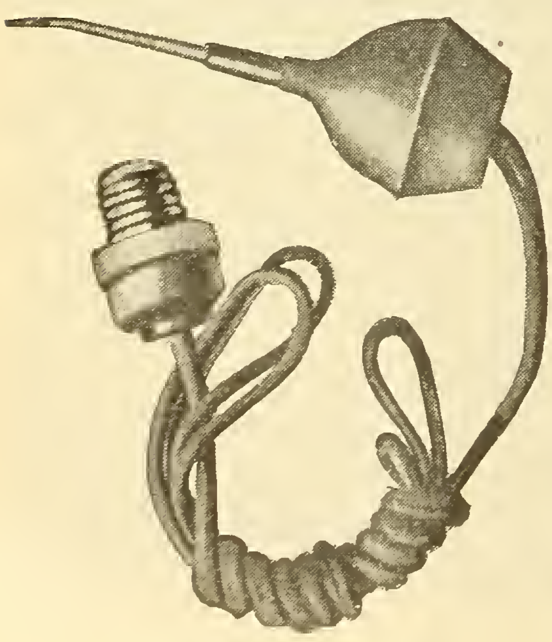




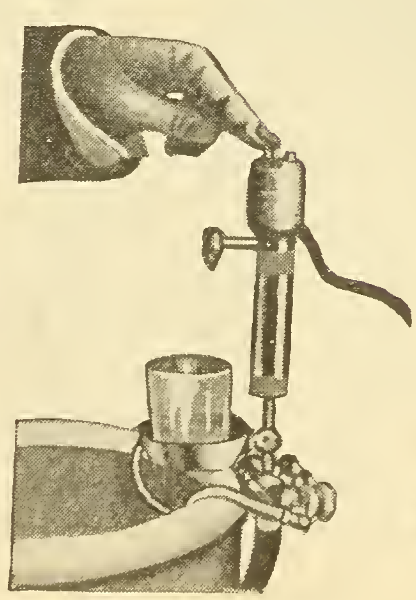
BATTERY TRUCK CRANE AT WORK

Electrical Aids for the Dentist

Electricity is applied in a score of ways in the dentist's office, but we still find him stepping clear across the room perhaps to heat the nozzle of his hot air syringe in the gas jet, or to get warm water—many times probably during an operation. The Presto hot air syringe does away with this. It may be placed right at his hand, and its heating element being connected to the lamp socket it is always ready for use. In the same way the little instantaneous water heater may be fastened to the edge of the basin. Another handy device, the instrument sterilizer, consists of a glass jar containing the water. Into this is plunged the heating element, which will bring the water to the boiling point in three or four minutes.



HOT AIR SYRINGE

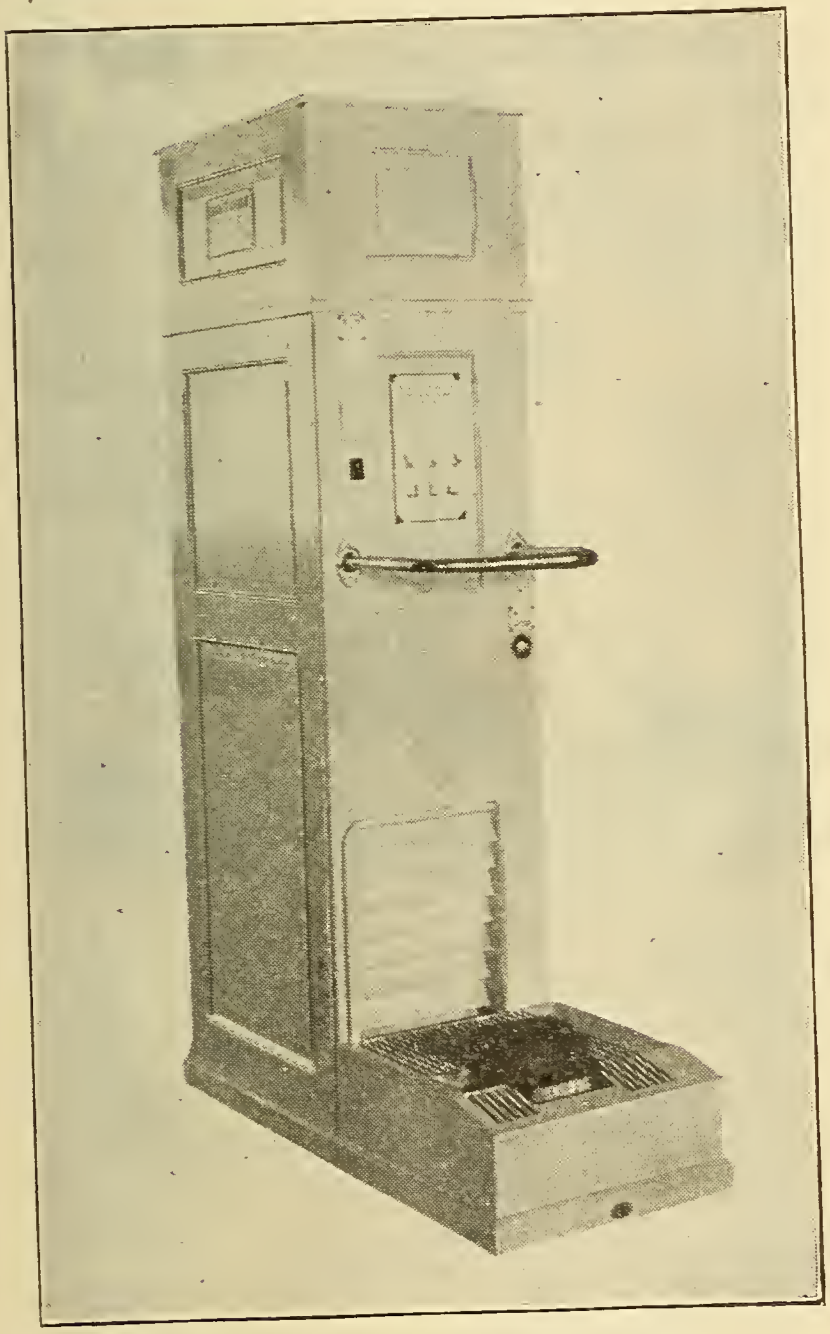


WATER HEATER

INSTRUMENT STERILIZER

Almost Human Shoe Polishing Machine

Swiss manufacturers do not, as a rule, stop short of the very last refinement in the designing and building of a device.



SHOE POLISHING MACHINE

As an illustration take this automatic electrically operated shoe brush, which is designed to clean the bottom and sides of one's shoes when entering a building.

A brush drum is lined with bristles so as to allow all parts of the shoe to be readily cleaned by lightly applying them against the bristles. The gross dirt scraped off the shoe falls through a grate into a box, whereas any lighter dust particles are sucked off by an exhauster and kept back by an air filter, thus allowing only pure filtered air to escape. The apparatus can therefore be installed even in closed rooms, corridors, etc. The drum and ventilating fan are operated by motor, thrown into connection by inserting a ten centime piece into the slot.

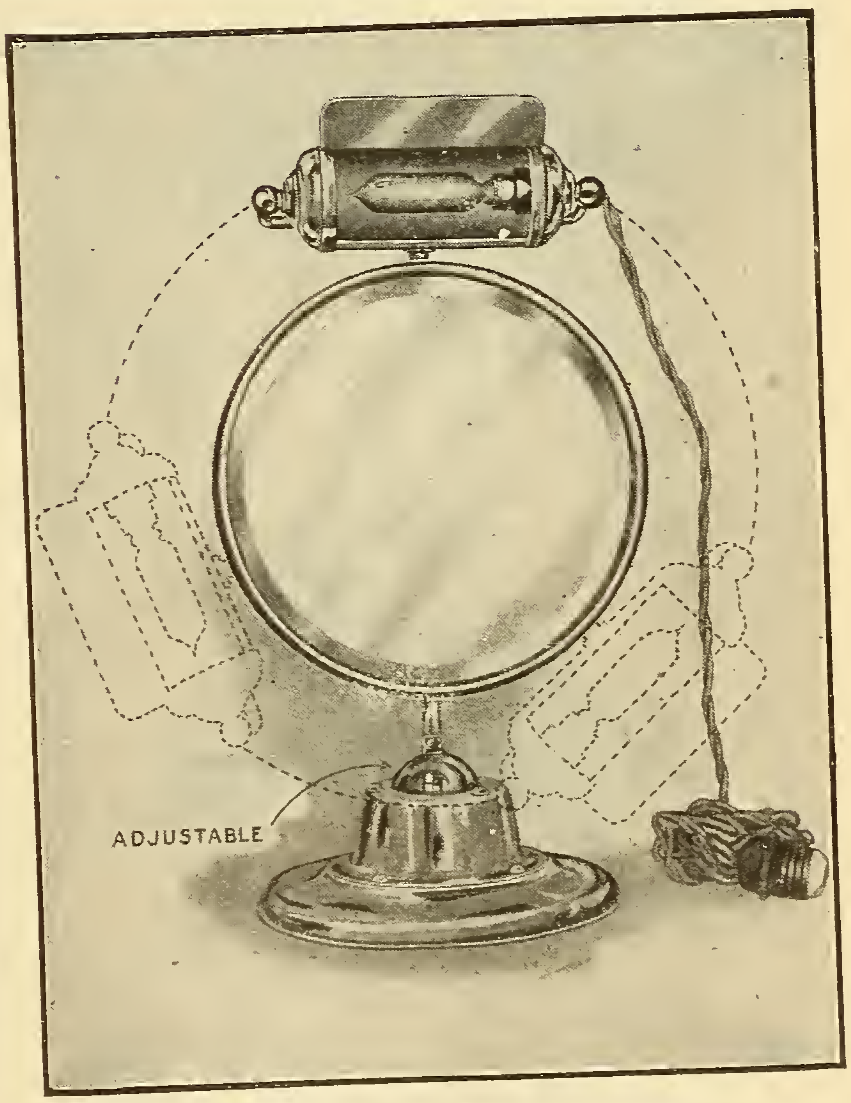
In damp weather a hot-air blower, set working simultaneously with the brush, is provided for drying the drum. The blower is, of course, switched out permanently in dry weather.

A coin tester serves to discard any spurious money, returning it to the user through a special discharge opening.

Machines of this type are in operation in the Federal and Central railway stations of Bale and Zurich, Switzerland, respectively.

Adjustable Mirror Light

One of the newest uses to which adjustable fixtures have been put is a practical combination of an adjustable fixture, mirror and shade, each part of this ingenious contrivance being adjustable. The shade, containing a six candlepower

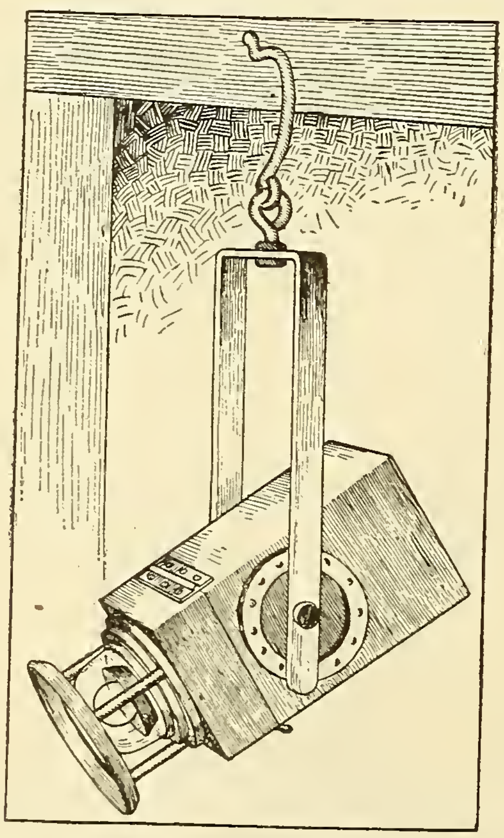


ADJUSTABLE MIRROR LIGHT

electric globe, either frosted or plain, can be placed at any desired point on the circular rim of the mirror, and the shade can be tilted so that the light falls either full upon the features or down upon the mirror. These devices can be carried about when traveling. They will be found most useful, as lights are seldom placed so as to be satisfactory for reading, dressing, or shaving. The cord furnished is nine feet long, permitting the mirror to be placed on any convenient table or dresser.

Locking Mine Lamps Magnetically

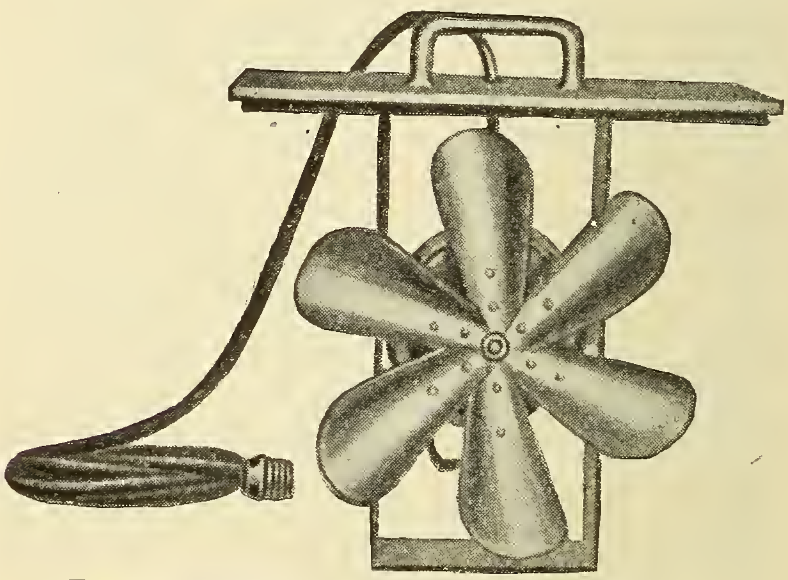
The incandescent electric lamps, being entirely enclosed, meets the requirements of an ideal mine lamp admirably, as it has neither an open flame nor a hot surface on which gases might be ignited. The only risk encountered is this: where storage batteries are used to insure long burning hours for a lamp, some ignorant miner might open the casing out of curiosity, draw a spark from the battery while tinkering with it and touch off the gases with this spark. While such tampering with the lamp is uncalled for in ordinary practice, the cautious mine owner guards against even the possibility of such a mishap by fitting each lamp either with a seal placed on it by the foreman, or with a lock to which only the foremen have keys. As a further variation of the locking scheme, one firm is putting out miners' lamps fitted with magnetic latches operated by a special magnet which the foreman carries. The illustration shows such a magnetically locked lamp arranged for suspension from a ceiling or timber.



MINE LAMP WITH MAGNETIC LOCK

Fan Blower for the Furnace

At this time of the year when the furnace is in operation, a good circulation of fresh air through the heating system and the rooms of a building is important. Fresh air is more essential to good health than heat, and a good heating system must provide for the circulation of fresh air. Of the many schemes advanced the most practical seems to be a fan blower placed in the cold air box.



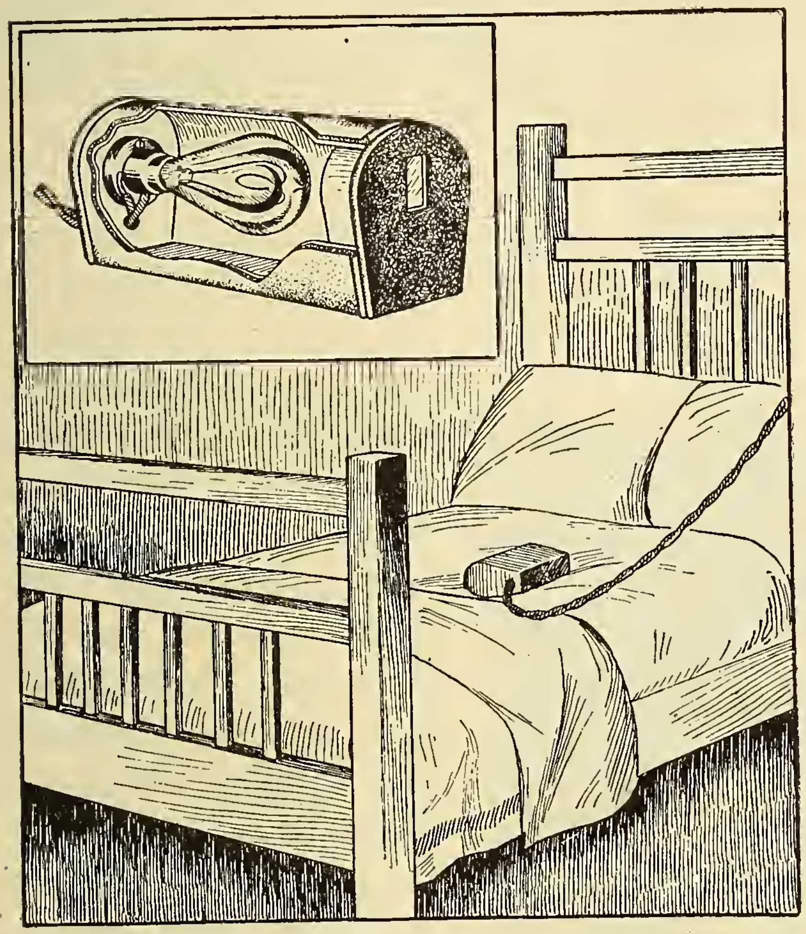
FAN BLOWER FOR THE FURNACE

A type of fan blower known as the Hawthorn consists of a moderate speed motor driving a six-blade fan and mounted on a supporting frame attached to a cast-iron cover plate. This cover plate is provided with a lifting handle, by means of which the blower can be easily removed from the cold air box if desired. No starting box or auxiliary equipment is necessary. A ten-foot lamp cord and socket is provided and connection can be made with any lamp socket.

The United States Navy Department has bought twelve electric trucks for the use of the Bureau of Yards and Docks. Eight of these are 5,000-pound trucks, the other four being standard five-ton trucks.

Warming the Bed

A device for making use of an ordinary incandescent lamp to warm up the bed before retiring during the cold fall



A NOVEL BED WARMER

and winter months is the subject of a patent issued to John Alden, Boise, Idaho.

The lamp is mounted upon one wall of an enclosing drum lined with asbestos or other suitable material. The other end wall is removable, making it possible to use the device also as a nurse's lamp, the body around the lamp acting as a shield for the light rays.

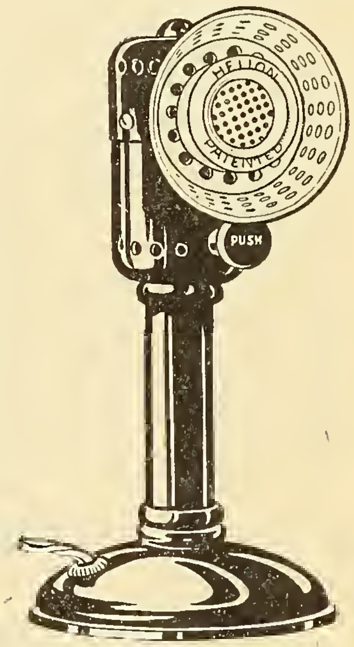
Two Lamps in One

By the very simple expedient of putting a base at each end of a bulb, the candle power of two lamps has been concentrated in one. The two filaments are exactly alike but entirely separate and distinct and connected in parallel, which means that the current divides and half of it flows through each instead of flowing first through one and then through the other. The result of this is that if either of the filaments is broken, the other will continue to burn.

This lamp was designed for a locomotive headlight. With a headlight using a reflector it is necessary that the source of light should be small in order that it may be correctly focused. For that reason the filaments are made in the shape of small coils.

Table or Desk Cigar Lighter

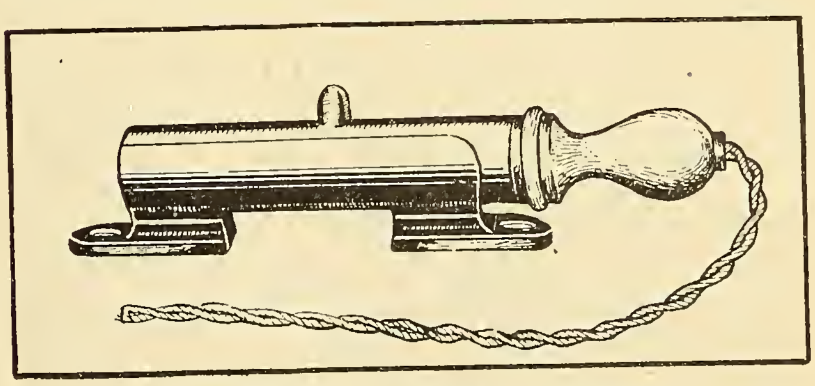
An electric cigar lighter made up in a form suitable for use on the club room table or wherever a stand is more convenient than a suspended lighter is shown herewith. While also made in a shape for suspending, the table type in appearance suggests a desk telephone without the receiver. The heating element is small, heats up quickly and will withstand a temperature of 1,700° C without harm.



DESK TYPE CIGAR LIGHTER

Cigar Lighters for Automobiles

English automobile enthusiasts have solved the problem of lighting their cigars or pipes without stopping their



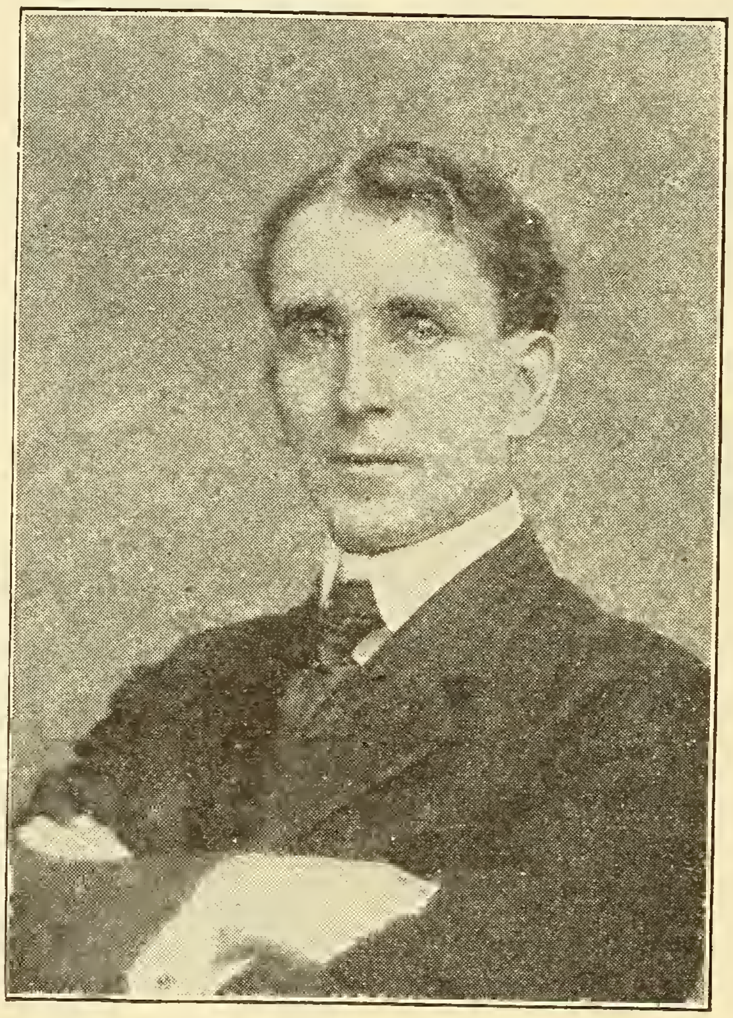
AUTOMOBILE CIGAR LIGHTER

cars. Having adopted electric storage batteries for their headlights and tail lamps, they only needed to add an electric cigar lighter connected to the same circuit. This is attached to a flexible cord and normally is slipped into a polished metal casing attached to the dashboard.

Electrical Men of the Times

JAMES GLENDENNING WRAY

The big job gets the big man, and after the man has succeeded invariably we like to know a little about how he did it. In the case of J. G. Wray, who is the chief engineer of the whole central group of Bell telephone companies, comprising Chicago, Cleveland, the Central Union and the Michigan and Wisconsin Bell companies, you would never get the information by asking him. He is a quiet and unassuming man and he would simply smile and start in changing the subject.



Among the graduates from the University of Wisconsin in the panic year of 1893, was James Glendenning Wray, who stepped out into the world with the degree Bachelor of Science in Electrical Engineering. He was 21 years old then and started to work for the Chicago Telephone Company. But he had considerable talent in the direction of journalistic work, and almost immediately went to Milwaukee to become managing editor of a new daily paper in that city, he having made a reputation for himself in journalism while at the university. But the panic came and quashed the newspaper and Wray went back to telephoning.

He started once more with the Chicago Telephone Company. In the 18 years he has been through every stage up to chief engineer of the company, and when a short time ago the five big companies centralized their forces into a group for more efficient conduct of the business, he was made chief engineer for the whole group. In brief: He knows telephone engineering from pole hole to answering jack; he has designed and patented important parts of the wonderful and intricate equipment himself, as for instance the keyless trunking system, used by the licensee Bell companies in all large cities; he knows how to handle men and men like him. Why shouldn't he be a good chief engineer?

It has been said that no one ever calls him Jim or Glen, but always Mr. Wray. This is true, but at the same time there was never a more modest, considerate man in the world—one more approachable.

Though his position is one requiring a great tax on his time and considerable traveling he finds opportunities somehow to do active work in his church and the numerous clubs to which he belongs, both technical and social. Neither has he ever forgotten his alma mater, and the Wisconsin Alumni Association of Chicago has very good reason to thank him for years of painstaking work in its behalf.

Modern Home Illumination

Modern artistic illumination includes an artistic fixture and practical efficiency of the lamp or lighting system. Wherever these two fundamentals are properly combined, the lighting scheme is ideal. The homemaker who puts some time and thought into the lighting installation of the home will be amply repaid, not only by the increased comfort in seeing and reading but in the artistic and aesthetic enjoyment of the home.

The incandescent or glow lamp is a beautiful invention which has made electric lighting practical for domestic purposes. Lamps are designed to give a certain candlepower when a certain amount of current is passed through them. The candlepower is based upon the horizontal rays; that is, those rays which come from the side of the lamp; for example, a lamp which gives eight candlepower at the side may not give more than five candlepower at the top. Some glow lamps are obscured or the glass is made dull by means of a sand blast. The great advantage of the obscured lamp is that it diffuses the light far more evenly than the ordinary clear glow lamp. A well lighted room is one in which no bright spots predominate with accompanying dark shadows, but where there is an equal distribution of soft diffused light.

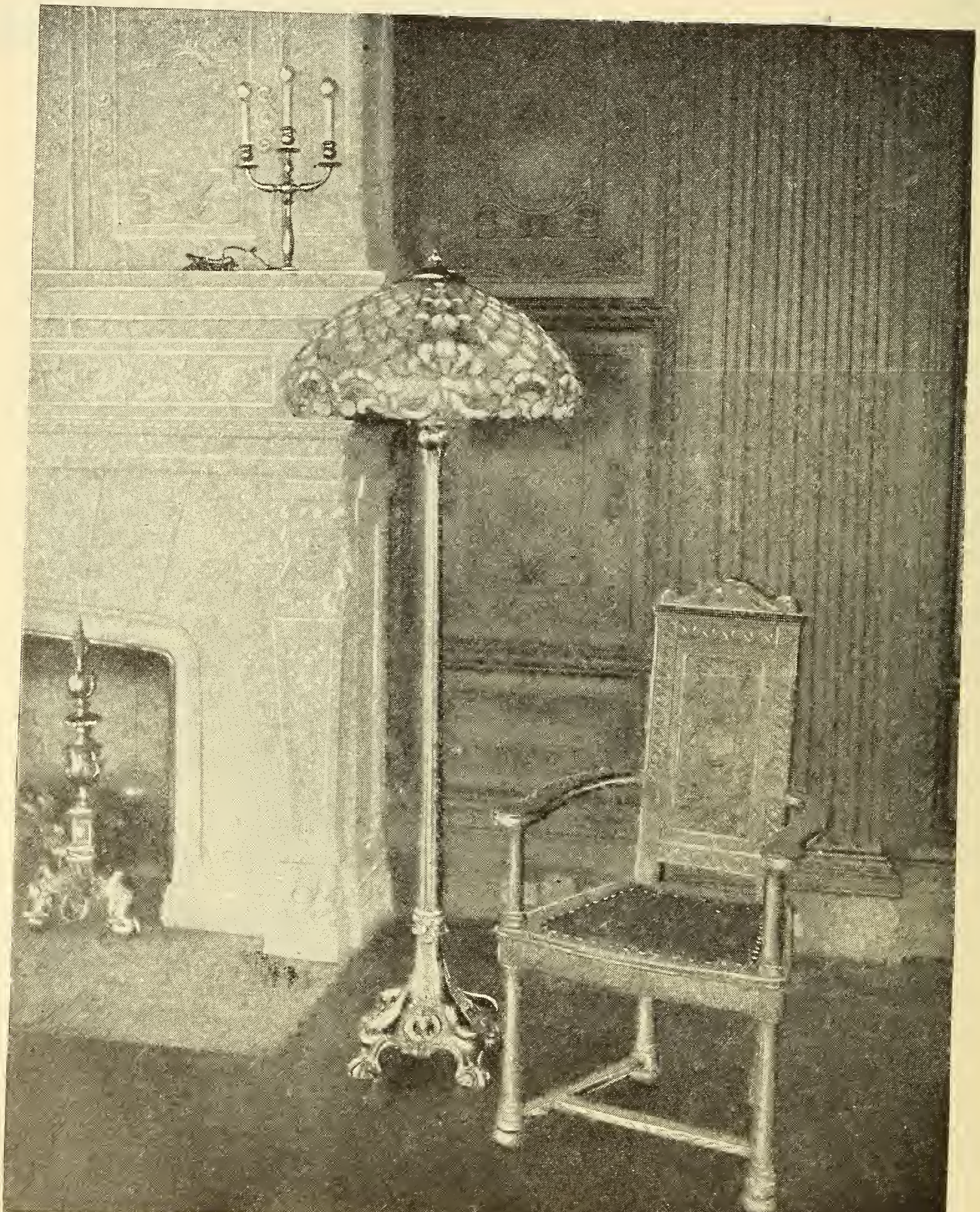
Fixtures have been divided into three classes: Those which hang down from the ceiling, those which project from the wall, and those which stand on the floor or table. Manufacturers are gradually getting away from the rigid chandelier designs, a single stem suspended from the ceiling. The best and newest fixtures are a combination of the direct and indirect systems and are most beautiful and artistic. Then there are the shower fixtures and the modified shower with delicately tinted opalescent globes, the semi-indirect fixture, the "quaint and olden" type, in the form of an old time English lantern, and the Arts and Crafts designs, the classical treatment of the shower and ceiling plaques with ribbon effects.

Floor standards are very fashionable and are far more flexible than the ceiling fixtures, as they may be moved from room to room and attached wherever there is an outlet in the baseboard. They are used chiefly for illumination of the hall and as piano lamps in the music room. These floor standards consist of a metal stem or standard in French bronze, hand chased to bring out the detail of design, with a Mosaic leaded glass dome underneath which the glow lamps are placed. The Verdi-antique floor standards are especially fine for reception halls and for use in the drawing room whenever a subdued illumination is required. The Chinese Chippendale lamp, one of the most expensive table lamps on the market, is exquisite in design with motif embodying Chippendale's best ideas of decoration.

The shops show a bewildering array of small electric lamps, exquisitely beautiful and adapted for every conceivable purpose in the home beautiful. It is now possible to so light one's home that even the plain woman achieves a delicate complexion and added beauty of feature.

This alone ought to be sufficient reason for the modern woman to study the possibilities of artistic illumination in the home.

One of the great advantages of electric lighting is that the consumer pays for no unnecessary light. With properly equipped switches and lamps placed in the right positions, it is possible to turn on the lamps just as they are needed and to turn them out when they have served their purpose.



FLOOR STANDARDS ARE VERY FASHIONABLE AND FAR MORE FLEXIBLE THAN CEILING FIXTURES

There has been a great deal of discussion recently as to the effectiveness of direct and indirect lighting systems, as at present commonly installed. Mr. J. R. Cravath, an illuminating engineer of Chicago, recently made some very interesting tests along this line. These tests were conducted in a basement room where all daylight was excluded. The ceiling and walls were of ordinary smooth plaster, very light cream in color. The floor was a reddish brown. The furniture consisted of several desks and some dark colored file cases. There were five lighting outlets, four of which were located in the approximate center of the four the ceiling with a prismatic reflector giving an extensive type of distribution. The reading desk was placed directly under the lamp in the center of the room. In test No. 8 indirect lighting fixtures

THE SHOPS SHOW A BEWILDERING ARRAY OF SMALL ELECTRIC LAMPS, EXQUISITELY BEAUTIFUL

quarters of the room, while the fifth outlet was in the center of the ceiling.

In test No. 7, outlet No. 5 in the center of the room was equipped with a tungsten lamp about twelve inches from

were hung from outlets Nos. 1, 2, 3 and 4 in the four quarters of the room. The desk was placed at the west side of the room and the subject upon looking up had the lighted ceiling over the four indirect lighting fixtures within the range of vision instead of direct light from lamps and reflectors as in a previous test.

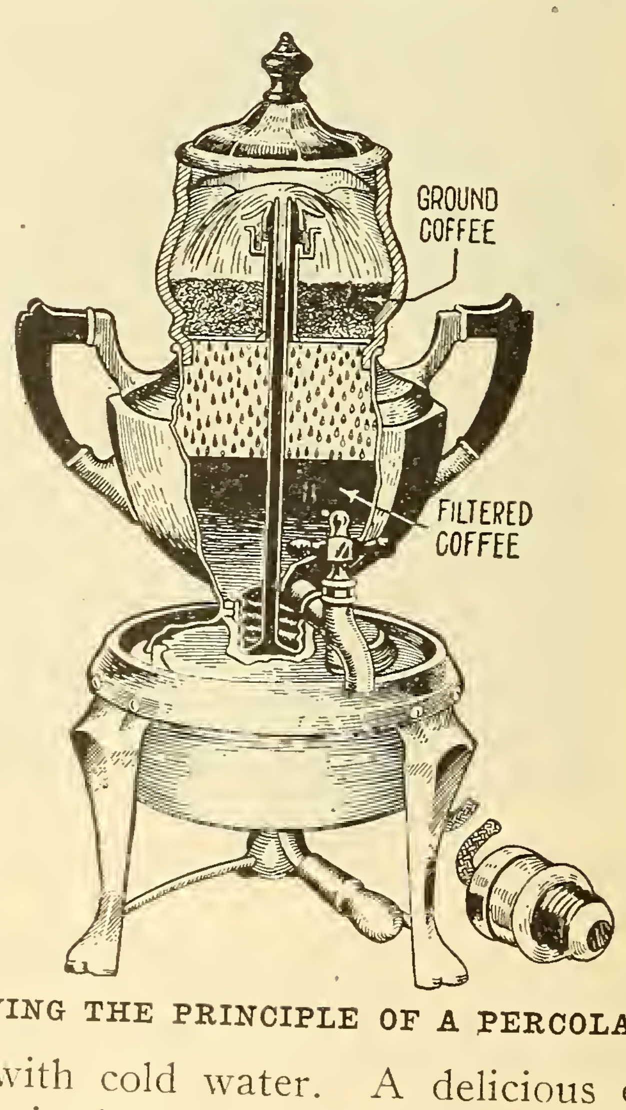
The test in which most of the subjects required the least illumination was test No. 8, in which the room was lighted from four indirect fixtures. The desk in that instance received light of the most diffused character. An indirect lighting fixture is one in which the source of light is concealed within a bowl or metal basin suspended by chains from a ceiling-rose. The light rays are thrown upward upon the cream colored ceiling and reflected downward by the ceiling and the result is a soft diffusion of light resembling subdued sunlight and free from glare, which is a marked contrast to the harsh effect of light coming from one direction and from a single point.

The results obtained by Mr. Cravath in his experiments emphasize most emphatically the importance of diffused lighting similar in character to daylight if the illumination is to have that soft and satisfactory quality which will enable work or reading to be done at any angle any place in a room. The concealing and shielding the light sources is of course most important in audience rooms, living rooms and all interiors where persons sit for some time with the light sources within the range of vision. The results reported by Mr. Cravath point to the broad general principle of obtaining working light from as large surfaces as possible, thus imitating the diffuse lighting conditions existing in daylight, to which the eye of man has been trained for untold ages.

Electric Spray Coffee Urn or Percolator

According to recent consular and trade reports the United States stood first in 1910 in the matter of coffee consumption, the total amount being over 860,000,000 pounds, or an average of 9.33 pounds per individual. The largest importations of coffee in the same year were from Brazil, Colombia, Venezuela, Central America, Mexico and the Dutch East Indies. The American people not only consume a large amount of coffee but they have devised the newest and best method of making their favorite beverage—by means of the electric spray coffee percolator. At the turn of the switch the electric stove under the urn supplies the necessary heat.

The excellent results obtained from these percolators is due to the spray pump and the better heat distribution. The pump is so designed that only a small amount of water is heated at one time in the base of the pump, the steam from this forcing out the water through the tube above it, thus obviating the necessity of heating a large amount of water before percolation begins. With the perfected construction spraying takes place in from one to five minutes, starting with cold water. A delicious drip coffee is obtained, the perfect accompaniment of electric toast.



SHOWING THE PRINCIPLE OF A PERCOLATOR

A Demonstration in Dirt

The lady in the first floor apartment was a good housekeeper. The lady in the second floor apartment was also a good housekeeper. An agent for a vacuum cleaning company called upon them. The second floor lady's husband had a near relative interested in the company. That was why she gave the agent houseroom—not that her rugs needed cleaning, my goodness no! Why, didn't she and the maid sweep thoroughly every Thursday and dust afterwards and clean as she had been taught to clean and dust and sweep? Moreover, her rugs had been scoured in the spring. The first floor lady took the agent upstairs and introduced him to the second floor lady because she knew that lady had been looking at vacuum cleaners but had not decided upon the one she would purchase. This was an electric vacuum cleaner, neat, light running and compact. The two good housekeepers watched the agent attach the cleaner to the ordinary lamp socket and then he ran the cleaner lightly, very lightly, over the rug on the front room floor.

"Of course," began the second floor lady, "you may find some dirt, because we always sweep Fridays, but company came in unexpectedly on Friday and we did not get in our usual thorough cleaning, and this is Monday——"

She expected some dirt but she was totally unprepared for the amount of dust and dirt that came out of the cylindrical bag. It was unbelievable. She blushed and then both women burst into laughter.

"Now," cried the second floor lady when she could get her breath, "let us go down stairs and see what is in your rug."

"Don't leave any of that dirt in the bag and bring it down stairs and say you got it out of my rug," cautioned the first floor lady as they all three descended the stairs. The agent smiled and shook the bag out when they reached the porch.

"Of course," he said, "I do feel somewhat discouraged about getting any dirt out of rugs that were thoroughly cleaned last spring. However, we will try."

He attached the long flexible cord to a lamp socket and ran the cleaner over a rug that looked immaculate. Then he emptied the contents of the bag upon a newspaper carefully spread upon the floor.

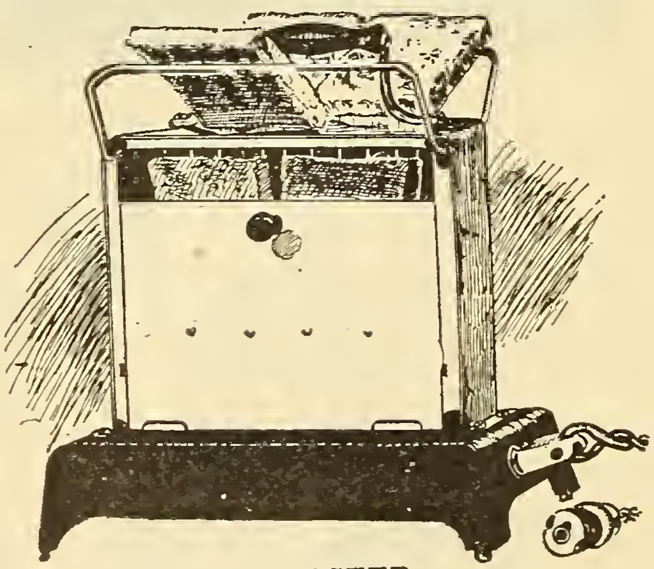
"Oh, oh, would you believe it?" cried the first floor lady in genuine distress.

"No, no," said the second floor lady in a paroxysm of laughter. "And you pretend to be so clean! I never would have believed it if I hadn't seen it with my own eyes. It is almost as much dirt as came out of my rug and we did not sweep Friday. You never can tell, you never can tell!"

Both good housekeepers bought an electric vacuum cleaner.

The Breakfast Room Toaster

This electric toaster is so handsome that it makes an appropriate gift for almost any occasion. It has a polished metal body in the center of which is an upright electric heater. On each side



TOASTER

is a door which swings outward and downward so that bread may be placed inside or removed without burning the fingers. When toasting, the doors are closed to confine all the heat for more effective work on the bread. Toast can be kept hot, or fresh bread can be dried on the new "keep-hot" rack.

Electra

Electra, an illuminated doll, was donated by the Household Department of Popular Electricity Magazine to the doll booth in charge of the Chicago Political Equality League at a big bazaar held in the La Salle Hotel early in December. She was charming and beau-

tiful to begin with, but after acquiring certain electrical equipment she became doubly attractive. Two tiny incandescent lamps nestled in her golden hair, which curled in genuine wireless waves about her fair face. Her necklace consisted of little glow lamps illuminated from a concealed battery by a tiny switch. She was pronounced a "lovely installation" and created a sensation not only by her unusual brilliancy, but by her practical advocacy of electricity in the household.

She was essentially a domestic doll, as indicated by her attire. She stood on her two pretty feet for things electrical in the home. She believed in getting more light on the subject of electrical equipment of the home. She was an inspiration to more than one carboned heart and played havoc with many shunt magnets of resistance. She enlightened with brave and successful insistence, the big crowds at the bazaar as to the unparalleled importance of electricity in modern life.

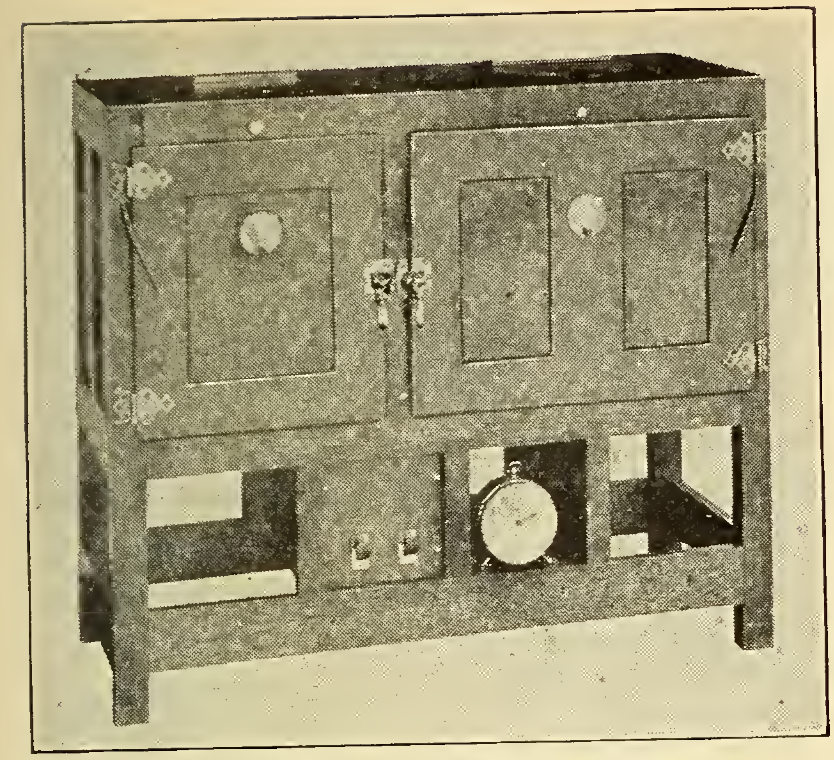
The Copeman Automatic Stove

Every woman looks at a new acquisition in the way of household furniture both from the artistic side and from the standpoint of real utility. How will it look? Is it a saving and what I need? Evidently the designer of the Copeman automatic electric cook stove had these characteristics in mind when he was drawing up the plans for this latest arrival in the field of electric cookery.

The stove—it is odd how the name stove still clings to the handsomely made wooden cabinets with which electric cooking is now usually performed—is attractive in appearance, being made in solid oak and finished to harmonize with any surroundings. The doors are fitted with nickel trimmings. The two compartments are made of rust-proof metal and the heater in each is arranged so that it can be removed and plugged in on top of the stove for frying or broiling.

In operation the attention required is reduced to a minimum. In one compartment are placed the vegetables. Closing the door a movable hand of the thermometer is set at the boiling heat.

The roast is placed in the other compartment and the thermometer set at the baking heat. The current may now be turned on or the clock may be set to do this later. In either case the indicating hand on the thermometer of each compartment registers the increase in temprature by moving around the dial towards the fixed hand. When directly over the fixed hand the boiling or baking heat is attained and the position of the two hands over each other automatically shuts off the current, leaving the dinner

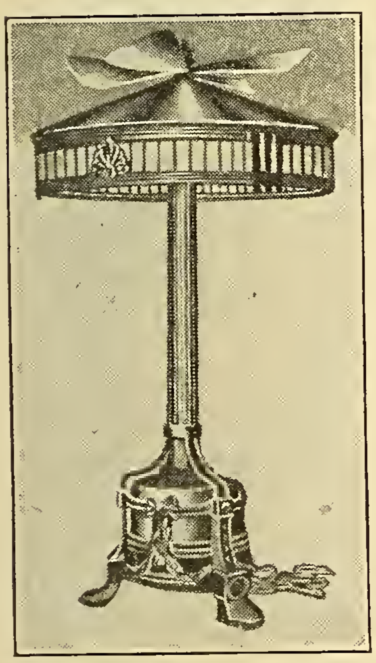


AUTOMATIC ELECTRIC STOVE

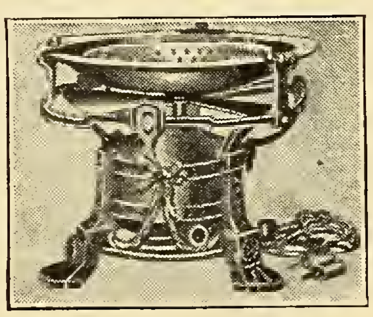
to cook from the confined heat as in a fireless cooker. No heat is wasted. If shopping or calling has been the work of the day it is but a matter of a few minutes to prepare the already cooked meal.

Novel Combination Fans

An English firm is offering a novel combination of fan and table lamp. The table standard is fitted for two lights and with a ten inch fan. It is handsomely finished in brown gold bronze and makes a welcome addition to the dining and reading



COMBINED FAN AND LAMP



FAN AND FLOWER DISH

tables, especially in warm weather. The ordinary desk or table fan, if the breeze is directed toward one, is frequently too strong and also a source of colds. The combined table lamp and fan overcome this annoyance. The fan rotates in a horizontal plane and deflects the air at a convenient angle, enabling those sitting at the table to enjoy a cooling breeze in summer or the benefits of change of air, without any ill effects. The table standard is a handsome ornament and the lights may be switched on at will.

Sometimes the table fan is combined with fruit or flower dish, consisting of a cut glass bowl. To the busy housewife who is frequently looking for something to put in the center of the table, this novel combination will doubtless prove a boon.

Plain Portable Electric Stove

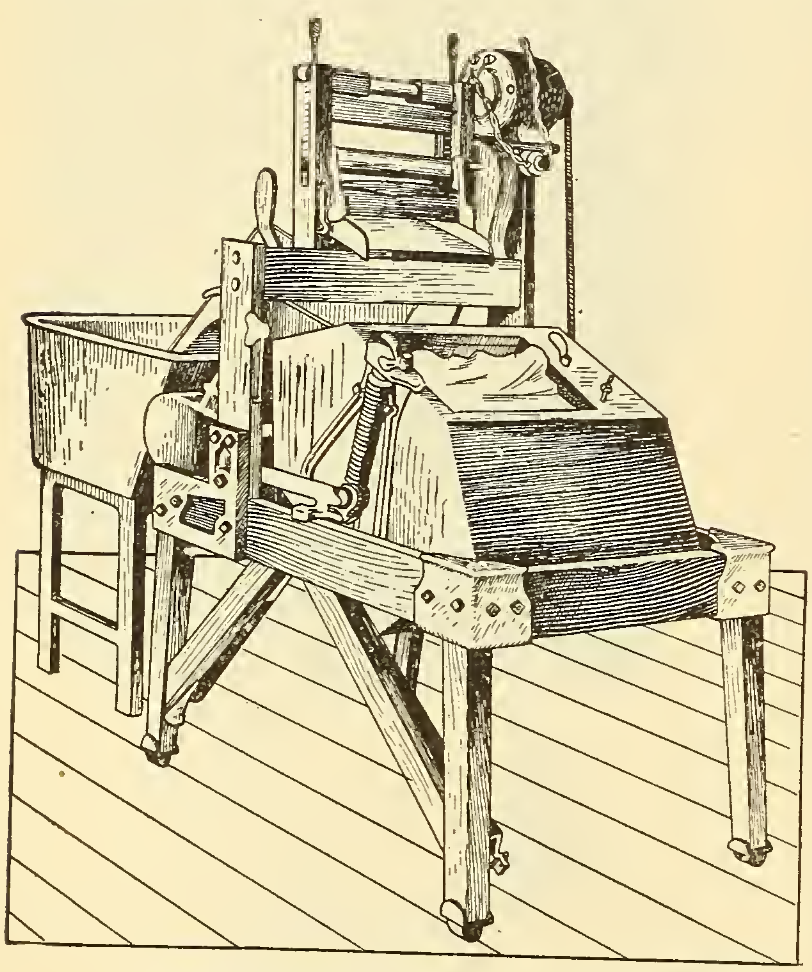
For light housekeeping or for one living in a few rooms an electric stove is invaluable. It has three great advantages, it is free from all odor and soot,

ELECTRIC STOVE

there is no danger of fire, and it does not heat up the room. It is very essential that any cooking utensil used on an electric stove should have a flat bottom in order that a close heating contact may be made. For this reason, it is desirable to use special utensils made to fit the stoves exactly and to lock on tightly. Still, good service is possible with the ordinary tin or copper tea kettles, coffee pots or sauce pans, provided these are not larger than the stove itself.

Washing Without Rubbing

The practical principle of washing clothes is well worked out in the Judd laundry machine. If you ask the laundress how she gets the clothes clean she will say, "By rubbing." Our mothers rubbed clothes on a washboard and our grandmothers rubbed with bent backs,



AN ELECTRIC WASHING MACHINE

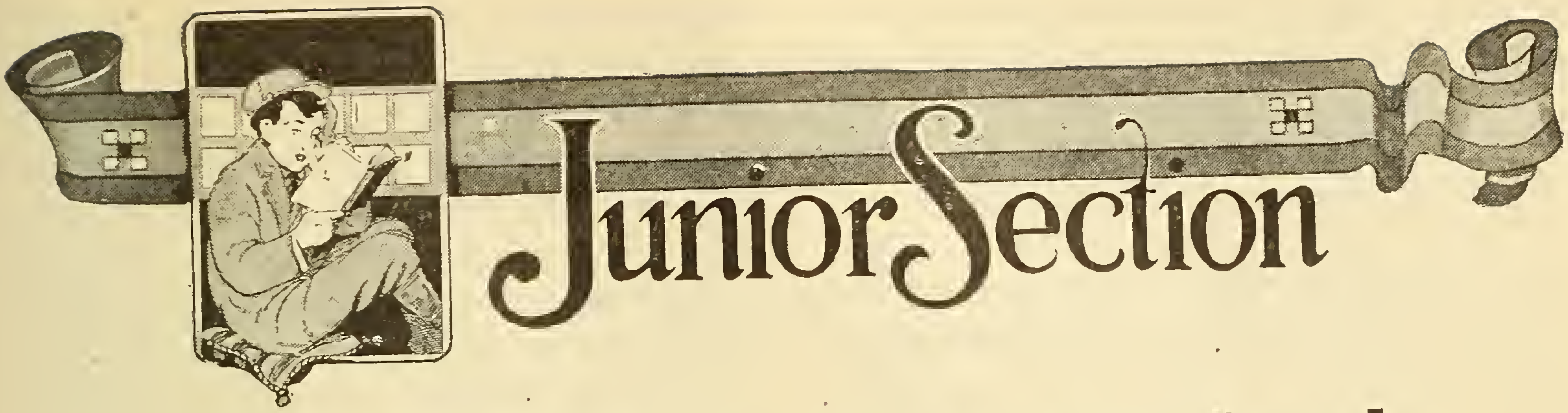
and wash day was a hard day. Now the whole principle of washing clothes is in the way the water is handled. The object of washing clothes is to get the dirt in solution, and our mothers and grandmothers managed this by dipping the clothes in water and rubbing them up and down on a corrugated board, which is bad for the clothes, as every woman knows.

Now the modern housewife is learning that it is not necessary to rub clothes to get them clean. All that is necessary is to get the water in and out of them quickly and with the required force. The Judd electric laundry machine does this perfectly. It can wash more clothes and better than any strong-armed laundress and without the wear and tear of rubbing. This machine is based upon a scientific and practical washing principle. It actually handles the water and forces it into, around, through and through the clothes about 100 times a minute. Clothes can be saved and washing made one of the easiest parts of housework since the electric motor has been brought into requisition to perform the once dreaded task.

What Is the Matter with My Iron

Once upon a time a housewife bought an electric iron. It was a good laundry iron and was very satisfactory—for a while. One day the iron would not work. It would not heat up properly and it performed its task with a languid indifference that was exasperating. She was perplexed and puzzled. The iron was comparatively new and she was sure that it should not act up and get out of order in so short a time.

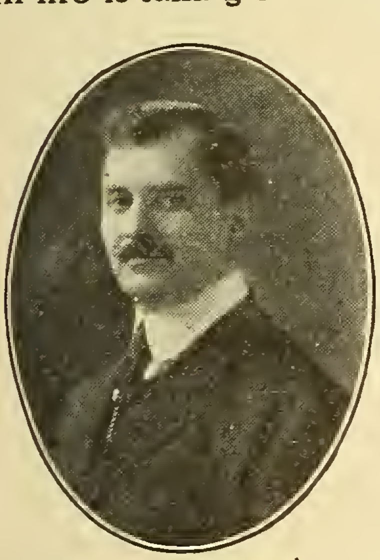
In her distress she appealed to an electrical man who was abiding in the household and he took the iron apart. Never take an electric iron apart yourself, but if you are so fortunate as to have an electrical man in your household, let him do it. He found the insulation decayed and the leading-in wires barely touching the heating unit. The iron was in a bad condition and the housewife was at a loss to account for it. Investigation however revealed the fact that the ubiquitous maid servant had played the star part in the electric iron's disaster. After using it she had plunged it into the kitchen sink and turned on the water to cool it off! Any self-respecting electric iron will act up under such circumstances, and will not do its work properly if it is abused.



Making Good in a Strange Land

By THEODORE VLADEMIROFF

To the boy who is beginning to meditate upon the great question, "What am I going to make of myself?"; who wants to go to college and become an electrical engineer but is afraid that he will not have money enough; or who fears that if he does go he may be "conned" out or that some other dire fate will befall him, this story will hold out encouragement. Mr. Vlademiroff came to this country a mere boy, without friends or money and knowing next to nothing of our language. The story of how he "made good" is interesting. We have persuaded him to tell it here for the sake of the inspiration that it will give to boys in whom the ambition to begin early to fight for a position in life is taking form.—*Editorial Note.*



The reason for writing this sketch of personal experiences, struggles and adventures is not prompted by a spirit of boastfulness, but rather to convey to the younger readers of POPULAR ELECTRICITY some of the difficulties a young man, who, born in a foreign country and coming to the United States without a knowledge of the English language, must overcome in order to become an electrical engineer.

I firmly believe that what a poor foreign boy can achieve without a knowledge of the language to start with, without money, relatives or friends, a native born boy ought to be able to accomplish far better.

Briefly, my native land (Bulgaria) was for five centuries under the Turks, and schools and churches were not allowed. When American missionaries came to Constantinople in 1850 Bulgaria awoke. A few years later schools and colleges were opened where boys and girls were taught the higher branches in their mother tongue. These schools existed only by consent of the Sultan of Turkey. Very soon the Bulgarians began to say among themselves that if American missionaries can come all the way to Bulgaria and establish schools, why cannot the Bulgarians have and control their own schools. And this latter was accomplished in 1855. Through history you are familiar with the terrible massacres committed by the Turks in 1876 in many of the finest provinces of Bulgaria; how Russia at a cost of 200,000 soldiers and much money marched her troops into Bulgaria to end the misrule and brutalities and received only the gratitude of a free people.

At this time, although I was only five years of age, I remember how one day the people fled in terror from their homes and sought protection with the Russian army and in the mountains. That night we watched from the mountains the burning of the city. The winter was spent near the Danube and in the spring we returned to the town where not a home was left—the ground being grown over by tall weeds, and where once the dogs and cats were pets, they now ran away to hide.

To each refugee who came back the Russians gave from five to ten bushels of wheat or corn, and often a cow, horse or mule. Having lost all, life was started anew, and at ten I was working in the fields. When thirteen, my father told me I was to go to the American boarding school at Samokor. My joy had no limit on the day when I left home and took the train for Samokor, Bulgaria. I had left the plow and all its hardships behind and a new field was opened to me from then on. As the school year's expenses were only about $50.00 or $60.00, which is not very much for America, but was a great deal for Bulgaria at that time, I attended school during the winter and worked on my father's farm during the summer until 1891, when I had finished a six years' course in five years. As every young man is required to serve in the army, I decided to do one of two things. I must either enter the army and serve out my time, or else find a way to go abroad for further studies.

I made a written application to the commander of the local military post to take me into the army, but he refused to do so because I was a minor. Now was my chance to go abroad, but where was the money? How could I secure the necessary passport? The mayor and the prefect—the two men upon whom my success or failure now depended—were my personal friends and the moment I informed them of my plans they gave me a passport. I borrowed $80.00 from my father and started for America on October 1, 1891.

I shall never forget my first impressions of America when I landed in New York, and my subsequent trip through the land of anthracite. I should have loved to have admired the country more and studied its mineral and industrial development, but I found very soon, and much to my sorrow, that I knew next to nothing of the language—not enough even to make my most necessary wants known, and the $5.00 in my pockets were fast taking wings, with no particular job in sight.

In a day or so I discovered that one of the boarders in the house where I stopped was a section boss of the city water department. I told him my plight as best I could and he gave me work digging pipe trenches. O! the aches of my back the next morning, and those terrible blisters on my hands! No one could have ever suffered more from blisters and muscular aches than I did then. I kept my courage through the second day, but the third day I had to spend in bed. Surely, I thought, America must hold out better things for me than mere trench digging and other jobs of that sort. I am willing to work at anything, only to earn my living in an honorable way and to feel that I am making headway.

After having spent several months looking for a means of earning my way through the University of Pennsylvania, in Philadelphia, and failing to find the means, I landed on a farm not far from the city. How good did that first farm meal taste to me after weeks of almost starvation rations in the city!

I had informed the farmer that I was an old farm hand, although but a few months in this country. He told me that he had a milk farm and I assured him that milking cows was my strong point, although I had only seen some years before how other people milk cows. I can yet see that row of 30 cows on that early March morning when we went in to start the milking. The owner gave me, as he then said, the easiest cow to begin with. She may have been an easy cow, but she must have been a very mean cow too, for try as I could she would give no milk. The owner and the other hired man had finished fourteen cows apiece while I was still tugging at my first. My fingers felt as stiff as bed posts and the muscles of my wrists simply refused to respond to my repeated efforts.

After all the other cows had been milked dry, the farmer came to finish the cow I had worked on for two long hours. Like all other nightmares, this one too had its ending.

I had made such a good showing at the local preparatory school where I could carry only a few subjects during that winter, that for the following year my tuition was given me free and a very desirable room in the dormitory was put at my disposal so that I could give all my time to my studies. I was happy and was going in the right direction.

During the summer of '93 I was offered a position at the Chicago Exposition, which not only enabled me to save some money, but also helped me to determine the profession I was to follow and the university I was to attend.

During the exposition I was struck by the wonderful things in the electrical exhibit and I decided to study electrical engineering.

On the 1st of October, 1893, I matriculated in the electrical engineering department of the University of Michigan, paid one-half of my tuition, and started the college year with still $25.00 more to pay before Christmas, and without one cent of income in sight. From now on my work was cut out for me. I not only had my regular college work to attend to, but also had to battle for the mastery of the English language and the earning of every cent that I was in need of during the year for board, room, clothes, books, stationery, laboratory fees, and the balance of my tuition. If anyone is inclined to think it easy, let him try it. The most difficult thing in a small college town is to find work that will pay. Often the looking for a job took longer than it did to perform the work. My troubles increased each day as the college semester advanced, instead of the reverse, because of the lack of a good working knowledge of the language. As much of the instruction was in the form of lectures, I had to act quickly in order to fully comprehend each sentence and then to record it. Most of my notes were a very peculiar mixture of English and Bulgarian—anything that I could work out when I reached my room.

Towards midwinter I found it very hard to have to work for my room and board, etc., and carry on my studies. One lady offered me the garret in her house free of charge. This I accepted gladly, although it was bitterly cold at all times, not having any heat of any sort, and being next to the roof tile. My bedding was frequently covered with snow if there was any sort of a wind blowing. I usually spent my evenings in the library till 9 p. m. As this was the closing hour I would then have to go home—up in my garret—and jump into my bed and read or study till the small hours of the night.

Each summer vacation I worked hard, but in one brief summer vacation it is next to impossible to find an occupation whereby one can earn and save enough to see himself through the college year.

During those years of hardships and privations, I discovered one very touchingly human characteristic among my American friends which did more to cheer me up and to instill fresh courage and determination in me than anything else. During each Christmas vacation when all students would go to their homes, I naturally had no place to go, but some one of the boys would always ask me to go and spend a part or all of my Christmas vacation at his home. Kind acts like these made me feel that after all, people like that, who could take a stranger into their home and make him feel that while there it is his home, are the real salt of the earth.

In four years' time one naturally would crowd a great deal of sunshine into one's life, but at the same time there is no night darker than the darkness one experiences when at the last lap of his college course, as it were, one suddenly comes face to face with disappointment and failure. Only a month or six weeks at the most before my graduation I found myself nearer to failure than at any time during the previous three years of my college life.

(To be concluded.)

Otto and His Electric Cat Trap

By H. F. STRICKLAND

Otto was the only son of the Rev. Joshua Candyman, the reformed Baptist minister and local chairman of the Society for the Prevention of Cruelty to Horses. Otto was the local genius. From wireless telegraphy to electric ozone machines, Otto was the great "I am" on the street where they had lived since moving to Maryville. Fritz was Otto's admiring chum and assistant, and was always on the job when there was any great experiment to be "pulled off."

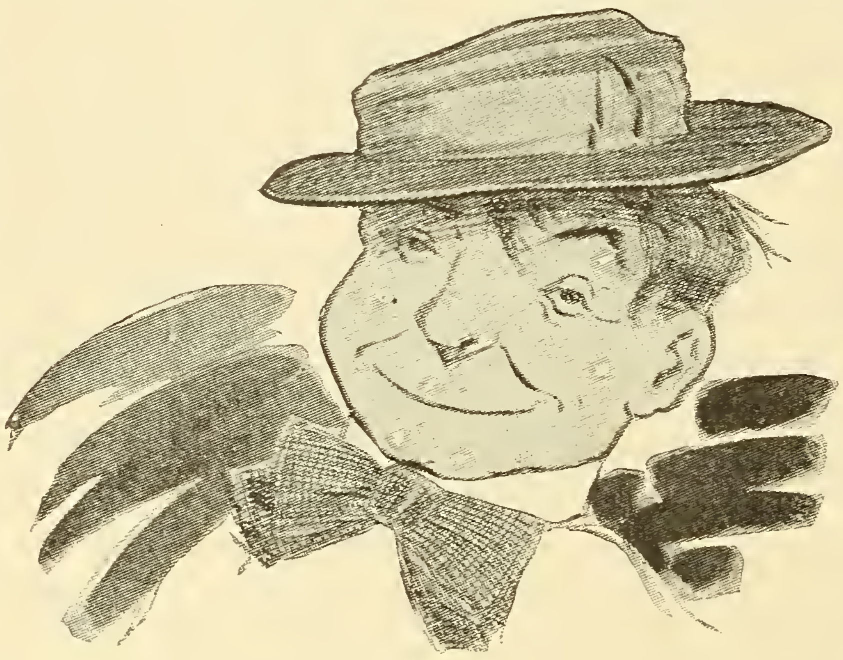
Otto had a workshop behind the house in which was a various assortment of junk from wireless coils to burnt-out lamps and batteries of every description. By some influence with the man at the street railway power house he had managed to get a wire tapped on to the trolley and run into his workshop, from which he operated an old 500 volt motor. Otto dearly loved his workshop and anything electrical

Now Otto's love of electricity and his workshop did not include the neighbors' cats and dogs. If there was one thing more than another calculated to irritate Otto during his wireless operating it was the wail of Togo, the pet gentleman cat of his next door friends.

One evening Otto put on his thinking cap and sat in the corner with a fresh chicklet in his mouth, and by the way his jaws came and went in sudden excellorandos, Fritz, who sat in admiration of his genius chum, was led to ask, "What is doing, Otto?"

"I've got it. I'll have Togo and the rest of the menagerie up against it before the flies come home again, see if I don't."

The sudden inspiration was just a little too much for Otto, so with a tremendous inhalation of air and a just as sudden expansion of the same and forming his mouth into an impromptu pea shooter, he shot his well chewed chicklet clear across the room and as quickly grasped Fritz by the arm and laid bare his deep laid plan to put it "all over" Togo and his band of canine "Merry Widows," who were rival suitors for his canine admiralty.



Otto

"It is easy," said Otto; "you see I have a line in here from the trolley wire," and it was made quite clear to Fritz that if he could establish a connection between the trolley wire and the ground through Togo's hind legs there would be something doing. A hurried plan was made with an old blue pencil, describing the *modus operandi,* which my readers can trace out showing just how Otto proposed to do it.

Now to make this plan clear, it is necessary to explain that the current that operates the cars comes along the trolley wire and passes down the trolley pole, where it reaches the motors, and then passes back to the power house through the rails and the ground. Now, it is quite plain that should any one or a cat be on the ground and touch the trolley wire or any other wire connected to it he would get a powerful shock from the trolley current.

Now, just how to apply this great idea was the point; so after two days and three nights of deep thinking, and after reading the various electrical magazines and pumping the man at the power house, the following plan was devised: Otto's workshop was built at the back of the

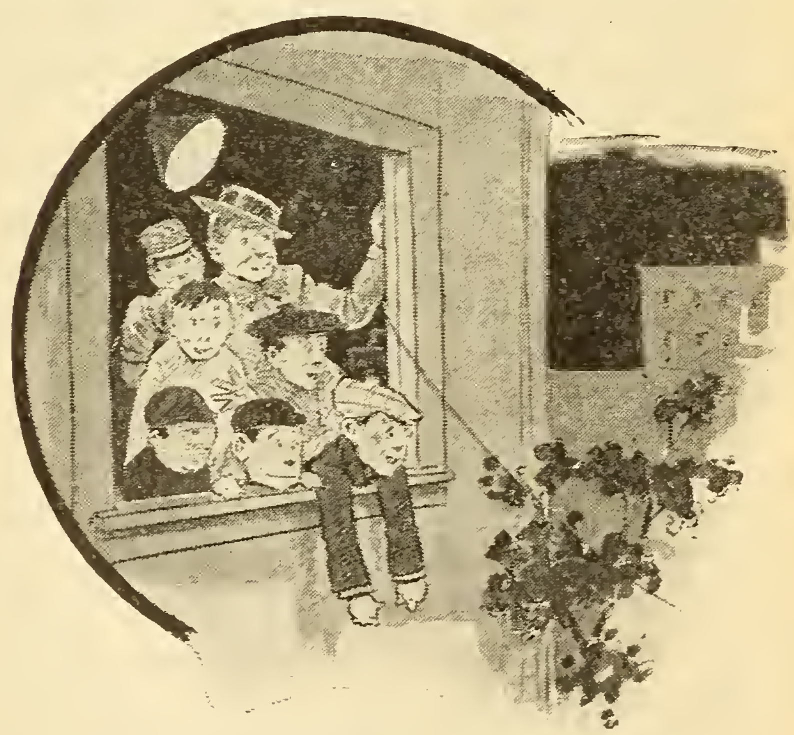
Togo

house overlooking the back yard and was admirably adapted as a watch tower for cats. At the back window Otto rigged up a reflector with a 32-candlepower lamp, which shone out on the yard, and any cats that appeared were clearly visible from the rays of the lamp. There was a hole in the back gate between Otto's yard and the lane, through which Togo and the rest of his admirers usually gained entrance. Just inside the hole the yard was floored with two-inch planking for about ten feet.

On this planking Otto laid copper wires about one-half inch apart under metal staples, these wires were alternately connected to the wire from the trolley and the ground so that each alternate wire was charged with 500 volts and the wire between was connected to the ground. Now, it is quite clear that when Mr. Togo walked across these rows of wires the current would pass from one wire to the other through "Togo," and it did. Otto, of course, knew the danger of leaving his current on these wires all the time, so he had a switch at the window beside the light. Otto and Fritz used up 2,000 feet of No. 16 bare wire and six boxes of double-headed carpet tacks in laying his rows of wires across the yard planking, and not being content with this, laid rows of wires along the top of the fence and on the roof of the shed. All being complete, the boys of the neighborhood were gathered together to witness the trial of the grand cat trap. The work was carefully examined and pronounced by the boss electrician, Otto, to be O. K.

About 8:15 p. m. it was quite dark and the young rascals gathered around the rear window while the 32-candlepower reflector was turned on.

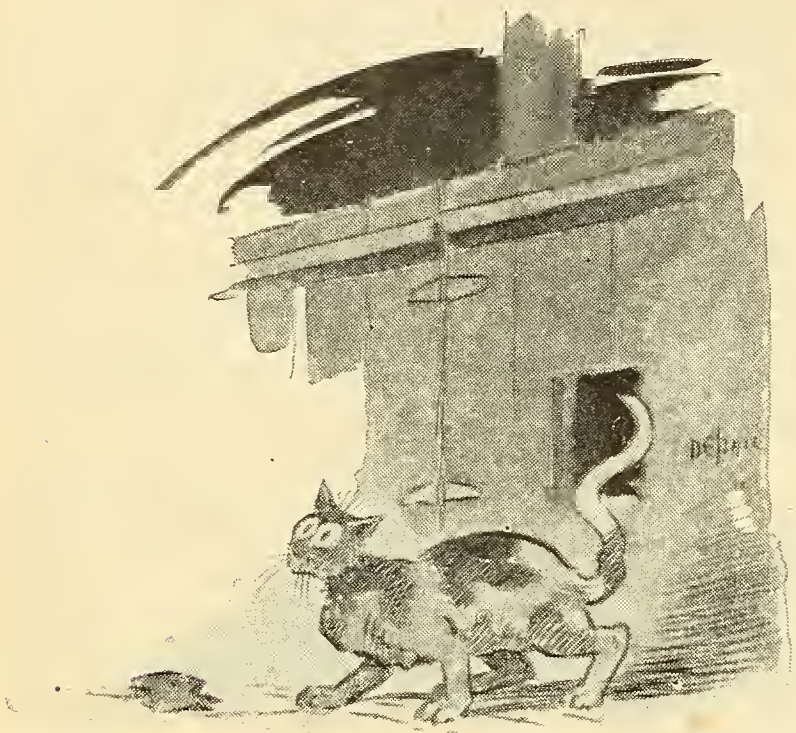
Immediately the yard was brightly illuminated and all hearts beat in eager excitement for the appearance of a stray feline roamer. They did not have long to wait, because the fish's head which Otto took care to get from Sarah, the cook, when she dressed the salmon trout for dinner, had been placed temptingly just inside the gate. Along came Togo meowing sadly, presently a pair of green eyes appeared at the hole in the gate. Would Togo come in the hole and walk across the wires? This question burned



Otto stood with his hand on the switch

within them; or would he get wise and just pass on with a catish smile. It seemed hours, but poor Togo decided the fresh fish meat was too good to pass over. Yes, here he comes—not a breath was drawn, in fact Otto was afraid the beating of their hearts would frighten Togo away.

Otto stood with his hand on the switch ready to turn the current into the wires the moment Togo trod thereon. One



There stood Togo fairly on the wires

moment more and one more step and Togo would have all fours on the deadly wires. The moment arrived. There stood Togo fairly on the wires just smacking his lips in anticipation of that repast of salmon trout coming to him. Just then Otto, who by this time felt like the man who turns on the electric chair in Auburn, pressed the button!

We-ow-ow-ow—! ! ! ow ow-hiss-spit-biff, biff—a wild rush to the fence, we-ow-ow-meow—whow and sixteen somersaults and a dark object sprang 24 feet into the air and finally landed on the soft grass in the yard.

For a few moments all was silence. You may have seen a surprised cat, but nothing could describe the injured expression on this cat's countenance. When the boys had recovered sufficiently they looked out and there was Togo. He looked at the light, but could not see the convulsed faces behind fairly screaming with delight at the success of Otto's grand cat trap. Togo looked dismayed and finally decided to return to the lane. Hardly had he moved towards the fatal boards when another pair of green eyes which belonged to another member of the local cat society, and who had heard Togo's shrieks, appeared in the hole under the gate. The same breathless wait and biff-we ow-ow-hiss-meow and up went tom cat No. 2.

This was a little too much for Togo.

That some one had put up a job on him was clearly evident, and that cat No. 2 was the guilty party was uppermost in Togo's mind, so Togo uttered a wild war cry and flew at cat No. 2. There was a wild time and both cats rolled over and over until finally they both rolled over onto the wires again. This was too good an opportunity to miss, so Otto's hand once more pressed the switch. The dent of cat cries that followed was a little too much for a big mastiff dog living in the same lane. His dogship managed to push the gate open, as it opened in from the lane, and the moment his paws touched the wires there was a yell that fairly paralyzed the neighborhood. Mr. Mastiff was unable to get out, as the gate would not open out, so getting his powerful body partly through the hole

Otto's dad could never explain it to the fire department

in the gate he gave a tremendous jump and away went the gate, hinges and all, and Mr. Mastiff tore down the lane.

Up went all the windows in the neighborhood. But this was not all, the dog's great claws tore up the wires and got them crossed and set fire to the boards and the fence. Some one rang a fire alarm.

This was the grand finish. We will drop the curtain. Suffice it to say that Otto only took one minute to pull his wires down and extinguish his lamp and there was a scatteration.

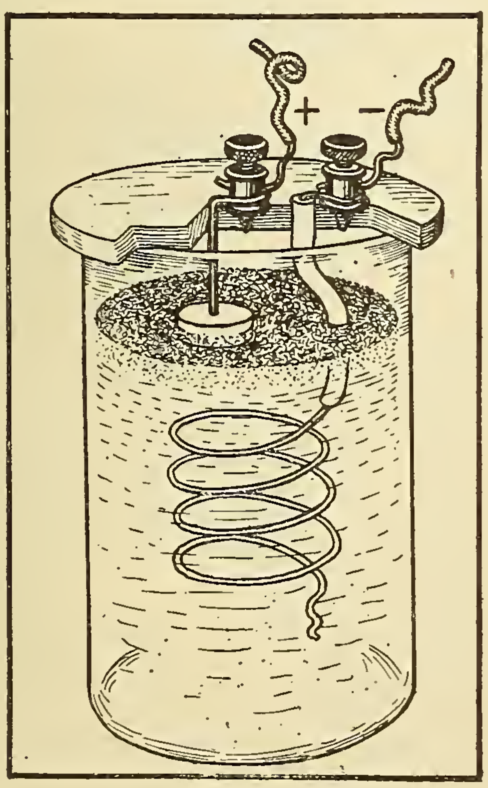
Otto's dad could never explain to the fire department. One day, however, an electrical inspector from the Fire Underwriters happened to see this connection to the trolley running into Otto's house, and this being a violation of the insurance rules, the deep-laid plot was unearthed.

Otto has now turned his attention to electrifying buttermilk so that it will cure the tired feeling, and never looks at cats without smiling the smile that won't come off.

Electricity from Cider

We are familiar with the simple carbon and zinc cell in which life depends upon the slow consumption of the zinc in a solution of sal ammoniac.

The cell described generates its current by the fermentation of apple cider. Procure a quart jar and fill it to within an inch of the top with sweet cider to which a pinch of salt has been added to



A CIDER BATTERY

lower its internal resistance. Sprinkle about a half inch of carbon dust on the surface of the cider, then fasten a hard piece of carbon to the top of the jar so as to press upon the dust, securing it by a copper wire. This forms the positive pole of the battery. For the negative pole immerse a piece of spiral copper wire in the cider, being careful to insulate it from the carbon by a piece of rubber tubing. A current will flow as long as fermentation takes place.

STANLEY RADCLIFFE.

When Larry Lifted the Lids

This is a true story. We say so right now because it may sound better than it would afterward.

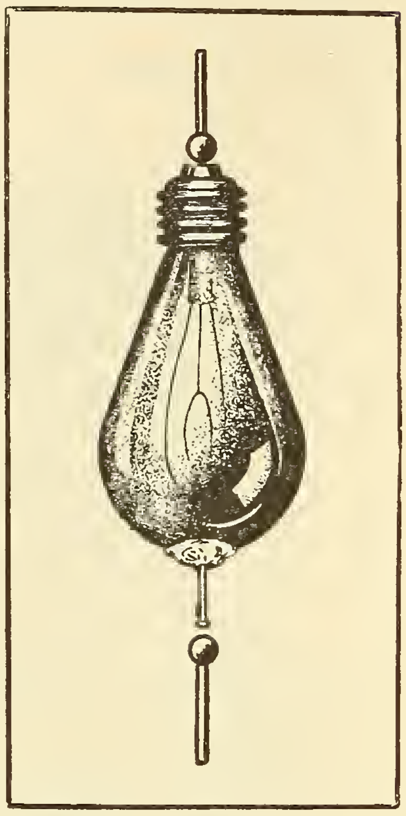
In a certain street was a large underground conduit for carrying telephone cables. At each street intersection there was a manhole in the conduit line. And above each manhole was a cover, perforated to allow any gas which might leak in to escape to the outer air.

But in the winter came a heavy fall of snow, and then came a thaw, and then more cold weather so that the holes in every manhole lid were tightly sealed with ice and the conduit was as fine a gas main as you could want.

So, on a winter morning when Larry opened up one of the manholes and stuck his torch into it to get a better look, there came a puff of flame and a muffled report. And down the street as far as one could see, the manhole lids rose simultaneously two feet into the air and fell back together. Thus was the world's record in lid lifting established by Larry O'Brien on a winter morning several years ago.

Geissler Tube from Old Lamp

I performed the following pleasing experiment with an old incandescent lamp and spark coil:



GEISSLER TUBE FROM AN OLD LAMP

On the pointed end of a common brass pin bend a loop at right angles to the body of the pin. Place this loop around the glass tip on the end of the incandescent lamp bulb. Soften a small lump of beeswax by working it between the fingers and seal the end of the bulb over air-tight to a distance of 3/8 inch out from the glass tip, taking care to seal in the loop of the pin close to the glass. Now place the bulb between the terminals of a spark coil or static machine, giving a 1½ inch spark, in such a position that the head of the pin touches one discharge ball and the brass of the bulb touches the other. The spark will pierce the glass and a pale blue light will fill the bulb. After the glass is once pierced, a coil giving a ¼ inch spark will operate the tube. Care should be taken to seal the wax closely to the glass, or air will leak in and spoil the effect.

HAROLD L. HAWTHORNE.

One on the Boys

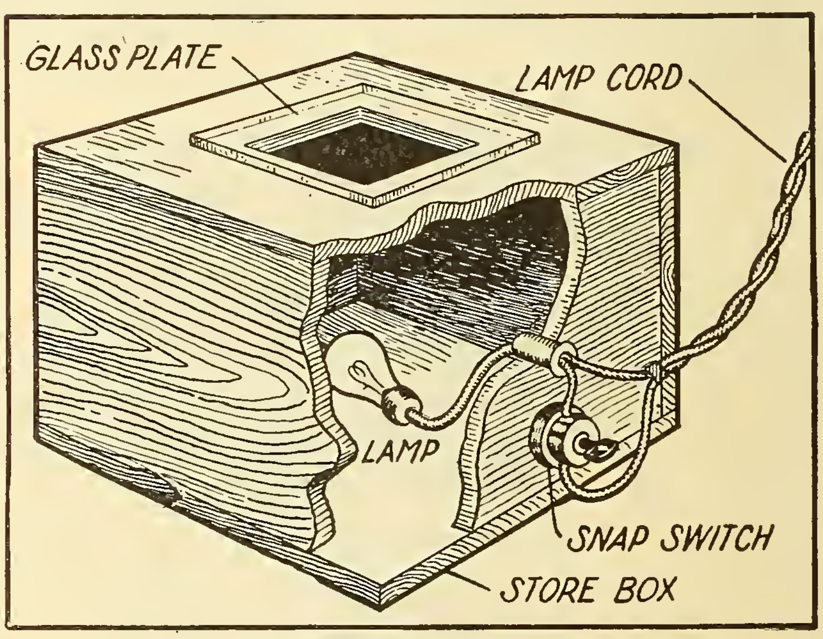
The owner of an apartment building in which the mail boxes and bells were situated in the hall was much annoyed by boys who opened the lower door, reached in and rang the bells. To protect each push button by connecting with a shocking coil would mean much wiring, so the owner hit upon the following scheme: A special door knob of insulated material was made in which two ornamental metal rings were placed. These rings were connected from the inside across a fairly strong induction coil and batteries. At the usual time for the fun to begin a yell was heard outside the hall door and a youngster was found with his hand glued to the knob of which he was unable to let go.

H. G. WILSON.

Home Made Device for Printing Pictures

A very handy device for the amateur or professional photographer who wants a home-made and simple apparatus for printing pictures can be made in a few minutes' time.

The drawing shows the scheme, which consists of a small store box about 12 inches square and an electric light of any



BOX FOR PRINTING PHOTOGRAPHS

candlepower desired attached to a drop cord running through the end of the box.

The hole should be made in the top of the box a little larger than the plate or film which is to be used. This hole should be covered with a piece of glass. The negative can then be laid on the glass face upward, and the printing carried on in the usual way. A flat weight should be placed on the print and plate to hold them securely in place while printing.

Underwater Wireless Telegraphy

Telephoning from London to Rome may become an easy and everyday affair a short time hence if the new receiver just perfected by Mr. Thorne Baker, the *London Daily Mirror* scientific expert, fulfils expectations.

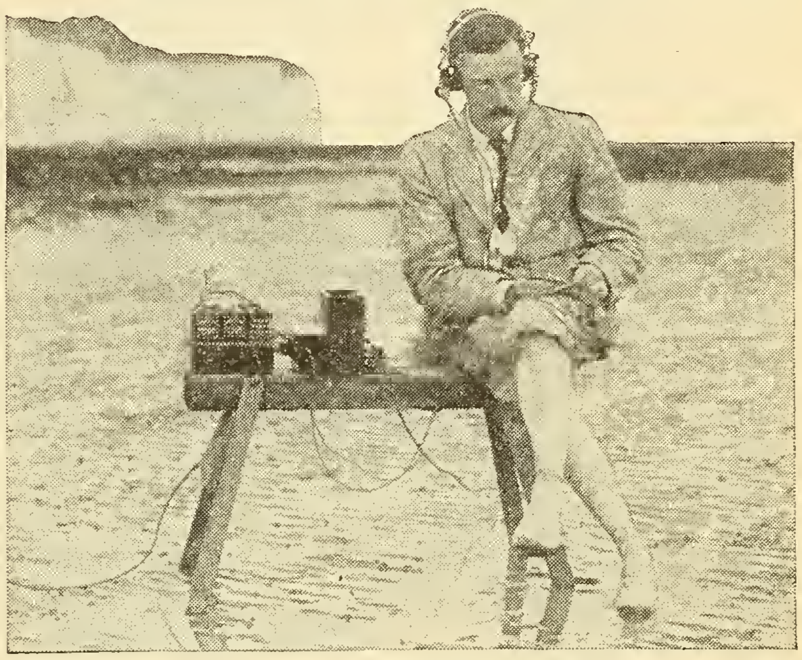
In the ordinary telephone receiver only the central part of the metal drum, which produces the sound, vibrates. Mr. Baker, replacing the metal fitting by a non-metallic preparation of his own, which is highly sensitive to sound, has made a much larger drum, which vibrates right

MR. THORNE BAKER AND HIS NEW TELEPHONE RECEIVER

up to the edge of the instrument, and gives a much more intensified sound than the ordinary receiver gives.

Furthermore, he has devised an adjustable collar to fit around his receiver. This collar absorbs those interfering vibrations which express themselves in the superfluous buzzing and hissing heard in an ordinary telephone.

In the course of his experiments Mr. Baker noted that musical tones were produced on his receiver with more than



MR. SHARMAN RECEIVING A MESSAGE

proportional clearness. This has a direct application to the progress of wireless telegraphy, since the best wireless signals are musical buzzes, and musical toned signals are being at present adopted by the French government for their new coast fog signals.

Recently Mr. Baker went to Pegwell Bay to try his receiver in connection with the Sharman system of wireless telegraphy, by which submarines can get into telephonic communication with battleships through the water. He claims that his receiver will pick up a wireless message at three times the present distance.

If his claim is substantiated, the naval commander of the near future will be able to marshal his fleet and direct its operations with more detailed precision than did the Japanese generals when they controlled the movements of their land battalions with the field telephone.

High Frequency Apparatus to Go with a Wireless Set

By JAMES H. DORAN

Many amateurs have undoubtedly wished to use their wireless transmitting instruments for the generation of high frequency currents. The only additional apparatus required is either a Tesla coil or resonator. These can be made with but little trouble and expense, and the experiments that can be performed with them are among the most instructive as well as the most spectacular in electricity.

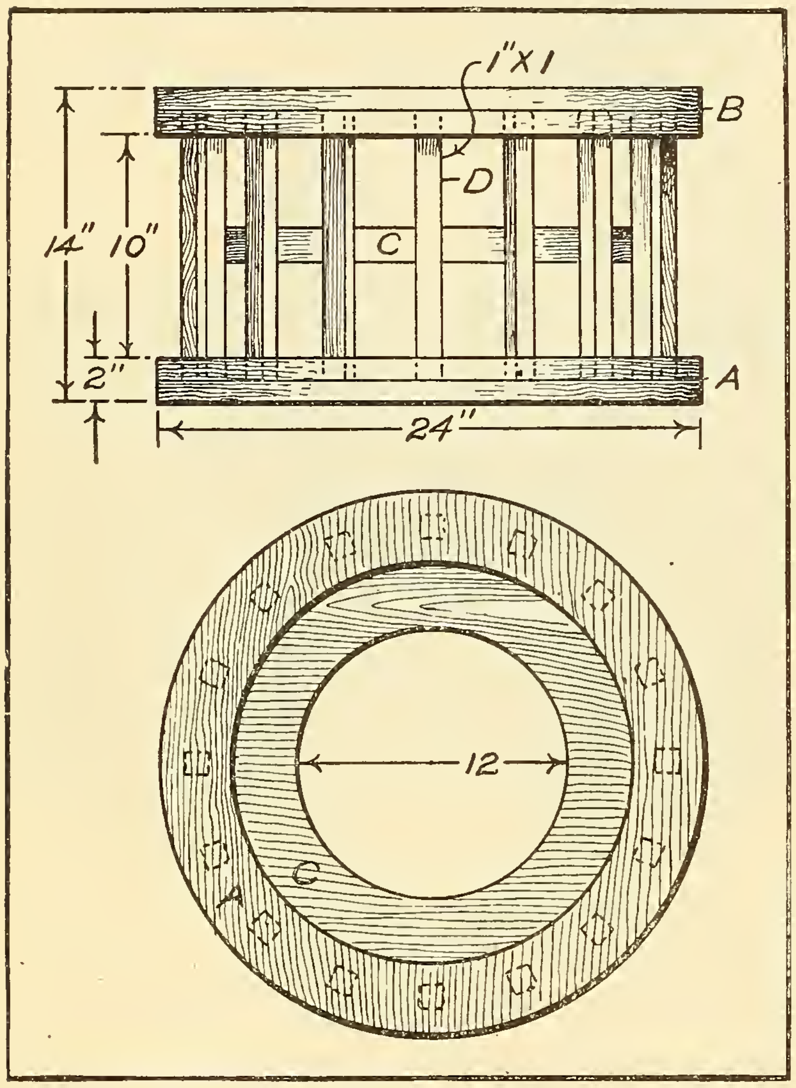


FIG. 1. PRIMARY FRAME

The coils and resonators described are for use with ¾ to 1½ K. W. transformers, condensers and spark gaps.

In the construction of coils and resonators of this type the primary is placed over the secondary and is about twice the diameter of the secondary. Only one layer of wire is used on the primary, the number of turns being from five to fifteen according to size of coil and number of wire.

For the primary frame cut out of one-inch hardwood material four circular rings two feet in diameter and two inches wide. Glue these together so as to form the end pieces (A) and (B), Fig. 1. Make sixteen pieces 1 by 1 inch, in cross section and twelve inches long. These are shown by (D), Fig. 1. Fit these into recesses extending through the two inside layers of (A) and (B) and glue. This forms a cage or drum on which to wind the primary wire. Into the center of the cage fix by means of pegs a circular block (C), two inches thick and with a circular opening in the center twelve inches in diameter. This block is to hold the secondary in place inside the primary. Give the cage two coatings of oil shellac and a coating of some good stain or varnish. When dry wind on the cage twelve turns of No. 4 hard drawn bare copper wire, spacing the turns evenly apart.

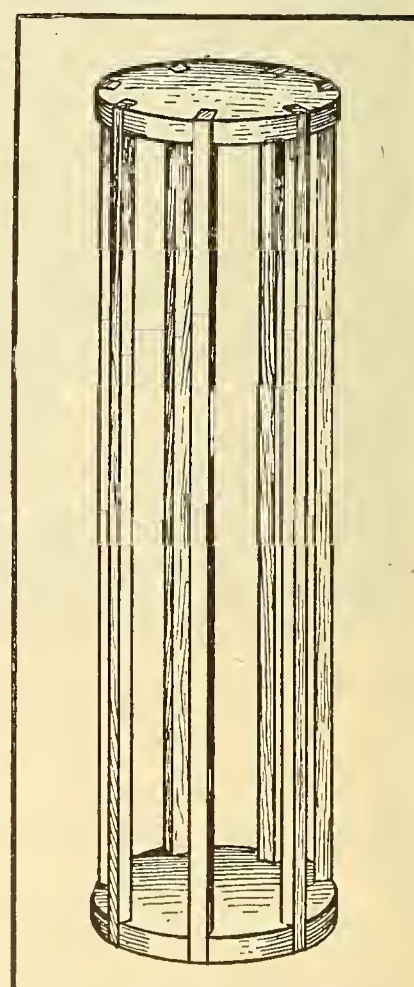


FIG. 2. SECONDARY CAGE

For the secondary make another cage 11½ inches in diameter and 50 inches long. The end pieces can be made solid and of 1⅛-inch material. The cross pieces or ribs should be 1 by 1 inches and are glued and fitted into the end pieces with the edges flush. About ten should be used. Fig. 2 shows the complete secondary cage. Give the cage two or three coats of shellac and when dry wind on several layers of leatheroid or heavily paraffined paper so as to form a stiff drum on which to wind the secondary wire.

In the center of the end pieces bore ¾-inch holes and suspend the drum by an iron rod run through these. Wind on

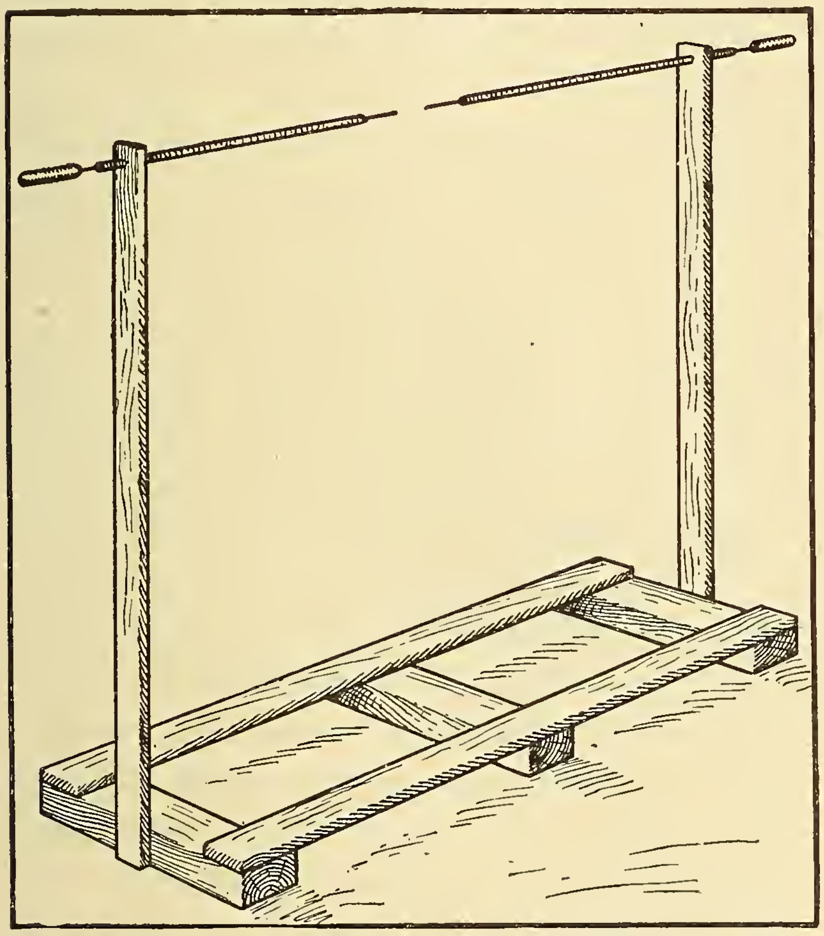


FIG. 3. BASE FOR COIL AND SUPPORTS FOR SPARK GAP

the drum 800 or 900 turns of No. 24 D. C. C. magnet wire, about five pounds will be required. Space the turns by winding in at the same time a layer of ordinary twine. When wound give the whole several coatings of shellac or micalac.

For the Tesla coil the primary should be fitted over the secondary and concentric with it. No nails or screws should be used in the construction of either the primary or secondary. The base can be made of three pieces of two by four 30 inches long and held in place by two pieces 3 by 1 inch, 50 inches long, nailed to these (see Fig. 3). To this base two uprights 3 by 1 inch, 61 inches long, are screwed and in the center of these the secondary (supporting the primary) is fastened by screws. The spark-gap is placed above the coil and is made of brass rods ¼ inch in diameter and 2½ feet long and supported by brass tubes two inches long fitted into the uprights and allowing the rods to slide freely. The ends should be filed to a sharp point, and hard rubber rods ¾ by 6 inches long should be used for handles.

The resonator is of the Oudin type. Its construction is the same as the Tesla coil except that the circular block (C) in the primary may be omitted. The secondary is placed in a vertical position and the primary at the bottom and concentric with the secondary. Instead of a spark gap of a ⅜-inch brass rod screwed into a 3-inch brass ball is used as the terminal, one end of the secondary being connected to the rod. Resonators of this kind are known as the unipolar type, the ground being used as the other terminal when two are necessary.

Fig. 4 shows the method of connecting the Tesla coil, the connections for the resonator being the same except that the bottom turn of the secondary is connected to the bottom turn of the primary and this grounded. Fig. 5 shows the resonator nearly completed.

The transformer used should give a secondary voltage of from 10,000 to 20,000, and the condenser of the best size

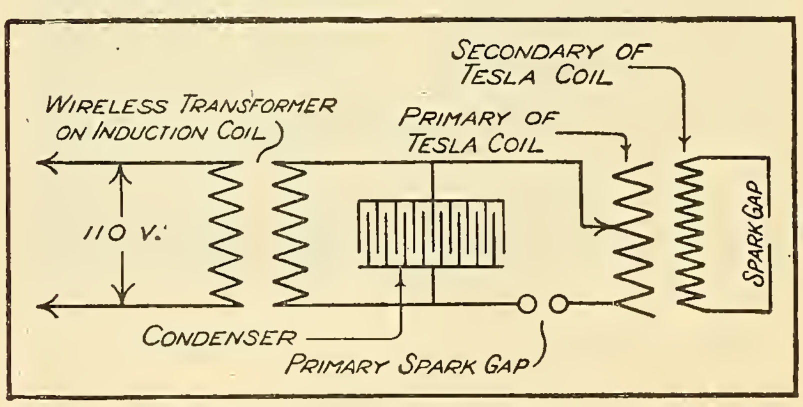


FIG. 4. METHOD OF CONNECTING TESLA COIL

suited for the transformer. The surface of the spark gap should be rather small, ½ or ¾ inch in diameter and some means should be used to keep it cool. It is preferably made of zinc disks.

The coil or resonator should be in tune with the other apparatus and this may be accomplished by varying the number of plates or sections in the condenser and the number of turns of wire in the primary of the coil or resonator. It is best in tune when the longest sparks can be obtained from the secondary. The primary spark gap should also be carefully regulated to give the best results.

When working properly with a one to 1½ K. W. transformer, etc., the sparks should be 30 to 36 inches long for the Tesla coil and somewhat shorter for the resonator.

The frequency varies considerably according to the capacity of the condenser and the number of turns of wire used in the primary. Using a condenser of .12 M. F. capacity it varies from 225,000 to

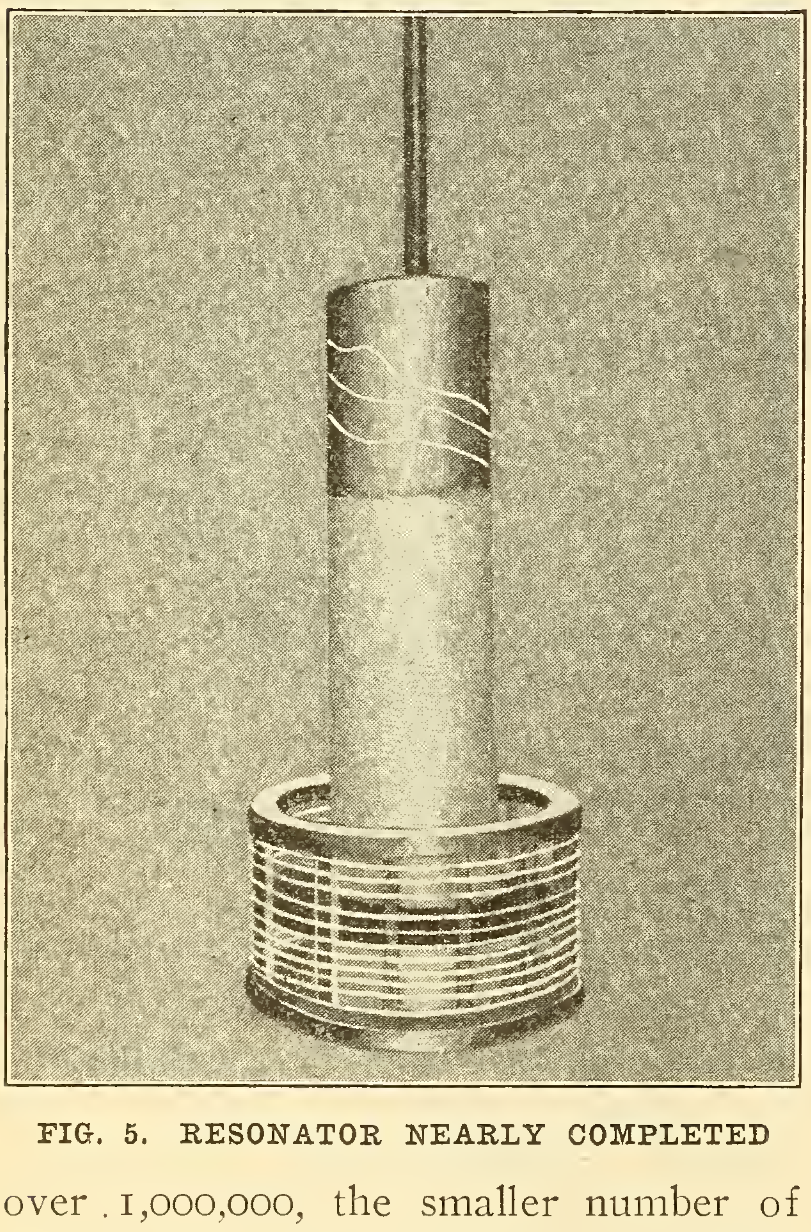


FIG. 5. RESONATOR NEARLY COMPLETED

over 1,000,000, the smaller number of turns used in the primary the greater the frequency. The voltage is difficult to calculate but runs up to about three-quarters of a million when working full force.

The above coil or resonator can be used with large induction coils (12 to 24 inch sparks) and even small ones sometimes give good results. The author has obtained sparks over 10 inches long by using a 2½ inch coil and a good electrolytic interrupter, and using about six to eight amperes on 110 volts in the primary circuit.

Smaller coils and resonators may be made for induction coils and ¼ to ½ K. W. transformers by making the secondary about four times as long as its diameter, and the primary twice the diameter of the secondary. The wire should be about No. 8 for the primary and No. 24 to 28 for the secondary. In resonators for small transformers and coils the length of the secondary should be about three to three and one-half times its diameter and the primary twice the size of the secondary. The wire in the primary should be about No. 8 and that in the secondary No. 28 to 32. However, the size of the wire makes little difference in either Tesla coil or resonator if not too small in the primary and if the instruments are tuned to resonance.

All the ordinary experiments can be performed with these coils and resonators and with the larger ones a great many uses will suggest themselves, and at present many of them are being used for research work in place of large induction coils.

New Wireless Telephone Tests

A test of the wireless telephone invented by Bernays Johnson, of St. Louis, in southern Illinois mines prophesies its eventual adoption for such work. Mining men and engineers who were present at a recent demonstration marveled at the accomplishment of the boy inventor. Although details of the system are not yet available, some of the remarkable results obtained will be of interest.

Mr. Johnson drove two rods attached to his instrument into a ledge 200 feet below ground, threw a switch to ring a bell in the offices of the mining company and a moment later talked with the superintendent. Then, proceeding into the mine half a mile, he dropped one of the rods into a puddle of water, pounded the other into the wall and again rang the bell. Engineers who conversed with him from the other end voiced their admiration for the simplicity of the telephone.

The test was significant in many respects. It showed that by using his special magnetic system Johnson has overcome the interference of minerals, and that dampness, instead of hindering, assists in the operation of the apparatus. The most interesting feature to the miners though, was the automatic talking-back-and-forth arrangement, which supplants the obsolete method of throwing one switch to transmit and another to receive, as was necessary in earlier types. The voice resounded almost as strongly as from a wire instrument and clearer, the "buzz" being eliminated..

The loud bell ringing which Johnson produced, even at great distances, pleased the inventor best, inasmuch as he was somewhat doubtful before the test. The inventor showed how he can ring selectively any of several hundred boxes from any telephone on the system. In this connection it must be remembered that with the wireless no central operator is needed. Under the mining law, however, selective ringing will not be permitted, the code making party systems compulsory.

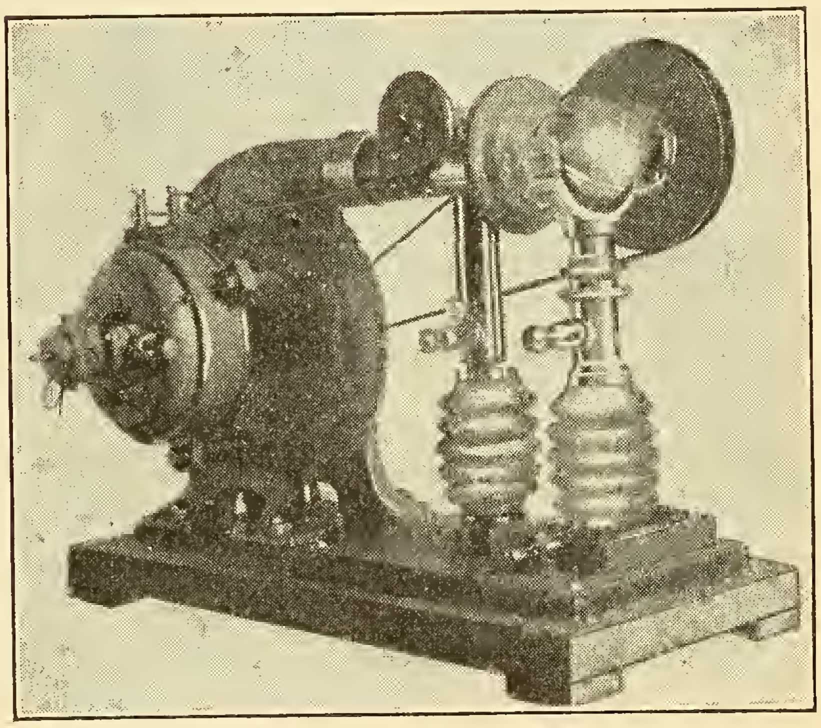
Mr. Joseph Lumaghi, mine owner, who asked the test, was pleased with the showing. He pointed out that the wireless telephone now nearing perfection will do away with wires so troublesome in the mining industry, for when attached to the walls often tumble with the slate at a critical moment, or when strung along the floor are tramped on and broken when needed worst.

Bernays Johnson is now 18 years old. In 1910 he was awarded the gold medal and diploma at the International Exposition held at San Antonio, Tex. Within a short time he will hold 200 basic patents in the various countries of the world.

GROVER REESE.

Revolving Spark Gap

A new spark producer has been brought out by the Paris firm of Ducretet and Roger. What is novel about it is that a metal ball is rotated by an electric motor, and it lies across the mouth of a metal cylinder which rotates at the same time. The spark passes across between the ball and cylinder, but is split up into numerous small sparks and the surfaces are



REVOLVING SPARK GAP

always renewed so that there is little danger that the metal will be worn by the sparks. A strong air draught is driven by a fan so as to pass through the gap. This prevents an electric arc from being formed here, which would be bad for the working of the apparatus.

College News by Wireless

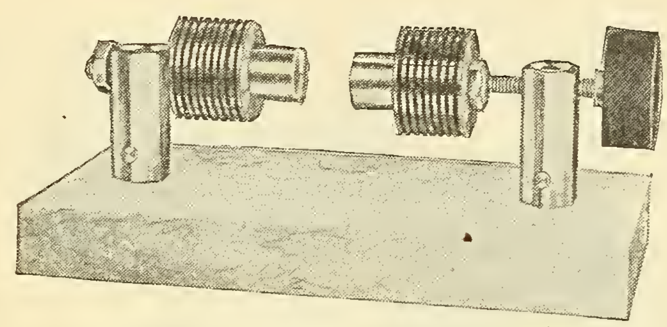
Few college papers are able to pay for telegraphic news service from other colleges, and so the electrical engineering department of the University of Michigan is organizing a college press service to exchange the news of all the universities by wireless.

The engineering department of each college is to erect its own station and by a system of relaying the messages to provide a medium for the free exchange of news for the benefit of the student publications from coast to coast.

Self Cooled Spark Gap

In order to insure the sustained high operating efficiency of a wireless telegraph transmitting outfit, the electrodes of the spark gap or "oscillator" must be kept as cool as possible.

A spark between hot electrodes will arc and cause the received signals to sound "mushy." In operators' parlance, it is impossible to "copy fast stuff" unless the spark sounds sharp and rings clear in the receivers.



SELF COOLED SPARK GAP

The electrodes of the spark gap may be cooled by air blast or by the use of radiator disks. The latter method, which has gained considerable favor commercially, incorporates the principle of self cooling embodied in gas engine designs in which iron rings encircle the cylinders. The greater area of the rings dissipates heat much more rapidly than could the cylinder alone.

The accompanying illustration shows a Worts-McKisson gap of the radiator type. The relative efficiency of the self-cooled over the non-cooled gap may be ascertained quantitatively by operating the spark continuously with and without radiator disks and noting the results in miliamperes on the hot wire meter.

The cooling system of the above gap was designed primarily for the heat developed in a three kilowatt discharge, although the manufacturers claim that it may be operated successfully on higher power, due to allowance for overload.

Questions and Answers on Wireless

By A. B. COLE

ELECTRO-MAGNETIC WAVES

1. Describe a simple system for the generation of electric waves, as used in wireless telegraphy.

A simple system is illustrated in Fig. 1, where (LJ) represents a leyden jar, or condenser, and (SG) represents a spark gap. If the condenser is charged to a certain potential by means of a static machine, an induction coil, or otherwise, a spark will pass between the spark gap terminals. The passage of the spark sets up electric waves which include greater and greater areas as they travel away from (SG), and become proportionately weaker, as shown diagrammatically by the current lines in the figure.

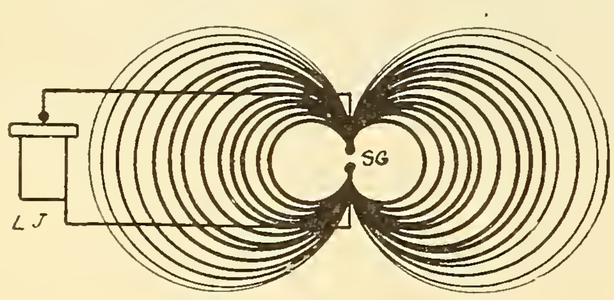


FIG. 1. SIMPLE SYSTEM OF WAVE GENERATION

2. Describe a more efficient system for the generation of these waves.

A more efficient radiation system is shown in Fig. 2. In this case the lower end of a vertical wire (A) is connected to one spark gap terminal, and the other terminal is connected to the earth (G), or is "grounded." An inclined or a horizontal wire may replace the vertical wire, but neither of these is as an effective radiator of energy for our purpose. All these forms are, however, used in practice, and are known as "aerial wires," "antennae," or simply "aerials." Aerials will be more fully discussed in answer to later questions.

A close examination of Fig. 3 will show that the aerial, the ground, and the air between the aerial and the ground, constitute a condenser. Thus, if we

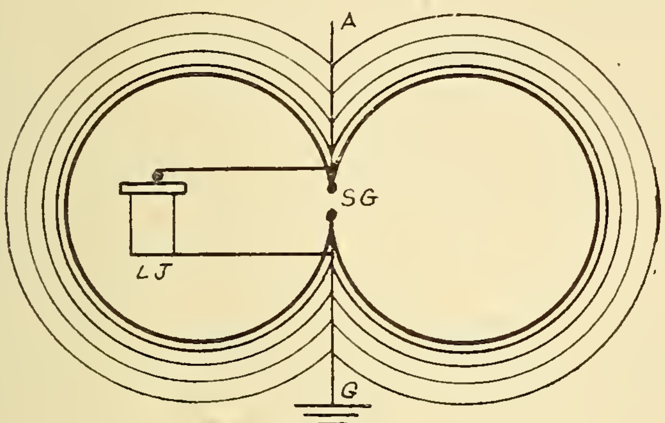


FIG. 2. MORE EFFICIENT RADIATION SYSTEM

connect the terminals of a static machine or an induction coil to the terminals of the spark gap (SG), and charge the aerial system to a certain potential, called a critical potential for the spark gap length we are using, a spark will pass be-

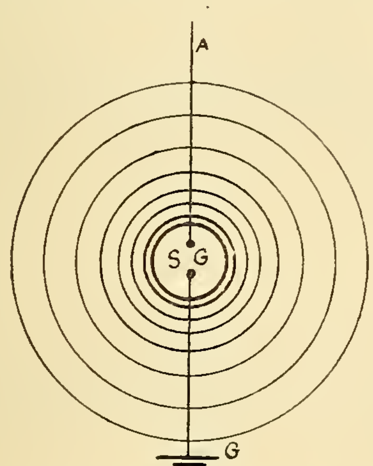


FIG. 3. THEORY OF WAVE RADIATION

tween the spark gap terminals, and electric waves will be radiated into space by the aerial system.

3. *How far will these electric waves travel in one second of time?*

About 186,000 miles; in other words, at the velocity of light.

4. *What effect have metallic or other conducting objects on the passage of electric waves?*

Such objects absorb the waves to a greater or less degree, depending on their size and electrical conductivity. The energy absorbed is probably converted into heat. An example of this absorption is the fact that signals from ships several hundred miles away from a certain commercial wireless telegraph station in New York City becomes stronger as these ships approach the station, but as they pass under the Brooklyn bridge, less than a mile away from this station, the signals become so faint that they sometimes cannot be heard at all. No doubt the steel structure of the bridge, which is of course grounded, acts as an aerial and absorbs the greater part of the energy transmitted by the ship stations as they pass beneath.

5. *What is resonance?*

Resonance may be explained by the following experiment: If two tuning forks which are capable of emitting the same note, are placed within ten or fifteen feet of each other, and one is set in vibration, it will be found that the other soon begins to vibrate and to emit the same note as the first. Electrical resonance is analogous to this mechanical resonance.

6. *What is "tuning?"*

Tuning consists in bringing two electrical circuits into resonance. Each wireless station has a certain "transmitting" wave length, which is the resultant of all the wave lengths to which the different transmitting instruments will respond as they are connected in the set. In commercial wireless stations this transmitting wave length is that wave length at which the station will have the greatest efficiency, and once found it is seldom changed.

If we have a receiving station at a distance, we will receive the greatest quantity of energy per second if this station is in "tune," or resonance with the transmitting station, that is, if it will respond to the same wave length as that used by the transmitting station. (Note the analogy of the tuning forks, question 5.)

Our object, therefore, is to cause the receiving apparatus to respond to this wave length. We may increase the wave length to which the set will respond by either increasing the inductance in the circuit of the aerial, tuning coil and ground, or else increasing the capacity in this circuit. In practice we tune approximately by varying the inductance, and then tune accurately by varying the capacity. Inductance is varied by a variable inductance or "tuning" coil, and capacity is varied by means of a variable condenser.

7. *How is a transmitting station "tuned up?"*

The remarks of the answer to Question 6 apply equally well to this process. Fig. 4 shows a simple transmitting circuit.

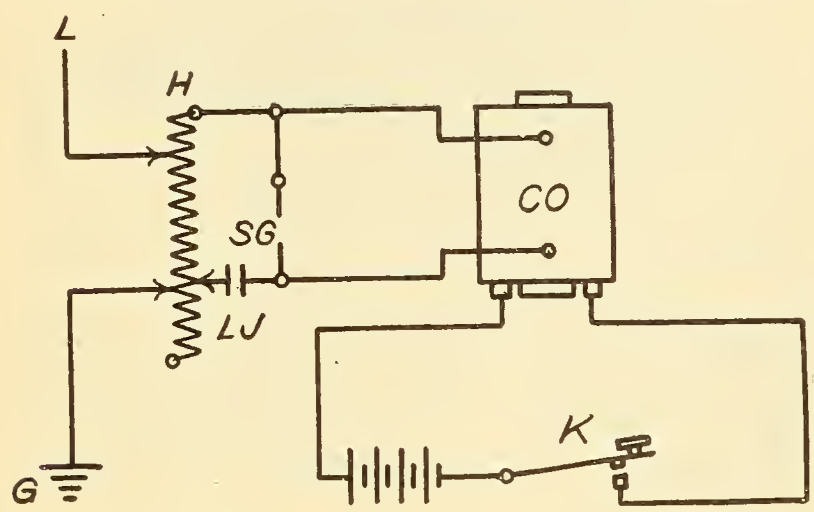


FIG. 4. SIMPLE TRANSMITTING CIRCUIT

The aerial is represented by (L), (G) is the ground, (SG) the spark gap, (H) the tuning coil, (CO) the spark coil, and (LJ) the condenser. We have here two separate circuits: First, the aerial, tuning coil, ground circuit; and second, the spark gap, tuning coil, condenser circuit. We use a condenser of sufficient capacity to give a blue spark, giving a crashing sound. A hot wire ammeter is connected in series with the aerial, and the variable contact points are moved along the turns of the tuning coil until the ammeter shows a maximum reading. When this occurs, the two above mentioned circuits are in resonance or "tune," and the greatest quantity of current is being radiated from the aerial per second.

8. *In what direction do electric waves leave the aerial?*

Electromagnetic waves are believed to be composed of two factors—the electric, and the magnetic. Both are radiated in directions perpendicular to the aerial. The electric component is the one used in most wireless systems of the present time.

9. *What is a "damped" wave?*

When a simple set is connected as shown in Fig. 1, and the leyden jar is charged to a critical potential for the spark gap, a spark passes between the spark terminals. Although this seems to be a single spark, it is in reality composed of a series of sparks. Fig. 5 shows what happens at this moment. If we let the line (VV) be the line of potential of "A," one spark terminal, with respect to "B," and let the other spark terminal and (OX) represent duration of time, it will be seen that the difference of potential starts to increase as the aerial becomes charged, and continues to increase until it reaches the critical value of the spark gap length employed, which value is represented by the point (C). The potential of "A" then drops suddenly as the spark passes, until the potential is negative with respect to that of "B." Then the relative potentials of "A" and "B" change again so that "A" is once more positive with respect to "B." This

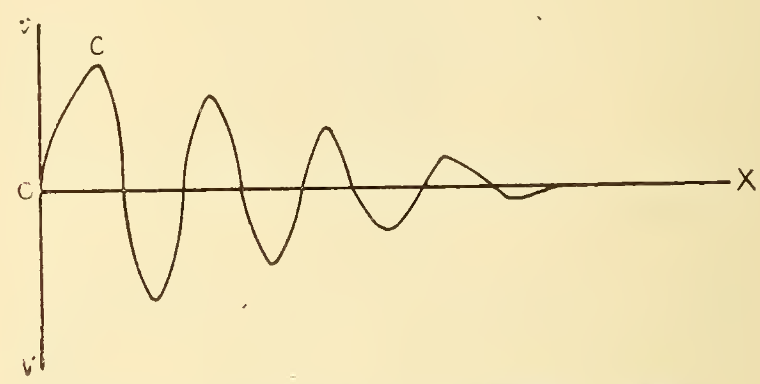


FIG. 5. CURVE OF A DAMPED WAVE

process continues, the points of maximum potential constantly coming nearer together, until the system comes to rest. Then another spark passes across the gap, and the same process is repeated. Fig. 5 illustrates a system in which the energy is strongly "damped," that is, the system comes to rest in a very short time after the spark passes.

10. *What are the main causes of "damping"?*

Resistance in the aerial and in the wires connecting the various instruments, the sudden throwing of all the energy into the aerial, and the radiation of the energy in a short time with respect to the interval between sparks.

11. *What type of wireless telegraph systems produces damped waves?*

The waves radiated by all systems in which a spark from a coil or transformer is used in connection with an ordinary spark gap to start the oscillations in the aerial system, are more or less damped.

12. *What is the main disadvantage of a damped system?*

A damped system radiates many different wave lengths, most of which may be combined to produce a resultant wave length, but more often there are two resultant waves emitted by a damped station. Since there are so many factors in the main wave length we cannot tune to all, although we can tune approximately to the resultants. Therefore, we cannot receive all the energy represented by the various waves, and consequently the receiving range will be decreased. Moreover, if another station is working on one of the component wave lengths of our station, the energy represented by this wave will interfere with the working of the other station.

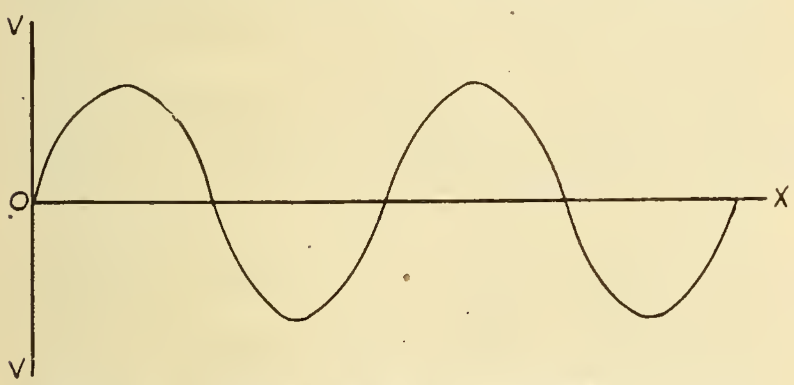


FIG. 6. CURVE OF AN UNDAMPED WAVE

13. *What is an "undamped" wave?*

This type of wave is produced by a system in which the oscillations when once started, continue indefinitely. In such a system the resistance of the aerial and the wires connecting the various instruments is zero, and the energy is supplied to the aerial as fast as it is radiated. In practice the resistances cannot be zero, but are made to approach as nearly as possible to this value, with the result of producing a nearly undamped wave. Fig. 6 shows the properties of an undamped system.

14. *What types of wireless telegraph systems produce nearly undamped waves?*

The arc and the singing spark systems, if properly constructed and operated, will do this.

15. *What advantage and disadvantage has an "undamped" system over a "damped" one?*

The advantage of close tuning, and the disadvantage of difficulty of regulation. The arc systems must be so constructed that very close regulation of the current supplied to the arc and very close adjustment of the circuits are possible, and the spark gap must be well cooled. The relations between the various instruments of a singing spark system must also be capable of close regulation, but when once properly adjusted it is easier to obtain good results with the latter systems than with the former.

16. *What is "static," and how can its effects be eliminated?*

At certain times the atmosphere becomes filled with electrical charges, and this is particularly the case previous to a thunderstorm. Particles bearing charges are continually moving about, and when two of opposite sign approach sufficiently near, a small spark or discharge occurs between them, and the charges are thereby neutralized. Each such discharge is a source of electromagnetic waves, which affect wireless apparatus, producing a click in the telephone receivers. These discharges are known as "static."

Static is a source of great annoyance to wireless operators, and at times it becomes so severe as to produce a steady series of clicks in the receivers. At such times it is almost impossible to receive over long distances, since the clicks effectually prevent the operator hearing faint signals. In tropical countries the static is very severe, often reducing the operating distance to a small fraction of that possible with the same equipment in countries of temperate or cool climate. Several inventors have claimed the production of static preventers, but none is in universal use today.

17. *How does sunlight affect the transmission of energy by means of electrical oscillations?*

Sunlight seems to absorb electrical oscillations. Signals can be sent considerably greater distances at night than in the day time.

DIRECTORY OF WIRELESS CLUBS

This directory of amateur wireless clubs and associations will be published each month. When a new club is formed the names of the officers, also the street address of the secretary, should be forwarded to us at once. Any changes that should be made in the directory, when designated by an official of a club, will be made in the next issue, after receipt of such advice.

Amateur Experimental Wireless Association.—David Kirk, President; Cornelius Hobbs, Vice President and Librarian; Lewis Kobie, Spokane, Wash., Secretary and Treasurer.

Allegheny County (Pa.) Wireless Association.—Arthur O. Davis, President; Theodore D. Richardson, Vice President; James Seamon, Leetsdale, Pa., Secretary and Treasurer.

Amateur Wireless Association of Schenectady, N. Y.—L. Uphoff, President; L. Beebe, Vice President; L. Pohlman, Treasurer; D. F. Crawford, 405 Lennox Rd., Schenectady, N. Y., Secretary.

Bridgeton (N. J.) Wireless Club.—Joseph P. Cox, President; Arthur Riley, Vice President; S. B. Ashmead, 275 Bank St., Bridgeton, N. J., Secretary and Treasurer.

Bronx (New York City) Wireless Association.—500 East 165th St., New York City.

Chicago Wireless Club.—R. C. Dickson, President; John Hair, Vice President; H. S. Ayers, Treasurer; Seldon Stebbins, Recording Secretary; E. W. Muellner, 6603 Langley Ave., Chicago, Ill., Corresponding Secretary.

Central California Wireless Association.—G. DeYoung, President; B. K. Leach, 860 Callish St., Fresno, Cal., Secretary.

Cincinnati Wireless Signal Club.—A. J. Lyons, President; E. D. Achor, Vice President; J. L. Anderson, 1839 Hopkins St., Cincinnati, O., Secretary and Treasurer.

East Buffalo Wireless Club.—Bernhardt M. Zeufle, President; Arthur H. Benzec, 701 Walden Ave., Buffalo, N. Y., Secretary and Treasurer.

Gramercy Wireless Club.—Walter Merrill, 121 E. 103d St., New York, N. Y., Secretary.

Guilford County (N. C.) Wireless Association.—Hermon Cone, President; Ralph Lewis, Vice President; Robins Tilden, Treasurer; Theodore Mans, Greensboro, N. C., Secretary.

Hartford (Conn.) Wireless Association.—P. S. Southworth, President; W. I. Hickmott, Treasurer; H. E. Chapman, 320 Wethersfield Ave., Hartford, Conn., Secretary.

Haverhill (Mass.) Wireless Association.—Wilfred Vigneault, President; Riedel G. Sprague, Vice President; Leon R. Westbrook, Haverhill, Mass., Secretary.

Hannibal (Mo.) Amateur Wireless Club.—Charles A. Cruickshank, President; J. C. Rowland, Vice President; William Nouse, Treasurer; G. G. Owens, 1306 Hill St., Hannibal, Mo., Secretary.

Inter-Mountain Wireless Association.—E. L. Bourne, President; D. McNichol, Secretary; J. G. McCullom, 219-5 East St., Salt Lake City, Treasurer.

Manchester (N. H.) Radio Club.—Earl D. F. McKewin, President; Clarence Campbell, Vice President; Earle Freeman, 759 Pine St., Manchester, N. H., Secretary and Treasurer.

Progressive Wireless Club.—George Holt, President; Silas Pace, Vice President; T. E. Story, Poplar Bluff, Mo., Secretary and Treasurer.

Rockland County (N. Y.) Wireless Association.—W. F. Crosby, President; E. B. Van Houten, Vice President; C. Tucker, Secretary; V. N. Giles, South Broadway, Nyack, N. Y., Corresponding Secretary.

Roslindale (Mass.) Wireless Association.—O. Gilus, President; E. T. McKay, Treasurer; Fred C. Fruth, 962 South St., Roslindale, Mass., Secretary.

Rochester (N. Y.) Wireless Association.—Edward T. Eastman, President; Merritt D. Mosher, Vice President; Lawrence Hickson, Treasurer; Arthur F. Wright, Secretary; Floyd E. Wright, Rochester, N. Y., Corresponding Secretary.

Springfield (Mass.) Wireless Association.—A. C. Gravel, President; C. K. Seely, Vice President and Treasurer; D. W. Martenson, 323 King St., Springfield, Mass., Secretary.

Sacramento Wireless Signal Club.—F. Strader, President; L. C. Huber, Vice President; G. B. Vard, Treasurer; E. Ratcliffe, 2119 H St., Sacramento, Cal., Secretary.

Southern Wireless Association.—B. M. Oppenheim, President; J. Fishel, 1435 Henry Clay Ave., New Orleans, La., Secretary and Treasurer.

Tri-State Wireless Association.—C. B. DeLa-Hunt, President; O. F. Lyons, Vice President; T. J. Daily, Treasurer; C. T. Cowan, Memphis, Tenn., Secretary.

Westchester (N. Y.) Wireless Association.—Stanley R. Maning, President; E. D. Moorhouse, 37 W. Main St., Tarrytown, N. Y., Secretary.

Wireless Association of Montana.—Roy Tysel, President; Elliot Gillie, Vice President; Harold Satter, 309 S. Ohio St., Butte, Mont., Secretary.

Wireless Club of Baltimore.—Harry Richards, President; William Pules, Vice President; Curtis Garret, Treasurer; Winters Jones, 728 N. Monroe St., Baltimore, Md., Secretary.

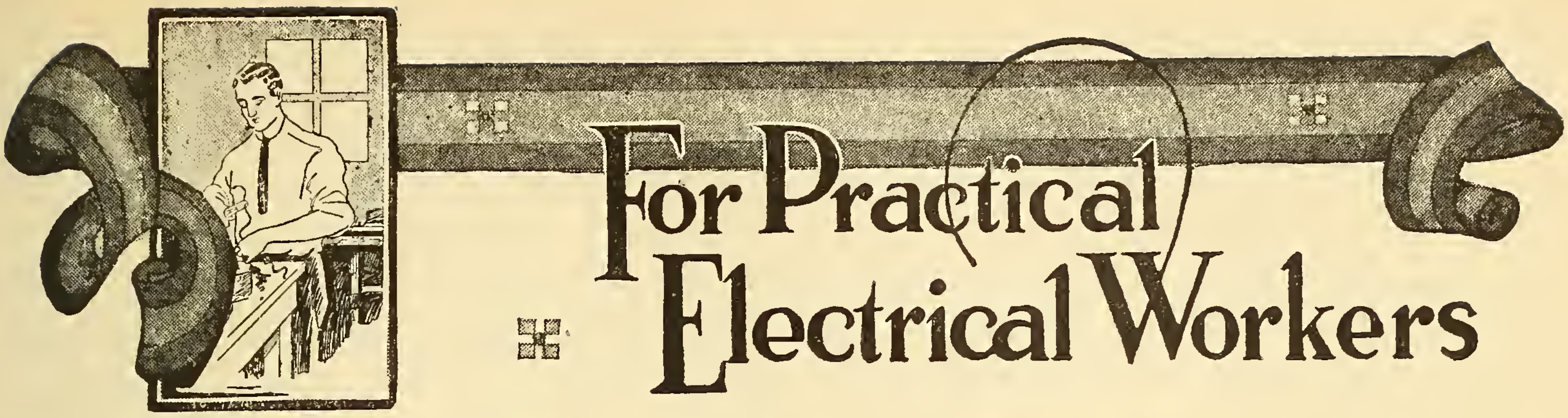
Waynesburg (Pa.) College Wireless Club.—C. W. Frietage, President; James D. Thomas, Chief Engineer; John Meighn, Waynesburg, College, Pa., Secretary.

Winnipeg (Manitoba) Wireless Association.—Alex Polson, President; Stewart Scorer, Vice President; Howard Pratt, Suite 5, Columbia Block, Winnipeg, Manitoba, Canada, Secretary and Treasurer.

Wireless Association of Easton, Pa.—W. Ballentine, President; John Q. Adams, Vice President; Weikel Jordan, Treasurer; E. J. Sortor, Recording Secretary; James Smith, Jr., 123 North Main St., Phillipsburg, N. J., Corresponding Secretary.

Wireless Association of British Columbia.—Clifford C. Watson, President; J. Arnott, Vice President; A. H. Mackay, Secretary; C. Roesterer, 1934 William St., Vancouver, B. C., Corresponding Secretary.

Wireless Association of Vancouver, B. C.—Cliff C. Watson, President; J. Arnott, Vice President; R. C. Bodie, Treasurer; A. H. Mackay, Secretary; C. Riesterer, 1934 William St., Vancouver, B. C., Corresponding Secretary.



Simple Two Phase Apparatus

By PAUL H. WOODRUFF

Two phase alternating currents for experimental purposes are usually inaccessible to the amateur. The history and development of alternating current power transmission, than which there is no branch of electrical science more interesting, owes almost everything to the use of two phase circuits; and a demonstration of their peculiarities is well worth making.

The common telephone hand generator, delivering alternating current at 20 cycles at an armature speed of 1,200 revolutions per minute, is usually operated by means of a hand driven gear wheel and pinion of five to one ratio. The large gear is journaled in lugs which project from the brass cups which form the bearings for the armature shaft.

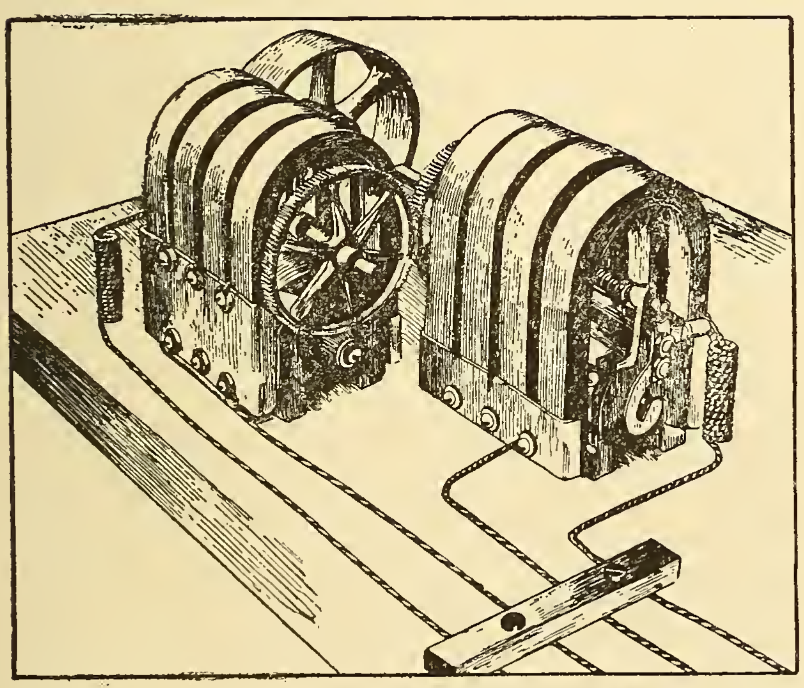


FIG. 1. A TWO PHASE GENERATOR FROM TELEPHONE MAGNETOS

Any two phase generator is virtually two generators, using generally the same field and armature core. Use is frequently made, however, of two distinct machines with their shafts coupled end to end so that their current impulses are ninety degrees apart. This is obviously the simplest arrangement, and is the principle, if not the construction, of the model shown in Fig. 1.

The baseboard for any hand driven apparatus should be large enough to enable the operator to hold it steady while driving; and as this generator offers a considerable resistance to turning, especially on short circuit, a good sized base is recommended. The block of wood on which the machines are mounted can well be almost a foot square. The two generators are fastened solidly to the base by means of screws through the lugs on their pole pieces. Their relative positions are such that their large gear wheels engage each other, the machines facing in opposite directions.

The end of the driving shaft on any of these magnetos is threaded to take a small crank. Instead of this crank, an extension shaft about six inches long is fitted to one of these threaded ends, the other end of the extension being journaled in a simple brass bearing of the correct height from the baseboard. This end of the shaft may carry a pulley for power drive, or may be fitted with a crank of somewhat larger dimensions than the one generally used for driving one generator.

When the proper adjustment has been made and the parts rigidly fastened to their base, turning the extension shaft will turn both armatures through their gears. The two phase adjustment is made by arranging the two armatures with their magnetic axes 90 degrees apart; that is, when one armature core has its iron faces in proximity to the field pole pieces, the other armature core is turned at right angles to it, with its windings facing the field. The two phase generator is now complete.

With this device we may repeat Ferranti's experiment with the copper cylinder, as shown in Fig. 2. Each rectangular coil consists of 40 turns of No. 22 magnet wire wound on a form three inches long and 1¾ inches wide, then slipped off the form and bound with thread to keep it in shape. The cylinder is a 2¾ inch length of 1½ inch brass tube. A slip of cork in its interior bears in its center a short piece of glass tube with its upper end sealed to act as a pivot. A long needle mounted point upward in a base supports the cylinder, leaving it free to rotate at the slightest impulse. The two rectangular coils are arranged at right angles and enclose the cylinder, the windings being separated slightly at the bottom to admit the needle without injuring the insulation. Using a four wire circuit, two wires are run from each generator to one of the coils. The cylinder rotates because the four alternating magnetic impulses of the two coils succeed each other about the cylinder; and the latter in trying to resist the drag of the currents induced in its metal body, itself revolves. Reversing the connections of one of the coils reverses the direction of rotation of the cylinder.

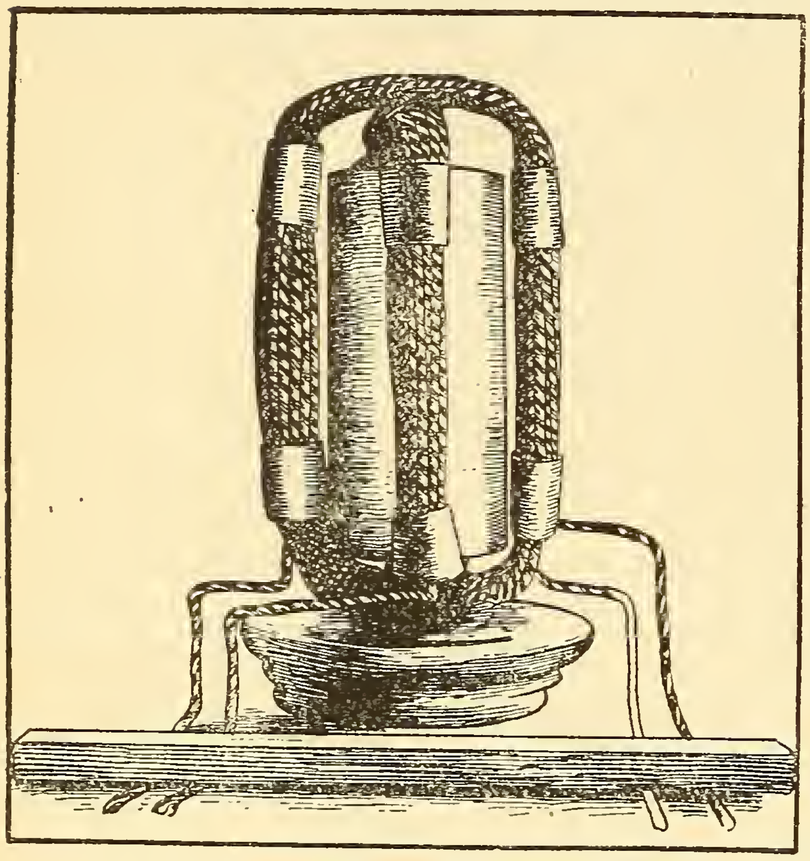


FIG. 2. FERRANTI'S EXPERIMENT

The metal frame of a telephone hand generator usually forms one of its terminals. By connecting one end of the coil windings together and running one wire from this point to the frame of the generator, we eliminate a wire and have a three wire, two phase circuit.

The familiar rotating field experiments of the early investigators are worth reproducing. A simple rotating field is made by mounting the four coils of two 80 ohm telephone ringers close together on an iron plate 1¾ inches square and 1-16 inch thick, opposite coils being connected in the usual way. A watch crystal laid on the ends of the four cores forms a convenient table. Small metal balls and light iron objects placed in the crystal will at once proceed to demonstrate the rotation of the magnetic field. Metallic objects suspended above the poles also illustrate the rotative tendency. A number of other experiments of this nature will occur to the observer.

From the rotating field experiment it is only a step to the model two phase induction motor. Indeed, we need only replace the watch crystal by a rotatable metal disk to have a self-starting motor. A simple way to suspend the disk is to center in it a slender shaft or spindle, pointed at the lower end and of such length that when this pointed end is pivoted in the center of the iron base of the rotating field, the disk just swings clear of the coil poles. A light strip of brass may then be bridged across from one pole to another, with a hole in the center in which the spindle of the disk will revolve freely.

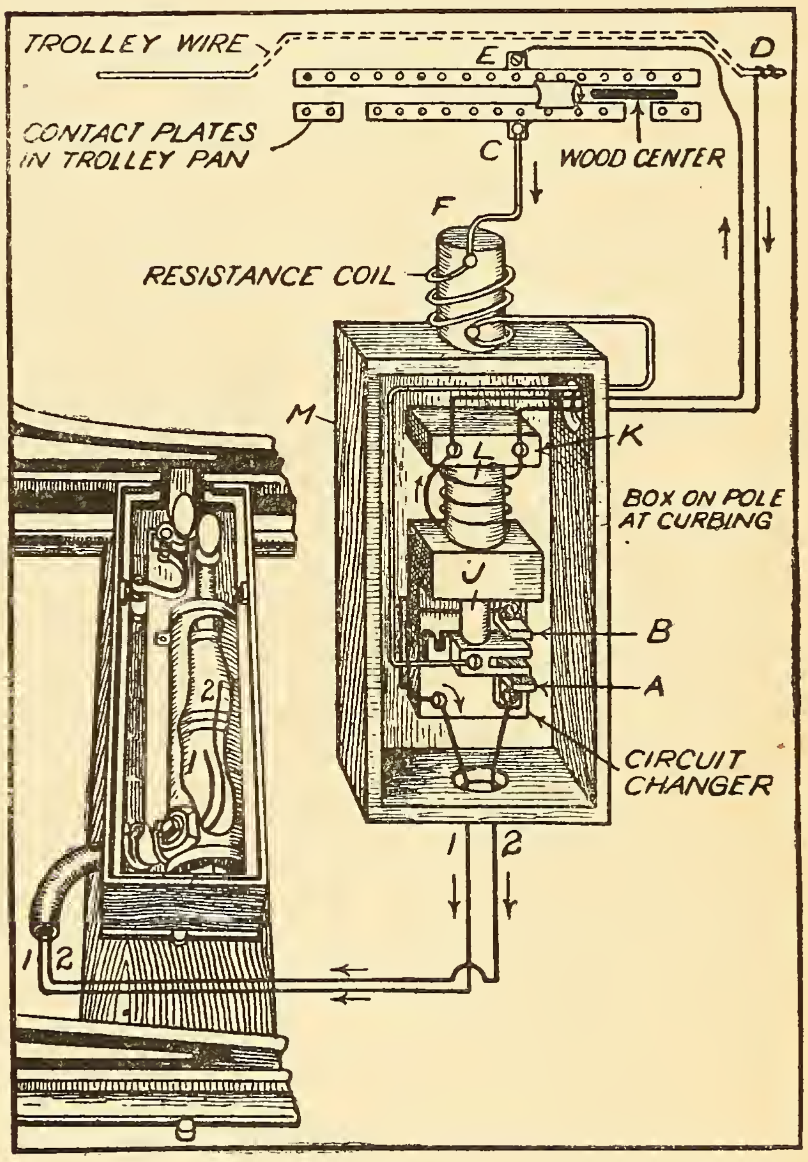
If something more pretentious is wanted in the way of a two phase induction motor model, the same field may be fitted with a Gramme ring armature. This is made by forming a ring of soft iron wire, with a cross section of about one-fourth inch and a diameter equal to the distance between the outer edges of two opposite pole pieces of the four pole field already described. This ring core is then wound toroidally with a layer of No. 22 cotton covered wire. At about eight equidistant points in the winding, loops are brought out, and these loops are subsequently bared and all connected together in the center. This may be mounted on a disk of wood, or even heavy cardboard, and arranged on a spindle as described for the plain disk.

How the Motorman Controls the Switch at Corners

You have often seen the conductor on a street car step off his car at a corner and lift a heavy iron lever at the side of the track when he wished to turn the corner instead of continuing on the straight track. When the automatic switch here illustrated has been installed the motorman now attends to this operation without leaving his position, by throwing the tongue in the track by solenoids and plungers which he controls electrically.

Upon the trolley wire is a metal trough or "pan" in which are metal and wooden strips over which the trolley wheel passes. The motorman "coasts" or in other words uses no current as his car and trolley pass the trolley pan if keeping the straight track. Should he use the current to run his car while the trolley passes through the pan the mechanism throws the tongue in the track for the curve. If an iron core is placed loosely part way inside a tube surrounded by a coil of wire or solenoid, the core will be drawn into the tube when current is turned into the coil. It is by such a device installed under the track that the switch tongue is moved.

The trolley pan consists of two strips of wood having their inner edges beveled and show with flat iron. The circuit changer is a solenoid magnet having a core armature that rests on plate (A) until magnetized sufficiently to lift it from (A) to (B). The trolley pan and circuit charger are connected by the dark wires from (D) and connect to terminal (K) of the solenoid, then leave terminal (L) and connect with flat iron strip



APPARATUS FOR MOVING A TRACK SWITCH FROM THE CAR

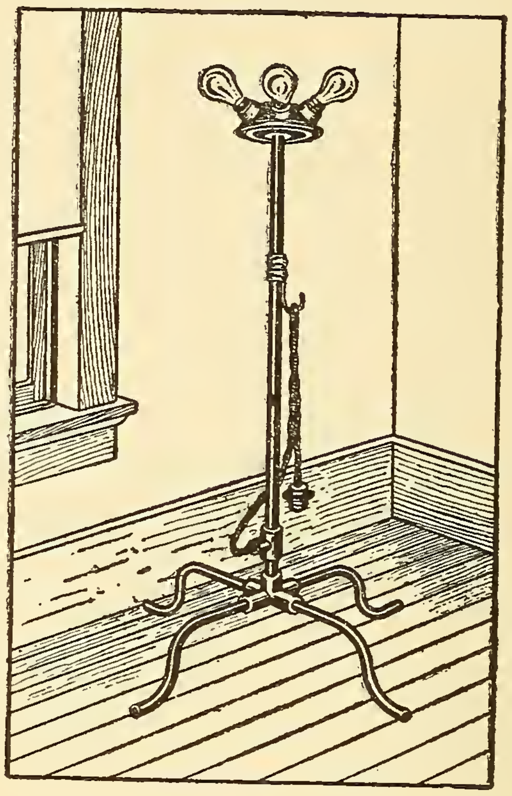
(E). The negative flat iron strip (C) is connected to the core armature (J) by the white wire from (C) and passes to the resistance coil (F). Suppose a car to be approaching with the motorman wishing to keep the straight track. He shuts the current off his car, allowing the car to run by its own momentum. When the trolley wheel reaches the contact block, it connects flat iron strips (E-C). Current passes from the trolley wire at (D) through solenoid (K-L) and comes back to contact strip (E), passes through the trolley wheel into contact strip (C) as indicated by arrows, then it goes down the white wire (C) to armature (J) through armature (J) to plate (A), to solenoid (2), and to ground, thus setting the tongue for straight track. In setting the tongue for the curve, the motorman keeps his current on while the trolley is passing under the pan. In this case the current, starting at (D), passes over the same route as in the first case until it leaves the armature (J) which is now in contact with plate (B), instead of (A), because the car is drawing current from flat iron (E) through solenoid (K-L). Instead of current going down plate (A) the current now passes from plate (B) to magnet (1) which sets the tongue for the curve.

The current that passed through the solenoid of the circuit changer in the first instance was only enough to supply ground magnet (2), but in the second instance flat iron (E) had to furnish ground magnet (1), also the current the car required. This heavier current, passing through the solenoid (K-L), caused the armature (J) to be lifted from post (A) to (B). If the track tongue is in the proper position for the motorman when he approaches, it makes no difference; he must operate just as he would were it not so.

F. G. Waldenfels.

A Portable Stand Lamp

A portable lamp stand is often most convenient and can be cheaply constructed in the following manner: Procure a screw attachment plug, some No. 18 reinforced cord and a four light cluster threaded for pipe. From a plumbing shop get 4½ feet of pipe to fit the cluster, a tee, a nipple two inches long, four nipples six inches long bent as shown in the cut, and a cross tee into which the four legs are screwed. The cord passes in through the tee and up the pipe to the cluster. A hook made of heavy wire may be fastened to the pipe to support the cord when not in use.



PORTABLE STAND LAMP

If a better appearance is desired enameled or brass pipe may be used.

Warren C. Thomas.

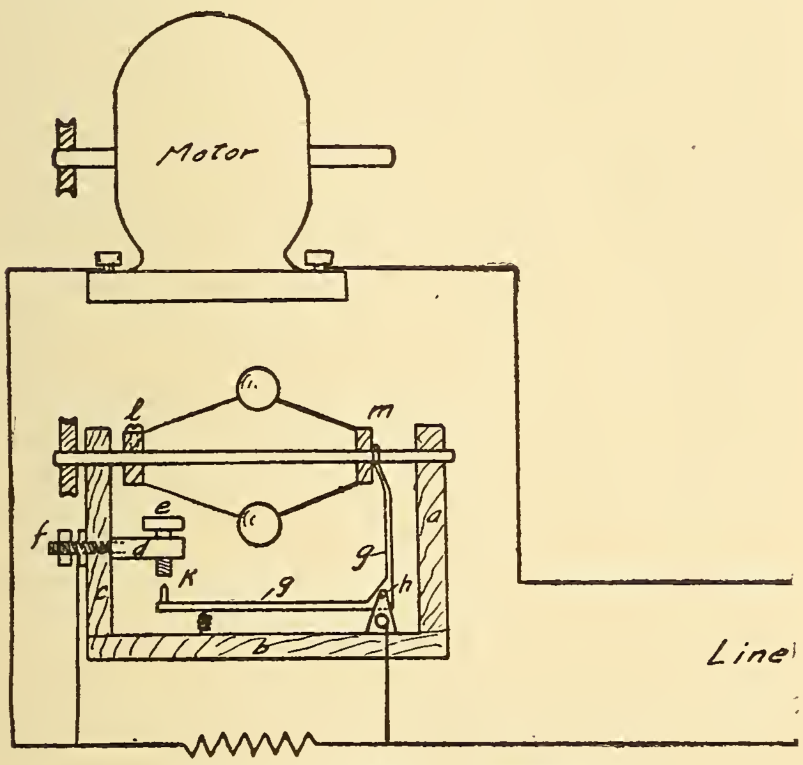
A Speed Governor for Motors

Often it is desirable to obtain very constant speed from a motor. Large motors having considerable angular momentum when revolving at full speed will operate at very constant speed if a constant voltage is applied and the load is not variable. Small differences in brush contacts, etc., will have no appreciable influence on the constancy of the speed of large motors owing to the magnitude of the angular momentum. This is not true of small motors. Chattering of brushes due to loose or badly designed holders and bits of dust or grease on the commutators will have considerable effect on the speed.

To obtain the desired constant speed a simple device such as is shown in the accompanying figure may be resorted to. A flyball governor is driven by a belt and pulley from the motor which is to be governed. The governor can be taken from some discarded apparatus such as a phonograph. Of course the size of the governor must not be too large for the motor. Common sense will dictate the choice.

The frame can be made of wood or other insulating material with brass bearings for the governor shaft. At (d) a metal plate is fastened to the frame. This holds an adjusting screw (e) and a binding post (f). The bell crank (g g) is pivoted at (h), and due to its weight it drops when the balls of the governor fly out at high speed. To make the action more positive a light spring may be attached to the horizontal portion of the crank (g).

The governor is shown in a position at a speed greater than desired. Normally the contact at (k) is closed, but when the speed becomes excessive the balls fly further apart, and as the governor is fastened rigidly to the shaft at (l) the end (m) moves toward the left and



MOTOR SPEED GOVERNOR

the contact (k) opens. When (k) is open a resistance is placed in series with the motor diminishing the current input and thereby the speed. The speed of the motor is determined within certain limits by means of the adjusting screw (e).

There are many possible arrangements of the parts shown in the diagram. The governing factors are the voltages of the motor and the line.

Under certain circumstances considerable sparking will be noticed at the contact (k), but by careful analysis this can be diminished to a very small amount. The arrangement shown in the diagram will cause little trouble due to sparking. If small motors are used with a potential of only a few volts the resistance may be dispensed with if the sparking is not sufficient to be objectionable. When operating, the contact at (k) is opened many times a minute so that good mechanical construction is necessary. This device has been used under several different circumstances and has been found to give remarkably constant speed with series motors. For governing shunt motors this device should be placed in the field circuit.

Analogies of Electrical Terms

BY DALE S. COLE

The term "Inductance" as used by technical writers and engineers carries with it a confused idea of what it really is and how and where it exists in the electric circuit. Perhaps the best way to understand a thing so as to retain it, is to form some mental or physical picture,—to compare it to something we do understand.

So, before trying to comprehend inductance it will be necessary to start at the bottom and add step by step the various points that are connected with it. In the first place, when an electric current flows in a wire we say there is a field set up around the conductor. This can be proven by cutting a hole in a piece of cardboard, drawing a wire through it and connecting the ends to some suitable source of current. On the card sprinkle some iron filings and distribute them as evenly as possible over the surface. Now turn on the current. The filings will arrange themselves in concentric circles around the conductor. Each little piece of iron becomes magnetized and assumes a certain position relative to the wire. This pertains more especially to the study of magnetism and will not be taken up here. Suffice it to say then, that there is a magnetic field around the wire as proven by this experiment. We can think of this as lines, closed circles, or better of whirls.

Let us now turn to the analogy suggested by Sir Oliver Lodge, which gives a very clear picture of inductance. Suppose these whirls surrounding the conductor possess inertia. Inertia is defined as that property of a body by virtue of which it tends to stay in its present state of rest or motion in a straight line unless acted upon by some outside force. These whirls, then, tend to continue in the same direction as long as the current is steady. They spin at the same rate of speed. Inertia effect does not come into play until there is some change. Reduce the current. These whirls tend to spin at the same rate of speed and due to their inertia they continue to do so for a slight period of time after the current is reduced. In this way they oppose the change in current. Their change lags behind the current change. Should the current rise they would oppose the change again and would lag as before.

Whenever we have a conductor cut by lines of force there is a voltage induced or set up. So, this change in the field surrounding the conductor is a cutting of the conductor by the lines of the field and hence voltage is induced. This voltage opposes the applied voltage or reacts upon it.

We have a similar reaction in the case of a heavy fly wheel. Suppose a heavy fly wheel to be revolving at a given speed. If the power is reduced the tendency will be for the system to slow down. Due to its inertia the wheel tends to revolve at the same speed and thus keep the shaft turning at that speed. Energy has been stored by virtue of the inertia, and this energy the wheel gives back to the system when the speed is reduced. The fly wheel lags behind the change. It opposes the change in the same way that the magnetic field does in the case above mentioned.

So conductors oppose changes of current by the generation of a counter or reverse voltage, and this reaction expressed numerically is called their "inductance." The name arises from "induced voltage." The unit of inductance is the henry. A circuit has an inductance of one henry when a counter voltage of one volt is induced by a change of one ampere per second. (Karapetoff Experimental Engineering.) It would be impossible to define the henry in simpler terms and embody all the ideas related to it. The meaning of volts and amperes we have taken up in a previous article.

Inductance differs from resistance in several ways. Resistance gives the same effect whether the current be steady or changing. Inductance is noticeable only when the current is changing. Resistance is due to friction of the molecules of the conductor. Inductance is due to the inertia of the field surrounding the conductor. Energy used in overcoming resistance is spent in heat. Energy applied for overcoming inductance is stored in the field. The shape of a conductor has no effect on resistance but effects inductance very greatly. The resistance of a wire is the same whether coiled or straight but the inductance of a coiled wire is much greater than that of a straight wire.

We have some inductance in all alternating current circuits, because the current is constantly changing.

Soldering Aluminum

Among the latest methods tried for soldering aluminum is one due to a Norwegian who cleanses the aluminum surfaces by immersion in an electrolytic bath and plates copper on them, after which he has no difficulty in soldering the coppered surfaces to each other. Offhand, this sounds like a complicated process, but the ease and speed with which electroplating can be done makes it comparatively simple and it may be one solution of the vexatious problem of joining pieces of aluminum.

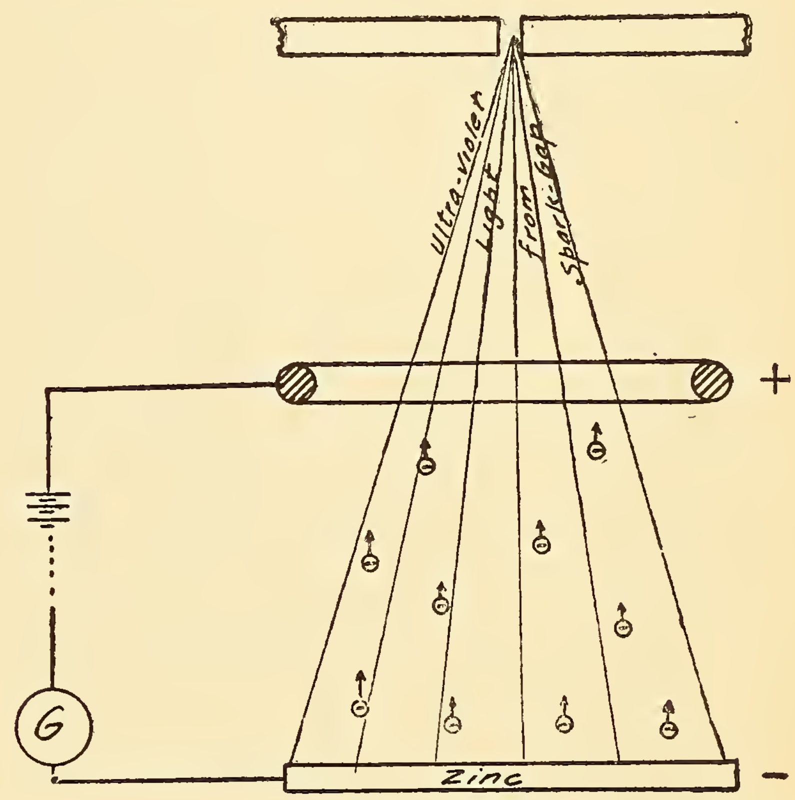
Photo-Electric Currents

One phenomenon which is going on almost everywhere, and of which most people are entirely unconscious, is the production of currents of electricity by the action of light. This is called photo-electric effect.

In 1887 Hertz, the scientist who was the first to produce electromagnetic waves which made wireless telegraphy possible, discovered that ultra-violet light when incident on a spark gap facilitated the passage of the spark. In other words a spark gap which was greater than the critical length at which a certain potential would break down the insulation of the medium between the points, would be easily broken down when ultra-violet light was allowed to fall on the gap. This discovery precipitated a great deal of investigation on the effect of light on charged bodies. It was proved by these experiments that a clean surface of a negatively charged piece of zinc rapidly loses its charge when exposed to ultra-violet light or even blue light. It might be well to define ultra-violet light as the radiation from luminous bodies which is invisible but which affects the photographic plate. It is sometimes called short wave energy because it is of shorter wave length than the visible rays. The loss of the negative charge on the zinc can only be explained in the light of modern knowledge by the fact that the negative electricity is actually expelled under the influence of light. If the plate is positively charged it will not lose its charge if proper precautions are taken.

Whether or not there are two kinds of electricity—positive and negative—it is sufficient to note that a negative charge on a body actually consists of many atoms of negative electricity which are called electrons. When the zinc plate was negatively charged there was an extra amount of negative electrons contained by the plate. The phenomenon can perhaps be best understood by reference to the diagram which is illustrative of the first method used in studying photo-electric effect.

The positive terminal of a source of 100 volts potential is connected to a ring shown in cross-section. The zinc plate is connected to the negative terminal. In series with the plates and the battery is the instrument (G) which must be able



APPARATUS FOR DETECTING PHOTO-ELECTRIC EFFECTS

to measure very small currents which are of the order of magnitude of .0000000001 ampere. This instrument is usually an electrometer. The source of ultra-violet light is a spark between iron or cadmium electrodes. An arrangement such as is used in wireless outfits will furnish the proper spark with iron or cadmium electrodes. The most accurate results are obtained in a vacuum because the complications due to the air otherwise present are avoided. In this case a quartz window must be provided owing to the fact that glass is opaque to ultra-violet light.

If negative electrons are expelled from the plate when the ultra-violet light falls on the zinc plate the little charged particles are immediately attracted to the positive ring and this constitutes a flow of current as is indicated by the instrument (G). A very small current flows even when the light source is screened from the plate owing to the natural leak-age. When the zinc plate is illuminated by the ultra-violet light the current flow is many times larger. If the battery terminals are reversed the zinc plate is positively charged. The action of light is to expel negative electrons, but owing to the fact that unlike charges attract each other the positively charged zinc plate prevents the escape of the negative particles.

This expulsion of negative electrons from metals takes place when X-rays are used instead of ultra-violet light, and when very refined measurements are made the expulsion of negative electricity can be discovered even in very faint light from any luminous source.

The phenomenon is, of course, very simple in appearance. However, all metals act differently and there are many conditions to be investigated. Zinc was chosen as an illustrative metal because it is very commonly employed in studying the phenomenon.

The experiment illustrated may seem to be of purely academic interest without any practical value, but it must be remembered that nearly 50 years elapsed before practical application was made of Faraday's epoch-making discoveries in electricity and magnetism. At present the study of photo-electric effect is assisting in formulating theories of matter and electricity, and who can predict what part this phenomenon will play in the future when perhaps all things will be done electrically and the present mysteries will be explained electrically.

Belting Small Motors

Sometimes it will be found that in driving machines with small motors by a belt the motor does not seem to be able to carry a load well within its normal rating. In that case see if the pulley of the motor is not too close to the pulley on the machine. If it is set too close the arc of contact between the belt and the motor pulley will be too small. Consequently the belt slips when the motor is heavily loaded. By increasing the distance between the center of the pulley on the motor and the center of pulley on the lathe, the arc of belt contact may be so increased that no further trouble will be experienced.

This point is always a good one to bear in mind in applying small motors. Too short belt centers mean that in order to prevent slippage the belt has to be very tight, which decreases the efficiency of transmission and brings a strain upon the bearings of the motor and possibly on the bearings of the device driven.

Cadmium in Connection with Voltmeter Readings

The question has been asked—How is cadmium used in connection with a voltmeter to take readings on a storage battery? The following explanation will be of interest:

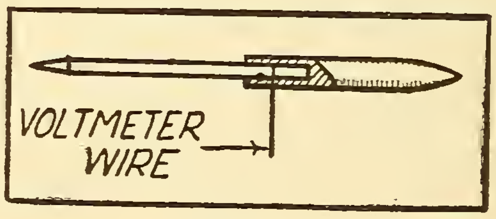


FIG. 1

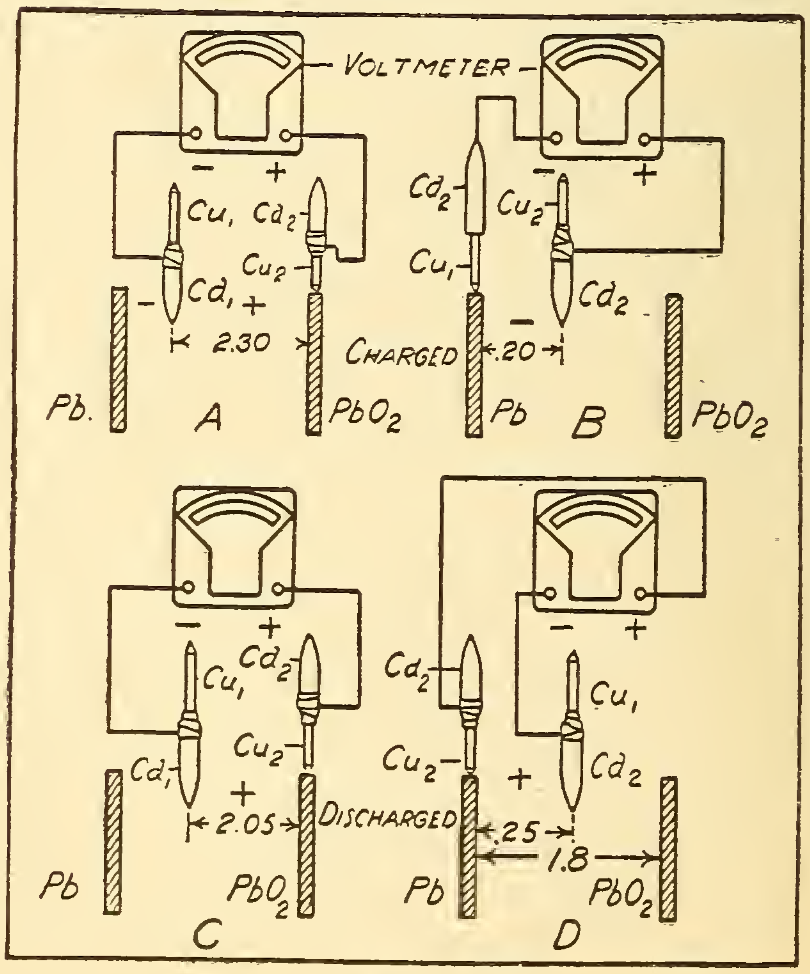


FIG. 2

In building new battery cells it is quite possible that the plates, although of the right color, may not be perfectly formed, and a reading taken across the cell plates though it gives the voltage between the plates, does not show the condition of each plate independently. To get this information a pair of cadmium contact pieces may be attached to the voltmeter terminals. These contact pieces, according to Lyndon, should be made, as shown in Fig. 1, of hard copper wire about 5-32 of an inch in diameter and screwed or pushed into a piece of cadmium about 9-32 of an inch in diameter. The voltmeter lead should be fastened about the middle point. The device may be improved if taped about two inches each way from where the voltmeter lead is attached, and the cadmium to prevent its accidental contact with a battery plate, should be enclosed in a perforated rubber tube. With two such contact pieces the reading across the plates may be taken by pressing the copper ends against the positive and negative lugs. To take further readings and referring to Fig. 2, wet the cadmium in acid, then make connections between electrolyte and plate, as at (A). This on a charged cell should give a positive reading at 2.30. If Cu2 be now brought in contact with the Pb plate, the voltmeter needle goes the wrong way, showing a negative reading; so immerse Cd2 connecting as at (B), and the voltmeter will read about .20. The voltage between the plates is then the sum of the two readings (A) and (B), or 2.5. If the reading from cadmium to Pb is not at least .10 volt, the battery is not fully charged, and charging should be continued until the proper value is reached.

In Fig. 2, (C) and (D) indicate the method to be followed in taking readings on a discharged cell. The cadmium is now electropositive to both plates and the potential between Pb and Pb O2 is found by subtracting one number from the other, giving 1.8. When this point is reached the cell should not be further discharged.

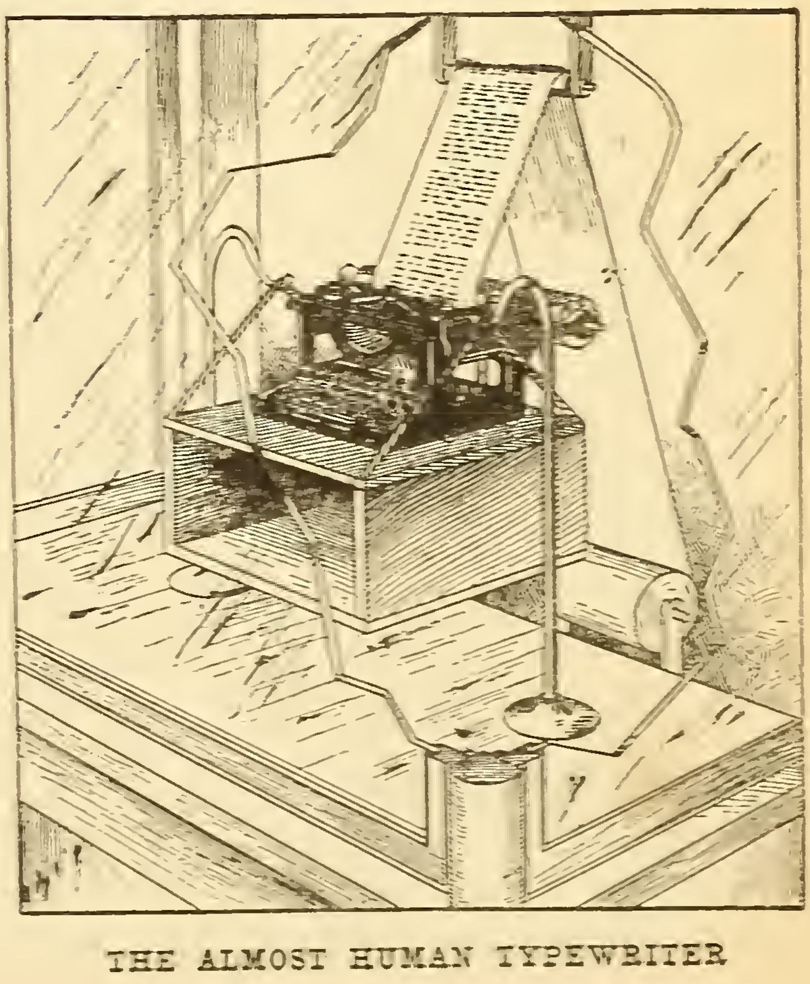
Electricity the Silent Salesman

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

Typewriter Appears Almost Human

A prominent typewriter company has an electrically operated typewriter in the window of its New York offices which mystifies and puzzles passers-by.

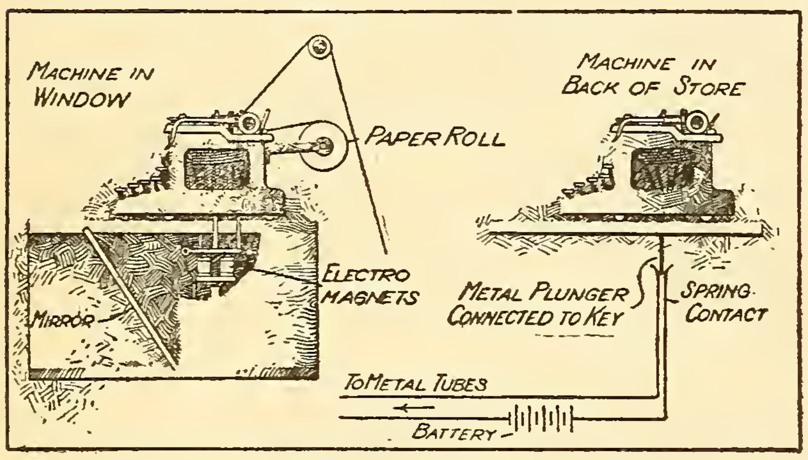
What appears to be an ordinary stock typewriter, mounted on an open front mahogany cabinet, is supported at the four corners by four heavy silken ropes suspended from two nickel plated tubes similar in shape to the davits of a boat. A strip of paper about eight inches wide passes from a roll mounted on the back of the machine, around the roller and up over another roller in the back part of the window.



THE ALMOST HUMAN TYPEWRITER

The keys of the machine busily set forth the good features of the typewriter in question on a strip of paper and operate without the aid of any visible human agency. A typist, however, seated at a machine in one of the offices is the operator.

The silken ropes supporting the machine are silk covered wires twisted into a rope. The cables are tied in a false knot, which appears to pass around the tube, but in reality passes through it, giving opportunity to establish electrical connections. The cabinet is full of electromagnets, one for each character or key on the typewriter. The keys of the typewriter in the back of the store complete an electrical circuit when pressed, and send a current through the proper electromagnets, thus depressing the corresponding keys on the typewriter in the



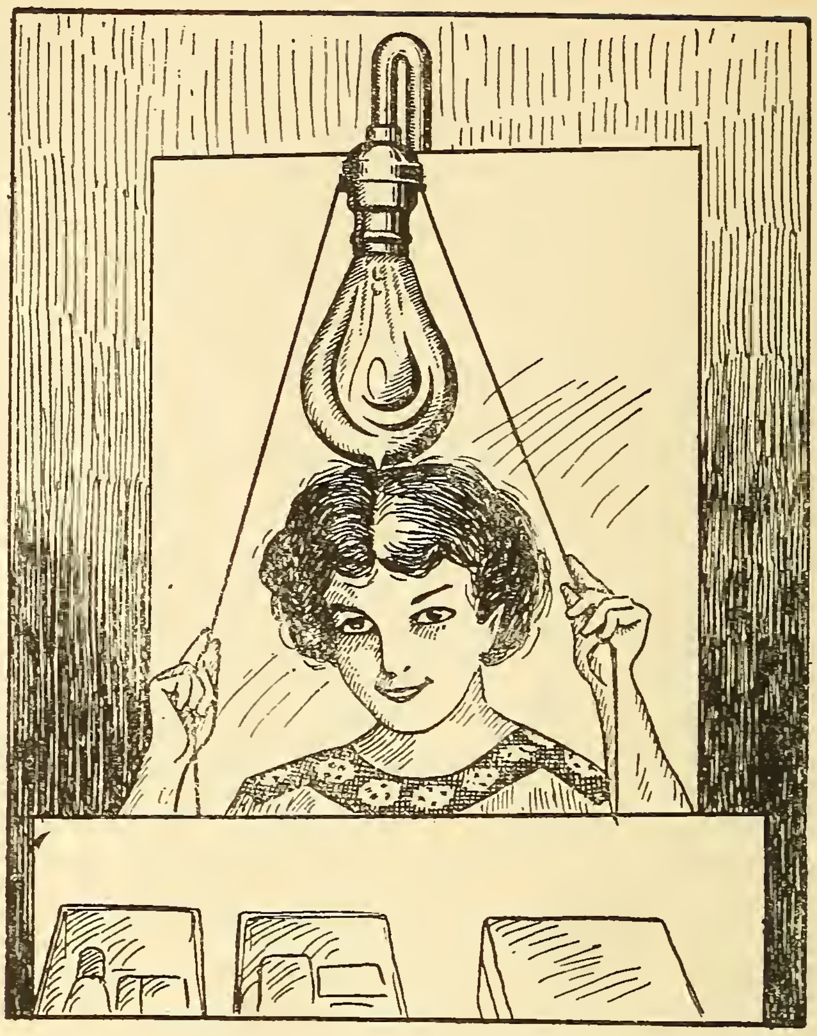
HOW THE TYPEWRITER IS OPERATED

window. Though the front of the cabinet seems open, by getting down close to the sidewalk and looking up into the cabinet one may see his own face looking down at him. The cabinet is not hollow. A plate glass mirror mounted at an angle in the box reflects the bottom and makes it appear like the back. The magnets and operating mechanism are between the mirror and the real back.

Advertising a Hylo Lamp

A clever device for advertising a Hylo lamp (one having a large and a small filament) is being displayed in the show windows of electrical supply houses.

The lamp is attached to a sort of easel carrying a card upon which is the picture of a girl. A second front card conceals a clock mechanism which operates flesh-



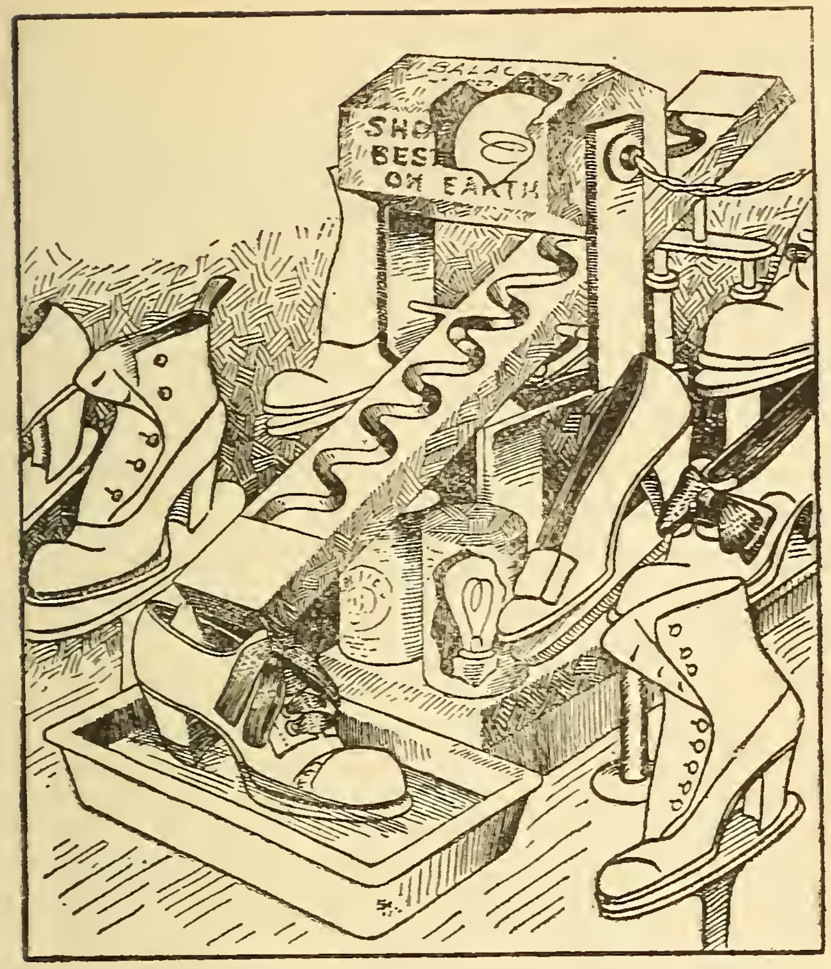
ADVERTISING A HYLO LAMP

colored paper hands and arms that alternately pull one cord and then the other, thus lighting the small filament and turning it out, and then doing the same with the large filament of the lamp. The scheme might also be employed to attract attention in various ways to goods or advertisements other than lamps displayed in the window.

Rolling Balls Catch the Eye

Motion seems to be the important factor upon which the success of show window advertising is based, judging from a device calling attention to a shoe oil.

A frame work supports upon a cross bar a sort of teeter board, at one end of which is attached a shoe which rests in a vessel containing water. In a groove in the board two heavy metal balls are free to roll. With the device in the position illustrated the balls roll to the lower end, disappear for a moment and apparently operate a switch which causes two parallel coils with a soft iron core connected to the other end to be energized. These pull the high end of the board down and lift the shoe out of the



NOVEL WINDOW DISPLAY

water, which runs off, owing to the oil dressing on the shoe. At the same time the two metal balls come out from their hiding place and roll along the groove to the low end on reaching which, and disappearing, the two coils become de-energized, let go the cores and the shoe again dips into the pan. The teeter board also opens and closes spring contacts which alternately light up the incandescent lamps in the revolving hexagonal box and in the two facsimile packages of Dri-Seal below.

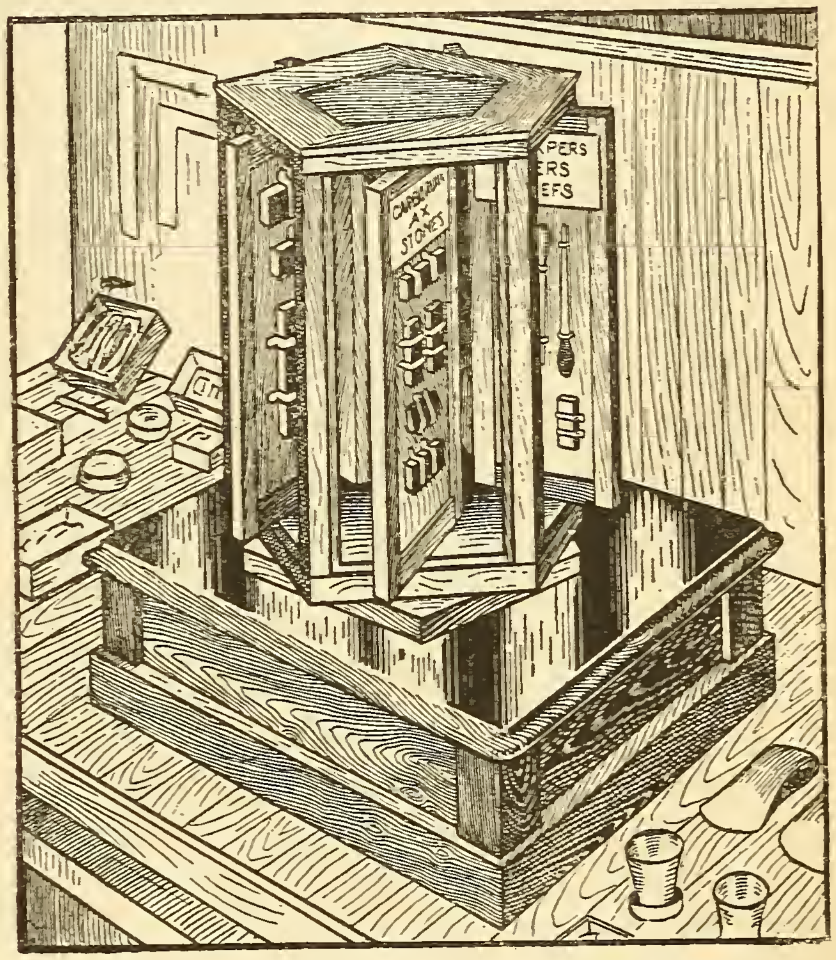
A Pantomime Pen Talk

Two miniature figures, one indicating by his smile that an easily filled fountain pen is a source of pleasure while the other seems to have gone the limit as to patience in filling his pen with a rubber bulb filler, are part of a Chicago stationer's show window exhibit.

Motion is imparted first to one of the figures and then to the other by a small electric motor and proper connections within the cabinet. The leaves of a small cardboard book on the front side of the cabinet are turned slowly enough for spectators to read the statements.

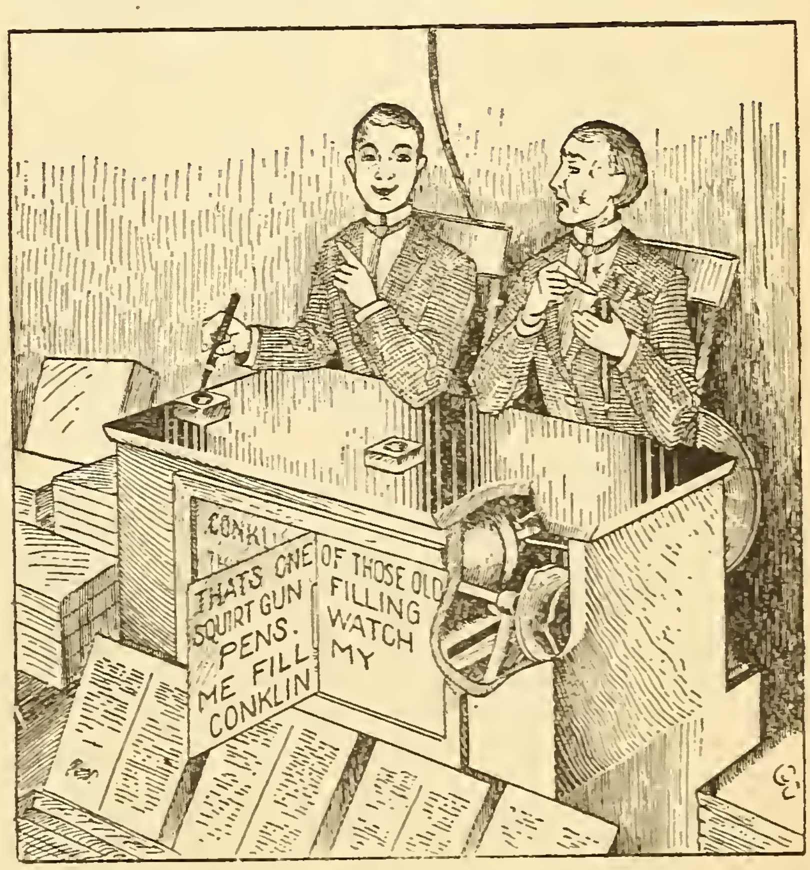
Carborundum Display Cabinet

A carborundum company is using a revolving five-sided cabinet to display the numerous articles made from carborundum. The area for display is doubled by arranging so that each of the five pan-



CARBORUNDUM DISPLAY CABINET

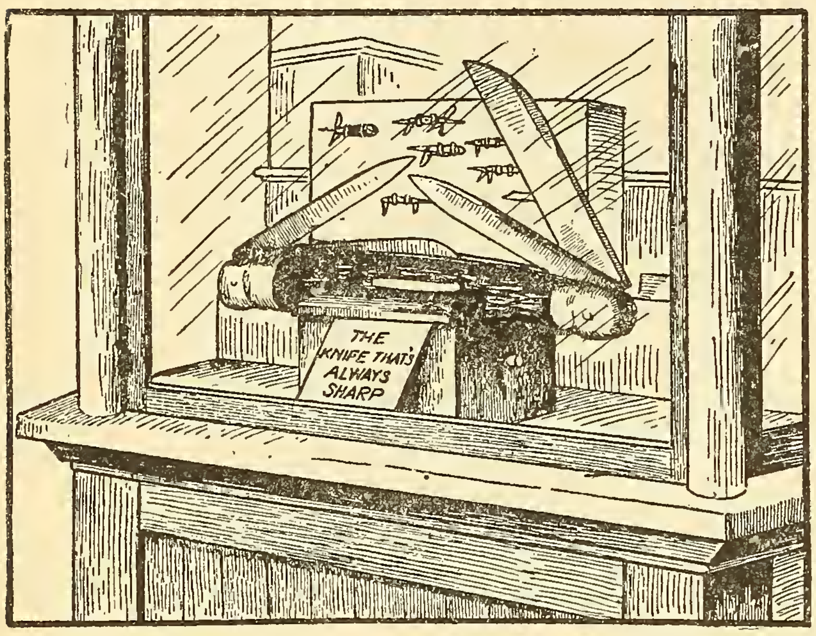
els revolves on its own axis, as the whole cabinet turns, both sides of the panels being used. The equipment is run by a small motor in the base.



A PANTOMIME PEN TALK

A Sharp Attraction

A huge jack knife taking up almost the full length of a show window is in itself quite enough to attract attention, but when this large knife slowly opens

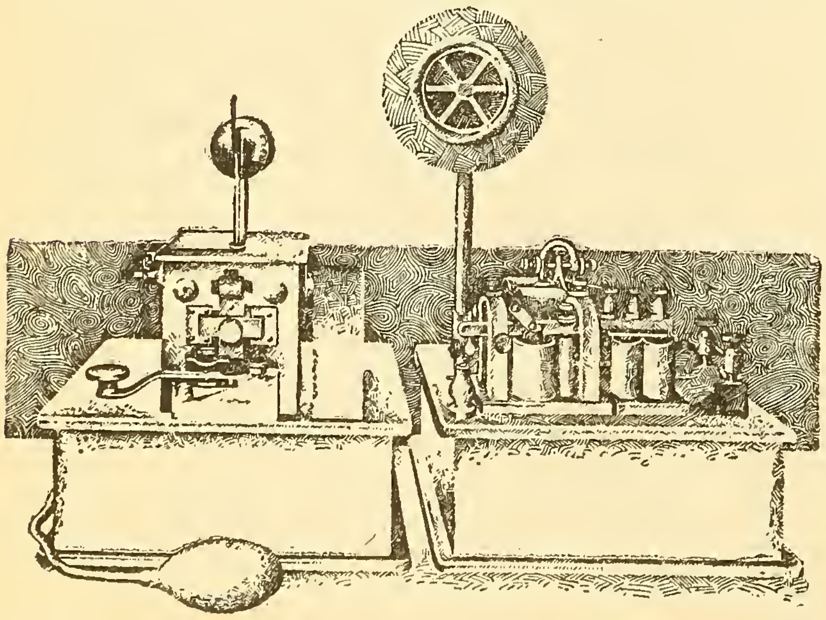


A SHARP ATTRACTION

and closes its blades, the attraction seems complete judging from the number of people who stop to look. The only suggestion that electricity is the motive power is the end of the motor shaft which projects through the side of the box upon which the knife rests.

Use Wireless in Advertising

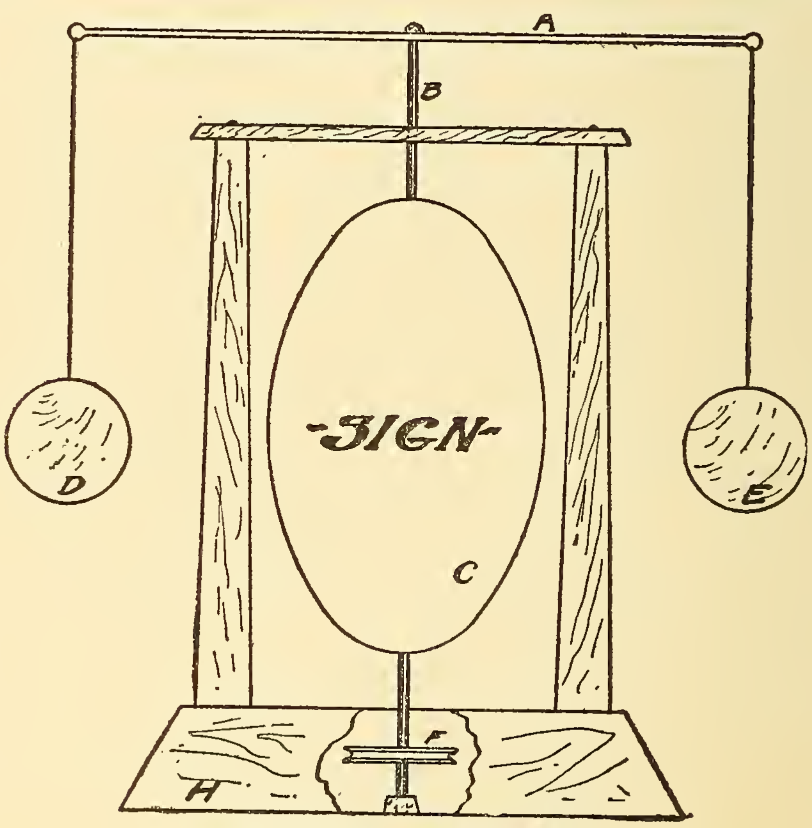
A rather novel application of wireless telegraphy to advertising purposes was made at a recent automobile show. The outfit consisted of the sending set on one end of a show case and the receiving set on the other. Instead of using the fingers to press the key in sending, a rubber bulb was arranged to operate it, this bulb being within easy reach of visitors. The wireless waves caught by the receiving apparatus operated relays which closed the circuit of a battery motor at the top of a column mounted on the cabinet. Attached to the shaft of the motor was an aluminum disk six inches in diameter upon which was printed an advertisement. This disk was revolved by the motor which was started and stopped by pressing the rubber bulb.



WIRELESS ADVERTISING NOVELTY

Attention Arrester

The cut represents an apparatus used for calling attention to a window display. A metal rod (A) is riveted to a revolving shaft (B), which motion causes the



ATTENTION ARRESTER

balls suspended from the bar to swing and hit against the glass of the window, provided the apparatus is placed in the proper position. The revolving plane may be made of heavy cardboard and may or may not be lettered. The best motive power is an electric motor, running at a fairly high speed. The base (H) should be in the form of a hollow box in order that should a belt be used it can easily pass from the motor to the grooved pulley (F).

CHARLES H. SAMPSON.

On Polyphase Subjects

Metal Plated Paper

German lithographers are beginning to use metal plated paper instead of thin metal sheets, preferring the former as the paper body gives a soft cushioning effect which cannot be obtained with the solid metal. For this purpose the metal is electroplated on the surface of the paper, which has first been coated with a layer of graphite to give it a conducting surface. The principle thus employed is old, but the difficulty has always been that the liquid in the plating bath would soak into the paper and would loosen the metal film from it even while this was being deposited. Now the users have learned that by first coating the paper with a varnish or lacquer impervious to moisture, they can make it immune against the direct action of the liquid, so that the film of metal will cling firmly to it.

Energy Used in Telephoning

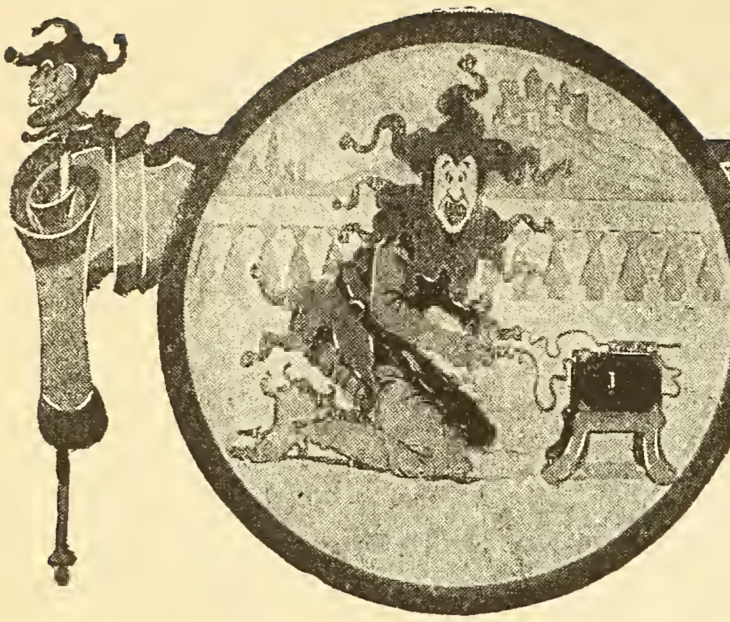
When one lifts the telephone receiver off its hook to call central and then talks a few moments with his friend, he realizes, of course, that a certain amount of electric current is used, and yet it seems such a very small amount as to be quite negligible. However, when we consider the millions of telephone calls that are made each year in the United States, we can see that the electric energy used is considerable.

The New York Telephone Company, which keeps very close tab on its affairs, estimates that a million telephone messages can be handled with an expenditure of 900 kilowatt hours. To produce 900 kilowatt hours in a power house will take a little over a ton of coal, say 2,025 pounds. A very conservative estimate will set the number of times the telephone is used in the United States at 10,000 million times a year, so the energy required for transmission may be set down in terms of coal as considerably over 10,000 tons.

The Electric Vehicle

Electric vehicles both for pleasure and commercial service have come to the front in the last two or three years more rapidly than the average person suspects. Many are still prone to judge them by the earlier types which are still within the memory of all, and which could in no way compare, in point of appearance and reliability, with the really wonderful cars which the manufacturers are now producing. The electric is not held up as capable of displacing the gasoline car, but it does have certain fields of its own in which it is supreme.

Beginning with the February issue, a four-part article will be published in this magazine describing the particular adaptability of the electric vehicle for certain classes of service, telling in simple language what the prospective buyer should know about the batteries and how to care for them, all about charging batteries, mileage and speed capacity of the vehicles, economy of electric trucks and delivery wagons, etc. The author, Mr. W. C. Jenkins, is a well-known magazine writer on practical and economical questions in general. He has taken up the study of the vehicle question with zest, and written an article which will be extremely enlightening and interesting to the non-technical reader.



Short Circuits

Ten-year-old Minerva stood watching with interest the shaping and building of a large hat upon which Miss Hamilton was putting the finishing touches. When it had been admired by all, the head trimmer asked:

"Minerva, do you think *you* will be a milliner when you get big?"

Instantly the child's face grew sad and she answered gravely:

"No, I guess I'm not going to be anything. I'm going away to college."

* * *

Willie—"May I go and play now, ma?"

Mother—"What, with those holes in your trousers?"

Willie—"No, with the boy next door."

* * *

"Who gave ye th' black eye, Jim?"

"Nobody gave it t' me, I had t' fight fer it."

* * *

Mistress—"Has Master Willie come in yet?"

Servant—"I think so, 'm. I haven't seen him, but the cat's hiding!"

* * *

A train in Arizona was boarded by robbers, who went through the pockets of the luckless passengers. One of them happened to be a traveling salesman from New York, who, when his turn came, fished out $200, but rapidly took $4 from the pile and placed it in his vest pocket.

"What do you mean by that?" asked the robber, as he toyed with his revolver. Hurriedly came the answer: "Mine frent, you surely vould not refuse me two per zent discount on a strictly cash transaction like dis?"

* * *

Condescending Chappie—"I weally can't wemember your name, but I've an idea I've met you here before."

Nervous Host—"O, yes, very likely. It's my house."

Talkative Passenger (trying to get into conversation)—"I see—er—you've lost your arm."

Gentleman (trying to read)—"So I have. How careless of me!"

* * *

Willie rushed home to his mother in great excitement for her to get him ready to go to the circus. "A lot of us fellows are going to get in free," he shouted. "We did some work for the show people. Georgie Jones carried water for the elephant and Johnnie Jones opened up baled hay for the camels." "And what did you do?" asked his mother. "Me? Oh, I had a fine job. I washed the snakes."

* * *

It was a beautiful evening and Ole, who had screwed up courage to take Mary for a ride, was carried away by the magic of the night.

"Mary," he asked, "will you marry me?"

"Yes, Ole," she answered softly.

Ole lapsed into a silence that at last became painful to his fiancée.

"Ole," she said desperately, "why don't you say something?"

"Ay tank," Ole replied, "they bane too much said already."

* * *

"Mr. Cleaver, how do you account for the fact that I found a piece of rubber tire in one of the sausages I bought here last week?"

"My dear madam, that only goes to show that the motor car is replacing the horse everywhere."

* * *

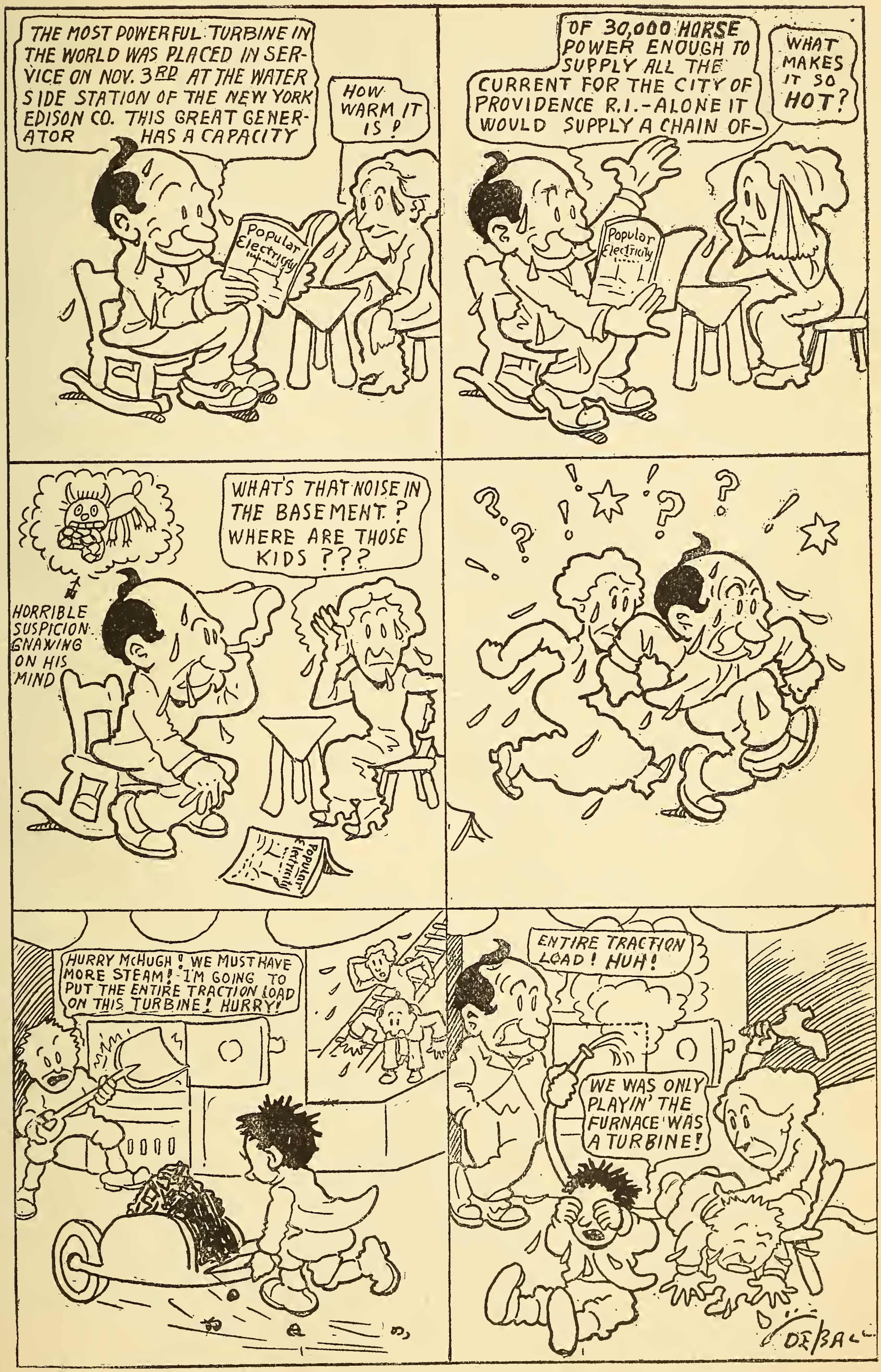
The afternoon of the big game between the Giants and the Athletics, Tom, entering the office, found a note from his employer, Mr. Soandso:

"I am going out—shall return at six-fifteen."

Tom left a note:

"I am going out, too; but you'll never know it, Old Glue-foot, for I shall return at six-fourteen."

But Tom got caught in a street car block and Mr. Soandso didn't.


THE MOST POWERFUL TURBINE IN THE WORLD WAS PLACED IN SERVICE ON NOV. 3RD AT THE WATER SIDE STATION OF THE NEW YORK EDISON CO. THIS GREAT GENERATOR HAS A CAPACITY
HOW WARM IT IS!
Popular Electricity
OF 30,000 HORSE POWER ENOUGH TO SUPPLY ALL THE CURRENT FOR THE CITY OF PROVIDENCE R.I.-ALONE IT WOULD SUPPLY A CHAIN OF-
WHAT MAKES IT SO HOT?
Popular Electricity
HORRIBLE SUSPICION GNAWING ON HIS MIND
WHAT'S THAT NOISE IN THE BASEMENT? WHERE ARE THOSE KIDS???
Popular Electricity
HURRY McHUGH! WE MUST HAVE MORE STEAM! I'M GOING TO PUT THE ENTIRE TRACTION LOAD ON THIS TURBINE! HURRY!
ENTIRE TRACTION LOAD! HUH!
WE WAS ONLY PLAYIN' THE FURNACE WAS A TURBINE!
DE BAL

Common Electrical Terms Defined

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

HELIX.—A coil of wire conductor. In wireless telegraphy it consists of a few turns of heavy brass or copper wire wound upon a hardwood drum. The transmitting helix provides the necessary inductance for the transmitting circuit.

HENRY.—The practical unit of self-induction.

HIGH-BARS.—Applied to commutator segments which form less wear or faulty construction are higher than the adjacent segments.

HIGH FREQUENCY.—A term applied to alternating current in which the alternations or change in direction of the current takes place many times a second. Ordinary frequencies for lights and motors range from 25 to 150 cycles per second. High frequencies measure the cycles in thousands per second.

HISSING.—The noise produced by an arc lamp when the arc is too short or the carbons are too coarse-grained.

HOME STATION.—The end of a telegraph line where the operators using the expression are working.

HORSEPOWER.—In electrical units the equivalent of a mechanical horsepower is 746 watts.

HORSESHOE MAGNET.—A bar of magnetized steel of U shape.

H. P.—Abbreviation for "horsepower."

HUMMING OF TRANSFORMER.—Noise produced by an alternating current transformer. A bar of iron very suddenly magnetized or demagnetized emits a snapping sound or tick due according to theory to the sudden arrangement of the molecules. This magnetization and demagnetization takes place many times a second in the core of a transformer and to it is due some of the noise. The mutual repulsion of the sheets of the transformer core and the attraction of the turns of the coils are two other causes of the humming. Tightly clamping the sheets and binding the coils will reduce the noise.

HYSTERESIS LOSS.—When a piece of soft iron is magnetized and then the magnetizing source removed, it is found that the soft iron does not lose its magnetism entirely but retains part of it. To take away this remaining magnetism a certain amount of energy must be used. This loss of energy to demagnetize the iron due to its "retentivity" is termed hysteresis loss.

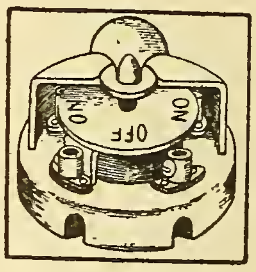
IGNITION.—In electricity the exploding of a gas in the cylinder of an engine by an electric spark between make and break contacts or between sparking points.

ILLUMINATION.—Referring to light either natural or artificial.

IMPEDANCE.—In general the term applied to any opposition to the flow of alternating current.

INCANDESCENT LAMP.—An electric lamp in which the current flows through a conductor in the form of a filament thus heating the filament to whiteness. The filament is sealed in a glass bulb which is exhausted of air, two short pieces of platinum being used to lead through the lamp stem to the filament ends.

INDICATING SWITCH.—A snap switch which shows by the words "ON" or "OFF" whether its circuit is made or broken. (See cut.)



Indicating Switch

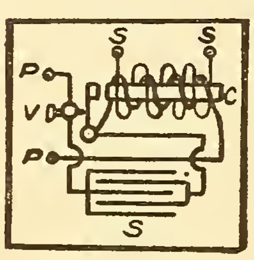
INDIA RUBBER.—See Caoutchouc.

INDUCED CURRENT.—The current induced in a conductor by causing the conductor to cut lines of force or by changing the density of the lines of force about the conductor.

INDUCTANCE.—A quality of a circuit by which it does not have the full current immediately flowing because the energy goes to build up a magnetic field around the conductor or in the coil. This quality is also shown when after the electromotive force is withdrawn from a circuit the current requires time to fall to zero.

INDUCTION.—The effect a current flowing may have upon itself or on adjacent circuits. For example, if one of two adjacent parallel wires carries current this wire by inductance will produce a current in the opposite direction in the other wire if this second wire is in the field of lines of force of the first wire.

INDUCTION COIL.—A device which by induction between two coils wound on the same soft iron core causes the primary coil to produce a higher or lower voltage on the secondary coil. A typical coil (see cut) has a core (C), a primary winding (PP), a vibrator (V), a condenser (S) and a secondary circuit (SS).



Induction Coil

INFLUENCE MACHINE.—A static electric machine. In one form it consists of two glass discs, one stationary, the other rotating in front of the first. On the principle of the electrophorus (See Electrophorus) the rotating disc is excited and metallic combs take off charges of opposite nature to leyden jars.