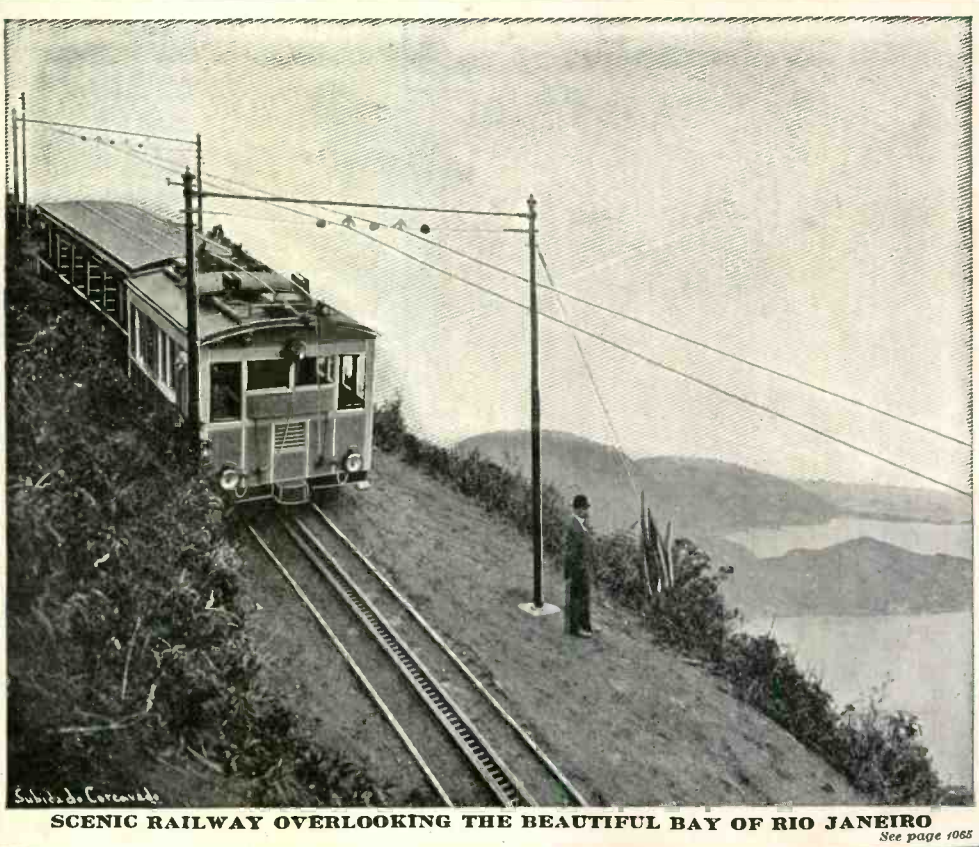
Epoch-Making Electrical Inventions In This Issue

POPULAR ELECTRICITY MAGAZINE

IN PLAIN ENGLISH
(NON TECHNICAL)



SCENIC RAILWAY OVERLOOKING THE BEAUTIFUL BAY OF RIO JANEIRO
See page 1065

Vol. III APRIL, 1911 No. 12

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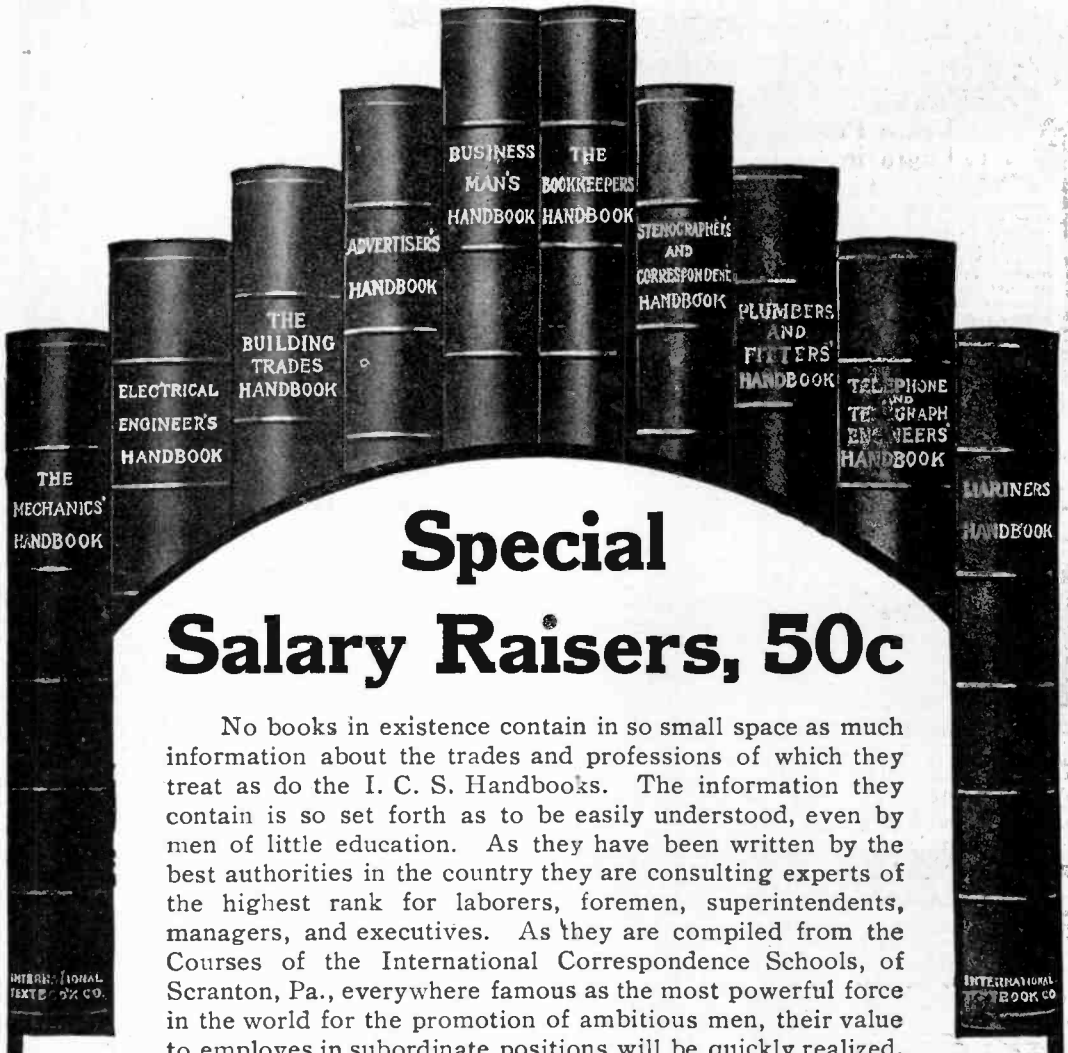

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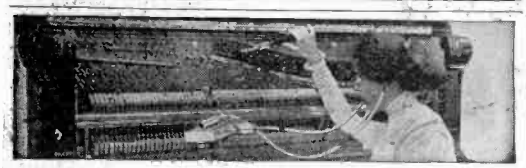

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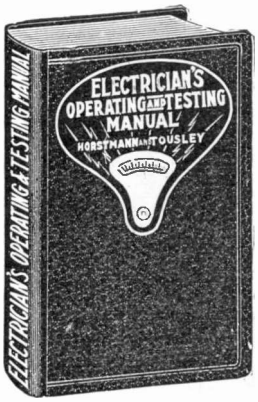

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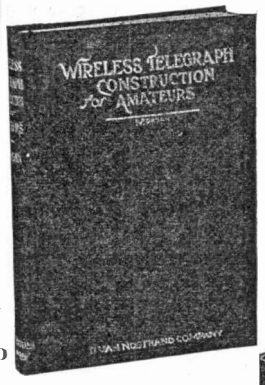

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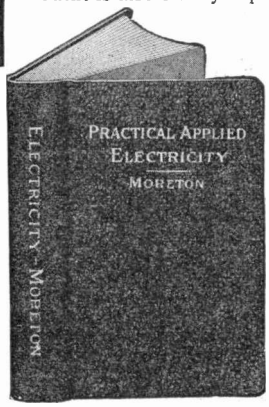

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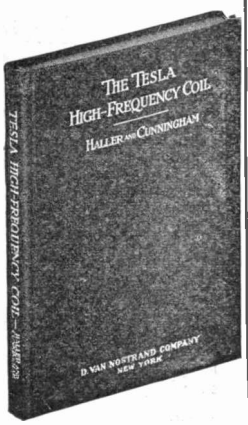

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POPULAR ELECTRICITY
IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor.

Vol. III — April, 1911 — No. 12

CONTENTS

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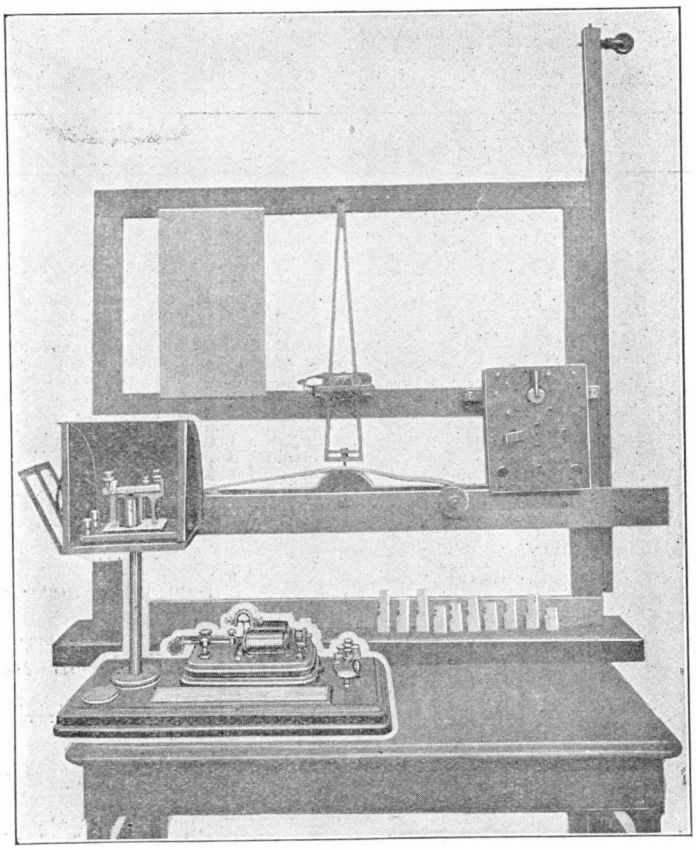

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Popular Electricity
In Plain English

Vol. III April, 1911 No. 12

Five Epoch-Making Electrical Inventions

By ELMER E. BURNS

What were the greatest electrical inventions? When this question is asked, and we cast about among the thousands of ways in which electricity is applied, five things stand out from all the rest. First in chronological order comes the telegraph; next the discovery of electric motor and its application to electric traction; then the telephone; the electric incandescent lamp, and, finally, the wireless telegraph. In this series of five articles Mr. Burns will relate the fascinating stories of these five great inventions, all of which are fraught with that element popularly termed "human interest."—Editorial Note.

I. The Telegraph

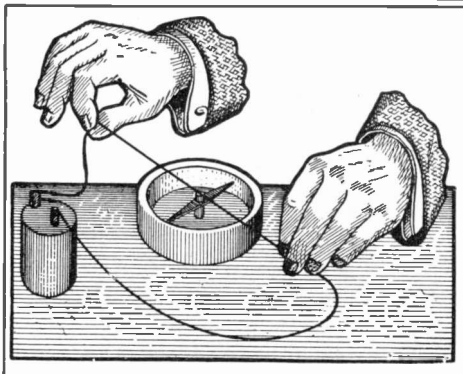
If you had mentioned the telegraph in a conversation with any intelligent person in the year 1840, he would have asked at once: "Which telegraph?" The word telegraph would have suggested to his mind not a wire carrying an electric current with sending and receiving instruments at either end, but it would have suggested, among other things, a system of semaphore signals similar to those used in certain forms of the railroad block signal system. France had the most extensive system of telegraphs of this kind in the world, five great lines extending from the capital to the extreme cities of the kingdom, a total distance of nearly 15,000 miles with a semaphore for every three miles. The signals were operated by human hands and caught by human vision. This system of telegraphs was maintained by the government at a cost of over $200,000 per year.

The need of some method of conveying intelligence to a distance was keenly felt and this clumsy method was the best that was then known. Certain forms of electric telegraph had been invented but these were expensive to install and uncertain in operation. So it happened that when Morse filed his application for a patent on his electro-magnetic telegraph, he did not claim the telegraph as a new invention but claimed "certain new and useful improvements in the telegraph."

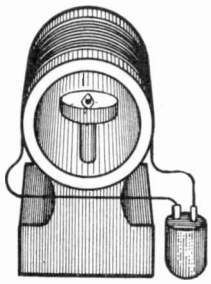
It is true of the telegraph as of many other great inventions that a little knowledge leads us to give undue honor and applause to one fortunate inventor while a deeper knowledge leads us to recognize the contributions of many minds and give honor to whom honor is due.

The Franklin Institute of Philadelphia reported to Congress that the time required to make signals with the Morse telegraph was "at least as short as that of the common telegraphs," referring to the semaphone and other visible signal systems.

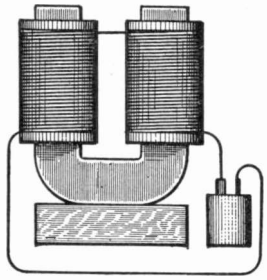
Benjamin Franklin was the first to conceive the idea of telegraphing by means of electricity and leave a record of his idea for the benefit of later investigators. He tried the experiment with four miles of wire, but the electric battery was then unknown and the discharge from an electrical machine or a Leyden jar could not be used for a practical telegraph. The invention of the electric battery revived the idea of an electric telegraph. Every known method of producing an electric current or a static electric charge and every known effect of an



Experiment of Hans Christian Oersted showing the magnetic effect of an electric current



Ampere's Idea of the needle telegraph



Professor Henry's electro-magnet

THE THREE FUNDAMENTAL EXPERIMENTS, THE PERFORMANCE OF WHICH MADE POSSIBLE THE TELEGRAPH

electric current up to the time of Morse's invention had been used in attempts to invent a telegraph. No success was possible, however, until the electro-magnet had been discovered and perfected.

The magnetic action of an electric current was discovered by Hans Christian Oersted, a professor in the University of Copenhagen, Denmark, in the winter of 1819–20. It was known that a stroke of lightning sometimes magnetizes steel knives or other steel objects that are in its path, and it was expected that an electric current would produce some magnetic effect if only the current were used in the right way. Oersted, after seven years of untiring work and many failures, one day while lecturing to his class thought to place the wire carrying the current in a north and south direction over a compass needle. He was surprised to see the needle swing round and point nearly east and west. When he changed the direction of the current still holding the wire north and south the needle swung round in the opposite direction and again pointed nearly east and west.

If the current were flowing toward the north the needle would turn so that the north pole pointed nearly west. If the current were flowing south over the needle the north pole would point nearly east.

In a few months a Frenchman named Ampere learned of Oersted's discovery and it occurred to him that here was the germ of an electric telegraph. If a long wire could be used and a current passed through this wire and through a coil around a compass needle then the circuit could be made and broken or the direction of the current reversed at the one end of the wire and the needle at the other end would swing to and fro and the movements of the needle might be arranged to indicate the letters of the alphabet and so convey a message.

A number of "needle telegraphs" were invented on the principle suggested by Ampere. Some of these were used commercially. The Cooke and Wheatstone needle telegraph was used in England as late as the year 1870. Inventors found difficulty, however, in making the telegraph work over long distances. Barlow in 1824 claimed to have demonstrated that the telegraph could never be made a commercial success. This prediction would have proven to be correct if no further discoveries in electricity or electromagnetism had been made. With a wire many miles in length the current was so weak that the magnetic effect was almost imperceptible. Two facts were yet to be discovered that would seem extremely simple even to the novice in electrical work today. We can scarcely understand that it should require many years to discover these two simple facts.

The discovery that made long distance telegraphy possible is due to Professor Henry of the Albany Academy, afterward secretary

of the Smithsonian Institution in Washington. Professor Henry was endeavoring to increase the strength of electro-magnets. Sturgeon had devised the horseshoe magnet with a single layer of wire, the iron core being first coated with wax, and the turns of wire not touching, for insulated wire was then unknown. Henry improved the magnet by insulating the wire and winding many turns of wire around the iron core. So successful was he that he produced a magnet weighing only 59½ pounds that would hold up a ton of iron. The great length of wire in the coils of this magnet meant, of course, increased resistance and weaker current, if no change had been made in the battery, but Henry found that what he called a "battery of intensity," that is, a battery of high voltage, would overcome the resistance of the long wire. These were the two things that were needed to prepare the way for the invention of a long distance telegraph, an electro-magnet of considerable strength even with a weak current flowing through its coils and a battery that would overcome the resistance of miles of wire. We should add another discovery, that of a battery that would give a constant current even with the circuit closed for hours. This we have in the cell devised by Professor Daniell of King's College, London, and in the gravity cell or crowfoot battery which is only a modified form of Daniell cell.

The materials for a successful telegraph were at hand when Morse took up the work. There was needed the practical man who should combine these materials and develop a working telegraph. That a man who up to the age of 40 had devoted his life to art, an artist, a dreamer, should become the practical inventor is one of the strange facts in the history of invention. When Samuel F. B. Morse first learned in a conversation on shipboard on his return from Europe in 1832 that an electric current will travel instantaneously through any known length of wire he had a vision of an electric telegraph girdling the earth. He felt that this was his work. He gave up his former vocation to a great extent. At times he faced starvation and in a little room provided for him by his brothers he gave himself up to working out his idea.

It was Morse's idea that the entire operation of sending and receiving a telegraph message must be automatic. He would not trust the human hand to manipulate the contact key nor the human brain to interpret the intervals denoting dots and dashes. He therefore made an automatic device for opening and closing the circuit at the desired intervals and an automatic recording instrument. The recording instrument was a pendulum carrying a pen at its lower end and a piece of soft iron opposite the poles of an electromagnet. When the current was sent through the coils of the magnet, the pen was drawn across a strip of paper. At first a weight and later a spring was used to pull the armature away from the magnet when the circuit was broken. If the armature was held against the magnet a very short time a dot was made, if for a longer time a dash. The instruments used in the first commercial work were smaller, the pen being carried by a short arm that was pulled away from the magnet by a spring when the current ceased to flow. It was the same cumbersome method of receiving the message, however, with the winding and unwinding of the tape, the whirr of wheels in the winding mechanism, the occasional breaking of the weight cord and the laborious reading and transcribing of the message on the tape.

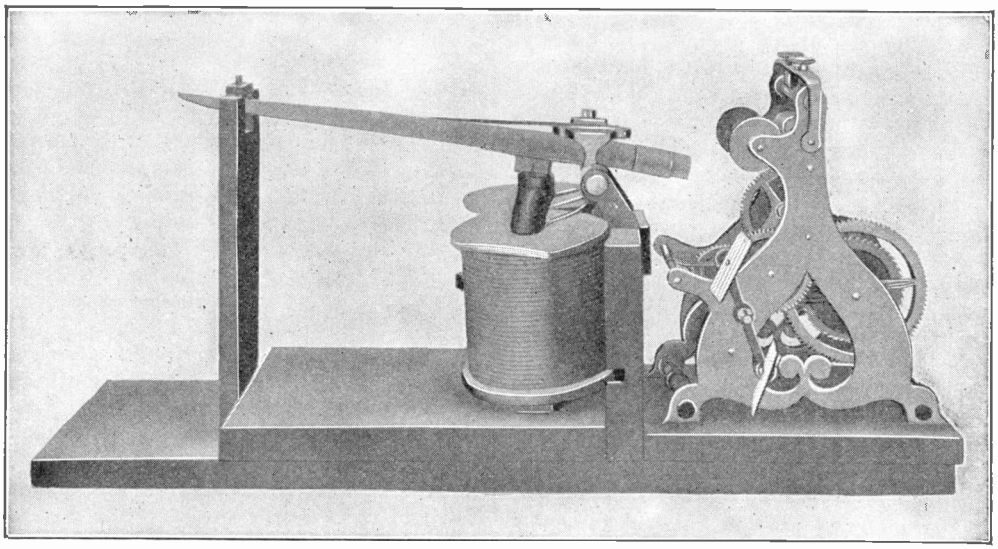
Although the sound system was secured to Morse in his patent, for years the Morse company vigorously enforced rules against receiving messages by sound. When in 1848, James Leonard, the fastest operator in the country, discarded the tape system and received messages by sound, he became the wonder of the telegraphic world. The famous showman, P. T. Barnum, happened to place a message in the hands of Leonard. He was so surprised at his speed in sending and astonished at seeing him receive by sound that he offered Leonard a large salary to accompany his show and exhibit his skill in taking messages by sound. The offer was rejected.

On the second of September, 1837, Morse gave the first public exhibition of his telegraph system, a message being sent through one-third of a mile of wire and recorded on the tape. In his first experiments Morse used an electro-magnet like the one employed by Sturgeon. He had not then learned Henry's device for increasing the strength of the magnet. The principle of Henry's magnet was given to Morse later by Mr. Vail, who became his partner. Without the assistance of Mr. Vail it is doubtful if Morse would have his telegraph a commercial success.

It was Mr. Vail who worked out the Morse alphabet. It occurred to him that the letters most frequently used should have the simplest signs. The problem of finding which letters are most frequently used had been already solved by the printers. So he chose the simplest signs for the letters that have the largest compartments in the typesetter's case. The most common letter of all, the letter "e," was represented by a single dot.

The Morse instrument was exhibited to the President and a Congressional Committee of the invention, if successful, is so extensive for good and for evil, that the government alone should possess the right to control and regulate it."

An appropriation of thirty thousand dollars enabled Morse to establish a line between Washington and Baltimore, on May 27, 1844. The first message was sent over this line. This was the famous message, "What hath God wrought?" dictated by Miss Ellsworth. Morse had abandoned all hope of favorable action by Congress, had gone to his hotel, counted his money and found



THE MORSE INSTRUMENT USED IN RECEIVING THE FIRST COMMERCIAL MESSAGE, FROM A PHOTOGRAPH OF THE ORIGINAL IN THE U. S. PATENT OFFICE. THE ORIGINAL AS FIRST BUILT HAD A PIN ON THE END OF THE ARM WHICH TOUCHED A ROLL OF PAPER OPERATED BY THE CLOCKWORK MECHANISM

in the winter of 1837-8, and then began a long series of committee investigations and reports. Although the Committee on Commerce reported to Congress in April, 1838, that "the influence of this invention over the political, commercial, and social relations of the people of this widely extended country, will, in event of success, of itself amount to a revolution unsurpassed in moral grandeur by any discovery that has ever been made in the arts and sciences," it was not until 1844 that Congress could be induced to make an appropriation for establishing the first telegraph line.

It is significant that this Congressional Committee reported further that "the power that he could pay his hotel bill and his fare home and have thirty-seven cents left, when Miss Ellsworth had brought him the news that Congress had made the appropriation for his telegraph. He promised her that the first message over the new line should be hers.

Morse made use of Steinheil's discovery that the earth could be used as part of the circuit. Steinheil had made this discovery in 1838 while trying some experiments on the use of the rails of a railroad as part of a telegraphic circuit. He found that the current would pass from one rail to the other through the earth, and the thought occurred to him that he might use the ground

itself and dispense with half of the metallic circuit. This plan had the added advantage that it reduced the resistance of the circuit one-half, for the resistance of the earth is practically zero.

Vail tried the experiment of using an earth battery and found that a copper plate buried in the earth at Washington and a zinc plate buried at Baltimore and connected by a wire was sufficient to transmit a message, though it was found that the current was very weak.

Morse had contracted for lead pipe for the line from Washington to Baltimore, intending to place the insulated wire in the pipe underground. The use of poles was an after-thought. Copper wire was at first used, for it was known that copper would conduct the electric current better than iron. The first telegraph lines erected in the United States were of No. 16 copper wire insulated at the points of support by means of cloth saturated with gum-lac. The copper wires were too easily broken so they were soon replaced by iron wires of a larger diameter. The resistance of iron is about six times that of copper, therefore an iron wire to have the same conductivity must have six times the sectional area or $2\frac{1}{4}$ times the diameter of the copper wire. Such an iron wire has about twelve times the strength of the copper wire which it displaces while its cost is less.

Morse said that if he could make his telegraph work through ten miles of wire he could make it work around the world. Henry's method of winding an electro-magnet combined with the relay made this possible.

The relay was invented by Sir Humphrey Davy in England and afterward adopted by Morse. He was using a needle telegraph and, finding the current very much weakened when passed through a long wire, he thought that the slightest motion of the needle would be sufficient to bring into contact two metallic surfaces, and so close a circuit including a local battery. This second current might close the circuit of a third current and so on without limit.

Though Morse did not live to see the fulfillment of his prediction, a message was sent around the world in 1896. This message did not actually encircle the globe but it did travel across the two continents and the Atlantic Ocean and back to the starting point, a distance of 27,000 miles.

Making Iron of High Purity

Several decades ago the copper industry was partly revolutionized by the introduction of electrical methods, it being shown that an electrolytic process could not only produce copper at low cost from ores which had previously been neglected, but that the copper thus produced was of unusual purity. Now it looks as if similar methods when applied to certain iron ores may also prove commercial. Experiments just reported by Prof. C. F. Burgess (of the University of Wisconsin) show that iron can be deposited in thick layers by passing a current through a solution of sulphate of iron, at a total cost of about one cent per pound for the current, chemicals and labor. What is more, the iron thus obtained is remarkably pure, that obtained at Madison testing as high as 99.97 per cent, which purity might be still further improved by taking unusual precautions. It would therefore seem well suited for competing with the high grade Swedish iron which is at present imported at considerable expense, and the electrical production of such pure iron may mean another step towards making the United States independent of foreign markets.

Silver Plated Porcelain

If the richness of silverware could be combined with the lightness and the heat retaining qualities of porcelain, the combination ought to suit a quite fastidious taste without involving either the cost of heavy silver or the easy denting of lighter metal.

Besides being a poor conductor of heat, porcelain also conducts electricity so poorly that it cannot be covered with a film of metal in an electroplating bath unless the surface could first be coated with a conducting covering. Recent German efforts towards this seem to have been successful, for a line of such ware has recently been put on the European market as "Electro-Porcelain." This consists of tea sets, platters, sauce dishes, water jugs and the like made of china with an outer coating of silver, or in some cases, of nickel. As the interior is of porcelain, it will not stain even when used with eggs and is more easily kept clean than the solid metal ware. Hot foods in it will keep warm longer than in silver ware and the plated porcelain is said to withstand the jars of handling better than fine china.

The Blind at the Key

By H. METTIE

One rainy, November night, as the station agent at Park Junction closed the office safe with a slam, the door of the waiting room opened, and a spectacled man, with a cane in one hand and a nickel-bound black leather case in the other, entered. After a moment's pause, he set the case on a seat near the door and walked straight up to the window.

"How about No. 4," he asked in a pleasant but eager tone.

"Why, hello, Mr. Wells," greeted the agent. "I didn't see you get off the train."

"No; I was in the country, about twelve miles below here, tuning some pianos, and one of my patrons brought me up in his buggy. I'm obliged to catch No. 4. We have to flag her, don't we?"

"Yes," answered the agent, and then he added, "There's a young woman here, too, waiting for that train."

Having completed his arrangements for the night and locked the office, the station official strode across the waiting-room to where the young woman sat.

"This blind man is going your way and knows all about the road and the trains," he explained. "I'll leave the lantern here for you to flag the train with," he added, as he placed it on a seat, "and I guess you'll have no trouble."

Above the lantern, in a socket on the wall, smoked and flickered a single lamp, which, as the agent opened and closed the door, flamed up and went out, leaving the lantern to do double duty." The girl shuddered. Half in pity, half in curious interest, her glance rested on the blind man who still leaned against the ticket shelf. She waited for him to speak. Finally, turning his sightless eyes upon her, he ventured:

"Miserable night."

"Indeed it is," she rejoined, "and such a dreary place to wait."

"Yes," he agreed, cheerful at the thought of her companionship, "but it might be worse." Then he took a turn or two about the room in order to get his bearings and relieve himself of the slight embarrassment he felt. "I've waited here a good many times," he added.

"It's my first experience," said the girl. "I missed connection with the accommodation, my train being an hour late, so I had choice between walking in the rain with the agent to a farm house a mile away or waiting. I confess I was dreadfully afraid, and it took all my courage to decide to wait; but"—she hesitated—"but since you are here it will not be so lonely."

"Thank you," said the blind man. Then by way of introduction, "My name is Wells."

"And mine is Helen Duglace," she returned.

The man sat down beside his leather case, feeling for it as he did so.

"Can't you see at all?" inquired the girl, solemnly.

"Not a bit," he replied.

"Isn't it difficult for you to go about alone?" was her next question.

"Oh, no, not now. At first when I undertook to solicit business, I found it trying,

but ten years of hustling have made it easier for me to get around, and now I find pleasure in traveling, coming in contact with people, studying them, and battling with the little obstacles we blind people have to encounter. Yes, I get along about as well as other people do, I presume. I have a good trade, and like my work." With his fingers he tapped nervously on the case beside him.

The girl peered into the darkness beyond the window and wondered how one who lived in constant gloom could smile and be cheerful. It was this thought which prompted her to say:

"Pardon me, but does it always appear dark to you?"

"Oh, no," he replied. "There can be no realization of darkness without light. It is only a matter of contrast, you know. I once saw, and, of course, I understand what you mean by dark. However, it has been so long since I saw the light that I seem not to be in the dark. When I feel the warm sunshine on my face, the world appears light. The knowledge that there is a lighted lantern there on the bench makes this room appear cheerful to me. Our mental world rotates between night and day almost in concert with the physical world. There is a softness about the atmosphere of a bright day which seems to throw light around me. Likewise the heaviness of a cloudy sky puts me into a semi-gloom. After all," he added, with a contented smile, "we live more in mind than elsewhere."

"Do you form pictures of people when you meet them?" asked the girl, with growing interest.

Wells leaned forward in an attitude of listening and did not at once reply. Suddenly he gave a little start and exclaimed:

"Great heavens! No. 4 is two hours late."

"Why, how do you know?" she asked.

"Just caught it over the wire. You see," he went on, "I used to study telegraphy a little, just for pastime, and it has served me well on several occasions. Station agents are so very economical with their knowledge that some of them find it hard to answer a civil question, so I frequently steal information about late trains."

"How remarkable!" said the girl.

"Not remarkable at all. I take the message just as they do. The operators do it by ear, and so do I. You asked me a moment ago if I formed pictures of the people I meet. Yes, especially of those who interest me. The voice is my strongest index of human nature. To me it is what the face, the eye, and the general expression are to you. It is the central feature that I remember as something that I liked or disliked. A voice lives in my memory as a face does in yours. Upon that foundation I build all other mental conceptions regarding those whom I care to study."

For some minutes there was a lull in the conversation. The water dripped monotonously in the spout, and the telegraph instrument ticked on industriously. Finally the girl spoke:

"Two hours late! That means nearly morning before the train comes."

"Yes," he answered slowly, as if his attention were divided between what she was saying and something outside. Presently he arose and moved toward her. 'I fancied I could hear low voices outside, but it may have been the barking of dogs in the distance. The rain, the telegraph instrument, and the ripple of the creek below here make it difficult to distinguish sounds."

"It must be close to midnight," observed the girl.

Wells drew a watch from his pocket, touched the exposed hands and said:

"Eleven forty."

"Please, may I see your watch?" she asked.

"It is not much to see,"—he replied, extending the hand that held the timepiece—"only an ordinary watch without a crystal," and he proceeded to explain the simple method of telling the time by touch.

Suddenly the girl clutched his arm and whispered, "Listen!"

The wooden platform resounded to heavy footsteps, the waiting room door opened, and a man walked in.

"Which way's the agent?" came in a voice of peculiar smoothness.

"Gone home," answered Wells.

"You folks waiting for the express?" questioned the stranger.

"We are," Wells informed him.

"Well, I don't see as you need this lantern," said the man, as he picked it up, "I do, so I'll borrow it for a while," and with a swish of his gum coat and a rattle of the lantern, he departed as abruptly as he had entered.

Trembling in every fibre of her body, the girl clung to the blind man's arm.

"That fellow means mischief," whispered Wells, "I must see what he's up to." And he gently loosened her hold on his arm.

"Oh, please don't open the door," she entreated. "He has a revolver in his belt."

"Keep right still," said Wells, "I'll not open the door, I'm only going to listen."

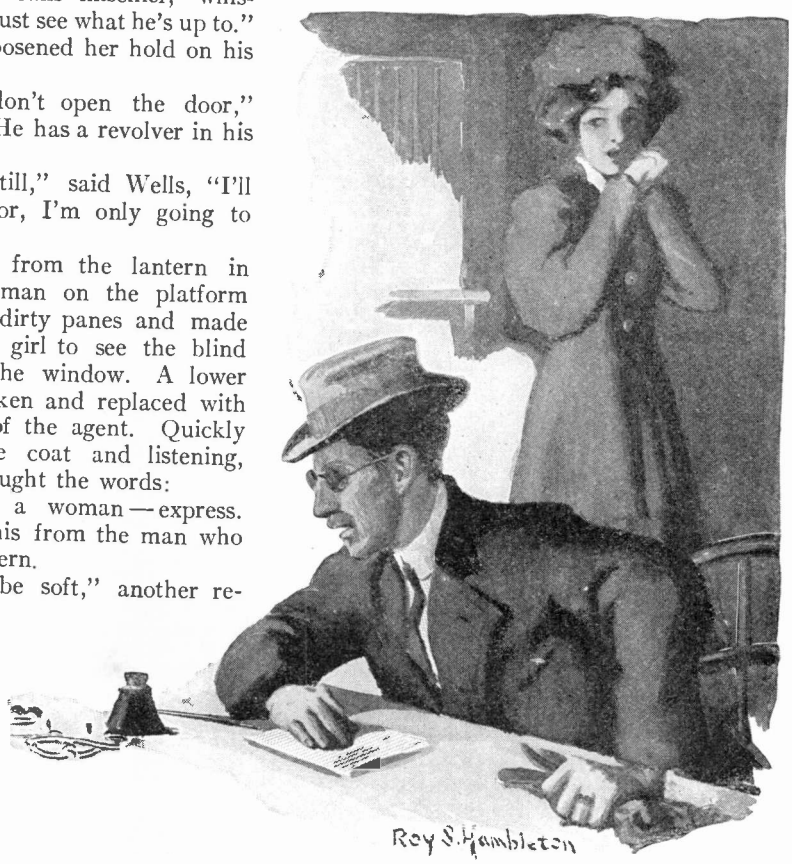
A ray of light from the lantern in the hand of the man on the platform sifted through the dirty panes and made it possible for the girl to see the blind man crouch by the window. A lower glass had been broken and replaced with a discarded coat of the agent. Quickly pulling away the coat and listening, Wells' keen ear caught the words:

"A man and a woman—express. Agent home." This from the man who had taken the lantern.

"The cut will be soft," another remarked.

"Anyhow, it's an easy job," said a third.

This was all Wells could hear, but it was enough to make him realize the situation. When the sound of their footsteps had died away in the distance, he straightened himself and returned to the side of the frightened girl who still stood trembling in the darkness in the middle of the room.



DROPPING INTO THE CHAIR HE FELT FOR THE KEY

"Don't be alarmed, Miss Duglace," he said, "they're gone and we're safe. I'm sure, though, that they mean harm to the express—in fact," he emphasized, "I'd be willing to bet every dollar I possess that there's going to be a hold-up in the cut south of here tonight."

"What makes you think so?" she asked.

"In the first place," began Wells, "that man is a professional train robber. He was caught once, and served two years in the State penitentiary, but he made his escape. You see, the warden of the prison is a friend of mine. I have frequently been in his home, and was there once while this man—Adams is his name—was a prisoner, and I heard him talk. I could never forget that peculiar quality of smoothness in his voice.

"How did it happen, then, that he did not recognize you?"

"He might have, for all I know, but that wouldn't make any difference. He thinks I'm helpless. He'll see, though, whether I'm helpless or not."

"Oh, I wish we could do something," said the girl.

Wells was feeling for his tool case. "We can," he said as he opened it. "I'm going to bore out the lock of the office door and get into that telegraph instrument."

"I'll stir the fire and make a better light," said the girl, anxious to be of some assistance.

In spite of the serious business at hand, Wells laughed softly. "Never mind the light, sister, the less we have the better."

"Of course! I must be crazy," she said, as she trembled in the darkness.

"You stand close to the outside entrance," he commanded, "and warn me if you should hear anyone approaching."

The girl guarded the door and listened, while the blind man's sensitive fingers carefully traced the key-hole and latch. Soon he was boring, and his hands, long trained in the use of fine tools, made rapid progress. So excited was the girl as she watched and waited in the darkness that she could almost hear her own heart beat. The wind whistled dolefully through the telegraph wires; the dull drumming of the water in the spout kept time to the dreary dirge of night. The sightless man worked on. Once, thinking she heard the faraway moan of a locomotive whistle, the girl exclaimed:

"O mercy! Mr. Wells, I believe the train is coming!"

"It can't be," he replied, as his watch closed with a snap.

A few minutes later the girl heard a soft stroke of the little saw; a few more turns of the drill, and then Wells whispered,

"The lock—at last."

"Thank God," murmured the girl.

The office door went back with a creak.

Along the inner wall crept the girl until she stood leaning against the facing of the broken portal. Wells was already inside the small apartment. His hand touched each object that he encountered, first a chair,then the iron safe, and finally the operator's desk. Dropping into the chair, he felt about until his fingers found the key.

"Here we are," he said. "Let's see. I believe H.T. is Hartford's call. I'll try it," and he began ticking off the letters of the call.

There was no answer.

"I may be mistaken," he said to himself, "I'll just spell it in full a few times."

How his heart throbbed when the distant office rattled the answer in quick, sharp clicks. Then he sent an answer to the signal as fast as his lack of practice would admit:

"Hartford, for God's sake hold No. 4. Outlaws in the cut a mile south of Park Junction to hold her up."

"Wait," broke in Hartford,' "she is coming."

Trembling with suspense, Wells waited for three minutes. Again the instrument clicked.

"We have stopped No. 4. Who are you?"

As quickly as he could, the blind man sent his story over the wire, and back came the command from Hartford to "Stay at the key."

All this time Miss Duglace stood in the doorway, waiting breathless with excitement.

"We caught the express at Hartford," he informed her.

"Great!" she exclaimed.

Then came another message from Hartford "Have notified sheriff at Williamsfield, and gang will be surrounded. Wait at Junction for No. 4."

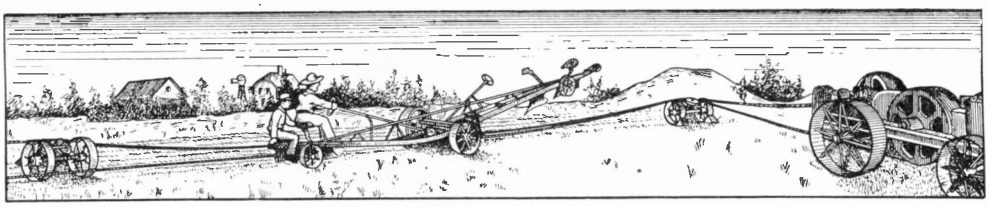
With a sigh of relief, the blind operator arose and made his way to where the girl stood.

"You are perfectly wonderful, Mr. Wells," she said. She could not see the smile that illuminated his face, but she could feel the gentle pressure of his hand.

Lest one of the robbers might return to the station, and discover what had been done, Wells replaced the lock and closed the door. Then he revived the dying fire and he and the girl sat down to wait.

Just before daybreak the blast of a whistle brought them to their feet, and a minute later No. 4, with the captured robbers aboard, steamed up to the platform.

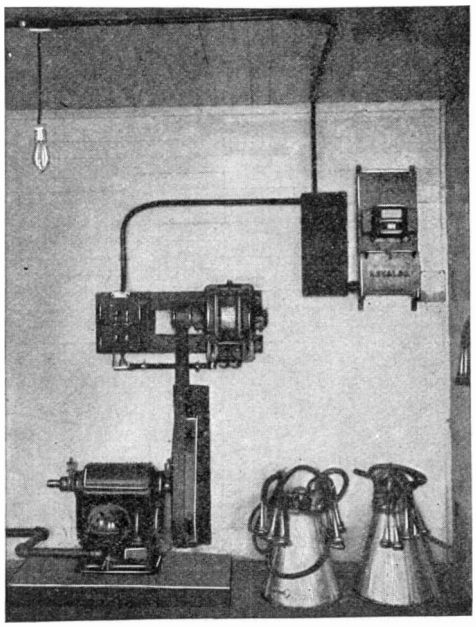
No telegraph operator ever received better pay for a night at the key, than that represented by the check which the railroad company sent to Frank Wells. It came to him in a letter while he was spending a week at the home of the Duglace family.



Electricity—The Farm Hand

When the young men of ten years ago left the farm because of its hard labor and long hours, to seek employment in the large cities where shorter hours and more genteel labor is said to be found, they did not realize how close they were on the old homestead to a time when electricity would be the hired man.

The means afforded for obtaining electric current are increasing. Electric transmission lines from centrally located generating stations now run from town to town through many farm districts, furnishing power and light wherever wanted along the line. In other parts of the country the trolley or interurban line is used as a source of current supply, while on some farms are streams, which, when developed, are capable of furnishing water power sufficient to generate current for use on one or several farms. When one of these sources is not available a plant consisting of a direct connected gasoline or gas engine and generator set, and is so built as almost to take care of itself, may be had at a moderate cost, and with a storage battery affords an ever ready electric supply.

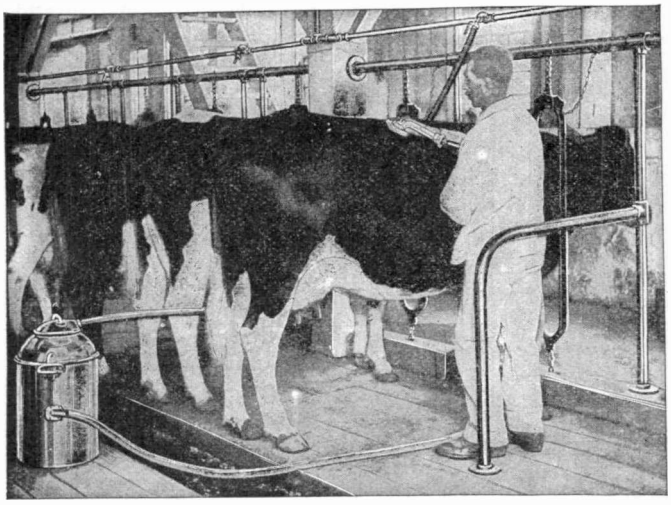


DAIRY VACUUM PUMP AND COW-MILKING MACHINE

It is not the purpose of this article to take up the ways of generating or obtaining electric power, for, if the gas-engine method is decided upon, there are engine and battery manufacturers who stand ready to furnish plans and estimates for an equipment suitable for any particular set of conditions. Similarly with water powers, each of which represents a special problem to be worked out. If there is an electric central station or interurban railway company prepared to furnish current to a rural district, it also has its agents and representatives who are prepared to give the farmer engineering advice as to the methods to be employed in obtaining and distributing the current. But it is the purpose to show by illustration and a few descriptive paragraphs the ways in which electric power can now be applied to farming operations.

The city man who visits the modern farm will have more trouble to escape being called "green" than has his country cousin in seeing the city.

The tallow candle and oil lamp and lantern are disappearing from the clock shelf in the kitchen and a turn of the switch lights any part of the house, barn or other buildings, and furnishes current to a dozen different labor-saving devices in the home. In the heavy work in the barn, shop, dairy and field, however, electricity is at its best.



COWS MADE SLEEK WITH A VACUUM CLEANER

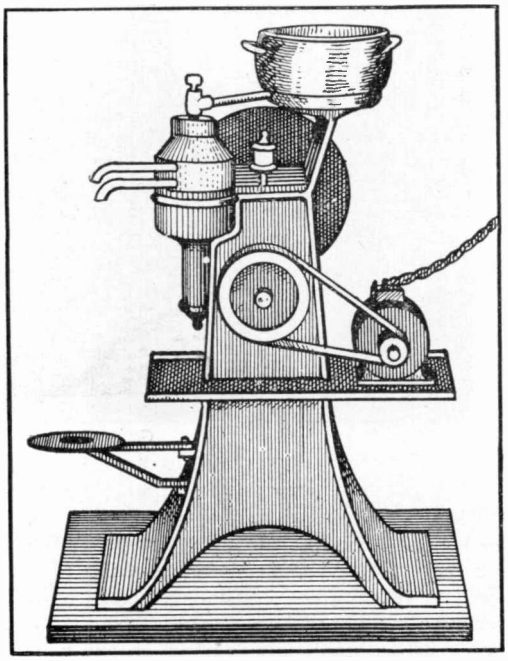
These things are said to be true on the modern farm, advisedly, of course, for it is not presumed that even a large minority of the farms of this country are as yet equipped with electrical conveniences. But the movement is growing, and each year the electrical manufacturers are developing new devices specially fitted for this work, and the electrical age is surely dawning for the farmer as it has already dawned for his city brother.

But to get down to specific examples: About the first thing we think of after the word "farm" is mentioned is "milking." Milking the cows by hand on a farm usually means getting up anywhere from four to five o'clock in the morning and is the after-supper job also. Electricity does this work in a quicker, more sanitary way. The outfit consists of a motor, suction pump, milk can and suction cups, these last on the end of a rubber tube. The can may be connected to a suction pump pipe outlet coming from the dairy, by a flexible rubber hose, the pump and motor being stationary in the dairy and utilized for other purposes. By making and breaking the vacuum in the tube suckers the milk is drawn and released into the can, giving no more discomfort to the cow than does her young calf in getting its breakfast.

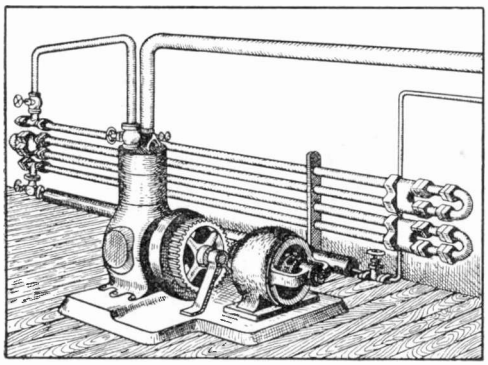
The dairy pump may be used also to operate a vacuum cleaner, with which, when the proper "tools" are connected, the coats of the horses and cattle may be cleaned after motor-driven rotary brushes have first "curried" and loosened the dust.

The dairy offers still more work for the motor, in operating the cream separator and driving the churn. We remember how mother used to work the butter in the old-fashioned wooden butter bowl, using a wooden paddle, but a motor-driven butter worker may now be made to displace paddle and bowl.

During the winter season in the country and after weather cold enough to form ice six inches or more thick on the lake or neighboring millpond, the farmers begin the "ice-harvest," helping one another to fill the several ice-houses which are often crudely built wooden affairs roofed over. The ice sawed into blocks is hauled to these houses and covered with sawdust, to be dug out the following summer. The use of ice thus gathered and stored is not altogether



ELECTRICALLY OPERATED MILK. SEPARATOR



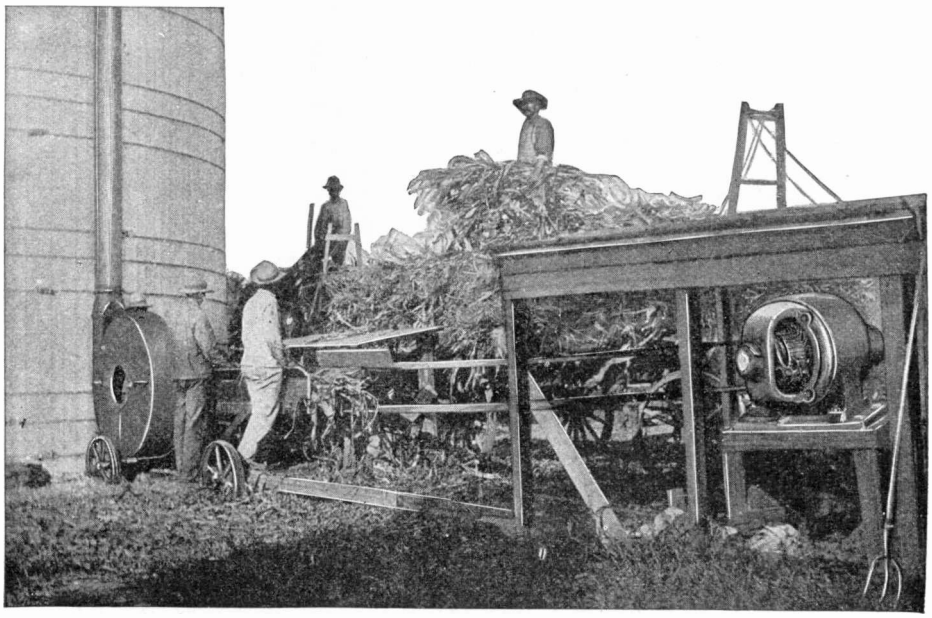
ELECTRICALLY OPERATED REFRIGERATOR

satisfactory and involves considerable labor besides. There is always present a good deal of water, it is not possible to regulate the temperature at which a chill room may be kept, the ice is always wasting away and it may also contain impurities.

Electric refrigeration does away with the ice-harvest even for the average farm by the use of motor-driven ice-machines which regulate themselves. Whenever the temperature rises or falls in the refrigerator the motor is automatically started or stopped, thus controlling by the pump, the circulation of the freezing fluid in the pipes. Outfits large and small are now on the market and the repeated trips to town for fresh meat during the hot weather of harvest and threshing time may be reduced to one or two, the cold dry storage of an electric refrigerator keeping a quarter of beef as long as desired.

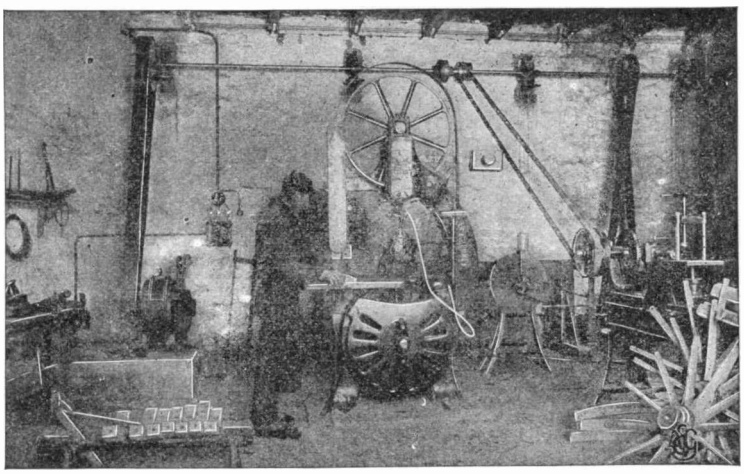
The modern farmer aims to utilize the full feed value of his corn and other fodder by cutting it up either by hand or horse-power and packing it in a silo. One of the illustrations shows the silo being filled the "electric way," a motor driving the fodder-cutting machine while a centrifugal fan blows the fodder up into the silo.

Nearly every farm has some sort of a shop where in bad weather odd jobs of repairing may be done on wagons, tools and farm implements. The shop shown is rigged up to run a lathe, a saw or any other needed machine from a single motor and jackshaft. Even the grindstone for the "love" of which many a youngster has lost out on an anticipated fishing trip, is here connected up, and future inventors, to compensate for past youthful drudgery, may yet produce an electric bait-digger. As but one machine out of several is usually operated at a time, a large motor is not necessary, and the cost of such an installation would not be excessive.



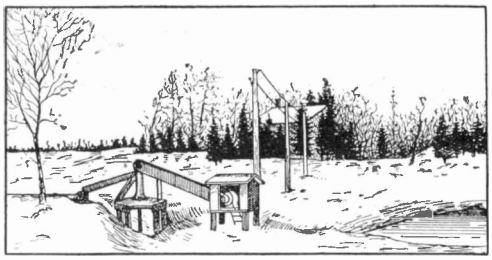
FILLING A SILO THE ELECTRIC WAY

That patch of ground, and every farm has one, which seems to have no bottom to retain moisture after a rain or spell of wet weather is not a source of revenue. Then, too, there are the inevitable droughts that come at just the right time to endanger some crop. A small motor-driven pump set up under shelter as in the illustration is just the thing to use in draining and in modest systems of irrigating.



THE FARM WORKSHOP

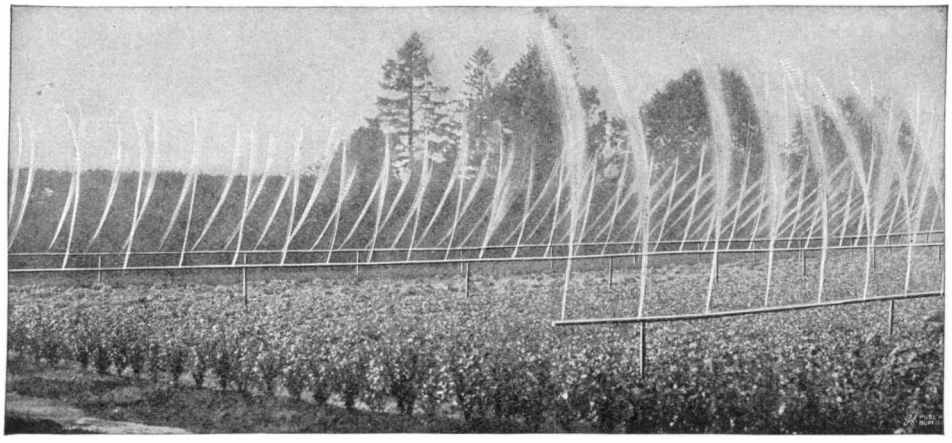
An interesting equipment in the form of a sprinkler system installed on a truck farm



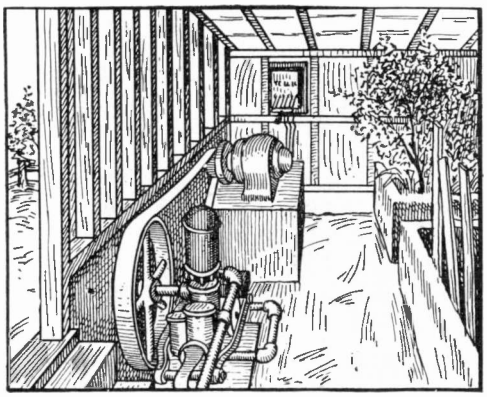
THAT LOW PATCH OF GROUND IS EASILY DRAINED

in New York State is here illustrated, pipes being run from the pump and on supports over the field. In some cases these pipes have been placed on supports high enough to allow the passage of a wagon under them. It is quite possible to arrange so that the water flow may be controlled from a distance as by the greenhouse electric pumping installation shown in one of the pictures on the next page.

Following the plow handles behind a team of horses is still the most common way of turning the soil except on large farms, where steam plows are frequent. Europe, however, and particularly Germany, has at least a dozen motor-driven equipments and there is but small doubt that the electric plow will some day come close to performing its share of work.



SPRINKLER EQUIPMENT INSTALLED ON A TRUCK FARM

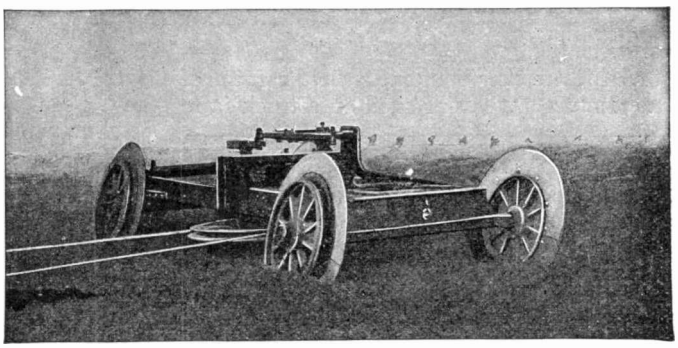


THE PUMPING OUTFIT IN A VACANT CORNER OF THE GREEN HOUSE

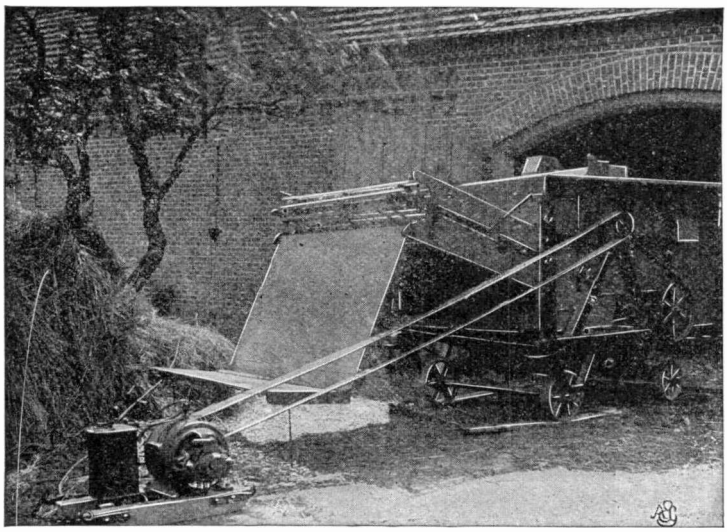
turned furrows will be practicable. Still, the pictures here shown of experimental equipments for electrical plowing are interesting as indicating one stage in the development so far attained. In this instance a jack carriage or truck carrying a motor and controller operates an endless cable and reel which, in connection with the anchor carriage and its flanged wheels on the opposite side of the field, drag the plow back and forth. One man at the jack carriage controls the motor, while a second looks after the plow. This is a queer looking implement arranged on the "teeter-board" principle with plows, steering gear and everything complete on each end of the beam, so by lowering one end or the other it will operate in either direction.

Edison predicts the extensive use of electric plows and rests this assurance upon the lightness, output and adaptability of his new storage battery, plowing thus being done with as simple an equipment as an electric automobile.

In the meantime, however, efforts in this line can only be called experimental and the day is still to come when electrically



ANCHOR WAGON USED IN ELECTRICAL PLOWING



A PORTABLE MOTOR APPLIED TO THE THRESHING MACHINE

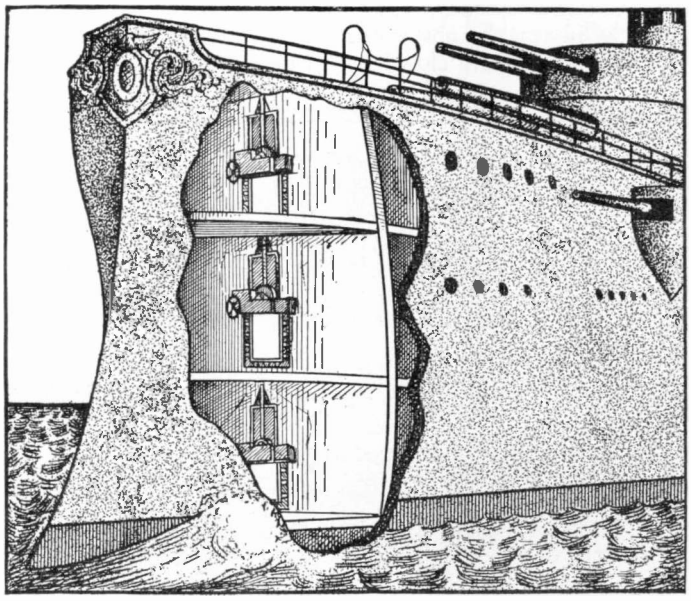
A motor which can be shifted from place to place, belted to a machine and readily connected by flexible conductor to a nearby outlet, finds unlimited uses on the farm. Such a one is illustrated in one of the pictures, being mounted, with its controller, on a sled. One horse can pull the sled and load to any location where it can be staked down ready for service, it being presumed, of course, that the premises are wired and provided with suitable

outlets for attachment of the motor cable near such places as the motor will find employment.

Probably most practical farmers when they read this over will contend that all the devices enumerated above would cost a small fortune and represent an investment far out of proportion to the value of the farm. In answer to this it must be said that there are farms and farms. Some of the largest, where all operations are carried out on a big scale might well use all the labor-saving means described and get a commensurate return on the investment. On smaller places again, perhaps for the first beginning only electric lighting and the portable motor for all around work would be advisable. These are matters which each farmer must decide for himself after first having carefully calculated the cost of a certain installation and then set off against this the actual econo mies and conveniences to be obtained.

ELECTRICAL OPERATION OF BULKHEAD DOORS

As nearly everyone knows the hold of a modern ship is divided into compartments by water-tight partitions extending clear across the hull of the vessel, and having communicating doorways, which may be closed by water-tight sliding doors. Thus in case of accident permitting water to enter one compartmen through the hull of the vessel, the inflowing water may not enter an adjacent compartment. As a rule, lengthwise compartments are avoided, because filling one of them for very long might result in careening of the vessel and throwing one screw out of the water and even capsizing the ship. Or water might get to the furnace room and put out the fires.



WATER-TIGHT BULKHEADS IN A SHIP, SHOWING ELECTRICALLY OPERATED DOORS

So we may assume that the vessel may have from three to 20 water-tight compartments separated by cross partitions, having on several deck levels through-ways which may be closed at once in case of accident or danger.

The demands of the present day are for control of any or all of the water-tight doors from some central station, as well as the possibility of controlling any one of them not only from this point but also from other points convenient to reach. The principal thing is to render the closing independent of human working of the separate individual doors. It is rather difficult, if not impossible, to have the partitions free from doors under the water-line. That would result in an inconvenience to passengers which the most strenuous advocates of safety among them would be the first to resent. So all the various water-tight compartments are connected by doorways, the water-tight vertically sliding doors of which may be opened or closed from above the water-line; and the prompt and perfect action of which is tested daily not only at sea but also in port.

The doors are opened and closed either by hydraulic cylinders, receiving pressure

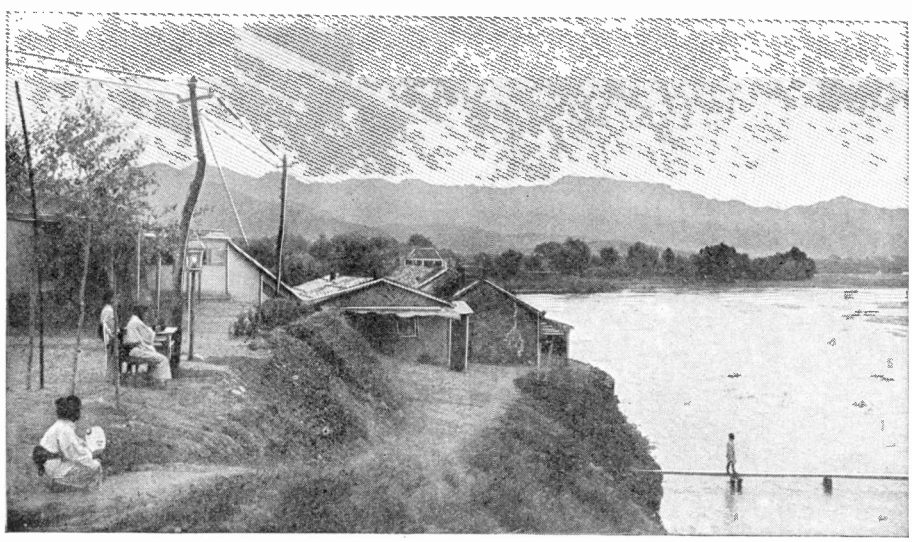
from machinery driven by steam from the main boiler room, or by small electric motors through a worm and worm-wheel. In the latter system, which is the most modern and altogether the most efficient, there is an apparatus, located on the captain's bridge, which automatically connects the various separate motors with an electric circuit, so that the doors are closed in short order.

Besides the device for closing every door from the bridge, there is also a hand-closing apparatus for each one, independent of every other; a small hand lever throwing in the necessary motor for the door in question and opening it. As soon as this lever is let go, the door closes automatically.

Should there be any mechanical obstruction to the closing of the door—or anything in the doorway itself—the motor would be switched out at once automatically, but in such manner that the instant the obstacle is removed the door will be at once closed by the motor. Such a case might occur by reason of a leaky coal bunker.

The motor in question is a slow running compound which may be quite suddenly overloaded without injury. It is of about one horsepower, but for a short time may be crowded up to three horsepower. The door is furnished with a rack which is driven by a pinion in connection with a worm gear. The wedging action of the door itself is such that it closes tightly, but is readily opened without any great friction. There is force enough in the motor to cut through any ordinary mass of coal which might get in the doorway.

In connection with both the electric or the hydraulic system there is a widely-ramified system of alarm bells, to notify all who are below the water-line; and as a rule there is on the bridge a control system by which lamps show the officer there at once which doors are closed, and which are open.



The Telegraph in the Far East

The new Trans-Manchurian Railway, of which the papers have had so much to say lately, is drawing the attention of the traveler to the famous hot springs of Hsiung-yuehcheng, and it is some comfort to the sick, gone there for healing, to know that they are in telegraphic communication with home. The telegraph has penetrated the farthest East. How primitive it is the picture above, showing the telegraph poles, attests. Any old pole will do, whether bulging or not, and underneath these posts my Chinese lady sits, meditating to the whisper of the wires overhead.

Magnetic Dip

By BROTHER POTAMIAN, D. Sc., Lond. Professor of Physics
in Manhattan College, New York

The property of a magnetic needle by which it takes up a definite direction under the influence of the earth's magnetism was used for navigating purposes in European waters in the Thirteenth Century. The other property in virtue of which a needle, free to move in a vertical plane, will not remain in a horizontal position was not discovered until the Sixteenth Century, the fortunate discoverer being Robert Norman, a compass-maker of Limehouse, London. Norman described this peculiar behavior of the needle in his quaint little book The *Newe Attractive* which appeared in 1581, though the discovery itself was made five years earlier, in 1576.

Norman possessed many of the qualities of mind and hand that go to make up the successful investigator of the phenomena of nature; for he was cool, careful, painstaking and resourceful. In pivoting his ships' compasses, he noticed that however carefully he balanced them they did not remain strictly horizontal after magnetization, the north-seeking end invariably dipping downward to some extent. Knowing as he did that the act of magnetizing changed neither the weight of the needle nor its center of gravity, he rightly inferred that this unexpected action of the needle was due, in some way, to the magnetic influence of the earth itself. With the instinct of genius—and Norman was no ordinary man—he bethought him of swinging the needle on a horizontal axis instead of on a pivot so that the magnet might be free to move up and down in o vertical plane; and in this way, he was led to the discovery which is known today as "magnetic dip," a discovery of cardinal importance in the science of terrestrial magnetism.

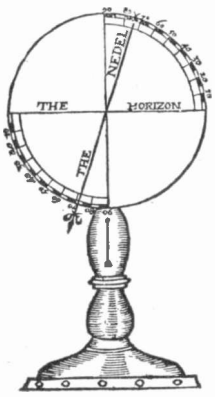


FIG. 1

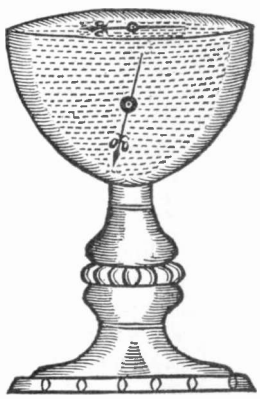


FIG. 2

Fig. 1 is copied from the *Newe Attractive* and shows that the dip in London was 71° 50′ when determined by Norman in the year 1576.

In Fig. 2, we have an apt illustration of magnetic dip devised by the ingenious artificer of Limehouse. Thrusting a steel needle through a piece of cork he pared the latter away until the needle floated horizontally at a certain depth. He next took out the needle and magnetized it. Replacing it very carefully so as not to disturb its position in the cork, he noticed not only that the needle sank to its former depth in the water but that it settled down in an oblique position at an angle of about 72 degrees.

The magnetic inclination at any place on land or on sea is determined by means of a carefully made dip-circle. Fig. 3 shows a laboratory model. After leveling the instrument, it is slowly turned around until the needle takes up a vertical position which it does when the plane of the circle stands at right angles to the magnetic meridian. The circle is next turned through 90 degrees in order to bring it into the meridian, after which the position of the needle is read at both the upper and the lower end for the purpose of eliminating any error that might arise from the center of suspension not coinciding with the center of graduation. The circle is next swung round through 180 degrees so that the side which faced east at first now faces west; the needle is read at both ends as before in order to eliminate this time any error that might arise from the non-coincidence of the magnetic axis of the needle with its geometric axis, or axis of figure. Finally, the needle is taken out of its bearings and its polarity reversed after

which it is replaced in the instrument and two more readings taken to eliminate any error that might be due to the non-coincidence of the center of gravity and center of suspension. The mean of all these readings will give the true value of the angle of dip.

There are many places on the earth's surface at which the dip is zero; *i. e.*, where the needle remains exactly horizontal. Connect all these places together and you will have the magnetic equator of our planet; it will be found to be a wavy line encircling the globe and nowhere coinciding with the geographical equator, though lying near it. As the inclination of the needle is zero on the magnetic equator, this equator is technically called the *aclinic* line. If we connect together a number of places at which the dip has the same value, the joining line will be an *isolinic* line.

It is a fact of observation that as we ascend the ladder of latitudes from the equatorial to the arctic regions, the dip of the needle increases until, at a certain spot, it reaches its maximum value of 90 degrees. The needle then stands vertically over the interesting area which we call the magnetic pole of our Northern Hemisphere.

When the sextant tells the fortunate pole-hunter that his latitude is 90 degrees, he knows that he has reached the goal of geographical exploration; so, too, when Ross (Sir James Clark) on the first day of June 1831 found that the compass had lost all directive power and that the inclination of the dip-needle was 89° 59.5′, he concluded that he had finally reached the north magnetic pole of the earth. Swayed by a feeling of gratitude, he christened the newly-discovered land *Boothia Felix* in honor of Sir Felix Booth, the wealthy Englishman who financed the expedition.

Later on, in the year 1841, Ross, in command of the *Erebus*, undertook an expedition to the Southern Hemisphere during which he endeavored to locate the south magnetic pole. The greatest dip observed was 88° 35′, and this was in latitude 76° 20′ S, longitude 165° 32′ E.

It is germane to the subject to say that, after surmounting great difficulties and enduring untold hardships, Lieut. Shackleton's men finally located the south magnetic pole on Jan. 16th of the year 1909. They found it to be at latitude 72° 45′ S, longitude 145° E.

It is interesting to note in passing that Gauss, one of the greatest mathematicians of the Nineteenth Century, determined the position of the same pole from available magnetic data and found it to be in latitude 72° 35′ S, longitude 152° 30′ E.

Professor David and the other members of the party sent out by Lieut. Shackelton were grievously disappointed at not getting nearer the polar dip of 90° than their 89° 48′; and it was with manifest reluctance that they abandoned all further hunt for the antarctic spot of supreme magnetic interest, being compelled to do so by constant blizzards, icy winds, dangerous crevasses and failing provisions. It has now passed into history that the discovery of the two magnetic poles

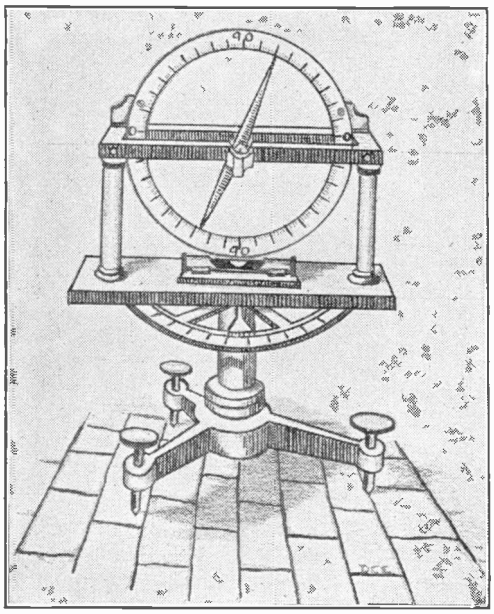


FIG. 3. LABORATORY MODEL OF A DIP CIRCLE AND NEEDLE

of the earth was made by officers of the British navy.

Observations on latitude have shown that the pole of rotation is not fixed and stationary as was universally believed until accurate observations of recent date disclosed its want of absolute steadiness, rhetorically called its "wobbling" propensities. These excursions of the end of our axis of rotation are, however, limited to a score of feet to the right and the left of the true polar point, whereas our magnetic pole indulges in sec-

ular wanderings of much greater amplitude, having shifted on a north-westerly course for a great many years at the rate of a mile and more per annum to return with the same impressive slowness to its original position in Boothia Felix. This we infer from the determinations of Ross in 1831 and those of subsequent arctic explorers including the observations of the Norwegian Captain, Roald Amundsen, in 1903-7.

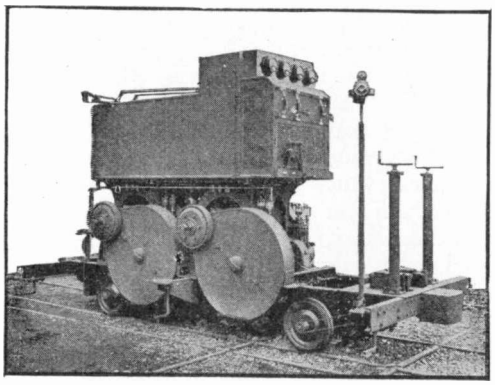
The dip of the needle is of no service to the traveler whether on land or on sea; but it is of primary importance in the science of terrestial magnetism as well as the physics of the globe. A study of the two elements —declination and dip—reveals the manner in which the earth's magnetism is distributed and enables us to realize the irregularity and complexity of this distribution.

Scenic Railway in Brazil

(Illustrated on the front cover, this issue)

According to the verdict of unbiased travelers few localities on the whole globe are equal in their charm to the bay of Rio de Janeiro, which has been a favorite theme for poets ever since its discovery 355 years ago. Sixteen miles long and nowhere over seven miles wide, its irregular shore line can easily be scanned from various vantage points on the picturesque hills which border it and particularly so from the Corcovado which rises to a height of nearly 2,200 feet above the bay and from which the capital city of Brazil draws most of its water supply. The view of the bay from different points on this mountain shows a continual variation of coast lines marked by a maze of inlets, of bird's-eye effects as to the city itself which stretches for nearly fifteen miles along the opposite shore, of clustered hilltops and of luxuriant tropical vegetation.

A single trip up this steep but scenic mountain will show even a skeptic why the difficult task of installing a railway reaching to the summit was warranted nearly 30 years ago. The road installed was a rack and pinion railroad operated by steam locomotives which too often belched out the smoke where it obscured the charming view. Now this road has been electrified, the power being supplied by a plant at Rio das Lages, fully 50 miles off. A 44,000 volt transmission circuit, arranged so that it can be increased to 88,000 volts if the demand for current grows, carries the current to substations where it is transformed into a safe voltage. Owing to the steep climb which ranges from grades of four per cent to some of 30 per cent, the rack and pinion feature of the old steam road has been maintained and a most unusual type of electric locomotive has been developed for this work by two Swiss concerns, the Oerlikon Maschinen-



ELECTRIC RACK LOCOMOTIVE WITHOUT HOUSING

fabrik and the locomotive works at Winterthur. This novel type of locomotive has a pair of 155-horsepower motors arranged so that they can serve as dynamos when going down hill so as to light the cars and furnish magnetic brake action on the downward trip while entirely disconnected from the twin trolley wires.

Bridge Wrecked by Electric Current

Recently a large wooden bridge stood over the Wabash River in Indiana. It was purchased by the county authorities to be replaced by a steel structure. The owners agreed to remove it in 30 days, which was a bigger task than was anticipated. They did not wish to destroy the piers or else it would have been blown up with dynamite. Neither did they wish to injure the masonry by burning the structure. Along came an electrician, then, who proposed to burn it apart with electricity.

Twenty-seven sills were to be cut in two simultaneously in each span and this was accomplished by burning them through with loops of iron resistance made red hot by the passage of electricity through the wires. The wires were arranged, the current turned on and in a few hours the last span had dropped into the river.

Invention by Effort and Study

By GEORGE ETHELBERT WALSH

Many of our great inventions appear to have been the result of accident rather than of well-directed and persistent effort, and there has grown up a pretty well defined impression that the inventor like the poet is born and not made. This theory has enough to justify it, in the lives of many of our great inventive geniuses, and we have records of inventions which seem to have sprung, without any previous thought or training, full-fledged and fully developed from minds gifted with unusual inventive faculties. But these accidental discoveries were in a great many instances the result of long study and work, and while the final achievement came suddenly and unexpectedly it was really the culmination of experiments and effort stretching over years.

In modern industrial life invention by accident receives less and less credit. The inventor of today is such by profession, and is equipped with experience and knowledge far more likely to aid in achieving results than the man without accurate training and study.

There is and always will be a certain element of luck, of accident, and of chance in invention, and there will be born men whose inventive faculties are much greater than those of the majority, but outside of a small number of well-known geniuses the greater bulk of our inventions come from unknown men and women toiling daily at their allotted tasks. Some of these are professional inventors who deliberately pursue this calling as a business, while others are working at various odd trades and industries but with an eye to the chances of possible self-improvement through the invention of some labor-saving machine or novelty. There are industrial organizations whose employees, no matter how humble and poor, are encouraged to make inventions, and if any one of them conceives a new idea he is given every opportunity to develop it. More than that, he is helped by experts, and if the idea proves feasible both credit and royalties are given.

In the last 50 years there have been over three and one-half million applications for patents, and over two and one-half million of these applications have been granted letters patent. A little less than one-half of these, or about one million, were granted in this country.

Sometimes we hear that the day of the inventor is past, and that the great fortunes realized on royalties will not be easily duplicated in the future. This conclusion is hardly warranted. The electrical field alone, although it has yielded vast fortunes to inventors, instead of being exhausted is now being diligently cultivated by companies which employ inventors on salaries, with a further promise of royalties on every successful achievement. Two of the greatest electrical manufacturing companies of the country have each an organized patent department, presided over by men of experience and ability. This board of inventors not only carries on a campaign of careful research, but it is on the lookout for all possible inventions from outside, as well as inside sources. Every employe is encouraged to make suggestions for improvements in his particular department, and if he has an idea of practical value it is developed for him. Some men appear to have the faculty of suggesting improvements, but not the ability to carry them out. Sometimes an ignorant workman can vaguely suggest how a thing ought to be done, but cannot tell exactly how. It is to develop such hazy ideas that boards of inventors are organized in many of our big industries.

Years ago when Niagara Falls was first harnessed, the theory of its organizers was that cheap electrical current would revolutionize lighting and rail transportation. But instead of achieving this result, the harnessing of Niagara gave as its first real benefit a stupendous impetus to invention. It was a great inspiration to inventive minds to have cheap electrical current furnished on a large scale and almost immediately experts began to delve deep down into the mysteries of electrochemistry to discover processes that could be developed and patented.

The Ampere Electrochemical Company was soon formed, consisting of inventors and electrical chemists, and it was more of a patent factory than a manufacturing enterprise. The aim was to discover and perfect

new processes, and then turn the results of their efforts over to manufacturing companies to exploit. They were inventors and discoverers pure and simple, and they no longer found inspiration in their work when their goal was once reached. In this old patent factory were some remarkable and ambitious men; old inventors who understood all the ropes and guides to success; an old college professor who was familiar with all the theoretical knowledge of the age; the practical electrician; the business man; the trained chemist, and young, ambitious men with their laurels yet to win. No hint, no theory, no suggestion was too insignificant for these men to consider and follow out.

From this group of men devoted to invention came such money-making patented processes as the manufacture of carborundum, the making of nitric acid from nitrogen and oxygen, the production of a low grade of artificial camphor from turpentine, and the manufacture of barium salts and calcium carbide by an electrical process.

One of the greatest inventors of the age, Thomas A. Edison, has often been chosen as a typical illustration of the value of chance or accident in inventing. Yet Mr. Edison's whole life work is a contradiction of this theory. He is one of the hardest and most diligent workers of the age. He spent ten years of intense application to the perfecting of a single one of his inventions, and worked nearly as long on his electrical storage battery. In his own words, in an interview with the writer: "Invention is the hardest kind of work, and requires the intensest application of every faculty. There is nothing haphazard about it. There is no luck in it. You reach your goal by a process of elimination. Every factor must be studied, examined, and then eliminated if it is not what you want, until you have narrowed the whole problem down to two or three points. Then possibly luck or accident may play a minor part. Some day the whole thing will dawn upon the mind, and you see the goal you have been working for."

William Sturgeon invented the electromagnet, and in 1825 he presented to the English Society of Arts his first soft iron electromagnet, for which he was awarded a premium of $150 and a silver medal. His life was a perpetual struggle against poverty, and finally friends secured for him a grant of $1,000 and an annuity of $250. But he only lived a few months to enjoy them.

In more recent times many unpleasant stories could be told of inventors who were robbed of the rewards of their discoveries through failure on their part to protect themselves properly. Discovering some great labor saving device, they have sold their patent outright for a nominal sum or disposed of it to companies who simply "shelved" it for years without utilizing it. The expected royalties did not materialize and the inventors did not reap any profits as a result. This phase of the subject emphasizes the necessity of some business ability as well as inventive gifts. The Patent Department of the Government protects the inventor in the use of his discovery, but it can go no further.

One of the discouraging features of the whole inventing profession is that about one in every three applications must be refused because they infringe upon patents already granted. In the majority of cases the inventors are innocent of any intention of infringing upon the rights of others. They are simply poorly informed. Nearly every day applications for patents are made covering important parts of machinery which have already been protected by patents. In order to work intelligently one must make an exhaustive study of his specialty to see what others have done in this field. An idea new to one may be old to others. Before going to the expense of making models and applications study up on the subject and exhaust the field. It is this hard work and effort which brings success.

The profession of the inventor is one of the best and noblest of his day, and it benefits humanity as well as the individual inventor. But it is becoming more and more a specialized profession. Great minds, and many minds, are at work all the time in the field, and the amateur has little show in outstripping the professionals. The safest way is to make a specialty of one line and stick to it. There may be no reward for years, but if one is possessed of reasonable inventive faculties the results are bound to come. Often the greatest inventions waiting for some one to discover and develop them are lying very close by. It may be in some article of furniture, a tool which we use constantly in our daily work, or an article of dress which we handle every day of the year. It is well to cultivate the home field first and try to improve things with which we are the most familiar and not those of which we have only a vague knowledge.

Electric Block Signaling

By SIMON DEUTSCH, E. E.

PART V

The basic principle of the automatic block signal system, where the signal indications are controlled by the position of a train on the rails, condition of the track, switches, derails, etc., was founded on the track circuit. As has been previously explained, the presence or absence of the wheels of a train or car on the rails included in the track circuit, is indicated by its effect, electrically, on the electro-magnet controlling the signal circuits.

The signal indications are mostly conveyed by the semaphore signal, position indications being apparent to the engineer at daytime, and light indications at night. The semaphore signal generally consists of a blade, pivoted on a high post, and attached to a blade carrying a casting which has openings for glass plates or lenses of different colors, the blade when at right angles to the post, denoting "Danger" or "Stop." This combination of pivoted blade and casting is is operated through the medium of a rod connected to an operating mechanism similar to that shown in Fig. 17, the colored glass moving into a position corresponding to the position of the blade, and giving at night, a like indication.

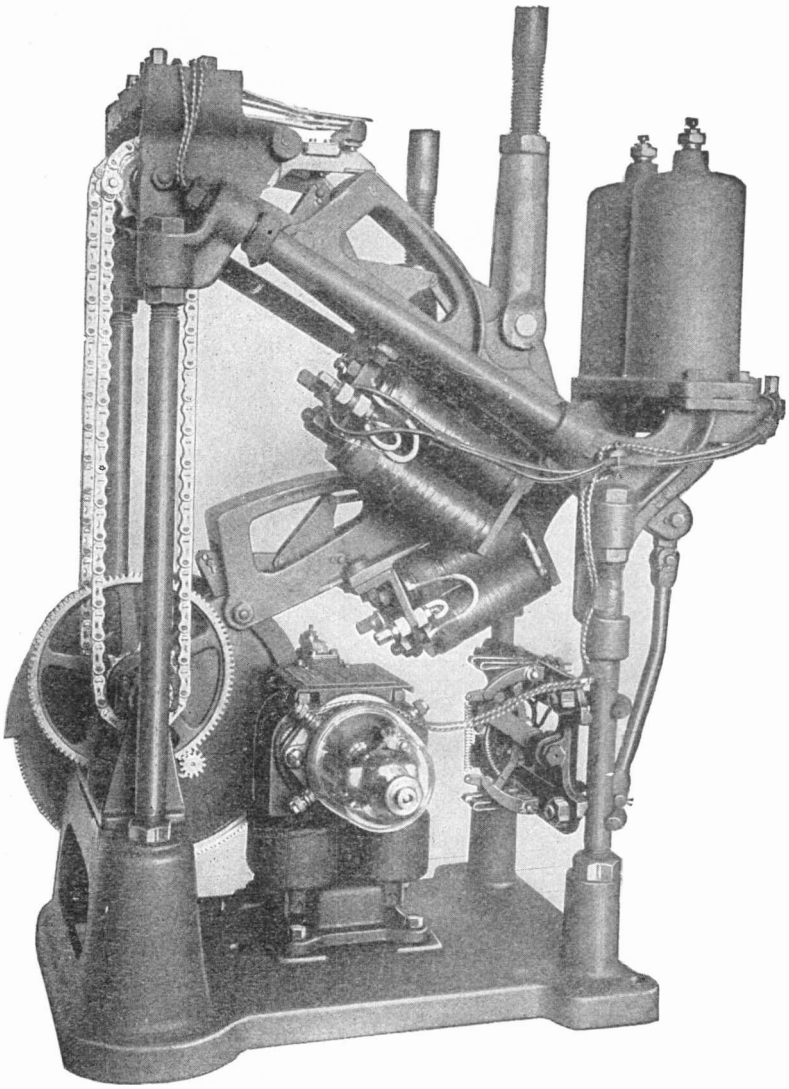


FIG. 17. MECHANISM WHICH OPERATES AN ELECTRIC SEMAPHORE

FIG. 18. THIS TRAIN HAS PROTECTED ITSELF—RIGHT-HAND SEMAPHORE INDICATES "STOP" TO FOLLOWING TRAINS

The means of operation shown by Fig. 17 consists of a motor driven gear and chain transmission, the chain being endless and interconnected at proper times to the blade operating rod through an electro-magnetically controlled arm, commonly called a slot arm. This slot arm, as will be noted, is permanently fastened to the blade operating rod, and carries with it a linked pawl which will engage with the operating mechanism,

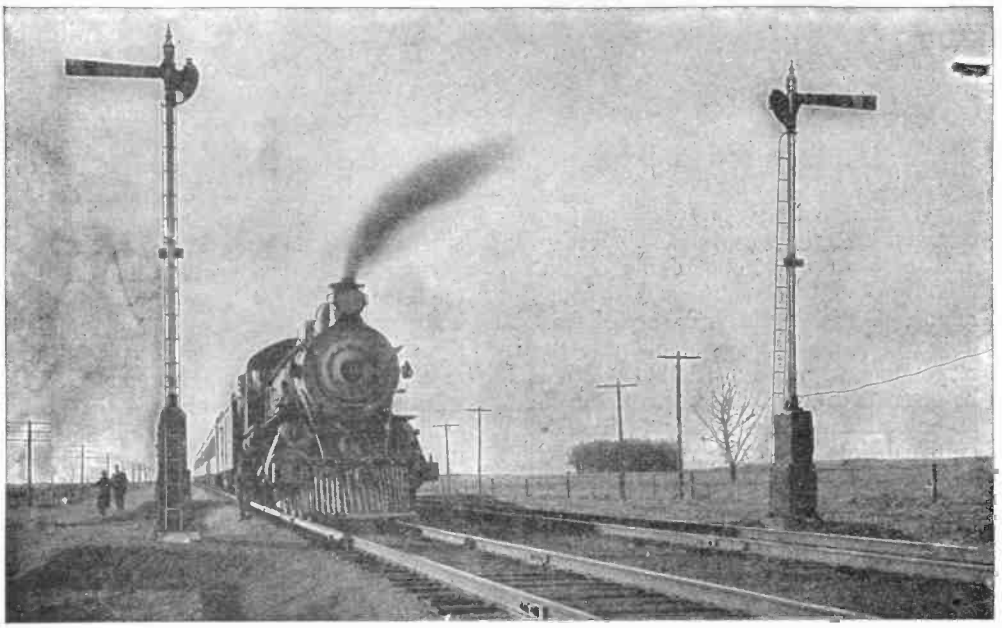


FIG. 19. LOS ANGELES LIMITED NEAR KEARNEY, NEBRASKA, OBEYING A "STOP"

only when the electro-magnet controlling this pawl, is energized.

Part of the current operating the motor is conducted into this electro-magnet, which generally consists of two windings, one of low and one of high resistance, by means of collector switches and flexible wires. As soon as track conditions are such as to cause the "track relay" to close the "signal circuit," the motor begins to operate and the linked pawl is simultaneously projected into path for engagement with the operating mechanism, due to the low winding of the controlling electro-magnet being in series with the motor. Thus the blade is carried from its original horizontal position, to a position corresponding with the indication which is to be given and at this point the motor circuit is automatically opened and the current switched into the high resistance winding of the electro-magnet, which uses but a small percentage of the original current, yet, is sufficient to hold the signal blade in the position to which it was carried. Inasmuch as the signal blade is in the "Clear" position the greatest part of the time, the function of the high resistance holding coil in reducing cost of power, is self-evident. Should any portion of this local signal circuit, or the "track circuit" to which this is secondary, be disturbed or deranged, current supply is immediately cut off from this slot arm "holding coil," and the linked pawl will be pushed from its path of engagement by the weight of the signal blade casting and rod, which are designed sufficiently heavy for this purpose.

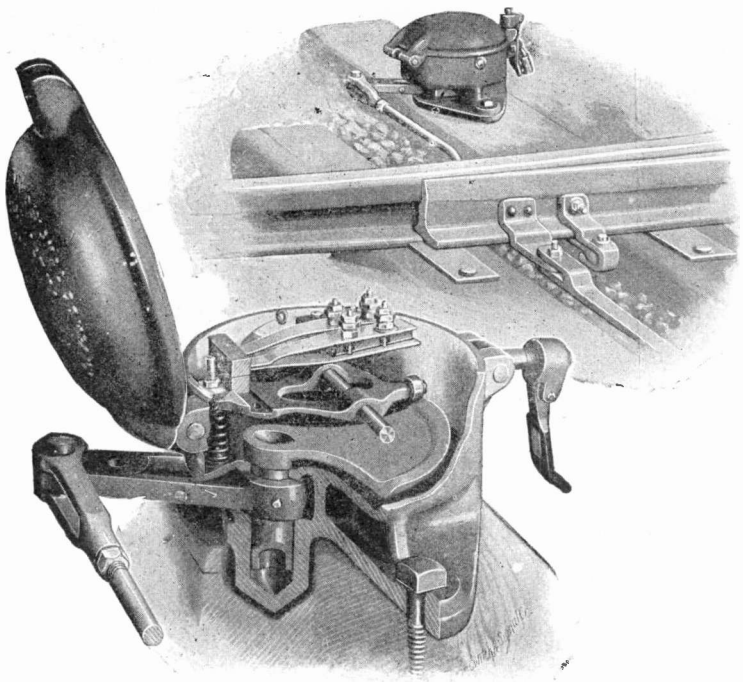


FIG. 20. MECHANICAL CONNECTIONS TO THE SWITCH POINTS

The operation of these signals in actual practice on the Union Pacific Railroad is clearly shown by Figs. 18 and 19. For protection against trains going into or coming from sidings, circuit controllers or "switch boxes," as they are commonly termed, are generally connected mechanically to the switch point, as shown by Fig. 20, so that a slight movement of the switch operates contacts in the switch box, which open or close the signal circuit. Normally all switches are set for main line trains, and the opening of a switch will set signals on both sides of the switch to "Stop."

In order that trains on a siding desiring to take the main line, may know whether or not other trains are approaching, a miniature signal, or switch indicator is placed at the switch stand, same being so connected electrically as to correspond with the position of the signals protecting that portion of the trackway within which the switch is located. In Fig. 21 is shown a common type of switch indicator.

Automatic block signals although primarily are thought of in the sense of protection, as a matter of fact hold an equally important position in increasing the ordinary traffic capacity over certain stretches of track. It is

without doubt a fact that were it not for the possibilities of automatic block signaling, many of the railroads now satisfactorily operating single track, would under the same traffic conditions be forced to double-track their systems.

In general, the ideal arrangement of automatic block signals, for securing the maximum capacity for train movements over a given piece of track, is to make such spacing as will overlap the maximum distance required to stop any train on the road. This can be decided from air brake tests, and

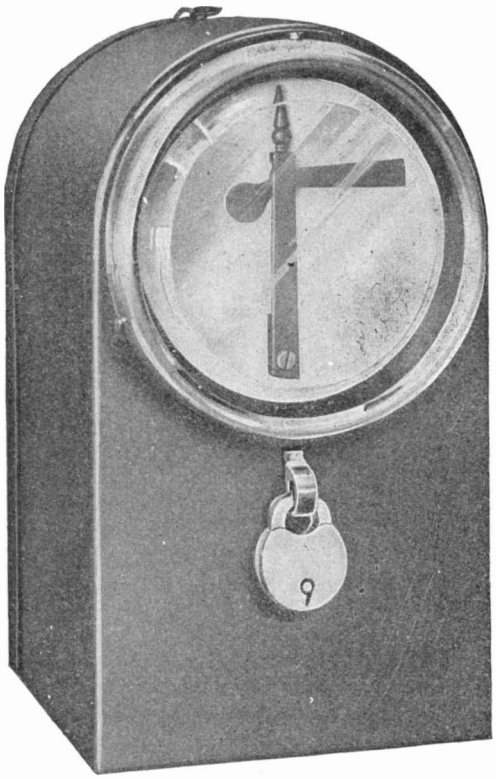


FIG. 21. SWITCH INDICATOR AT THE SWITCH STAND

this distance would naturally be the maximum length of the block.

Since it is more difficult to stop on a descending grade than on an ascending grade, the blocks would gradually be lengthened out on the descending grade, and gradually shortened on the ascending grade. As large terminals are approached, the blocks would gradually be shortened on account of the limited speed and congestion of traffic at such places. Having fixed the locations, the control of the signals should be such as not only to warn an engineer when he reaches a block which is occupied, but also to warn him in time to permit him to stop his train before reaching the entrance of the occupied block.

With this arrangement and control of signals, it would be possible to start two trains from one end of the line, two blocks apart, run them the entire length of the protected road at the same speed.

(To be Continued.)

A Telephone Repeater

Chicago talks every day by telephone with New York, and those who have given these accomplishments little attention often wonder why it is not possible to talk over still greater distances just as easily as we telegraph. The reason lies in the fact that the minute fluctuations in the talking current are damped out and lost if voltage and current of sufficient power to travel over longer stretches of wire be used.

"Why not have a repeater, as in the telegraph system?" is asked.

That is just where the rub comes in. A telephone repeater—for years the dream of inventors—is what is needed, but also, alas, what nobody has ever been able to make work on a commercial basis, unless the repeater of Charles Adams Randall, latest comer in this particular field of invention, should prove to be a practical business proposition.

Mr. Randall exhibited his telephone repeater at the recent Independent Telephone Convention in Chicago, and, although full particulars concerning its construction were not divulged, it apparently did the work over a dummy line equivalent to an actual line a thousand miles long. It has also been demonstrated on a series of short telephone lines in Iowa connected up to aggregate 4,460 miles.

The principle on which this repeater is based embodies the use of a special transmitter which will permit of the passage of heavier currents at higher voltage than ever before used for telephony, and that without any frying or sizzling and fusing of contacts. Furthermore, when a transmission is made, as far as is practicable a receiver at the distant end of the line talks into another of these high power transmitters and on your voice goes, from coast to coast if need be. This latter feature constitutes the repeater proper.

Correction

By one of those exasperating typographical errors which will sometimes occur in the printing of a magazine, it is made to appear in the March issue that Mr. Edward Schildhauer wrote his own biography under "Electrical Men of the Times." The biography was not written "by" Mr. Schildhauer. It was prepared in this office. Mr. Schildhauer is a modest man and it is a shame to have that one little word put him in an embarassing position.—Editor.

The Aero-meter

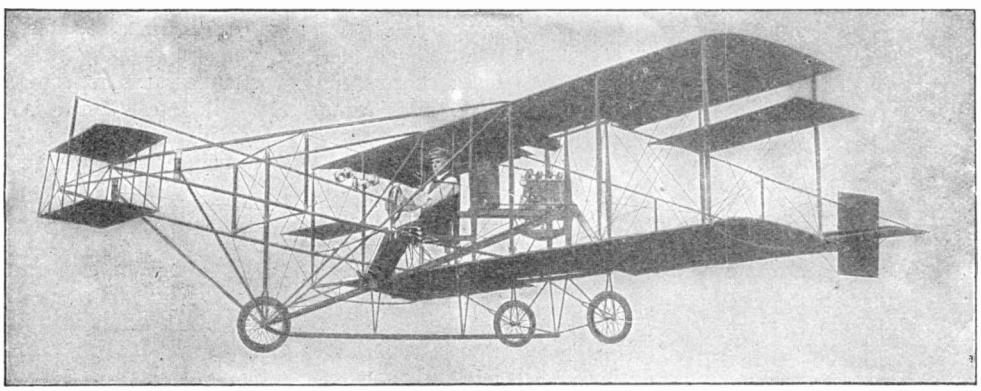
No legislative speed laws control the aeronaut's flight, nor are likely to; but other laws, old as Time, immutable as the Polar Star, he must observe, for the penalty of violation is Death. Can inventive genius supply this need and reduce the dizzy pace to miles per hour?

The lifting and supporting power of the planes depends on the speed at which they are driven through the air; and all evolutions depend on the supporting power. It therefore becomes of the utmost importance to the aeronaut to know at what speed he is moving through the air. A breeze may be retarding him, so far as the earth is concerned, or it may be blowing him onward; but his flight, his ability to sustain his weight and that of his machine, is governed by his speed through the air that carries him, and by nothing else. It would not help him to observe speed indications based on his movement over the earth. He must measure his speed with reference to the air that carries him.

As a consequence we now have the aerometer, one of the first aeroplane "accessories," its inventor being Mr. A. P. Warner of Beloit, Wis. On the front of the aeroplane are mounted four little cup-shaped devices on the ends of two arms placed at right angles to each other. These are similar to the ordinary wind velocity indicator. These rapidly revolving arms turn a very small dynamo which generates electric current. The faster the arms rotate the higher the voltage or electrical pressure developed. In fact the voltage is exactly proportional to the speed, so that it is possible to measure this voltage on a little meter right in front of the aviator's eyes and have the face of this meter calibrated to read in miles per hour instead of volts.

An Electric Sandwich Man

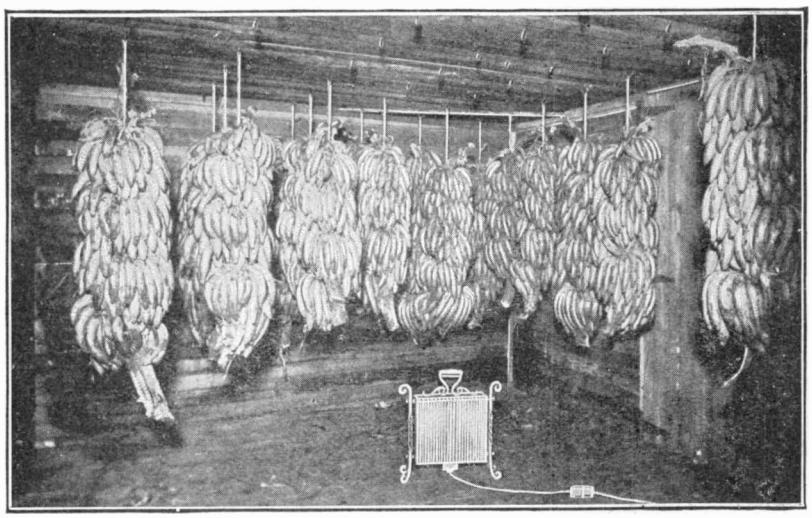
A retailer who believes in advertising through the medium of "sandwich men" recently employed one to walk the sidewalks after dark each night in the neighborhood of the store. The man was decked out in evening dress, with silk hat and open shirt front. Upon the bosom of the laundered shirt the trade-mark and name of some article on sale at the store that employed the walker was formed by small battery lamps—a miniature electric sign. The man flashed the lights at intervals and when persons about him least expected it. In time the walker became known by the name which he flashed across his shirt front. A battery secreted in his clothes and a push button to press completes the outfit.



AEROPLANE EQUIPPED WITH AERO-METER

Ripening Bananas by Electric Heat

Among the many uses to which electricity is put there is none more novel than that of ripening bananas. A dry heat is necessary because of the steam arising from the sweat of the fruit during the ripening process. Also, a temperature of about 75° F. must be maintained in the room at all times. These conditions are best maintained by placing a small electric radiator in the room.



Courtesy of "Chained Lightning"

RIPENING BANANAS ELECTRICALLY

Getting a Ship's Location During Fogs

When a vessel is near enough to land so that it can receive ordinary sound signals sent out from some point on the shore, these will be much longer in reaching the ship than a wireless message sent out at the same time from the same place. In fact, the time consumed in transit by the wireless signal will be too small to be measured by ordinary methods, since the wireless wave travels at the rate of over 186,000 miles per second. For any distance within hearing, such as five or ten miles, this time interval will be negligible so that we can assume that the message is received on board the vessel at the same instant that it is sent from the shore.

But if an audible signal (like the firing of a gun or the tapping of a gong) is sent at the same moment, this will travel through the air at the rate of only 1,123 feet per second, assuming the temperature to be at about the usual average of 60° F. Therefore if both signals are sent simultaneously and the mariner notes the difference in time of their receipt, multiplying this by 1,123 will give the distance in feet between him and the source of the signals. Then since there are 6,080 feet in a nautical mile, there will be 11,230 divided by 6080 or 1.85 sea miles for every ten seconds of intervening time.

Knowing this, the mariner who is groping round in the fog somewhere near land can call the nearest wireless station and ask the operator to tell him its location and to send out simultaneous sound and wireless signals, from which he can easily figure his distance from this wireless station.

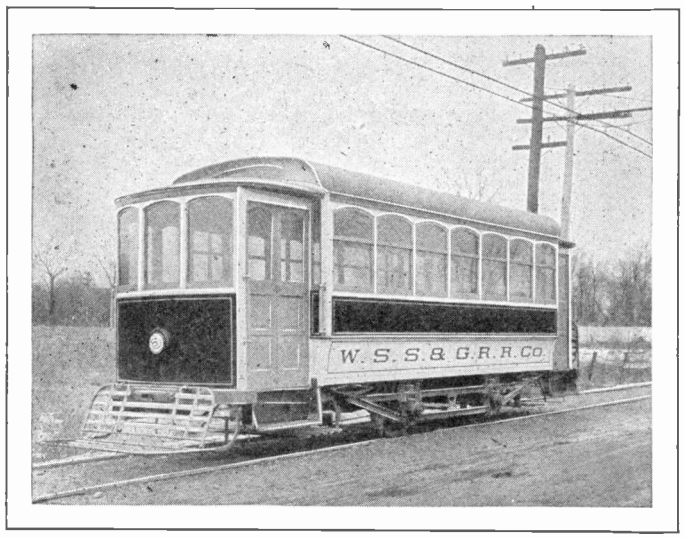
Suppose the interval between receiving the wireless message and hearing the sound to be 27 seconds, that would mean a distance of just five miles, hence he will know that his vessel is somewhere on the outer edge of a circle drawn on his map about the location of the wireless station with a radius of five miles. Now suppose the vessel travels in a fixed direction (as shown by its compass) for say four miles (as shown by its log) before getting another pair of signals which show that it is now seven miles from the same point on the shore. Then if the pilot were to cut out a triangle having 5, 4 and 7 mile sides to correspond to the scale of his map, laying this triangle on the map so that the four-mile side is in the direction just traveled by his ship while the opposite point is at the wireless station, the end of the four-mile side will show the present location of his vessel.

To avoid the cutting out of paper triangles, Capt. W. J. Smith of the Seattle Nautical School has invented a folding rule with a third part sliding on one of the two jointed ones. By using this rule on his chart he can find his location in the above manner almost instantly.

If the simultaneous wireless and audible signals were sent out regularly say every half hour during fogs by certain stations, the mariner would not even need to call for such signals, but could always get his bearings in this way when near enough to the shore to catch the sound waves. Hence Capt. Smith predicts that in the near future such an issuing of simultaneous signals at stated intervals during foggy weather will become a regular practice as an aid to navigation.

Can the Battery Car "Come Back?"

Among the very first attempts at electric railroading the experiment was tried of operating cars by means of storage batteries. This scheme was abandoned at a very early stage in the development and the overhead trolley and the third rail were considered to be the only practicable methods of supplying power to a car. In those days storage batteries were too inefficient and would not "stand the racket." There is a tendency, however, in almost all lines of development to revert, at some time or other, to earlier types. The question now is: Can the storage battery car "come back?" Since the new Edison battery has been perfected and tried out on a working basis for the operation of street cars many are inclined to think it can.



CAR OPERATED BY STORAGE BATTERY

Some mention has already been made in these pages of the new "Beach Car," as it is called after its designer, Ralph Beach, which has for some time been operated on two of the crosstown lines in New York City. These cars are equipped with Edison batteries and possess certain economical advantages which may lead to an extensive adoption. Just now the most interesting equipment of this sort is being operated in Washington, D. C., by the Wash. Spa. Spr. and Gretta Railroad. Aside from the fact that this line, now a trolley line, will have its wires taken down altogether, the point of greatest interest is that this road, four miles in length, consists entirely of grades, with the exception of about 800 feet, the length of two sidings which are at level. The grades range from one per cent to eight per cent, and some of them are very long. The car is said to operate over the Washington grades beautifully. It makes the schedule speed of four miles in fifteen minutes, which includes all stops, and which is barely possible to maintain with trolley cars.

The Beach car is able to take full advantage of its coasting qualities. Once it reaches the peak of a long grade, the men "turn it loose," and with its chain gear, roller bearings, and independent wheel action it coasts down the hills faster even than automobiles alongside on the country turnpike. The ordinary trolley car cannot be allowed to coast very much because of the inadequate spring arrangement—at an unusual speed it occilates at the first rail joint, and the brakes have to be applied constantly—whereas the battery car does not "rock at all," even crossing switch frogs.

This coasting feature and the small savings here and there in the weight of the car, the independent wheel action, in the gear-

ing, etc., altogether result in a very considerable saving in power per car mile, according to tests which have been made.

What effect the Beach car may have in the ultimate elimination of the overhead trolley, which, after all, does seem somewhat unsightly and cumbersome, it is impossible at this time to foretell. But undoubtedly it is doing its full share of the "pioneer work."

Trackless Snow Plows and Trucks

Encouraged by the success of the trackless omnibuses in Italy, Austria, Switzerland and California, several manufacturers have been experimenting with trolleyed vehicles for other than passenger purposes. In Austria the Daimler Motor Society has lately been using trackless trolleys for heavy hauling, two of its new types being shown in the illustrations. One of these is a hooded truck with a carrying capacity of four tons, the vehicle itself weighing about half as much.

The other is a trackless snow plow which has a big advantage over the usual plows of the traction companies in that it can be shifted from one part of the road to the other. The plow as shown has a wagon box

TRACKLESS TROLLEY TRUCK

for hauling the snow and proves surprisingly effective.

Three men with this trolleyed plow were able to remove as much snow in one day as six men with two teams formerly moved in two whole days.

Telephone in the South Pole Quest

A telephone system is to be installed at the south pole, or as near to it as explorers can get. Captain Scott, who recently started on a search for the earth's lower extremity, took with him a complete telephone equipment, consisting of five sending and receiving instruments, a number of light poles and six drums, each containing thirteen miles of aluminum insulated wire. The drums are so made that they can be attached to the rear of a sleigh and the wire laid on the snow as fast as the sleigh moves forward.

TRACKLESS TROLLEY SNOW PLOW

Uninsulated wire was selected because of its lightness. It is believed that the extreme dryness of the atmosphere will make insulated wire unnecessary, and the increased conductivity due to the extremely low temperature will more than compensate for any leakage of current.

The telephoner receivers and transmitters are made of wood because it is feared that ebonite would crack under the effects of the extreme cold.

It is planned to run several lines from a central station, one to an observatory a mile away, another to a post in the open air five miles distant and another to the explorer's headquarters 26 miles distant from the central station.

This telephone system will be of great assistance in enabling simultaneous photographs to be taken.

Sunday Telephone Letters

Not to be outdone by the American system of lettergrams under which a telegraph message sent at night is mailed by the operator at the receiving station so as to reach the addressee in the morning mail, the English are introducing a novelty in the form of Sunday telephone letters. Here the idea is to get the message to the person addressed without the need of carriers such as the special delivery messengers to which we resort in this country when we want letters delivered on Sunday. The Englishman writes on his envelope: "To be telephoned on Sunday," and adds an extra half cent of postage for every 30 words or fraction thereof. Then the postal clerk at the receiving office calls up the person addressed by telephone and conveys the message without leaving the post office. If enough postage is included, the same message may be delivered by telephone to a number of different parties in the same city.

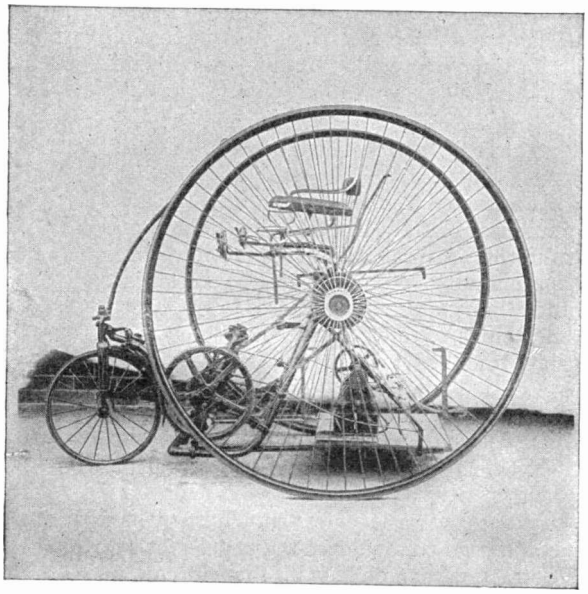
Odd Electric Vehicle—'89 Model

In the September, 1910, issue of POPULAR ELECTRICITY there was presented a picture of the first electric automobile. That is, it was the first electric road vehicle approaching the lines of present-day construction. If we include under this category any kind of vehicle for road work driven by batteries the odd machine shown herewith antedates the one above mentioned by two years. The machine is best described in a letter from Mr. Fred M. Kimball of Boston to Mr. Day Baker, manager of the New England office of the General Vehicle Company. To quote from this letter:

"Agreeable to your request, I hand you herewith negative of the tricycle to which my firm, Fred M. Kimball & Co., adapted the electric drive for Mr. P. W. Pratt of this city about the year 1889.

"The switches on the extended arms in front of the seat were used, respectively, for ringing an alarm bell and governing the supply of current furnished the motor.

"The motor, as you will observe, was a two-pole, back-geared machine and transmitted its power to the foot pedal shaft by means of a sprocket pinion, gear and sprocket chain. From the foot pedal shaft, power was transmitted to the driving wheels by another sprocket chain.



QUEER ELECTRIC VEHICLE OF '89

"The vehicle was equipped with six cells of storage battery, and the crate in which the batteries were assembled was supported by spiral springs from the crane arms, seen projecting fore and aft, respectively, just above the axle. A mechanical band brake, the operating lever of which is seen rising just behind the seat, was an important factor of the outfit, which weighed, all together and ready to operate, about 300 pounds.

"The flexible leads which connected the motor to the battery can be seen coiled up through the spokes of one of the driving wheels. They are identified by one U-shaped terminal, which is plainly discernible.

"This machine was first tested in Winthrop Square, Boston, just after the first concrete pavement was laid therein; subsequently, it was run for several weeks on Columbus Avenue, which, at that time, had just been repaved with concrete."

"The original owner, Mr. Pratt, used the machine two or three years in Boston after which it was taken to Atlantic City and was one of the attractions of the Board Walk.

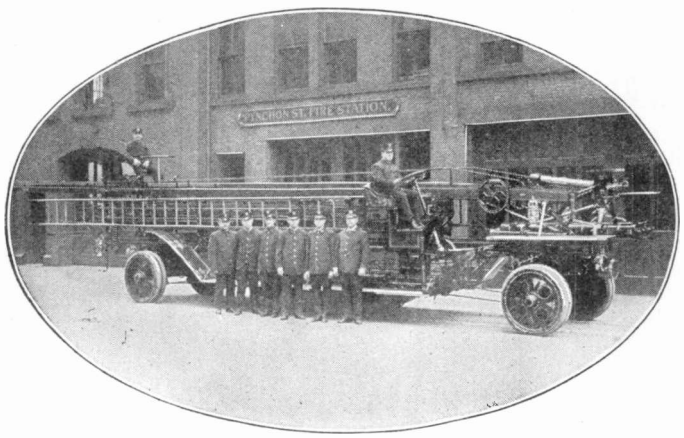
Tungsten Production in 1910

According to the *Electrical World* the production during 1910 of 1,824 short tons of tungsten concentrates is believed to be the largest annual output made by this or any other country up to date, although the total value of the product falls below the figure of 1907. The value of last year's output was $832,992, while that of three years ago was $890,048.

Nearly all the tungsten is produced from fields in Colorado and California, and in the former state the Boulder field, which is the greatest producer, is situated. The second largest field is the Atolia field in California. Arizona, Washington and Nevada also contribute to the output.

A Hook and Ladder Electric

The first electric hook and ladder truck ever built has just been turned over to the Springfield, Mass., fire department. Like the electric fire engine and hose reel the electric motors propelling the truck are located in the wheels themselves and the armatures turn as one unit with the wheel hubs.



A HOOK AND LADDER ELECTRIC

The building of such a long, ungainly vehicle was somewhat of a problem and the vehicle as a whole was the product of no less than four firms. The battery being made by one firm, the trucks and running gear by another, the wheels by a third and the body by a fourth.

The four motors located in the wheels impart a maximum speed of 20 miles an hour, and 80 cells of the new Edison batteries are utilized to furnish power. An automatic arrangement in the engine house provides for the charging of the batteries at all times that the hook and ladder is in the house, thus the batteries are always fully charged and ready for use. An electric search light provides light at night and plenty of it, giving about twice as much light as two ordinary automobile headlights combined.

Pocket Lamps at the Opera

The average play-goer glances over his program before the curtain rises and remembers the names of the actors well enough so that he does not need light at his seat while the curtain is up. But with music lovers it is often different, for the true connoisseur likes to bring his score with him and to watch it during the course of the concert or opera. Then the serious problem arises: Shall the house be darkened sufficiently to make the stage stand out by its brilliancy, or shall there still be light enough so that patrons of the opera can read their librettos or scores?

That this is still a live question, was shown by some discussions overheard during the recent Grand Opera season at Chicago, where some advocated a moderate illumination of the auditorium all through the evening, with a correspondingly more intense lighting of the stage. Others suggested that as the light for reading librettos and music scores was only needed at the listener's lap, this should be supplied by a miniature lamp fastened to the seat in front of him and placed too low to shine into the eyes of anyone. While this hardly seems practical, it recalls the experience of the Convent Garden Opera House in London some years ago during the Wagner festivals. There so many of the regular attendants brought pocket electric lamps with them that the scattered flashing gave a sort of firefly effect which was so distracting to others that the management had to prohibit the use of such portable lamps.

LAMP AND REFLECTOR USED BY A LONDON PHOTOGRAPHER TO BRING OUT THE DETAILS OF FEATURE AND COSTUME

Photographing Actors and Actresses

No people, as a class, pose more frequently before the camera than those of the stage; and certainly no one can be more particular about the perfection of the resulting pictures than the modern actors and actresses. It is not merely artistic pictures and faithful portraits that they want, but photos that will truly portray their individuality and that will show the richness of their garb to the minutest detail. For this purpose any direct sunlight is inadequate, as it leads to "flat" effects. To make the latter stand out, requires a diffused light which can be obtained during the day through windows facing northward by a proper manipulation of screens and curtains. Whenever there are clouds, or when the sun is low, even a fine north exposure of the studio will not give good results.

With the electric light, the available intensity (and therefore shortness of exposure) is easily under the photographer's control. And yet many users of arc lamps have fallen short of their artistic possibilities by exposing the sitter to the direct rays of the lamp instead of diffusing the light; consequently, some have concluded that the electric light could not equal the diffused daylight for the richness of its effects and the wealth of detail reproduced by its use. That this impression is far from true, is proven by the photograph of an English stage favorite reproduced herewith. This was taken in a fraction of a second by the intense light of an arc lamp having four pairs of carbons, the light being reflected and diffused from the interior of a dome-shaped reflector which is collapsible like an umbrella, being made of black gingham lined with a special twill.

This odd-looking lamp and reflector outfit as perfected by Marion & Co., Ltd., of London, is easily adjusted to throw the light just where it is wanted, the top of the reflector being usually about eight feet above the floor.

Mr. Thomas A. Edison celebrated the sixty-fourth anniversary of his birth on February 11 by a particularly busy day at his laboratory in Llewellyn Park, Orange, N. J. He received telegrams of congratulation from a number of the leaders in the electric lighting industry and other scientific fields.

Why Electric Light Bills Vary

The farmer has his busy season in the summer months. It is different with the electric light companies. They make hay when the sun does not shine.

The change in the seasons takes place so gradually that most people do not realize

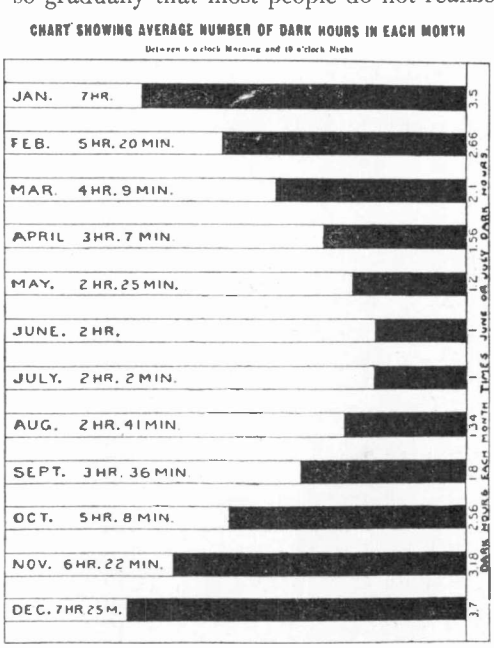


DIAGRAM SHOWING WHY LIGHT BILLS VARY

that the hours of darkness, that is the working hours of darkness, are nearly three times as long in December as they are in June. The exact relation between these hours is shown in the chart, which gives the hours of darkness between 6 o'clock in the morning and 10 o'clock at night.

Naturally the amount of light used is not necessarily in exact proportion to the hours of darkness, but if people go to bed earlier in the winter they also stay out doors in the summer, which evens matters, so the light bills follow the chart fairly closely. This particular chart is true of the Great Lake latitudes. It was prepared by an electric lighting company to give its patrons ocular demonstration of why their light bills vary. Of course the moral is: "Do not rail at the lighting company if your bills increase as winter comes on." Instead, take your bills for a year back and see if their relation is not pretty nearly shown by the chart.

Most Artistic Display Sign Ever Built

In this day of striking electrical display signs, it is unusual for signs of extraordinary size to combine as many unique and original effects as are shown in this mammoth display sign at Louisville, Ky., erected in Federal Park, where by actual count 20,000 people pass every night, between the hours of 5 and 11 o'clock.

The huge steel frame work of this sign, which is built by R. H. Frazier of the Federal Sign System, is 100 feet long and towers 60 feet into the air above the surrounding buildings. At each end is a massive Corinthian pillar forty feet in height, surmounted by a huge ball of wrought iron and art glass four feet in diameter. The sign is divided into six rectangular display spaces, each measuring 20 by 30 feet, upon which are built the various advertising displays. Over the sign the word "Louisville" is shown in huge letters.

The illumination is accomplished by means of 5,503 lamps and the color effects are startling in their beauty and effectiveness. Except for a few red lamps at the base and in the scroll in the capital, the two pillars are a blaze of white light, supporting the beautifully colored art glass balls which are lighted from the interior. The word "Louisville" and the strip lighting separating the panels are outlined in white light.

One of the display signs shows a pianist playing a grand piano, operated by a flasher which causes the player's hands apparently to move up and down the key-board of the piano and her body to assume different positions.

The street car is the most realistic moving effect on the sign and rivals in cleverness the famous chariot race sign in New Nork. The wheels of the car, outlined in blue lamps, revolve forward, and the track, outlined in white, apparently moves backward. Apparently the car is rushing forward at full speed, and its headlight (a 100-watt tungsten lamp) and the sparking trolley wheel adding to the realness of the effect. Suddenly a gong rings twice, the trolley stops sparking, the wheels cease revolving and the car stops.

LOUISVILLE'S ARTISTIC SIGN

A firm of electric contractors in London, England, has installed, as an advertisement, an electrically driven time ball which drops every hour. This is said to be the most reliable public time-piece in London.

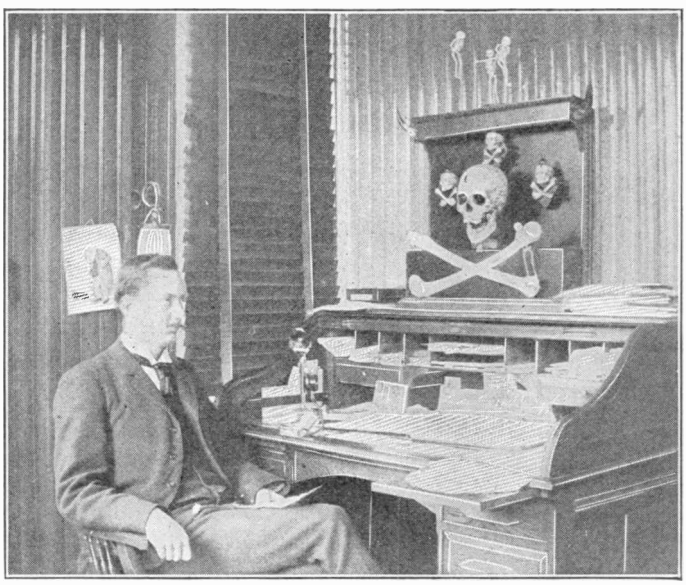
The Story of a Skull

By G. A. WOOLSON

"Studying anatomy?" asked the insurance agent as he gazed at the skull and cross-bones on the ebonized panel over the desk.

"No," drawled Smyth, "I sometimes have commercial visitors or insurance agents that bore me and need a little help."

Smyth touched an unobtrusive button and the hideous bullet-pierced skull turned from side to side, the jaws opened and shut, and the eyes glared in fiendish glee.



THE GHOSTLY SKULL FLANKED BY SMALLER COMPOSITES

The insurance gentleman took out the cigars and said, "Good afternoon."

"Are you disturbed by gruesome things?" asked mine host as he displayed the aforesaid ebonized panel with its weight of horror over his desk. The ghastly skull flanked by smaller composites thrown out in high relief by the somber background and velvet drapery which filled the open space black above, was a trifle startling. An electric button was again pressed and the illuminated skull gnashed its teeth and turned from side to side, and the little skulls followed suit. Lighted or otherwise, no thief or safe-breaker would linger long in the above presence.

The history of the skull is briefly told:

Away back in the seventies, two New England men—Brown and Jones—had charge of ranches in New Mexico for several years. One season a couple of desperate-looking men attached themselves to their camp. One night Jones, who was apparently sleeping rolled up in his blanket, overheard a conversation between their uninvited guests.

"We have got to shoot Jones," said the giant of the pair, "he is getting suspicious of us."

"Hate to kill a man in cold blood," replied the other.

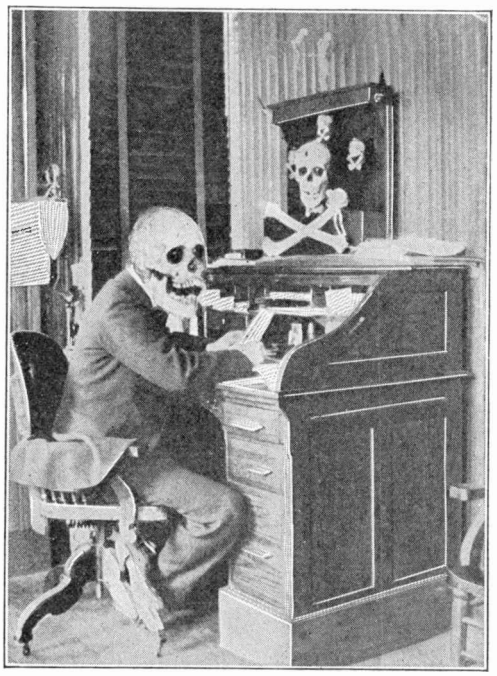
"Can't be helped. I am sure he is on our track. You watch your chance tomorrow and I'll watch mine; which ever gets the first 'll pop him over."

Jones waited until his would-be executioners were snoring like more worthy men, stepped between them with a revolver in each hand, and shot them both. One of the men proved to be Tom Taylor, a noted highwayman, for whom a large bounty was offered. The dead men were buried after the manner of the Wild West.

A few years later, when Brown and Jones were ready to quit the ranches for good, typical souvenirs of the rough life about to close were in order; consequently the skeletons were unearthed. Brown appropriated the skull and thigh-bones of Tom Taylor. The former is remarkable for size and extraordinary development of all but intellectual propensities. The unusual length of the latter bones indicates a height of nearly seven feet, a formidable brigand, as his record proved.

Later on, these important factors in the anatomy of the once powerful Taylor came into the hands of an eccentric genius, who, although lacking perhaps in reverence for "the dead past," is sufficiently optimistic and practical enough to re-animate the deceased Taylor in the following manner:

In the cabinet was mounted a small motor easily controlled from the chair in front of the desk. This motor operated a train of gears and an eccentric that turned



A LITTLE TRICK OF THE PHOTOGRAPHER

a rod on which the skull was mounted; so as to make it face in different directions as a human head would be capable of doing. Another cam operated a crank that caused the jaws to open and shut with rapidity. A circuit-breaker interrupted the current that went to the red lamps in the eye sockets, thus giving the appearance of winking. This breaking was irregular so as to make the uncanny object at times wink rapidly and again stare for a moment. At the same time the little skeletons were operated by strings with due effect.

If the ghost of Tom Taylor should come "riding adown the gale," the temerity of the unscrupulous gentleman would probably be duly punished and what penalty could be more fitting than a transposition of skulls as shown in the second picture—a little trick of the photographer It is a curious fact that even facial expression of inanimate subjects is influenced by pose of body. "To see ourselves as ithers" *may* "see us," even by an odd trick of photography, is no doubt good for the soul.

From Coal to the Car

A small town in the middle west had enjoyed the benefits of a tiny central station for some years. The station consisted of one single cylinder engine and an old-fashioned dynamo. The position of chief engineer, which embraced a variety of duties, had been held by one man from the start. He was an Irishman, one Mike Flaherty. A small boy in the town developed some curiosity on the subject of electricity, and finally decided to ask the chief engineer for information.

"Mr. Flaherty," he said, "what makes electricity?"

Mr. Flaherty surveyed the youngster with calm scorn.

"And don't ye know that, even. Phwat for do ye go to school at all?"

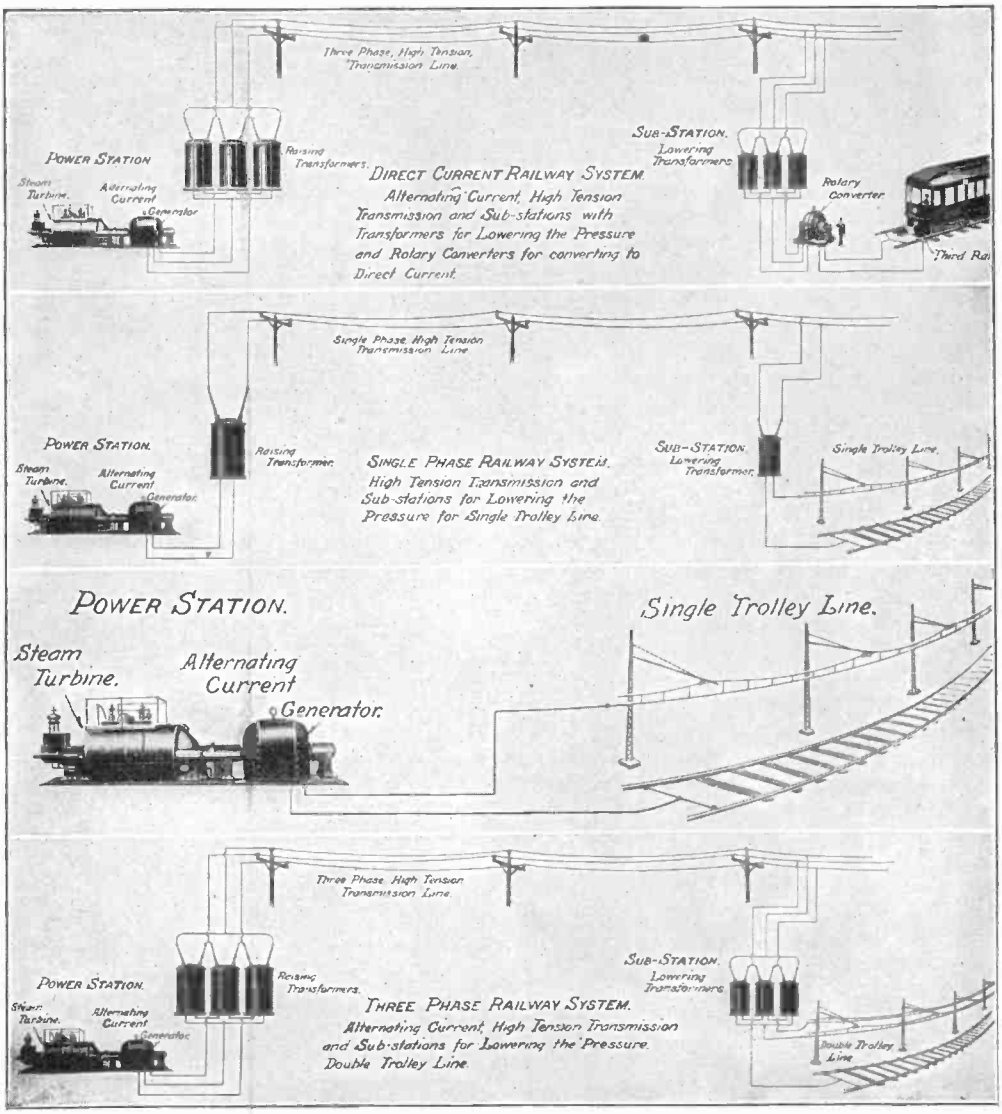
"But what makes it?" persisted the boy.

"Well, 'tis little time I've got to waste on the likes of ye, but out av pure goodness av heart I'll tell ye. If ye rub the side av a cat what do ye get? Sparks. Electricity. 'Tis the same with this masheen here. Them little sticks av carbon rubs on the copper armyture, and what do they get? Electricity. Fr-r-riction, I belave they call it. Yes, me boy, 'tis friction makes electricity."

And the boy went away inflated with wisdom.

Most people, or at least most readers of this magazine, know better than that, but there may well be a good many who do not understand exactly how electricity is transmitted from power houses to electric cars. In fact the pictures accompanying this article were prepared by Mr. George Westinghouse to illustrate a talk he delivered last summer before one of the greatest electrical societies in the world—the American Institute of Electrical Engineers.

The first diagram shows the essential parts of a direct current railway system. The electricity is generated at the power station at the left. It is what we call three-



HOW ELECTRIC CARS SECURE THEIR POWER

phase alternating current. Yet the car is using direct current. Why, then, is alternating current generated at the power station? Because we can use transformers with it. Why do we want to use transformers? To change the voltage. Why do we want to change the voltage? Because the same amount of power can be transmitted with much smaller copper wires when high voltage is used. And copper is expensive. Also, since the current gets smaller as the voltage gets larger, and since the "line loss" varies with the square of the current, we do not lose so much power on the way when we transmit it at high voltage.

Because it is easier to build low voltage generators, we generate our electricity at say 440 volts, "step it up" to 6,600 for transmission, and "step it down" again where we want to use it. This is at the substation, shown to the right on the diagram. Then we change it to direct current by means of a rotary converter, and send it out into the third rail or trolley, as the case may be, usually at a pressure of either 600 or 1,200 volts. The current goes from the third rail

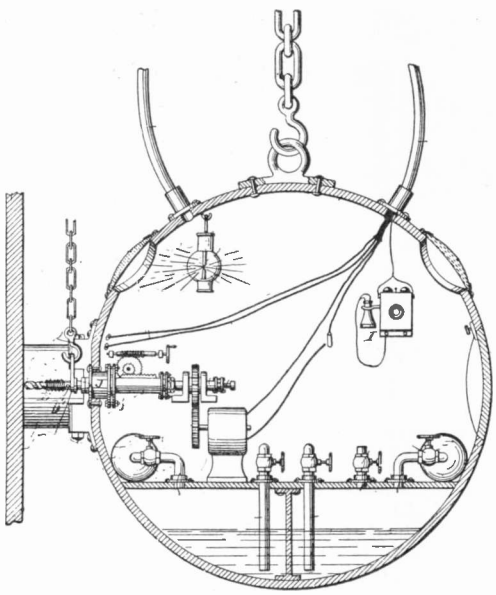
through the motors and back over the other two rails.

The second diagram shows a single-phase alternating current system. It is a good deal like the direct current system we have just seen, except that we make single-phase alternating current at the generators in the power plant, instead of three-phase. We raise its voltage at the power house and lower it again at the sub-station. Then we feed it direct into the trolley wires, and it comes back through the rails.

If the distance between the power house and the cars is not great we can get along without transformers and feed the current from the generator directly into the trolley wire as shown in the third diagram.

The last diagram shows a three-phase railway system. It is exactly the same as the direct current system until we get to the sub-station. There we have transformers for lowering the voltage, but instead of having one trolley, we have two, for three-phase current has to have three paths to travel.

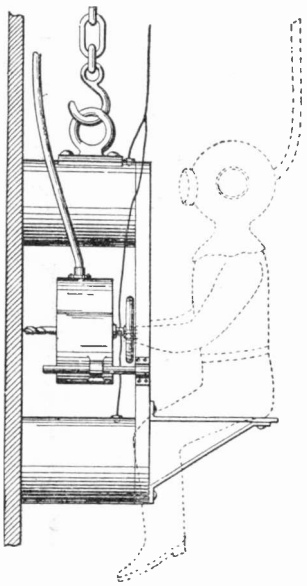
The direct current system is by far the most commonly used in this country. Next comes the single-phase, and after that the three-phase, of which the Cascade Tunnel electrification on the Great Northern Railroad is the only American example.



ELECTRICALLY EQUIPPED DIVING BELL

Lifting Wrecks From "Davy Jones' Locker"

When disaster sends a vessel to the bottom there is always the question of whether the cargo and ship will pay for the expense of raising. At present one means used in raising a vessel is to attach cables to the sides by hooks in portholes, or on projections, or to pass the cables beneath and lift the ship bodily. But difficulty is met in attaching cables, especially if the vessel is at a depth greater than that at which divers can work. Then ordinary methods fail and the vessel is considered lost.



MOTOR DRIVEN DRILL WORKING UNDER WATER

A patent granted to RobertO.King, Buffalo, New York, provides means for attaching lifting cables to a vessel even when sunk in water too deep for a diver in his helmet. The equipment consists of a strong metal spherical diving bell or ball into the side of which is built a drilling machine operated by a motor inside. The bell is large enough to allow one or two men to work. Air is supplied through piping from above, the operators not suffering in consequence from high air pressure. Water in a lower compartment regulated by tanks of compressed air is used for ballast. An electric cable runs the drill motor and energizes electromagnets on the side of the bell holding it firmly against the armor plate of the vessel when necessary. Powerful lights may be directed through the windows of the bell and a telephone line enables the divers to communicate with their helpers.

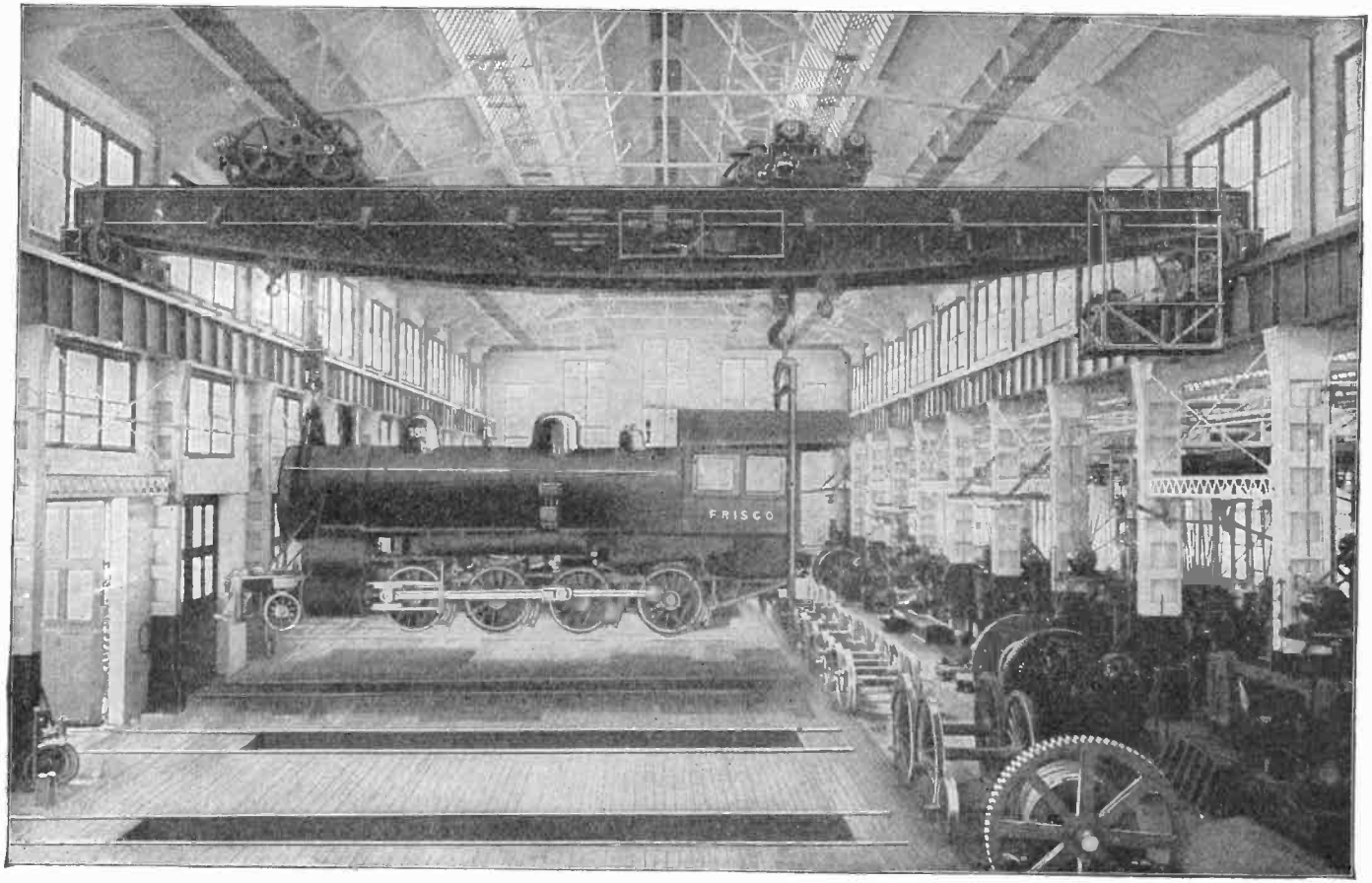
The second illustration shows the device built for operation by a diver in helmet when the wreck is not in too deep water.

Artistic Shadow Dancing

In reviving shadow pictures, the Palace Theatre at London has departed widely from the crude farce effects and the "horse play" that have characterized the shadow performances with which we are all familiar. Instead of presenting burlesque pantomines, the new shadow effects are catering to the same high taste which appreciates the best that sculptors have produced in ancient as well as modern times — lines of beauty, gracefulness of movement and rhythm of action. To attain the artistic in shadow effects has proven far more difficult than in the ordinary stage dancing, as the lack of color schemes and of a second dimension to give a depth and setting to the picture impose rather severe limitations. Indeed, some of the popular stage diversions, such as clog dancing, skirt dancing and even the ballet for this reason lose much of their artistic effect when presented in the shadow form.

Thanks to the ease with which electric lighting lends itself to all sorts of stage effects, the setting is no longer as bare or as colorless as it was with the shadow pantomine in which many of us took part as amateurs when we were younger. Instead of a vast, uniformly bright screen the picture now stands out against a bright background gradually shading off to a dark border, giving the artistic blended effect as of a vignette in a photograph. Nor is it entirely void of color, as the use of colored slides before the spot lights make the shadow figure stand out in the complementary color: dark green against a pink back ground, brown against a greenish screen, and so on. In some cases it has even seemed appropriate to have another lamp project a suitable pict ure on the screen as a background for the dance; as for example, a temple scene for some of the Greek dances. Indeed, so many different effects are obtainable by a judicious use of electric lights that it should be easy to satisfy a wide range of tastes; and if the artistic shadow dances which have already charmed London audiences also set a new standard for stage grace in America, this may be due in no small measure to the lighting effects without which the shadow pictures of earlier days were limited to hurly-burly presentations.

ELECTRICITY MAKES POSSIBLE ARTISTIC SHADOW DANCING



ELECTRIC CRANE CARRYING 187,000-POUND LOCOMOTIVE

Playing With a 93-Ton Locomotive

On the opposite page is a picture showing how a modern electric crane is able to pick up and carry about a locomotive weighing 187,000 pounds. The span of this great traveling crane is 74 feet and the vertical lift 29 feet. The entire weight is carried by a pair of massive steel girders which run on wheels on two girders at the sides of the erecting room. The lifting hooks are raised and lowered by motors mounted on the carriages on top of the crane. These motors are all controlled to a nicety by the man in the cage at the right end of the crane. There he stands in his majesty and by the manipulation of a few levers and switches he lowers away the hooks, picks up the 93-ton mogul and moves quickly and silently down the long room.

The Honey Bee a Live Battery

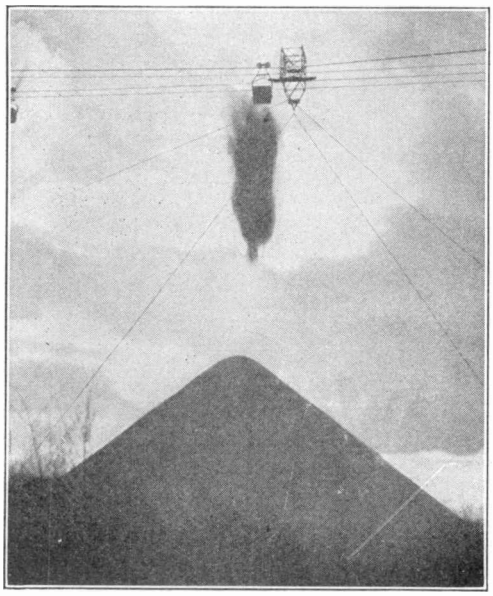
In the following letter from Mr. L. K. Smith, of Grant, Fla., there is the germ of an idea for "electro-naturalists" to investigate. He writes:

"GENTLEMEN: Your magazine is a live wire. The article 'Live Batteries,' page 376, by W. H. Miller, is of special interest to me in the description of these fishes' storage batteries, for it solves the problem of the honey bees stinging without injecting any of the contents of the venom sac. After handling bees eighteen years I note the similarity in the shock imparted by the ignition system of gasoline motors and that of the impact of an angry bee, and I ask myself this question: Has the honey bee a battery in the flakes of wax which it secretes along the sides of its abdomen in thin narrow flakes separated by the telescope-like sections of the abdomen? And at this moment I am convinced that the honey bee is a live battery although not able to prove it by an experiment with electrical apparatus."

Most of us are aware, from experience, that when an angry bee, coming full tilt, hits us in the face, something more than a tickling sensation is felt, even though the bee does not pause long enough to do any real stinging. Whether the feelings so excited are the result of "nerves" on the part of the person being bombarded or are in reality caused by an electric shock no one, to our knowledge, has ever explained. It is conceivable, however, that the busy bee, whose wings beat the air with tremendous rapidity, may constitute within himself a little machine for the generation of static electricity, after the manner of clouds, which generate great quantities of such electricity through friction with the air. Then, given a little leyden jar of telescopic wax flakes, as suggested by Mr. Smith, he might be ready to do business.

Caught in the Act

This unusual photograph was taken at the Thetford Mines in Quebec. It shows very graphically the methods employed in disposing of asbestos chats, a waste material



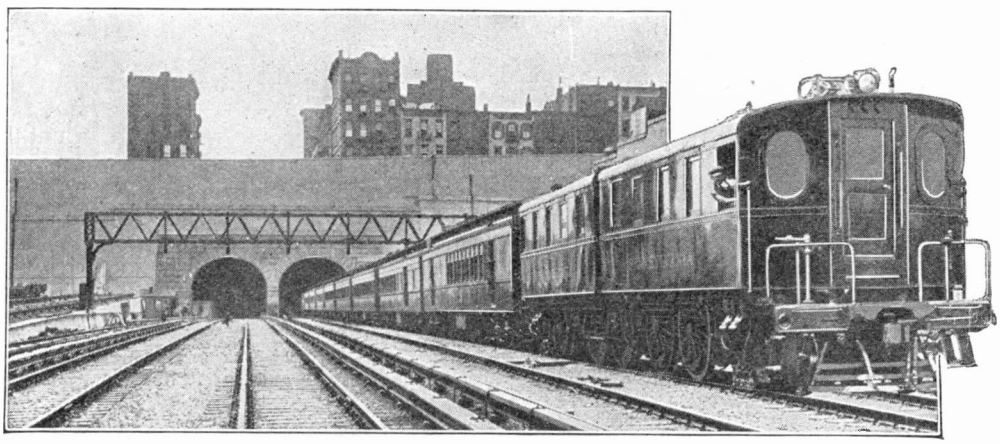
CAUGHT IN THE ACT

produced at the mines. Ninety tons of this waste are handled in an hour by the buckets of the electrically operated aerial tramway.

Two cables on which the carriers travel are supported by towers 100 feet high. Below the carriers are the endless traction ropes, operated by motors at the loading station, which drag the carriers with their buckets out over the line at the rate of 250 feet a minute. Each bucket holds 1,500 pounds of chats, which, at the proper moment, is automatically tripped and dumped on the waste pile as shown in the illustration.

Electric Locomotive the Largest

One of the great Westinghouse electric locomotives, of which nine more have just been added to the equipment of the Pennsylvania railroad, is shown just leaving the tunnel in New York City. These locomotives



ELECTRIC LOCOMOTIVE WHICH WEIGHS 312,000 POUNDS

are by far the largest ever built. They weigh 312,000 pounds or 156 tons. Each driving axle weighs 50,000 pounds. They are of the articulated, double-cabin type with a total wheel base length of 55 feet, eleven inches. The maximum draw bar pull (recorded test) is 79,200 pounds; normal speed with full train, 60 miles per hour. The two motors on each locomotive, aggregating about 4,500 horsepower, turn the drive wheels by means of cranks and connecting rods.

Magnetized Rails Upset Compass

Leaving Gary, Ind., with a cargo of steel rails, bound up Lake Michigan, the captain of a lake vessel was recently surprised to find after steering for twelve hours steadily by his compass and the chart that his ship had approached within a mile or two of the west shore when by his reckoning he should have been almost in mid-lake. After correcting his course and steering carefully by landmarks and stellar observations during the remainder of the voyage, he reported the peculiar behavior of his compass and found that this load of rails had been loaded by electro-magnets from the rail mill to the flat cars used to run onto the docks. The rails are lifted by huge horseshoe-shaped electro-magnets and sufficient magnetism had remained in them from this momentary magnetization to deflect the compass more than a point when stacked end to end in the hold all in the same direction. The trouble might be averted, of course, by reversing alternate cars as the rails are loaded into the vessel.—*Electrical World.*

Electricity

I my destiny fulfill,
Servant to the human will;
  I am yet the fleetest courser,
I am first in speed and skill.

Everywhere my track is free—
Over mountains, under sea;
  Through the world's remote dominion
South and north are one to me.

All that sundered lives require,
All they proffer and desire,—
  Swift as light I waft their message,
Speed their thoughts along the wire.

From the ship by danger pressed,
O'er the ocean's heaving breast
  I, its hope in hour of peril,
Flash the tidings east and west.

On through time the earth will roll,
Yet am I its life and soul;
  Over it my thought pulsations
Knit all lands, from pole to pole.

EUGENE C. DOLSON.

Electricity in German Breweries

By DR. ROBERT GRIMSHAW

The brewing industry has reached the high stage of perfection which now characterizes it by the fact that it has not confined itself to utilizing the results of experience and researches in malting and brewing alone, but has drawn on many other industries for improvements all along the line—technically and commercially. In this connection, electricity in the arts has not been forgotten; and the illustrations here given (by the courtesy of the Siemens-Schuckert Works) show this progress in various branches of the business.

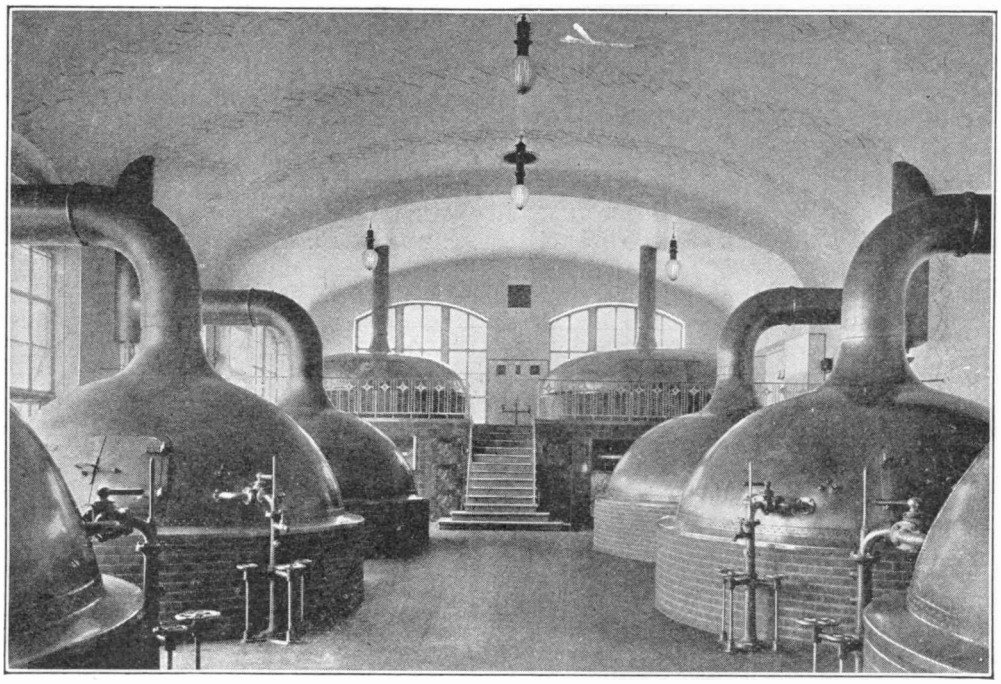


FIG. 1. THE "MASH ROOM" IN A GERMAN BREWERY—ILLUMINATION BY ENCLOSED ARC LAMPS

In the first place, illumination, which is of great importance in brewing, has received due consideration. In Fig. 1 we see the "mash room" of the Thomas Brewery in Muenchen, lighted by arc lamps, and Fig. 2 the corresponding machinery-room immediately below it with incandescent lighting.

The introduction of electric drive for the machinery has found great favor by reason of the simplicity which it brings with it, as well as on account of the saving thereby achieved. Figs. 2 to 4 inclusive show electric drive in several parts of a brewery, the motors being of a special type, designed with due regard to the particular conditions under which they work. For instance, the winding of such motors as run in damp rooms must be protected by a special device against dampness. Where the motor requires protection from mechanical injury or from dropping or spraying water, or where for any cause the touching of a current-carrying part is to be prevented, it is covered with a protecting casing as seen in Fig. 2. Where there is a great deal of water about, the motors are fully enclosed, as seen in Figs. 3 and 4.

In the same way, such electric apparatus as switchboards, safety appliances, starting devices, etc., are protected by a hood or

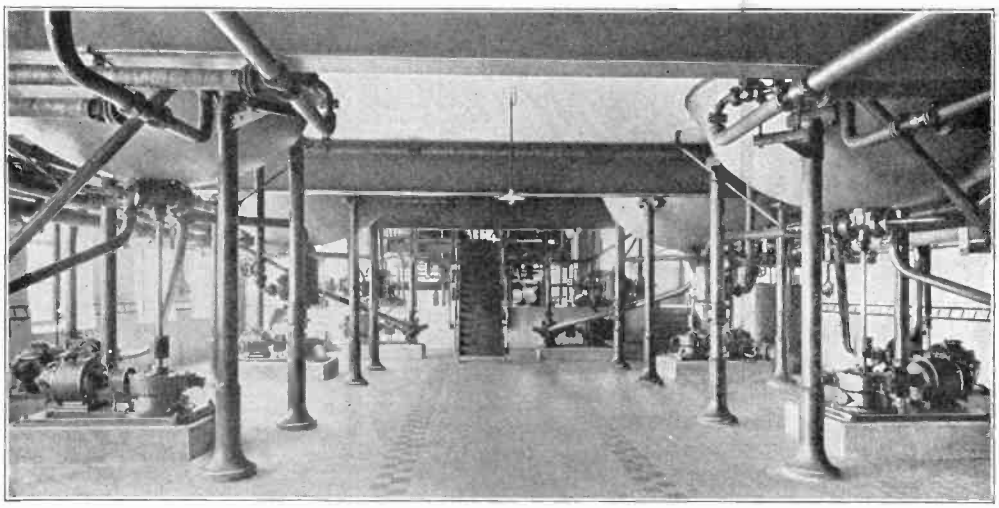


FIG. 2. SHOWING THE ELECTRICALLY DRIVEN PUMPS DIRECTLY BENEATH THE GREAT RETORTS IN THE "MASH ROOM"

casing, to exclude moisture and also prevent injury to the attendants.

Among the examples of electric drive may be mentioned that of the mashing pans and the mash pumps. Fig. 2 shows for instance, the employment of motors for this purpose in the mash department of the brewery above mentioned. To drive the stirring device there are necessary motors of from four to eight horsepower, with rotation speeds which are regulatable within very wide extremes. The machinery is started from the mash-tub house by hand-wheel, shaft and gear-wheels. In the back-ground in Fig. 2 there can be seen the motor for driving the cloudy mash pump, spent malt machinery, etc.

Other machines which are electrically

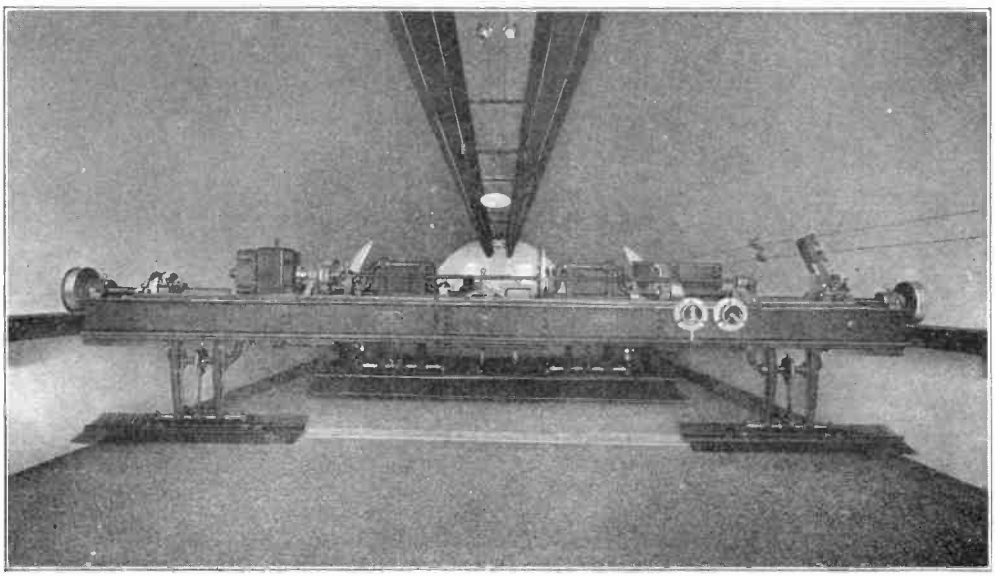
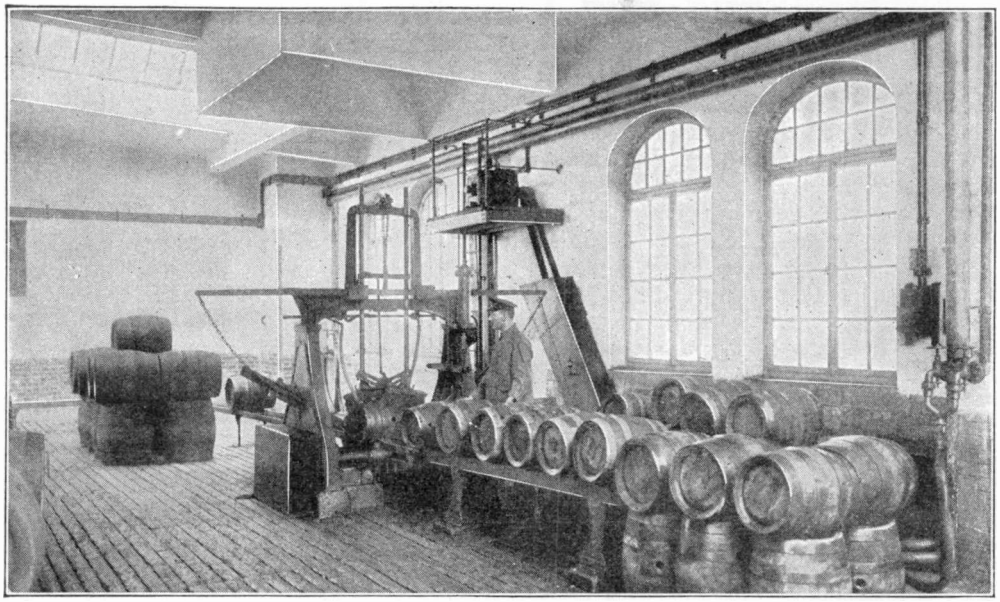


FIG. 3. MOTOR DRIVEN DEVICE LIKE AN OLD-FASHIONED HAY RAKE FOR TURNING AND SPREADING MALT



ELECTRICALLY DRIVEN MACHINE WHICH WASHES KEGS AND BARRELS

driven are those for mixing, washing and ventilating, removing the germs and polishing the grain, the grinding mills, and the apparatus for the spent malt.

A very important application of electricity is in the mechanical malting rooms, where the material is spread and the green malt turned by a sort of electric traveling crane from which are suspended devices something like old-fashioned hay rakes. Also the washing of the malting-floors, the leveling and turning of the malt heaps, as well as the transportation of the cars to the malt-turners, is electric, effecting a very great saving of labor. Fig. 3 shows a malt turner driven by motors.

Among other electrically driven machinery may be named the vacuum pumps, that for handling the spent grains, etc., and in all the various processes connected with storing and shipping, electricity is used as far as possible to save hand labor. Fig. 4 shows, for instance, the electrical drive of a barrel-washing machine in the Paulaner brewery, Muenchen. This machine is driven through a countershaft by a 2.8 horsepower enclosed electric motor, standing on a bracket. The barrels are washed outside and in without any attention on the part of the workmen; so that the thoroughness of washing is not dependent on the workmen's attention or conscientiousness. The machine for pitching the interior of the kegs, washing out the bottles and pasting on the labels are electrically driven.

It is therefore evident that there is hardly in the brewery a single machine for driving which electricity may not be used to simplify and cheapen the application of the power from the prime mover.

Electricity Wrongly Accused

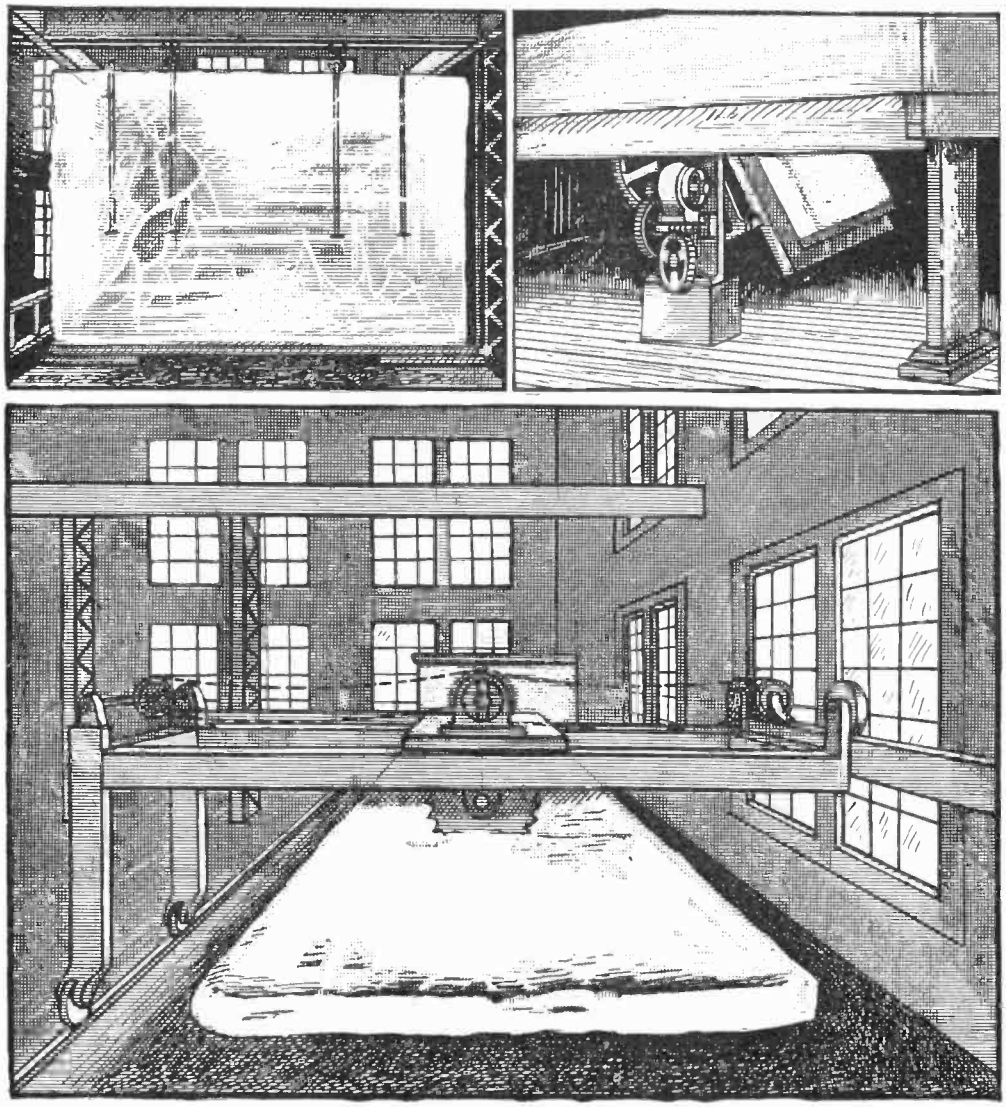
The hue and cry that electricity is a great fire hazard has no foundation, in fact, as is so often proven by the fire reports of large cities where electricity is extensively used.

According to the report of the New York Board of Fire Underwriters electrical fire losses were extremely small for the year 1910. But 24 fires out of the large number investigated were caused by electricity, the property loss being only $27,530. Five fires were due to short circuits; nine to grounds on gas or other piping; two to sparks thrown from operating switches; three to overloaded circuits; one to defective joints; one to loose contacts and one to the heat from an incandescent lamp placed on inflamable material. Of two causes under this head resulting in no damage, one was due to an explosion of an incandescent lamp in gasoline, the other to the igniting of a moving picture film.

Handling and Cutting Ice Sheets

In a plant where artificial ice is made it is interesting to study the methods of handling the product, now done principally by the power of electric motors. In the first place the ice is frozen in huge sheets as large as the size of a good-sized room. To facilitate handling eye-bolts are frozen into each sheet by means of which the latter is picked up by an electric crane as shown in the first picture. Then it is easily transported to a tilting table, also operated by a motor as shown in the second picture. By means of this table the ice sheet is lowered and slid on to the cutting floor without breaking or cracking.

Over the cutting floor a buzz-saw, carried by a movable bridge, is arranged to travel back and forth along the bridge, cutting through the ice as it goes. The motor just above the saw not only turns the latter but furnishes the power for propelling it across the bridge.



ICE SHEETS ARE HANDLED AND SAWED BY MOTORS

Timing Bullet Speeds

By ALBERT SCHEIBLE

The simplest method of testing the efficiency of different powders for propelling firearm projectiles consists in comparing their initial velocities when forced from the same bore by these different explosives. In other words, if we set a screen or target at a fixed distance from the muzzle (say 100 feet or 100 yards) and find the exact time which it takes the projectiles to reach this target, we will have a comparison of the initial velocities from which we can judge the effectiveness of different powders.

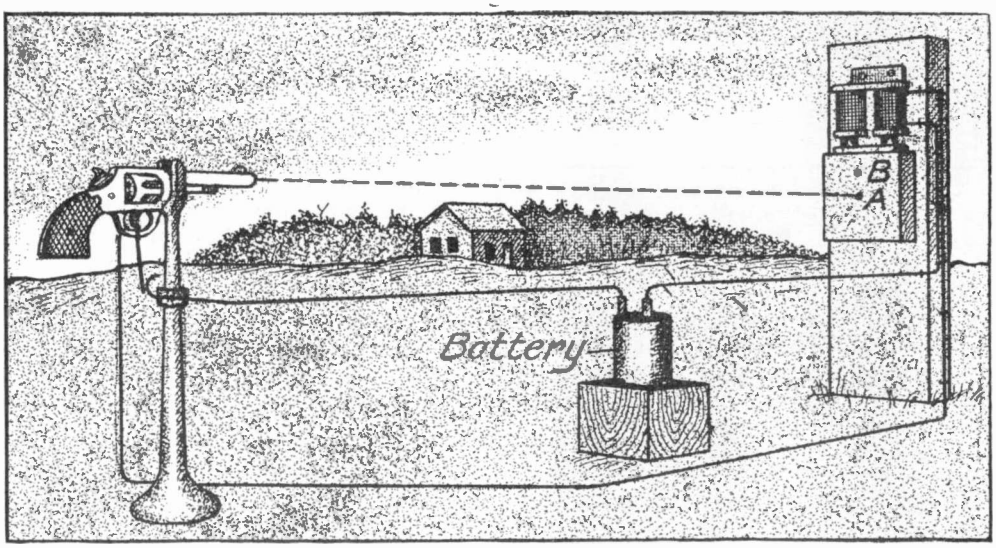


FIG. 1. ONE WAY OF TIMING BULLET SPEED—BY FALLING TARGET

In making such comparisons, electricity has long played an important part, being used in widely varying ways. For instance, one of the methods used in the 70's employed as a target a screen supported by an electromagnet and released at the moment of firing so that the bullet would strike higher on the screen than if this had been stationary. To make sure that the release of the screen would be simultaneous with the firing, the trigger of the pistol or gun was extended to make a contact through which the current passed to the magnet (Fig. 1). When the trigger was pulled, the circuit was opened and the magnet let the screen drop so that the bullet instead of striking at (A) would pierce the screen at (B). The vertical distance between (A) and (B) would depend upon the time spent by the screen in falling, which was equal to the time spent by the bullet on its way, assuming that the breaking of the contact took just as much time as the stroke of the hammer and the exploding of the cartridge. The time that the screen was falling is easily determined by the distance through which it fell before it was struck by the bullet (from the law of falling bodies). However, any variation in the interval of time necessary for the hammer to act and the cartridge to fire, might change the results materially, as the time intervals involved were all quite small. So this method was improved by having the magnet circuit broken, not by a contact on the trigger (which might act before the shot was actually fired) but by a fine wire or gauze which the bullet pierced immediately after leaving the muzzle.

In more recent years various other methods of timing the speed of projectiles have involved the same principle of measuring the time over long distance, so that these tests usually had to be made out of doors. The long ranges were used because they

made the time interval longer so that any errors in recording the time would be much smaller in proportion to the elapsed time than they would be for the short ranges. If smaller lapses of time could be measured with equal accuracy, the testing might be done at short range and much more conveniently. This has lately been made possible by a new bullet-velocity meter brought out by one of the most prominent European

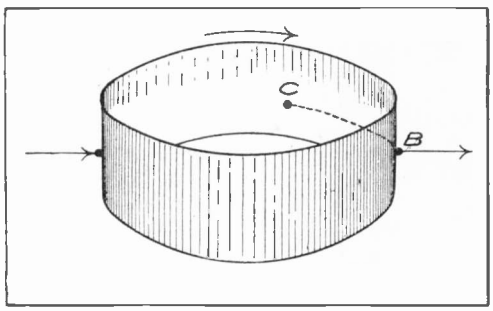


FIG. 2. PRINCIPLE OF THE HARTMANN-BRAUN BULLET TIMER

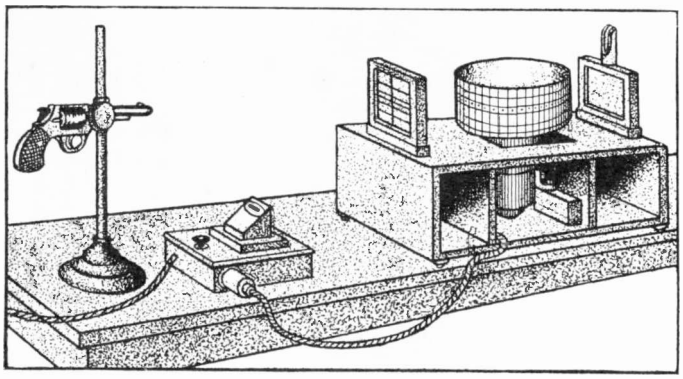
makers of electrical measuring instruments, Hartmann & Braun, Frankfort, A. M., Germany. The new device works on the principle that if you shoot a bullet diametrically through a thin paper drum or cylinder (as in Fig. 2) the point (B) at which the bullet leaves the cylinder will be diametrically opposite the point at which it entered. Now if this cylinder was rapidly rotating in the direction indicated by the arrow, the point (B) would no longer be opposite the entering point by the time the bullet reached the other side of the cylinder, so that the bullet would pierce the latter at a point (C). Then the distance around the circumference between (B) and (C) would depend on the time it took the cylinder to rotate that distance, this being equal to the time spent by the bullet in passing diametrically across the drum. By having the cylinder rotated at a fixed speed (say 2,000 revolutions per minute) it is easy to calculate this time and thus determine the speed of bullets without resorting to long ranges and cumbersome apparatus.

Of course the reliability of this method depends on getting an accurate record of the speed at which the drum rotates.

For this purpose the simpler types of speed indicators are not as accurate as many other laboratory devices, as for instance those used for telling the rate at which an alternating current changes its direction. The makers of this device therefore adopted the ingenious plan of letting the shaft of the drum produce an alternating current whose pulsations will be equal in number to the rotations of the drum. This is done by a simple commutating device on the shaft of the drum, from which wires run to the "frequency indicator" pictured just to the right of the pistol in the cut A knob on the base of this indicator adjusts a resistance so as to vary the speed of the motor.

All the operator has to do, after starting the motor is to adjust the speed till he gets the desired reading on the frequency indicator and then fire the shot.

In practice, the shots do not always pass exactly over the center of the drum and allowances have to be made for any deviations from the proper firing line. For this purpose flat

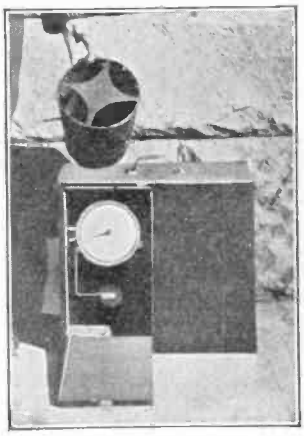


HARTMANN-BRAUN BULLET TIMER READY FOR A TRIAL

screens of thin, ruled paper are placed on either side of the drum and the bullet holes in these show the actual course followed by the bullet. Then it is easy to determine the angle of rotation through which the drum has traveled by applying a straight-edge between the holes in the two screens.

Electricity Saves Fruit

Fruit growers will welcome the electric frost alarm, which by its timely warning will save thousands of dollars' worth of fruit from freezing, and yet allow the orchardists to sleep nights instead of sitting up to watch a thermometer. The device is small and compact, having a certain resemblance to a clock in a square case, and it is equipped like a clock with two hands. One of these registers the degrees of temperature, while the other is set at the danger mark, which differs for the various fruits. When the thermometer hand reaches the point at which the alarm hand is set, a bell rings and continues ringing until the sleepers are aroused and shut it off. The electric thermometer is placed in the orchard and connected by wires with the sleeping quarters of the ranch foreman or whoever is responsible for the frost protection.



ELECTRIC ALARM AND SMUDGE POT

This device is operated in connection with the oil-burning smudge pot, extensively used by fruit growers in California and Florida. These pots are placed between the rows, about one hundred of them to an acre, and as they are kept filled and in readiness the laborers merely apply a torch to each, and the resulting heat and movement of the air prevents the frost from settling.

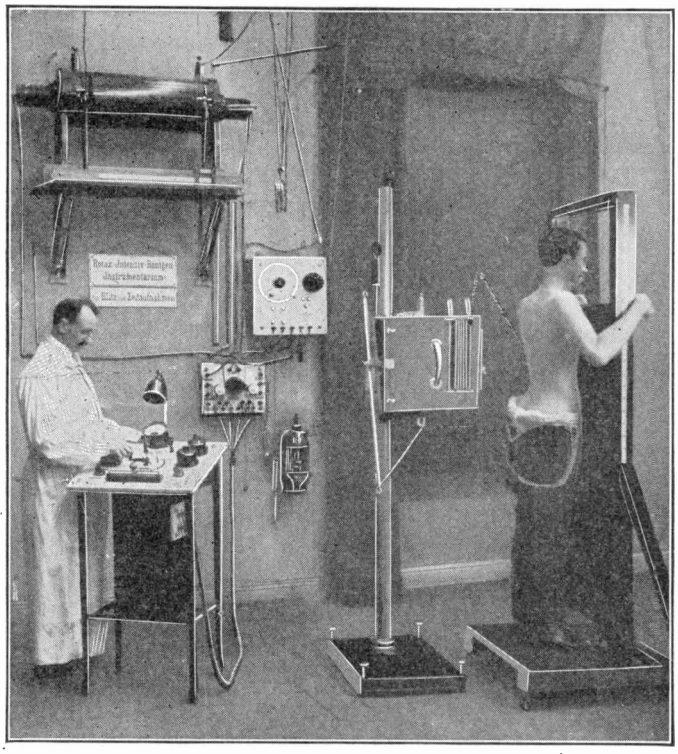
At the Moose Mountain workings in Ontario, Canada, an electro-magnet has taken the place of a steam shovel for loading iron ore. The ore is first broken up by blasting, and then picked up by the magnet, 800 pounds at a time, and loaded into cars. This saves the expense of new buckets formerly worn away by the hard ore.

ORCHARD PROTECTED FROM FROST BY SMUDGE POTS

X-Ray Pictures of the Stomach

By DR. ALFRED GRADENWITZ

Considerable difficulty has been so far experienced in obtaining X-ray pictures of the stomach, on account of the characteristic ("peristaltic") motions of that organ. Unless therefore the duration of exposure be reduced to a minimum, the outlines of the X-ray picture are liable to become blurred, thus wiping out any finer details. Another necessity difficult to comply with is to provide for a visual X-ray examination being made previous to the taking of an X-ray picture, so as to get an adequate idea as to any constrictions and expansions in the walls of the stomach. Again, as the X-ray picture should be taken immediately after radioscopic observation, the outfit should contain a simple switch allowing it to be made ready at a moment's notice for either operation.



TAKING AN X-RAY PICTURE OF THE STOMACH

The outfit constructed by a Berlin company effectually eliminates all these difficulties and is equally suitable for radioscopic and radiographic work (flash-light, instantaneous and long-exposure views) as well as for therapeutical radiation.

The outfit merely comprises a high-intensity induction coil mounted on two brackets, a quick-break switch, a Rotax interrupter and a distributing board connected with a switching desk. A special universal stop allows the intensity of X-ray radiation to be readily adapted to any special conditions. When experimenting on persons in an upright position there is used a vertical support comprising a universal slide against which the subject is placed. The apparatus is operated as follows:

After having taken a "bismuth meal" (diaphanite or bismuth) required for any X-ray photography of the stomach, the subject is examined radioscopically immediately after which an X-ray picture is taken. After adjusting the switch to instantaneous working, the time of exposure is adjusted for on the scale and the apparatus is thrown into circuit.

Since the first of the year the National Bureau of Standards has adopted a new value for the standard volt in this country to correspond with that in England, France and Germany. The change, while numerically very slight, will be felt in the incandescent lamp industries. The change is based on the value of the Weston cell at 20 deg. C. Heretofore we have rated the cell at 1.091 volts; now the rating is 1.0183 volts.

The Electric Stevedore

The big stevedore who pushes trucks around the freight houses, and whose chief strength is physical rather than mental, will have to look for another job if other companies follow the lead of those along the New York docks, where the electric freight truck is being used in his place.

This truck carries its own power in storage batteries. It is hinged in the center and can get over almost any inequality or scoot around a corner like a big caterpillar. It will run eighteen miles on a single charge at a maximum speed of 4½ miles per hour. Two tons of freight makes a nice comfortable load for it but it can carry four tons at a pinch. It has solid rubber tires and can be steered from either end. The operating cost with current at six cents per kilowatt-hour is about ten cents per mile.

THE ELECTRIC STEVEDORE

A STARTLING GATEWAY

A Startling Gateway

A remarkable specimen of grotesque art is the dragon gate at Venice, California, which stands before the Oriental pavilion of that resort. It has a height of about 20 feet and is in the type of Japanese portal made familiar by "tea gardens," but the startling feature of it is the pair of huge gilt dragons coiled around the upright posts and apparently hanging on by their murderous looking claws. These dragons are brightly gilded and with their menacing fangs and bristles form the substantial theme for a nightmare. As they are brilliantly lighted by incandescent lamps that follow their sinuous course around the posts, they are as spectacular by night as by day.

The Indianapolis & Louisville Traction Company has taken a novel method of advertising, with the intention of reducing the number of accidents. In carrying out the plan, blotters bearing a list of the most common causes of accidents have been distributed among the school children in the vicinity of the company's lines.

From Out the Leyden Jar

The Vandalia Railroad recently conducted an interesting experiment with the telephone as an aid to freight-train operation. On a freight train of 123 cars, one and a half miles long, drawn by two engines, a telephone wire was strung along over the tops of the cars, connecting telephone instruments in the caboose and engine cab. The movement of the train was directed by the conductor who, sitting in the caboose, telephoned his orders up to the enginemen.

* * *

The Colonial Sugar Co. is about to establish a system of wireless telegraphy at its mills in the Fiji Islands. The mills are situated on different islands, and some of them are hundreds of miles apart. Their steamer "Fiona" is also to be fitted with wireless apparatus. When the installations are completed at all the mills communication will be maintained between all the company's properties, and will enable the "Fiona" to be advised by wireless at which island she is required to call.

* * *

Two new telephone lines between London and Paris are being opened for public service and two more are promised in the spring. With the new lines in operation around 400 conversations per day can be transmitted between the two capitals.

* * *

An electrical teleprinting apparatus enables the Berlin police to print notices in 200 stations in the city and its suburbs simultaneously.

* * *

One million electric lights glow in Los Angeles every night, as shown by the connection records in the city electrician's office.

* * *

The experiment made by the Canadian Pacific Railway in train dispatching by telephone has proved so satisfactory that a further 2,000 miles of track is to be fitted with telephones for this purpose, making a total of 4,254 miles in operation.

* * *

A platinum mine was recently opened between Pecos and San Antonio, Tex., and a shipment of the ore has already been made to Boston.

The principal forms of tungsten ore are tungstates of iron, manganese and calcium; more rarely of lead. Tungsten trioxide is a bright yellow powder, which is almost insoluble in hydrochloric or nitric acids; hence by boiling the suspected mineral with hydrochloric acid, the presence of tungsten may be detected by the appearance of the bright yellow precipitate. With the addition of metallic tin or zinc the trioxide is further reduced, the lower oxides showing successive colors of blue to brown.

* * *

Canada purchased from the United States in the eight months ended November 30, 1910, electric insulators and batteries and telephone and telegraph instruments valued at $2,417,569 and only $53,209 from all other countries.

* * *

The Navy department is planning to establish a wireless system along the Aleutian islands, according to advices from Washington. The system, when established, will naturally work in harmony with the present wireless system operated in Alaska by the Signal Corps of the Army in connection with the cable which places Alaska in communication with the outside world.

* * *

The Illinois Traction System is preparing large excavations made in the ground at Riverton and Mackinaw which will be filled with coal, and afterward covered with water to shut out the air. Each reservoir will hold about 12,000 tons of coal and will be lined with cement.

* * *

The largest telephone exchange building in the world is to be erected soon at a cost of about $1,500,000, by the New York Telephone Company.

* * *

The wire guessing contest at the Chicago Electrical Show which waged fiercely about the pillar built of spools of wire was won by Prof. John D. Nies of the Lewis Institute, Chicago. His guess was 19,415 feet, while the measured length of the wire was 19,416.1 feet. Prof. Nies now travels about in a new "electric."

ELECTRIC CURRENT AT WORK

NEW DEVICES FOR APPLYING ELECTRICITY

An Electric Milk Jug

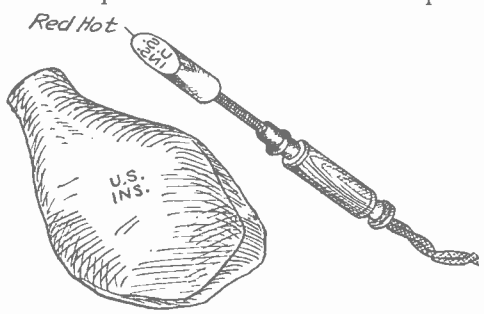
The British fondness for hot milk is reflected by the electric milk jugs now offered on the English market in one, two and three

ELECTRIC MILK JUG

pint sizes. They have the heating element in a separable base which can also be used for warming or heating other dishes.

Electric Branding Iron

Electricity is even used to stamp the United States imprint on ham and other meat prod-



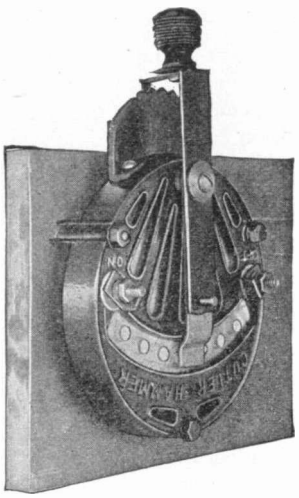
ELECTRIC BRANDING IRON

ucts, designating that they have been approved by the pure food inspector. The Vulcan branding iron by which this is done is made on the principle of an electric soldering iron. It is connected to a convenient lamp socket with a flexible cord. The conductors pass down through the wood handle and terminate in a heating element inside the die. When the current is turned on the die is heated to a red heat,

Speed-Regulators for Small Motors

A great many people now operate sewing machines, buffers, small blowers, washing machines, jewellers' and dentists' lathes, coffee mills, adding and copying machines, etc., by small electric motors of from one-twentieth to one-sixth horsepower. To use these machines to the best advantage a regulator should be used in connection with the motor so that the speed may be varied.

To meet these requirements a very small but at the same time trustworthy regulator of the Cutler-Hammer type has been developed. It is only six inches in diameter and weighs only 2½ pounds. The operation is by means of a simple sliding lever. Seven contacts are provided giving seven running positions, or these contacts can be arranged to provide one "off" point and six running positions.



REGULATOR FOR SMALL MOTORS

The picture shows one of these regulators provided with a projecting lever or handle which carries a pointer to indicate the position of the contact arm on the buttons below. So arranged it can be mounted underneath a table top, carrying a copying machine for instance, with only the handle and indicator projecting. Then, although the regulator is out of sight and out of the way, the operator, in varying the speed of the machine, can tell by the indicator on what speed the motor is operating.

Sterilizing Liquids by Ultra-Violet Rays

By DR. ALFRED GRADENWITZ

Those rays which in the scale of the prism lie beyond the range of visible light waves are detected only by their chemical effects, especially by the action they exert on photographic plates. Investigations have shown these radiations (termed ultra-violet, that is, beyond violet) to exert harmful effects on living tissues, and especially, to destroy all kinds of minute organisms, such as the microbes.

In view of this behavior it occurred to a French physician, Dr. Billon-Daguerre, that ultra-violet rays could be utilized for the sterilization of liquids, and the experiments conducted by him actually confirmed this prevision.

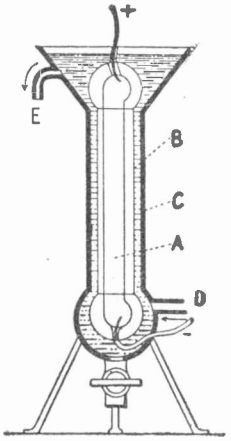


FIG. 1. FIRST APPARATUS OF DR. BILLON-DAGUERRE

The first apparatus used by the doctor consisted merely of an exhausted quartz tube (A) Fig. 1, filled with mercury vapor in the interior of which an electric arc could generate those useful radiations. The tube was surrounded by a protective quartz sleeve (B) and an outside brass cover (C). It may be said in this connection that the use of quartz instead of glass is quite imperative, as glass absorbs most of those precious rays. Even air is impervious to them and this is why the vacuum tube arrangement (similar to the well-known mercury lamp) is adopted.

After passing into the apparatus the liquid to be sterilized flows in the annular space between the protective sleeve and the brass cover in an extremely thin layer, thus undergoing the sterilizing effects of the ultra-violet rays given off from the lamp.

The next apparatus designed by Dr. Billon-Daguerre, as represented in Fig. 2, consisted of a cylindrical quartz bulb (A) traversed by the current; this likewise formed a mercury lamp. A quartz sleeve (B) soldered to the ends of the lamp insulated the latter from the contact of the liquid to be sterilized, the intermediary space (V) being exhausted. This apparatus was completely immersed into the liquid to be sterilized, and this underwent the action of the lamp without becoming heated, the vacuum (V) constituting an efficient insulation.

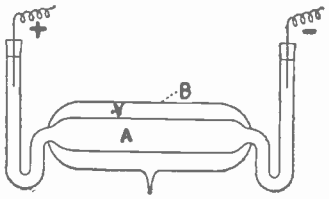


FIG. 2. CYLINDRICAL QUARTZ BULB

In order now to produce a perfect sterilization of the liquid, the latter had to be brought in all its parts into direct contact with the lamp. This is achieved in the apparatus represented in Fig. 3.

A siphon system consisting of a set of bent silver tubes collects the liquid from the outside sleeve (B). The ends of these siphons are so cut as to adapt themselves as far as possible to the curvature of the sleeve, thus allowing the liquid to be collected from the immediate neighborhood of the lamp.

For the sterilization of milk, which is impervious to ultra-violet light, the tubes (T) are given a considerable thickness, Fig. 4, thus causing the liquid to pass in a thin layer between the lamp and the discharging tubes. By increasing the number of these tubes, the volume of the liquid discharged from the apparatus can be increased in proportion. According to the inventor this lamp (which is located in a relatively small glass case) is able to sterilize, with an electrical consumption of only two amperes and 110 volts, 3,600 litres of liquid (wine, beer, milk, etc.,) per hour, while in the case of clear water the output may even be raised to 10,000 litres, a litre being about .26 of a gallon,

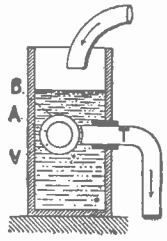


FIG. 3. SIPHON TYPE OF STERILIZER

In spite of these satisfactory results, Dr. Billon-Daguerre unceasingly endeavored to improve his apparatus. The drawback so far experienced was that the effective rays were accompanied by other radiations belonging to the visible part of the spectrum, and which were practically devoid of chemical properties, and accordingly, of any

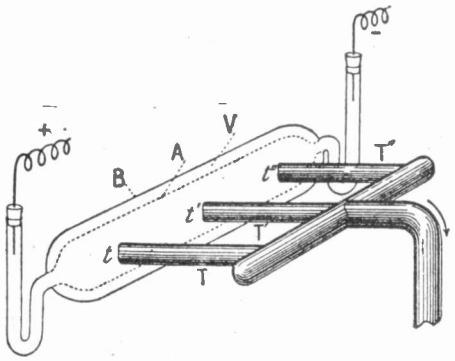


FIG. 4. APPARATUS FOR STERILIZING MILK

sterilizing effects, serving only to dilute the rays and to reduce the efficiency of the apparatus.

This is why the Doctor proceeded to design a lamp able to produce only chemical radiations. Now, by investigating the familiar Crookes and Geissler tubes, containing carbonic acid, hydrogen, sulphide, or other gases, he found the photo-chemical effects exerted by their radiations to be about 25 times more energetic than those obtained with ordinary ultra-violet rays. In fact, the spectrum of those gases showed evidence of radiations of extremely short wave-length (far shorter even than the ultra-violet rays generally used) and which, in view of their situation beyond the ultra-violet, he termed "hyper-ultra-violet" rays.

These radiations were found to possess so extraordinary a microbe-destroying power as to allow of an instantaneous sterilization of the liquids.

It will therefore readily be understood that by substituting for the mercury lamp in the apparatus described above, a Crookes tube of variable shape, the output of the apparatus can be considerably increased, the same effects as above stated being obtained with an incomparably lower electric consumption (two amperes and five to six volts).

It may be said that the sterilizing effects are due exclusively to the radiations, and not to the ozone and oxygenized water generated by their action. In fact sterilization is absolutely instantaneous.

The latest apparatus recently submitted to the French Academy of Sciences (Fig. 5) consists of a quartz tube, 9.8 inches in length, and .79 inch in diameter, containing extremely diluted hydrogen which is traversed by the induced current of a small induction coil, giving sparks .6 inch in length with two amperes and six volts. This minute amount of electrical energy is transformed nearly entirely into invisible rays of extraordinarily short wave-lengths, the chemical action of which is at least 20 times as great as that of mercury vapor lamps.

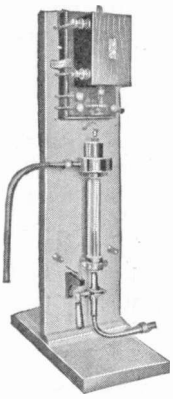


FIG. 5. LATEST FORM OF STERILIZER

As the water sterilized by this process is not heated, it remains perfectly fresh, and its taste is not altered in any way. On account of its small dimension and easy handling it can even be used in private houses while on the other hand, its remarkable efficiency makes it quite suitable for use in the very largest installations. In the case of municipal water distribution plants the water is sterilized immediately in the mains, and in order to avoid any breakage, the lamps are located outside of the water conduits, the ultra-violet rays penetrating into the water through two quartz windows.

Another sterilizing apparatus based on the action of ultra-violet rays has been designed by the Westinghouse Company (limited) and comprises a mercury vapor lamp of the Cooper-Hewitt type, suspended above the surface of the liquid, and which exerts on the micro-organisms in the latter immediate destructive effects without the intermediary of any ozone or oxygenized water.

He Overcame the "Impossible"

Some fifteen years ago a real estate man in looking over a building which came under his care out on Chicago's West Side found in charge a young lad who performed the numerous duties of elevator boy, engineer, etc. The boy's knowledge of things, his confidence in himself and his great desire to know something of electricity led the real estate man to install a private lighting plant in the building. Entrusted to the lad's care, it never wanted for attention, and it was a friendship thus begun between Perkins B. Bass and Austin Kimble that helped lead to the invention and manufacture of a motor that, to those who have made a study of electricity, does seemingly impossible things.

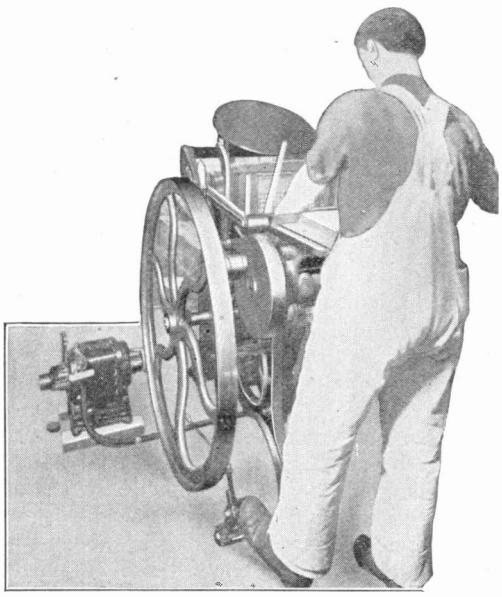
But the story of the man who thought it out is full of interest. Upon the advice of his friend he took up a correspondence course in electricity and it was not long before he was told as a result of his investigating turn of mind that an alternating current variable speed motor was an impossibility without using a wasteful resistance, controller or rheostat with it.

"Well, I'll build one then," he replied, for it was always the seemingly impossible things that Kimble thought worth trying out, his queries in this line often causing his electrical associates to smile. As the first step to change the meaning of these smiles, a shop not more than fourteen feet square was set up in a barn, with his wife as first assistant, and an old automobile engine to furnish power to a lathe. His first motor armature was mounted on a broom stick for a shaft, but demonstrated that he was on the right track. Fitted with a steel shaft, it was sold, but for less than it cost. Another motor was built and sold, and then others followed.

Mrs. Kimble advanced from helper to armature winder, then bookkeeper. Business grew. The lad of yesterday was coming on, but by hard work. He had accomplished one thing thought "impossible." He frequently slept on a cot in the shop during these years for two reasons: To save time going to an from work and to work out new problems that came to his mind whether during night or day; for Austin Kimble thought best at night and often would get up at two or three o'clock in the morning to try out in the shop some new idea that came to his mind.

Finally the little shop was abandoned for a larger place, and then for a second time business forced expansion and yet the third and fourth time, to the present factory location which the visitor can see will not long provide sufficient room.

Kimble's single phase alternating current motor operates off single, or any phase of two or three-phase circuits. Without a controller or resistance the motor starts, runs at *any* speed from 300 up to 3,000 revolutions per minute, may be reversed while at full speed by throwing a single lever from one extreme point to the other, or stopped by placing at mid-position this lever which merely shifts the brushes.



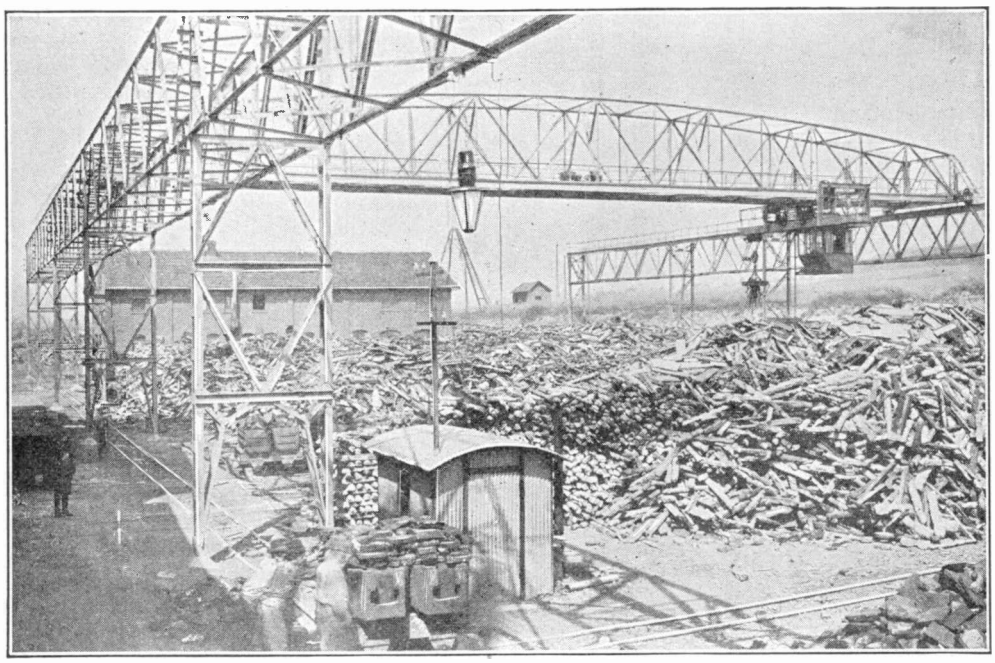
VARIABLE SPEED ALTERNATING CURRENT MOTOR DRIVING A PRINTING PRESS

Electrical engineers and professors are incredulous until they see the motor doing these things. Further and unlike other motors the current, speed and power all increase or decrease together. There is no surge of current to blow fuses when starting the motor.

Built in sizes of from $\frac{1}{8}$ to ten horsepower the motor has solved the problem of economy and variable speed regulation where alternating current is available. The illustration shows a motor operating a printing press, the operator having complete control by a foot lever.

The World's Greatest Pig Yard

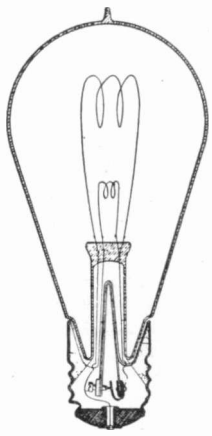
Where is the world's largest pig yard? Most men will answer Chicago, Omaha, or Kansas City, thinking of the immense stock yards at each place. But by actual count the larger stocks of pigs are found far from the packing industries, for in certain industries the word pig means something quite different from the porker of our barnyards or the guinea among our household pets. In the iron and steel trades the word pig denotes the slab or stick form into which iron is first poured when it comes from the blast furnace. To avoid being caught short of their supply of such raw material in case of railroad troubles, most users like to carry a huge stock of these pigs on hand. Formerly they were handicapped in this by the long time it took the laborers to unload and afterwards to cart the heavy bars. Now this work is made easy by an electro-magnet on a traveling crane which picks up ten to 20 of the pigs at a time and holds them until the current is turned off. With the handling of the pigs thus simplified, the yards used for storing them have grown to immense proportions, like the one of which our cut shows only a part, this being a German pig yard.



ELECTRO-MAGNET HANDLING PIG IRON

Lamp and Flasher Combined

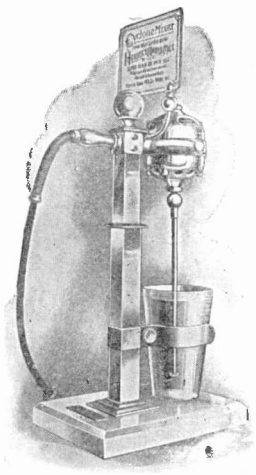
An incandescent lamp having two different candle-power filaments and with a make and break thermostat for flashing them contained in the neck or screw shell of the lamp is described in a patent issued to William J. Phelps, Detroit, Michigan. A bent bar thermostat of two metals such as brass or steel closes the circuit through the high power filament. The current heating the thermostat opens the circuit as the bent metals expand, placing the long filament as a resistance in series with the low power short filament. As the latter has a greater resistance per unit length than the long filament the short filament lights up. The thermostat now carrying no current, cools and again closes the circuit through the high power filament.



LAMP AND FLASHER COMBINED

Electric Drink Mixer

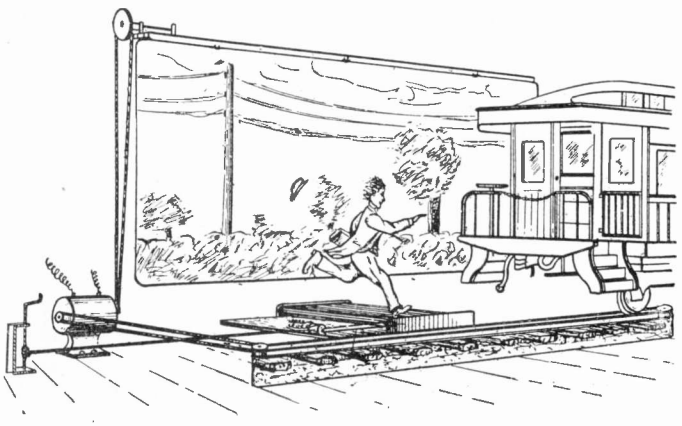
Ever quaff an "electric milk shake?" It's delicious, and in this age of things electrical will surely become popular. The "O-See-Us" drink mixer runs by electricity and consists of a little motor mounted on a suitable stand. Direct connected to the motor is a vertical shaft on the lower end of which is a large thick button. Running at high speed the button will mix thoroughly any drink that you now shake or stir. All flavors are perfectly blended and the customer gets a more satisfying drink in less time than by the old "arm-strong" method.



ELECTRIC DRINK MIXER

Producing a Stage Illusion

To cover an invention for producing illusory effects on the stage, a patent has been granted to TimothyR. Barrett, Bordentown, New Jersey. The arrangement provides means for showing a person vainly endeavoring to catch a train, boat or other conveyance. In the back ground is an endless curtain upon which is painted a panoramic view of scenes along the route of the conveyance. At the front of the stage is a narrow endless curtain painted to represent the ties and rails of the railroad track as in the illustration, the wheel of the coach being turned by contact with the edge of this curtain. Between the two curtains a moving sidewalk operates fast enough to enable the actor to produce a good imitation of a frantic attempt to catch a departing train. Both curtains move at the same rate of speed operated by an electric motor.

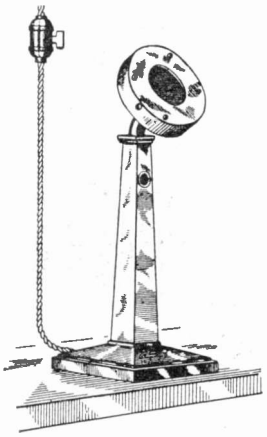


STAGE ILLUSION

Cigar Lighter

This device is not a telephone but a cigar lighter. The cross-wire within the transmitter-like opening is a resistance wire bent back and forth to afford plenty of hot wire against which to place a cigar to be lighted.

Platinum wire which is often used in lighters is expensive and breakable. It is the object of this invention to so construct a cigar lighter that the current can be transformed or stepped down to a lower voltage and increased amperage, enabling the use of a much coarser and stronger wire, of a much less expensive material which will offer a greater heating surface, and will come to the glowing point in the shortest possible space of time. A small step-down transformer is therefore enclosed in the body, the current being turned on by pressing the push button. A patent on the device has been issued to Victor E. Extrom and Thomas G. Boardman of Tomahawk, Wisconsin.

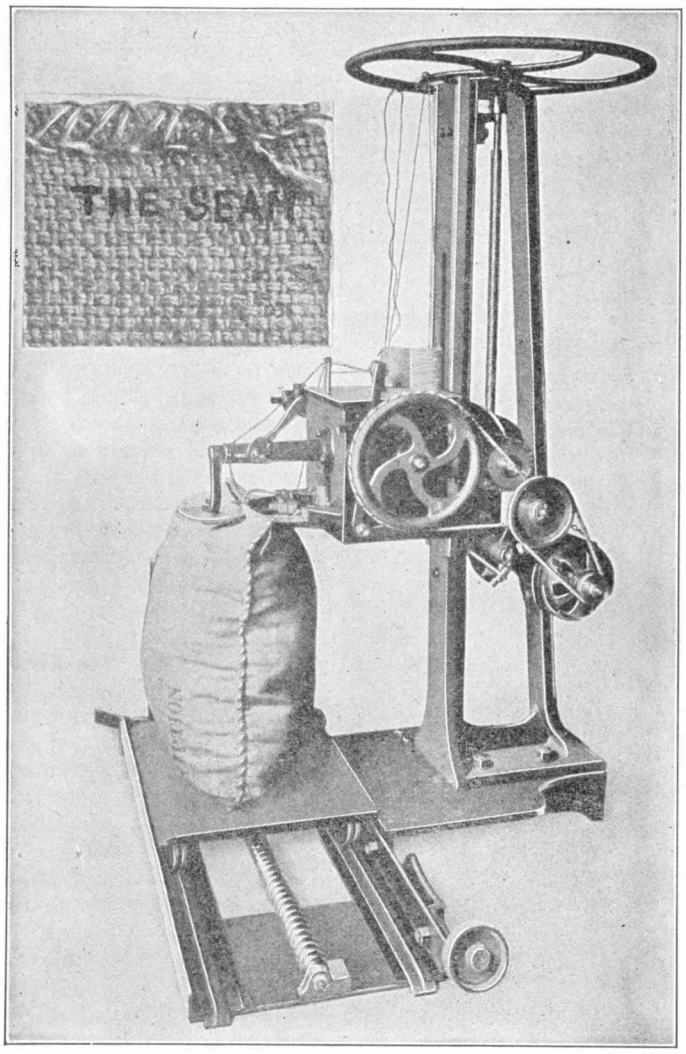


CIGAR LIGHTER

Sewing Up Grain Bags

A bag stitching machine invented in Germany by A. von Hasperg, actually sews up the mouth of a filled bag. The bag itself is placed on a little wheeled cart which is automatically moved past the needle after each stitch, the sewing mechanism being easily moved up or down to match the height of each bag. The machine sews a peculiar seam of interlocking stitches which it tangles at the end of its run so that no hand knotting is required, but which can be quickly unraveled after cutting one of the thread loops at the right end. A quarter horsepower electric motor does the work.

The peculiar stitch produced by this machine cannot readily be duplicated by hand, hence bags closed in this way will show at a glance if there has been any tampering with their contents in transit.



GRAIN BAG STITCHER AND SOME OF ITS WORK

Making Blue Prints From the Original Drawing

In making blue prints it is necessary that the drawing be made on transparent material. As ordinary drawing paper is practically opaque, a tracing must be made from the original on transparent tracing cloth. Obviously, therefore, if the original drawing could be made transparent by some process, so as to be used in blue printing, one time-consuming step would be saved. This might be done with inflammable liquids, such as gasoline, but there would be great danger of burning up the drawing, especially if an arc light were used in printing.

If the sheet could be drawn through some safely handled liquid which would make it transparent and then dried, we could get the needed transparency in less time than it takes to tell about it.

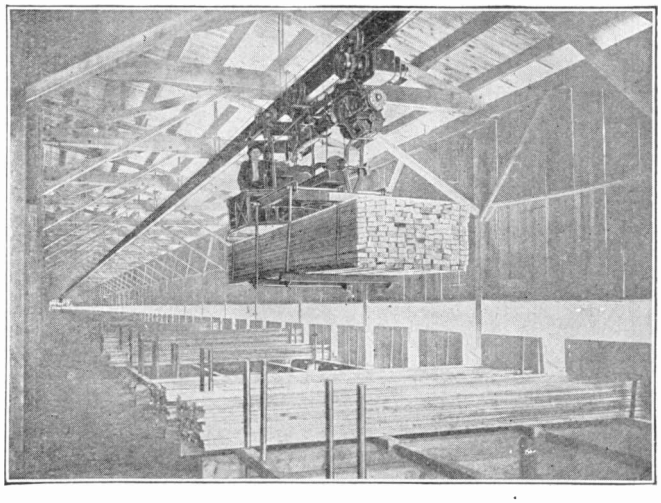
Carrying out this principle, a New York firm has brought out a "Mechanigraph" in which the drawing is passed between rollers into an electrically heated liquid and then carried by moving tapes over the drying rollers which are also heated by the same current. All the operator has to do is to start the paper between the rolls and to turn a crank just as if he were using a clothes wringer. The liquid used is said to be non-inflammable and

to cost only a third of a cent per square yard of the paper treated; and as the current is used only for short periods, its cost would be more than covered by the saving in tracing cloth. The space occupied by the apparatus is less than would be needed by a single draftsman, though a single such device may replace scores of tracers, thus increasing the capacity of the draughting room.

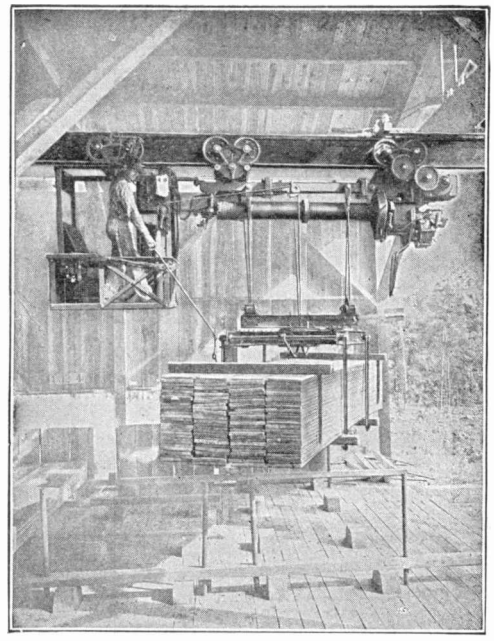
Monorail for Handling Lumber

Not very far back the lumber as it was produced in the mill was handled and stored by hand labor and with teams to cart it from one shed to another. Now, in many instances an electric monorail system whisks the lumber about with incredible rapidity and at a great saving in labor expense.

The tracks of the system are steel I-beams hung high above the floor level. Suspended therefrom on wheeled carriages are a cage for the operator, a winding drum for lifting a sheaf of lumber and the motor for doing the lifting and propelling. The lumber is piled, to begin with, on cross bars. The monorail car is then run over the lumber and a set of tongs lowered away until they can be hooked under the ends of the cross pieces. Then the load is raised and carried away over the track to the particular tier on which it is to be placed, all these operations being controlled to a nicety by the man in the cage.



A LOAD UNDER WAY IN THE SORTER SHED



RAISING A LOAD AND GETTING READY TO NEGOTIATE A TURN

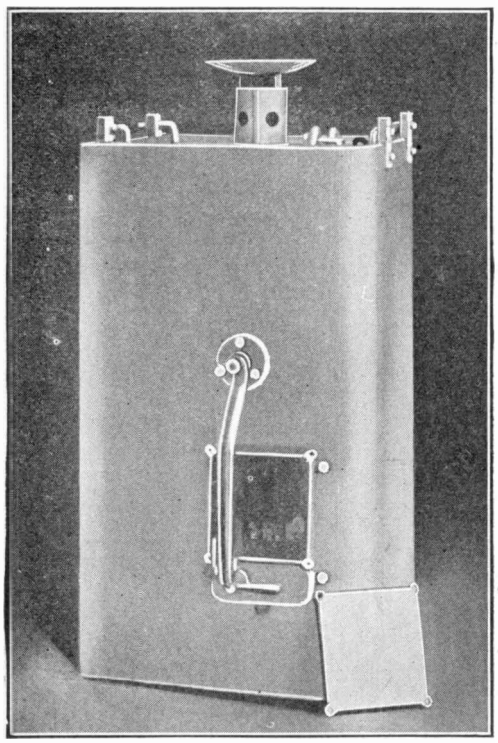
Automatic Fire Extinguisher and Alarm

A German inventor has developed a new device which is at once a fire alarm and fire extinguisher. It consists of a carbonic acid generator to be placed in the room to be protected. It operates in connection with a thermostat which closes the circuit to the alarm and generator when the temperature of the room gets above the danger point.

When the thermostat makes electrical contact, by an excessive temperature a pawl is disengaged by the armature of an electro-magnet in a small chamber on the outside of a fire extinguisher. This releases a lever which causes a small tank containing sulphuric acid within the extinguisher, to tilt by its overweight, the acid flowing out through small holes into a solution of potash contained in the outer vessel,

Instantly large volumes of carbonic acid gas are produced by the mixture of the acid and potash solution, from 5,000 to 15,000 liters of this gas being produced within 30 seconds, according to the size of the extinguisher, and thrown into the room by a surplus pressure varying up to one atmosphere. As is well known combustion cannot take place in an atmosphere of carbonic acid gas, so the fire is extinguished.

At the same time an electric fire alarm circuit is closed giving the alarm at any dis-

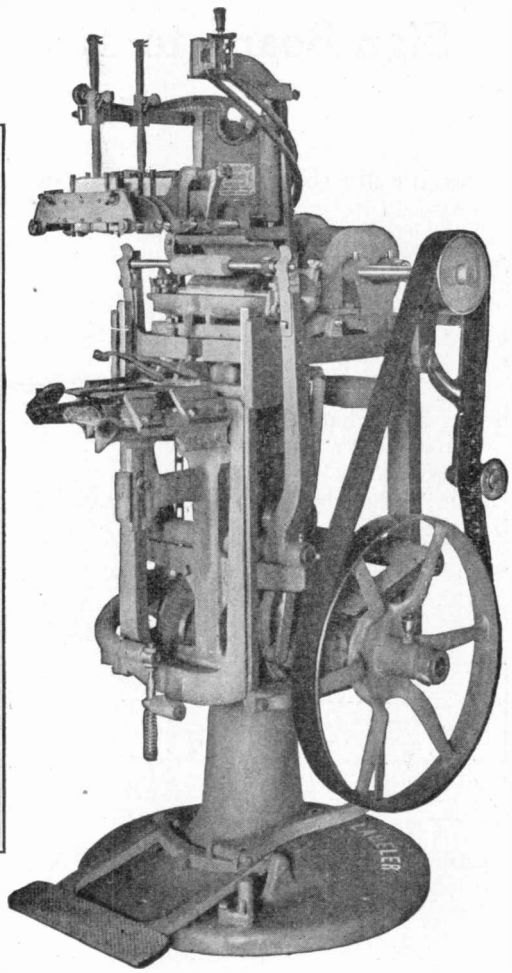


AUTOMATIC FIRE EXTINGUISHER AND ALARM

tant point desired. Then, if the carbonic acid gas has not completed its work other means may be employed to put out the fire.

Machine Puts Labels on Bottles

The next time you pick up a bottle containing wine, a vegetable sauce or something else, just notice the paper labels on it. There is probably one around the body and another on the neck of the bottle, and although these labels are in many cases put on by hand yet a machine which will do all this automatically in one operation is here shown. The Economic Labeler does what might seem impossible to the casual observer for it will handle round, square, hexagon, oval or flat bottles, gluing the entire surface of the label to the bottle, or simply the edges of the label as desired. Cams, rolls and prongs all acting as if alive take the labels from a



MACHINE FOR PUTTING LABELS ON BOTTLES

holder on the machine in which 1,000 may be placed, put on the glue and finish the job with accuracy and speed. An electric motor furnishes the power.

Edward C. Pond of Petersburg, Va., has patented a device for photographing the dials of electric meters, thus giving the meter reader an infallible record of his work.

FOR PRACTICAL ELECTRICAL WORKERS
HOW TO MAKE AND OPERATE ELECTRICAL DEVICES

Sign Board to Facilitate Ticket Selling

By THERON P. FOOTE

The theatre box-office man has his troubles.

"Two tickets near the front, please," calls a patron. The box-office man hands him E-5 and 6.

"Oh, No!" objects the buyer, "I want something near the front." E-5 and 6 are put back and B-2 and 3 offered.

"Are those on the aisle?" Again the tickets are exchanged for B-4 and 5.

"How much?"

"Two dollars."

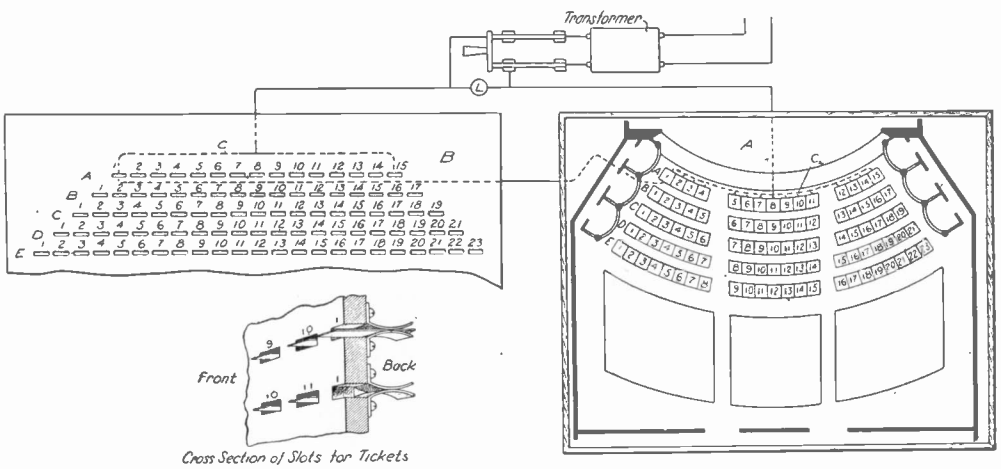
"Oh! I thought they were 75 cents each," is the response.

"No, rows A to E are one dollar, E to N, 75 cents."

"Well, then give me two seats in E on the aisle if possible," and during all this time others are waiting perhaps to hear the same thing by the next in line.

The device here illustrated would do away with the annoyances noted, enabling a theatre-goer to know at a glance what seats are not sold, take his choice and put down his money with "Give me B-4 and 5."

The general arrangement for the equipment is as follows: In the vestibule of the theatre may be placed a board (A) about ½ inch thick and large enough to contain a full chart of the seats in the theatre, allowing a ½-inch square for each seat. After locating the seats by squares, ¼-candlepower lamps are set in the board by drilling a ⅜-inch hole in each square to a depth of ⅜ inch, and then a ¼-inch hole the rest of the way through. Miniature sign receptacles may be set in these holes. A common wire (C_2) is now connected to one side of all of these receptacles in which small lamps are placed, this common wire being connected to one side of the transformer as shown. From the other side of each lamp a wire is run into the ticket office and connected to the lower of two brass spring clips shown in the detail



SIGN BOARD TO FACILITATE TICKET SELLING

drawing which is a cross-section through (B).

In the board (B) which may be about ¼ inch in thickness are cut slots 1-16 inch wide and 1-16 inch longer than a ticket is wide each slot representing a seat on the chart in the vestibule. On the back of board (B) which may be mounted out from the wall on brackets the spring clips are mounted as shown in the detail, one above the slot, the other below. The brass pieces make contact when in position but when a ticket is inserted from the front they are sprung apart and thus serve as a switch. Each upper clip is connected to a common wire (C), as at A-1, and this common wire runs to the transformer.

After low voltage lamps have been placed in the receptacles of the vestibule board a frame containing glass frosted on the inside is mounted in front of the lamps and with black oil paint a chart of the seats drawn on the glass and numbered as in the theatre and on the ticket board of the box office.

When the tickets are all in the slots of the board (B) the lights are all out, but as soon as a seat is sold the ticket is pulled from the slot, allowing the brass clips to make contact and light the lamp under that seat in the vestibule chart.

From the seats over the unlighted lamps the purchaser makes his selection, before he gets to the window. He then tells the location by number, pays the price, and makes way for the next. The glass may also contain the scale of prices for seats in different parts of the house, thus enabling the patron to know this when making his choice.

A step-down transformer which lowers the voltage to ten volts will simplify the wiring requirements and reduce the cost of current by using low-voltage low candlepower lamps.

Practical Don'ts for the Electrician

Don't wire a building and leave the wires sagging.

Don't use fuses that are not enclosed.

Don't put a pulling strain on a lamp cord.

Don't use the edge of a knife to clean a wire.

Don't allow the switchboard to get out of repair.

Don't leave the conduit pipe ungrounded.

Don't use an unnecessary amount of wire and tape to do the job.

Don't place the fuse plugs in such position that water can get to them.

Don't use emery paper on a commutator; it will soon ruin it.

Don't leave a joint without soldering it.

Don't throw a switch lever in and out too slowly.

Don't forget that mica is one of the best insulators.

Don't put up rosettes without their proper fuses.

Don't use dry cells where a constant current is desired and expect to get the best of results.

Don't allow dirt and grease to come in contact with the switchboard or rheostat.

Don't attempt to switch the brushes while the motor is running at full speed.

Don't place the hands about the generator when it is not necessary.

Don't forget that electricity is an unseen force and keep your mind on your work.

Don't use a screw-driver or pliers unless the handles are well insulated. Many a life has been hurled into Eternity because of this.

Don't put in a new brush without first fitting it to the commutator.

Don't start a new motor without first making a close examination of it.

Don't put wires crossways without first putting bushings between them.

Don't leave a key in a socket and expect no one to tamper with it.

Don't overload a circuit beyond the carrying capacity of the conductors used.

Don't use anything but fuses that are authorized by authority.

Don't work around the generator with your pockets crammed full of steel tools, as it is dangerous.

Don't sweep the floor and clean while the generator is running, as the dust that settles on the generator will be very injurious to it.

Don't solder a joint close up to the wall or woodwork, without first placing next to it a sheet of asbestos.

Don't forget that a generator should have a good blowing out with a strong blast of air occasionally.

Don't wind a large wad of tape over a joint after splicing, for a splice should be covered with just enough tape to make the splice the same size as the original insulated wire.

Don't forget that pure coin silver makes a very good emergency contact point.

Don't throw a rheostat lever too quickly but give a little time.

Don't put two solid carbons, or two cored carbons in an alternating arc lamp.

Don't throw a switch before you know a connection has been made.

Don't splice a small line and a large one together.

Don't enclose a generator in a place where it cannot get air.

Don't try to make a splice without first cleaning the wires.

Don't use acid in soldering a wire.

Don't fail to place the switches in places that will be handy to get at in case of fire.

Don't put a generator or a motor on a shaky foundation.

Don't disconnect a number of wires without tagging them, as some one else may have trouble in finding the proper connection.

Don't attempt to trim an arc lamp while the current is on, turn it off.

Don't overload the motor or generator for a very long time, as it will be very injurious to the machine.

Don't leave loose bolts, nuts, tools, etc., around the generator, for they are liable to get into the machine and something serious might happen.

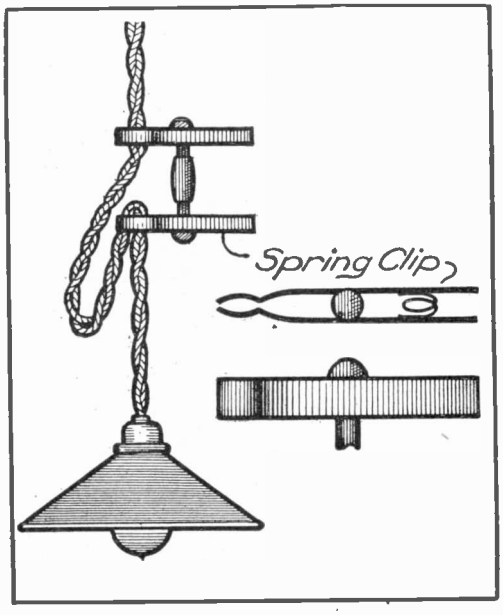
Don't allow visitors to wander about among the belts and machines. They are not aware of what could or might happen to them.

Removing Oil From Water

One of the most persistent problems confronting the steam engineer has been that of removing the oil from the condensed steam which is obtained when using steam engines. This condensed steam, in the form of very hot water, is economical to use over again in the boilers if the oil can be taken out of it. The engines must have the oil to lubricate them, hence it is partly diffused through the steam and unless it is separated from the latter after this is condensed into water, the oil may be troublesome in the boiler. Mechanical devices, as used to effect this separation, have so far succeeded only in removing about three quarters of the oil, but a new electrolytic method is much more efficient. This works on the principle of forming a basic salt in the water through the action of an electric current and when this salt sinks to the bottom of the electrolytic tank, it carries most of the oil with it. Tests recently made with this new Davis-Perrett process are said to have shown that 98.5 per cent of the oil was thus separated from the water, and that at the remarkably low cost of only three cents per 100,000 gallons of water.

Spring Clip Cord Adjuster

A convenient lamp cord adjuster has been patented by John Maitland of Lynn, Mass. The drawing explains the principle, which is very simple. Two spring clips, working somewhat on the plan of a spring clothespin, grip the cord at two points and are held together by a short connecting member. As much or as little slack as desired may be included between the two clips in order to adjust the position of the lamp to the particular height desired.



SPRING CLIP CORD ADJUSTER

Pressure of a Church-organ Bellows

In the side view, Fig. 1, is shown a one-half horsepower, single phase, back-geared electric motor pumping an old church-organ bellows of the reciprocating type. As an automatic speed regulator cannot well be used in connection with this current the homemade mechanism as described below was devised to govern the air pressure. Being fixed at the proper distance above the bellows it is operated by the action of the bellows itself.

The slide, (shown in detail at (S) Fig. 2) made of $\frac{1}{4}$ inch hard fibre, is readily adjusted to break the motor circuit at any desired fullness of the bellows. Any convenient number of holes for the removable pins may be used in both parts.

In Fig. 2 (A) is a knife blade switch terminal with spring washer under screw-head

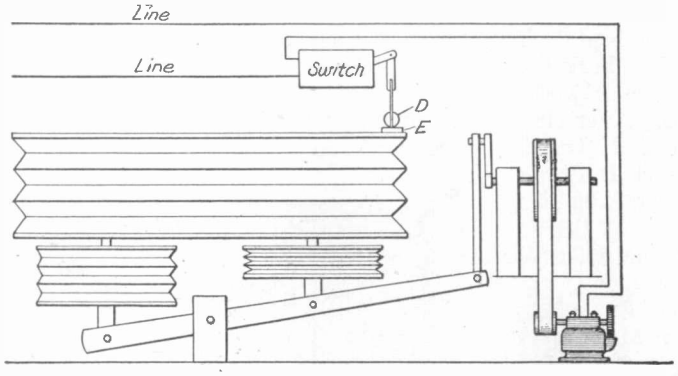


FIG. 1. MOTOR DRIVING CHURCH ORGAN BELLOWS

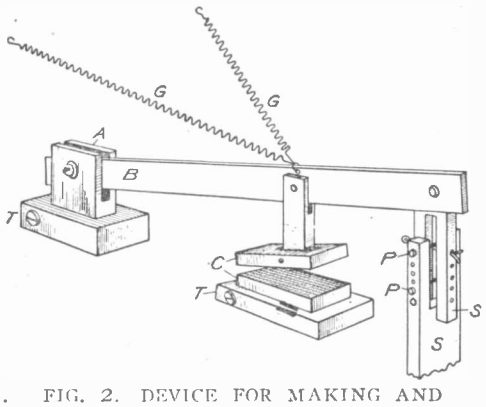


FIG. 2. DEVICE FOR MAKING AND BREAKING MOTOR CIRCUIT

and carries the copper blade (B) which may be of any required length.

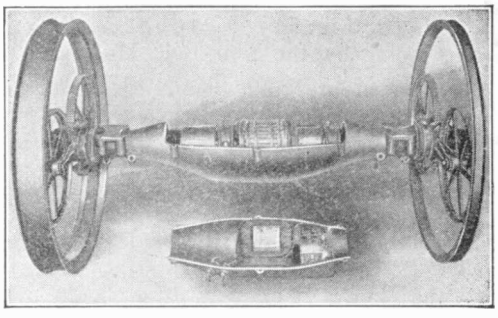
As the current is interrupted quite frequently when the motor is in operation, carbon blocks (C C) are used to insure a continued smooth surface and good contact.

The iron ball from an old two-ball cord adjuster answers admirably for a weight (D). The spiral springs (G) are of sufficient tension and so situated as to make a quick break before the upward pressure of the bellows separates the carbons. It will be noted that the upper carbon is not quite centrally pivoted, thus keeping one end in contact until springs (G) operate. The pull of these springs is nearly parallel with blade (B), when the circuit is closed and cannot act until the blade is slightly raised.

The play between pins (PP) allows the bellows to rise until the lower pin (P), with the later assistance of springs (G), trip the switch and stop the motor. Due, now, to the fall of the bellows the weight (D) finally closes the circuit again, the upper pin (P) coming into play.

Hollow Axle with Motor

An unusual form of gearing for driving an automobile is represented by the Walker



MOTOR ENCLOSED IN THE AXLE

balance drive. The armature of the electric motor is mounted directly on the axle of the vehicle. As the armature turns the axle must turn with it. Then, on each end of the axle is a small pinion driving two larger gear wheels which in turn transmit the power to an annular gear on the inside of the wheel rim. The entire axle and motor are enclosed.

Electrical Men of the Times

ELMER A. SPERRY

One of the pioneers in modern electrical development is Mr. Elmer A. Sperry, now of New York City. He was born at Cortland, New York, on the 12th of October, 1860. After eleven years at the State Normal and Training School, Cortland, he studied at Cornell, beginning with a special course of lectures in 1879 under Dr. William A. Anthony, Professor John E. Sweet, Professor Moler and others of this period. This was the first electrical course of study in America.

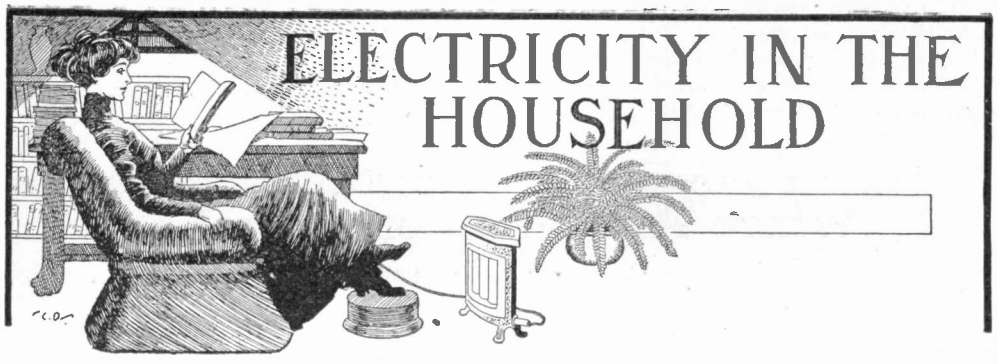
On graduation he started a manufacturing concern of his own in Chicago, in the latter part of 1880, namely, the Sperry Electric Company, which made arc light dynamos, lamps and motors. He also became later engineer of the Standard Electric Company, the Sperry Electric Mining Machine Company, the Link-Belt Machinery Company of Chicago, the Sperry Engineering Company and the Sperry Electric Railway Company of Cleveland, Ohio.

In 1883 he started, and for some years operated the first central station for electrical supply in Chicago; lighted the Chicago Tribune Building, Marshall Field's, etc. This was later consolidated with the Arc Light and Power Company and finally absorbed by the Chicago Edison Company.

In the early '80s Mr. Sperry began constructing electric mining machinery, the concern becoming the Sperry Electric Mining Machine Company. This was the pioneer in this line of work, which is now being carried on by its successor, the Goodman Manufacturing Company of Chicago. About this time he also perfected a system of electric traction in which field much pioneer work was done. He has also done much research work in connection with internal combustion engines, especially of the compound type, one of these engines reaching the thermal efficiency of over 40 per cent as measured at the brake.

Mr. Sperry was one of the founders of the American Institute of Electrical Engineers, before which body he has presented a number of papers. He also was one of the founders and organizers of the National Electric Light Association, being active in the early years of the history of this institution, and having been chairman of the Committee of Call of the first convention. He has read papers and presented discussions before this body and at the twenty-fifth anniversary at St. Louis, in May, 1910, read an interesting account of the creation of the Association in 1885. In addition to this, he was one of the founders of the American Electro-Chemical Society and has presented papers before that body.

Among other things, Mr. Sperry developed the Townsend electrolytic cell which now forms the basis of the largest producer of alkaline and bleach in this country; the factory is located at Niagara Falls. He has for many years been engaged on original research work in connection with practical applications of the gyroscope; and has delivered a number of illustrated lectures on this subject. He has been working with the United States Navy in the development of the larger engineering type of gyroscopic apparatus for steadying ships and also for battle and marine compasses, and "gyros" for steadying aeroplanes. Mr. Sperry is now engaged as a general consulting engineer in New York.

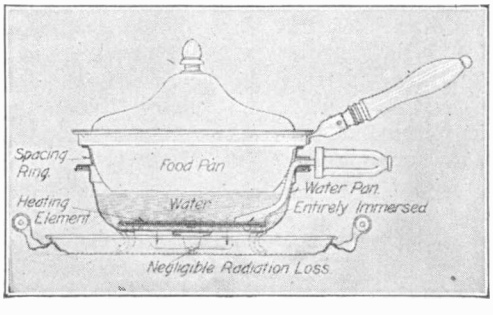


Alcohol Chafing Dish Changed to Electric

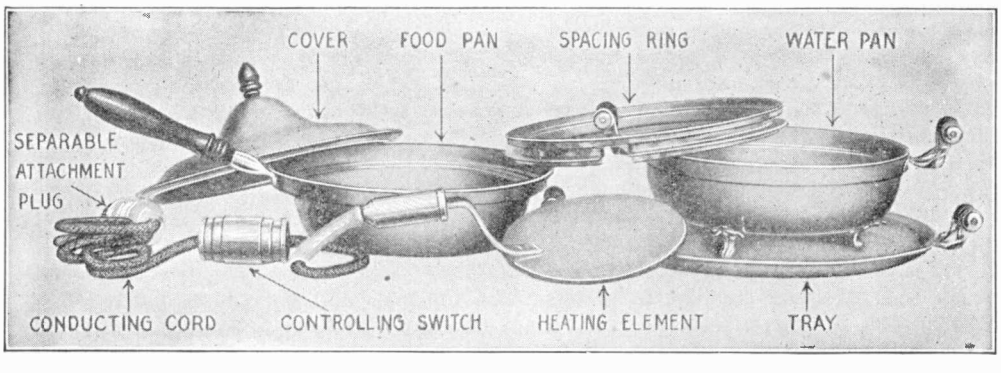
In accordance with a law well known to electrical engineers the efficiency of the heating element which is a part of your electric chafing dish, coffee percolator or any other electrically heated device of similar nature cannot be increased. As far as actually turning the energy of the current into heat is concerned one is as efficient as another. The problem, then, is to apply the heat from this element in such a manner that none of it will be lost.

In a new type of Westinghouse chafing dish the manufacturer claims certain advantages in the above respect. The new chafing dish, the parts of which are shown in the "exploded view," consists of an ordinary chafing dish to which is added a disk type heater and a spacing ring to provide for its admission. This heater somewhat resembles a stove lid with handle permanently attached. The electrical conductors to the heating element are carried up through the handle, called the lead arm.

A glance at the sectional view shows how the parts go together. You first place the necessary amount of water in the water pan and then suspend the heater in the water. Next put on the food pan. The whole outfit may be bought complete, or, if you have an old chafing dish of the alcohol type, having an outside diameter of water pan of $8\frac{3}{4}$ to $9\frac{3}{8}$ inches, it may be converted into an electric by the use of the spacing ring



CROSS SECTION OF NEW CHAFING DISH



"EXPLODED" VIEW OF NEW CHAFING DISH

alluded to. The spacing ring and heater may be obtained separately for this purpose.

The claim for increased efficiency is based on the fact that, as you will notice, the heater element is entirely surrounded by water instead of the under side being exposed to the air at the bottom of the dish, as in some other types. Therefore all the heat from the heating element must enter the water, which does the cooking.

Where Art and Science Meet

By T. VERNETTE MORSE

There are two classes of women who entertain. The one, who, with plenty of servants at her command, gives her orders, calls in the extra "help" that is necessary, invites the guests that belong to her "set," provides plenty of amusement, and is in every respect a queen among the social leaders.

Frequently she is the envy of her near-by neighbors, whose means do not admit of such expenditures, although they instinctively long for the same privileges under the same conditions.

For some reason the woman who entertains in this conventional manner does not, as a rule, give her guest half as much pleasure as the resourceful woman, who never lacks for ideas that are at once novel and interesting.

Friends of the latter soon learn that she has the ability to give them pleasure, and her invitations are looked forward to with delight.

The rooms may be small and plainly furnished, but they are always comfortable and homelike, only a few friends are invited at a time, consequently there is no crowding. Every hostess is, or should be, a law unto herself, giving of her hospitality for friendship's sake.

With electricity in the house, many novel results may be obtained. For a company luncheon why not bring into use the electrical percolator, chafing dish and toaster? Invite some friends to assist and let each one of them prepare a favorite dish. There is always good cheer where every one is busy, and the general air of preparation finds an interesting echo in the hearts of the guests, who will no doubt catch the spirit of the occasion and thereafter combine in groups for the purpose of entertaining. At such a gathering there is a feeling of good fellowship that is often lacking in more formal occasions, and all will go so merrily that the hostess and her friends actually forget the cares and anxiety of life in the enjoyment of gracious hospitality.

The housewife who understands the artistic arrangement of the table will make a simple repast appear like a banquet. Snowy white linen, fresh flowers and bright silver properly arranged are the first requisites.

For the conventional or formal luncheon the polished table with individual embroidered doilies is generally used, although a luncheon cloth covering the table is always in good taste. The menus for use in serving from the electrical appliances may be varied, as there is plenty of heat for the cooking, and by the use of a side table the extra dishes may be removed without confusion. For hot water there is nothing to equal the convenient glass globe electric heater which is ornamental as well as useful.

Excellent company luncheons may be served from the following attractive menus which may be varied and enlarged to suit the occasion:

MENU NUMBER ONE

Cream of tomato soup
Creamed chicken in patty shells
Rice croquettes Jelly
Celery salad
Ice cream Cake
Coffee demi tasse

Cream of Tomato Soup.—Place one can of tomatoes in the stew pan and cook slowly for half an hour, add one-fourth teaspoon soda, rub through strainer. Make a white sauce of one quart milk, one teaspoon butter, ⅓ cup flour, ½ teaspoon pepper, salt to taste. When sauce is thoroughly cooked add tomatoes and serve immediately.

Creamed Chicken.—Two cups cold diced chicken, ⅛ teaspoon celery salt, a few drops of onion juice. Make a cream sauce of two

tablespoons of butter heated in the chafing dish. Add two tablespoons of flour, salt, pepper, add one cup of thin cream. When the sauce is cooked add chicken and heat through. Serve in patty shells.

Celery Salad.—Cut the celery into fine pieces; add half as much chopped apple as celery. Serve on lettuce leaf with mayonnaise dressing.

MENU NUMBER TWO

Consomme soup
Creamed sweetbreads with mushrooms served on toast
Saratoga potatoes
Fruit salad
Orange ice Lady fingers
Chocolate

MENU NUMBER THREE

Clear soup with salted wafers
Chicken croquets with creamed peas
Medley salad Toasted crackers
Charlotte russe Bananas in jelly
Coffee with whipped cream

MENU NUMBER FOUR

Beef tea
Escalloped oysters
Nutlet sandwiches Waldorf salad
Chocolate cream Mixed cakes
Coffee with cream

A little practice in arranging a neat family luncheon will soon enable one to extend the courtesy to a small company without the slightest confusion.

Electric lights hidden in the foliage of plants is an attractive feature in decoration.

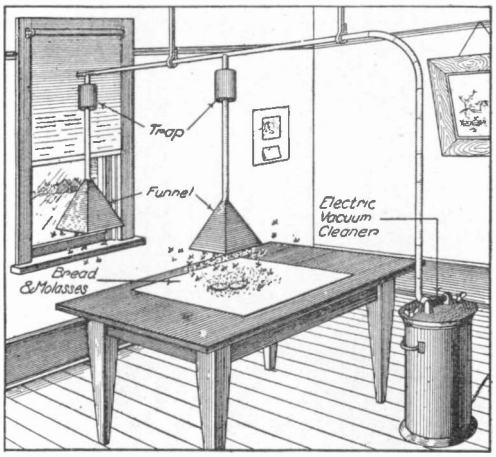
The woman who is able to overcome her inclination to follow "style" blindly, who cultivates her good taste through the proper application of her life to the conditions by which she is surrounded, who is kind and gracious to the faults as well as the good qualities of others, need have no fear as to the result of her entertainments, for they will reflect her own character and receive the grateful acknowledgement of her friends.

No Sweeping, No Dusting

There is no more reason why a woman should have to sweep and dust than there is why she should have to cook over a fireplace. Sweeping and dusting are signs of a time that should be past. Such methods of cleaning were all right when better methods were unknown. Vacuum cleaning is a better method. A vacuum cleaner gets all the dust and makes none—so there is no dusting and electricity does most of the work. The little work that a woman does is not burdensome. The air she breathes while cleaning is clean. No dust settles in her hair. When her task is finished, she is not in need of a bath. And, if she has been running the cleaner for an hour the cost of the electricity consumed is less than three cents.

Vacuum Fly Trap

A great campaign is now on, fostered by the United States Government and the health departments of various cities, against flies as carriers of disease germs. In line with this movement a Colorado housekeeper has made novel use of an electric vacuum as a fly trap. As shown in the drawing, a series of funnels are hung at the windows, over tables, or wherever flies are apt to buzz

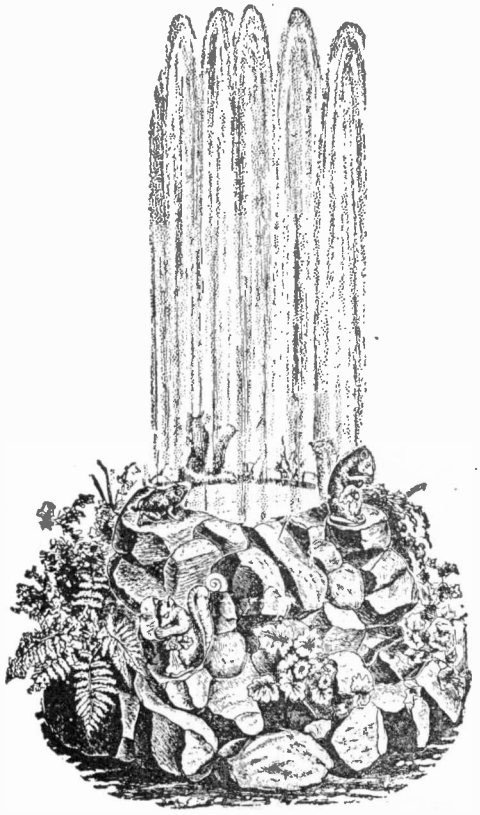


CURIOUS VACUUM FLY TRAP

about. The moment a fly gets close to a funnel the suction overcomes its wing power and it is drawn up into the fly trap, never to return. This trap has a valve which closes the suction tube when the vacuum motor is shut down, otherwise the flies might trace their way back to freedom. At convenient times the trap portion is taken off and immersed in hot water to kill the flies. If preferred the flies may be chloroformed. An interesting line of investigation would be to ascertain how many flies per kilowatt-hour of electric energy can be handled in this manner.

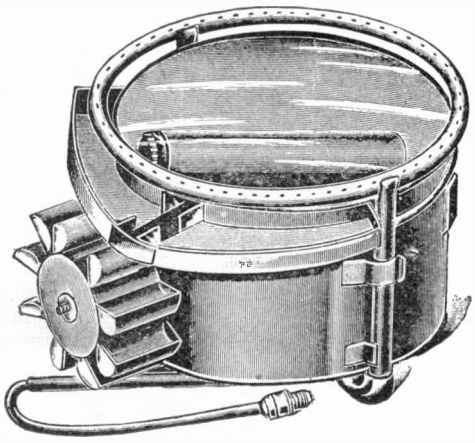
Small Color Changing Fountain

An artistic electric fountain of small size, so as to be suitable for the home, is the product of a Boston firm. Unlike most of the larger fountains, this type has the jets for the water arranged around the rim of the basin, letting the spray fall inward upon a glass plate through which the light of an incandescent lamp penetrates the finely divided particles of water. In running off this glass plate the water turns a little water-wheel of the old-fashioned bucket type, which is geared to a glass cylinder surrounding the lamp. The cylinder is colored in sections, so that the spray changes from blue through green to yellow, from orange to red



COLOR CHANGING FOUNTAIN

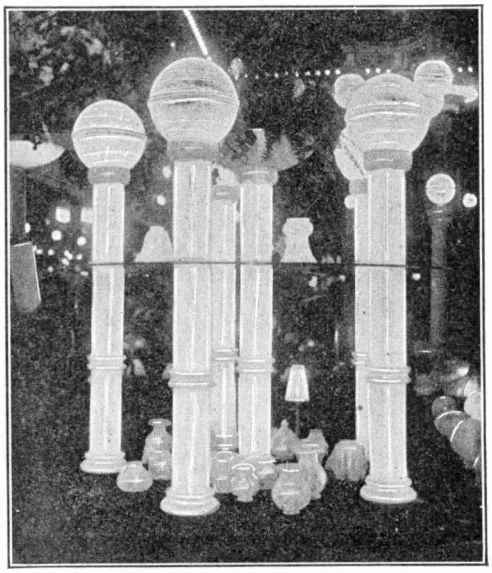
and then through purple back to blue. A single 32 candle-power lamp is used, thus requiring very little current, and as the waste water works the color changes, no motor is needed for this. Hence the cost of operation is very small, although the effect is a charming one



A LITTLE WATER WHEEL CHANGES THE FOUNTAIN COLORS

Pillars of Glass

Little beyond mere mention is needed to recall to the memory of Chicago Electrical Show visitors the beautiful marble like pillars of Alba glass surmounted by globes of the same material in the Macbeth-Evans exhibit.



PILLARS OF GLASS

Illuminated from within, these pillars afford a most strikingly beautiful decorative effect which can be compared only to alabaster marble. Reflectors and globes made from this material have high diffusing power.

Construction of Small Motors and Dynamos

By CHAS. F. FRAASA, JR.

CHAPTER IV.—BEARINGS, SHAFTS, COMMUTATORS, BRUSHES AND BRUSH HOLDERS

The bearings for the models are shown in Figs. 13 to 15 of this chapter, and the dimensions are given in tables III and IV. Fig. 13 shows the method of shaping the bearings. There are three successive stages shown in this illustration: first, the strip of metal of which the bearing is made is cut in from both ends; second, the ends are bent apart after heating, and third, in the final shape the arms are bent so as to be perpendicular to each other.

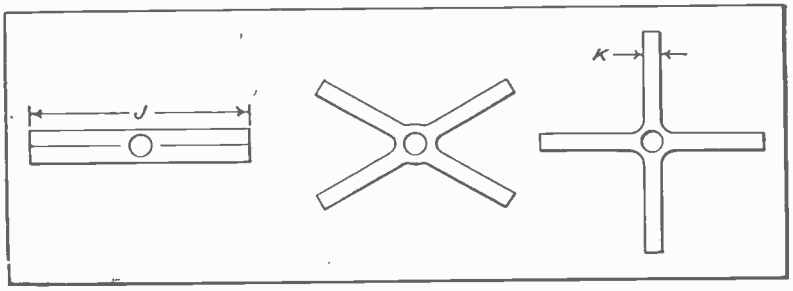


FIG. 13. METHOD OF SHAPING THE BEARINGS

For the 50-watt size, the material is ¼ inch thick, and for this purpose procure from the blacksmith, a strip of soft steel ¼ inch thick by two inches wide, and about fifteen inches long, and either have the blacksmith finish it, or do it yourself. Saw a line down the centre of each end of the strip, as shown in Fig. 13, heat the strip, and work to shape.

When the bearing is of the proper shape, place on the boring machine and drill a 13-16-inch hole in the centre, and through this hole place a piece of ½-inch (internal diameter) brass pipe, 1½ inches long. In the smaller sizes this brass pipe should be driven in at a tight fit, but in the larger sizes must be held in place by small set screws. The holes for the bolts of the field magnets which hold the bearings in place should now be drilled. Reference to Figs. 14 and 15 will make this plain.

A grease cup, shown in Fig. 16, is a valuable addition to the bearing. To make this, drill a one-inch diameter hole in a piece of

TABLE III

DATA FOR PULLEY END BEARINGS, REFERRED TO FIG. 14

(K EQUALS 1 INCH FOR ALL TYPES)

Type	A Curve Radius	B	C	D	E	F	G	H	I	J	L
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
A	3½	¼	5	1	7	¼	2¼	¼	5-32	12	1½
B	3½	¼	5½	1½	7⅞	¼	2¼	¼	5-32	14	1½
C	4½	¼	6	1⅞	9½	1	3¼	¼	5-32	16	1½
D	4½	½	7	2	11⅞	1	4	1	5-32	18	2

TABLE IV

DATA FOR COMMUTATOR END BEARINGS, REFERRED TO FIG. 15
(K EQUALS 1 INCH FOR ALL TYPES)

Type	A Curve Radius	B	C	D	E	G	H	I	J	L
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
A	3½	¼	5	1	7	⅜	½	5-32	14	1½
B	3½	¼	5½	1¼	7⅞	4	¾	5-32	15	1½
C	6	½	6	1⅜	9¼	5¼	¾	5-32	16	1½
D	7	½	7	2	11⅜	6¾	1	5-32	18	2

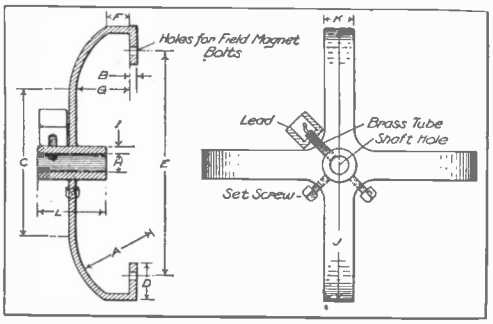


FIG. 14. PULLEY END BEARINGS

one-inch wood, and fasten by means of tacks a thin piece of wood on each side of it covering the hole. Drill holes through the two thin cover-boards, their centres coinciding with the centre of the one-inch hole, and put a piece of ¼-inch (internal diameter) brass pipe through one side till it extends into the large hole about one-fourth inch. Then put a wooden plug in the end of the pipe in the block, and pour molten lead into the other hole, (A) Fig. 16. The casting should now be removed from the mould, and a ½ or ¾-inch diameter hole drilled in the top, down to the tube. Remove the plug in the tube, and put a wick in it. This makes a very good grease cup.

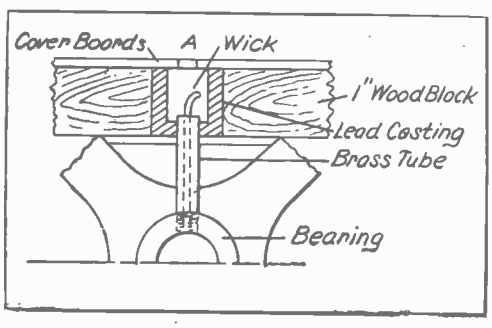


FIG. 16. GREASE CUP

The end of the brass tube should not be threaded, and should be screwed into a threaded hole in the brass bearing.

The dimensions of the shaft are shown in Fig. 17, referred to table V. The shaft may be cut from material similar to that of the shaft of the boring machine and may be turned to shape, but must not be cut off until all the machine work is done. The shaft is turned in the same manner as the armature core (see Chapter III), and with the same tool holder. The tool holder is fastened at the proper place by the same method as was employed in turning the armature—inserted through a hole in the bed of the boring machine and clamped by lock nuts. At the position which the armature and commutator will occupy, cut a slot or

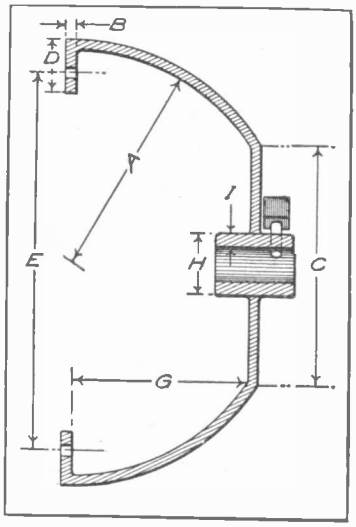


FIG. 15. COMMUTATOR END BEARINGS

keyway in one side of the shaft with a small cape chisel. This slot or keyway should be ¼ inch wide by about ⅛ inch deep, so that a key of the above size will fit into it tightly. One of these keys is shown in the illustration of the commutator, Fig. 18.

The commutators of these small machines are very simple in construction, being composed of a hardwood core on which are fastened the segments, cut from a short piece of brass tubing. The commutator is

shown in Fig. 18, and is dimensioned in table VI. It is fastened to the shaft by means of a key, as shown.

To construct a commutator for the 50-watt machine, mount on the boring machine shaft a piece of oak about $\frac{3}{4}$ inch long, and of sufficient diameter for turning a cylinder $2\frac{1}{2}$ inches in diameter. Turn down as smooth as possible and shellac its surface. Obtain a $\frac{3}{4}$-inch piece of $2\frac{1}{2}$-inch (internal diameter) seamless drawn brass tubing and drive onto the cylinder. If making a commutator for the two-pole field, divide its perimeter into eleven parts by eleven equally spaced lines drawn parallel to the shaft; if for the four-pole field, divide it into 33 parts. The 100-watt commutator with a two-pole field should be divided into eleven equal parts; the 300-watt, thirteen, and the 800-watt, fifteen. On the four-pole types: 100-watt, 33 parts; 300-watt, 39; on the 800-watt, 45.

Between the lines drawn on the commutator, and near the ends of the tube, drill one pair of holes to each segment marked off. Use flat-headed screws in the hole on one end and round-headed screws on the other. The flat-headed screws should be countersunk. When this is done cut the commutator tube into segments, by cutting the metal out along the lines with a hacksaw, cutting entirely through into the wood. Be careful that the segments are separated, and brush out all small saw cuttings from the saw cuts.

TABLE V

DATA FOR SHAFT DIMENSIONS, REFERRED TO FIG. 17

Type	A	B	C	D	E	F	G	H	I
	in.	in.	in.	in.	in.	in.	in.	in.	in.
A	2	$1\frac{1}{2}$	$6\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{3}{4}$	$\frac{1}{2}$
B	2	$1\frac{1}{2}$	$6\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$\frac{3}{4}$	1	$\frac{3}{4}$	$\frac{3}{4}$
C	2	$1\frac{1}{2}$	$9\frac{1}{2}$	2	$1\frac{1}{2}$	$\frac{3}{4}$	1	$\frac{3}{4}$	$\frac{3}{4}$
D	3	2	$11\frac{1}{4}$	3	2	1	1	1	1

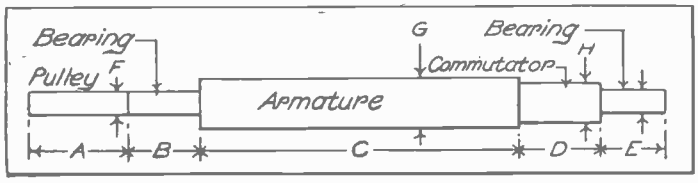


FIG. 17. SHAFT

Now loosen up the screws on the segments, and raise one segment at a time, and by means of shellac, fasten enough mica in the saw slots to completely fill them. Then screw the segments down tightly, and on the boring machine, turn down the face of he commutator and the flat-headed screws with a light cut. The armature leads are to be connected under the round-headed brass screws.

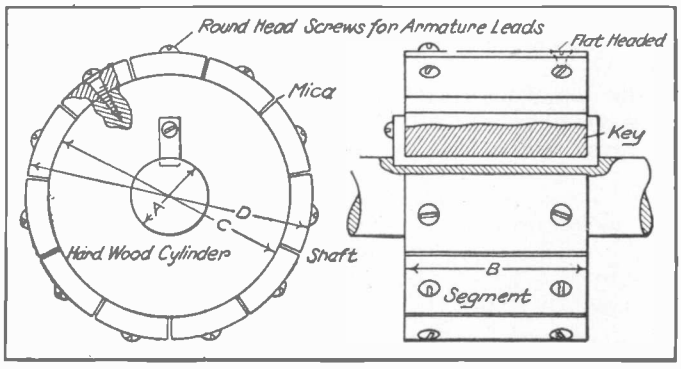


FIG. 18. COMMUTATOR

The brush holders Fig. 19 of these machines are all designed for carbon brushes. These brushes may be cut down from larger sizes

TABLE VI

DATA FOR COMMUTATOR DIMENSIONS, REFERRED TO FIG. 18

Type	A	B	C	D
	in.	in.	in.	in.
A	$\frac{3}{4}$ or 1	$\frac{3}{4}$	$2\frac{1}{2}$	2 13-16
B	$\frac{3}{4}$ or 1	1	$2\frac{1}{2}$	2 13-16
C	1	$1\frac{1}{4}$	$\frac{3}{4}$	$3\frac{1}{2}$
D	1	$2\frac{1}{4}$	$\frac{3}{4}$	$3\frac{1}{2}$

if the proper sizes are not at hand. The dimensions of the brushes are given in table VII under (A) and (F). The brush holders are made of a strip and a block of copper or brass. The strip, cut to the dimensions shown, should be bent to shape, and the block, $\frac{1}{4}$ by $\frac{1}{2}$ by $\frac{3}{8}$ inch fastened in place by screws. Drill and tap a hole in

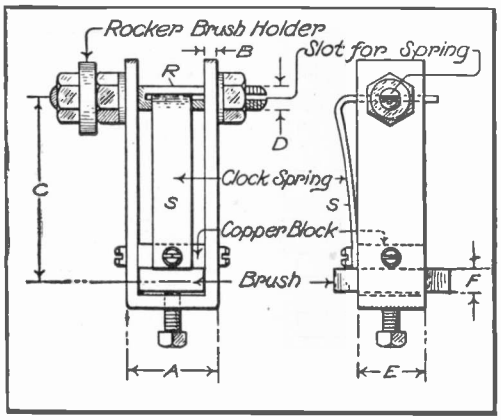


FIG. 19. BRUSH AND HOLDER

the top of the $\frac{1}{4}$ by $\frac{1}{2}$ by $\frac{3}{8}$ inch block for a screw which is used as a connector for flexible brush leads. Drill the holes for supporting

TABLE VII
BRUSH HOLDER DIMENSIONS REFERRED TO FIG. 19

Type	A	B	C	D	E	F	F
	TWO POLE AND FOUR POLE					Two Pole	Four Pole
	in.	in.	in.	in.	in.	in.	in.
A	5-16	$\frac{1}{8}$	$1\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	5-16	$\frac{1}{4}$
B	$\frac{3}{8}$	$\frac{1}{8}$	$1\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$
C	$\frac{3}{4}$	$\frac{1}{8}$	2	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{8}$
D	$1\frac{3}{4}$	$\frac{1}{8}$	$2\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{8}$

the holder on the rod (R), in the end of the holder. Then drill and tap the hole of the screw (T) which clamps the brush in place. Cut the rod (R) to the proper length; thread the two ends, and cut a slot down one end with a hacksaw for the spring. Insert a piece of clock-spring in this slot, and bend it so that it will bear down on the brush as illustrated. Washers and nuts should be placed on both ends, and the brush holder fastened to the rocker brush support, Fig. 20. The rod (R) should be insulated from the support by an insulating bushing and

TABLE VIII
ROCKER ARM BRUSH HOLDER DIMENSIONS, REFERRED TO FIG. 20

Type	A	B	C	D	E	F
	in.	in.	in.	in.	in.	in.
A	13-16	$1\frac{3}{4}$	$2\frac{1}{4}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$
B	1 1-16	$2\frac{1}{4}$	$2\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$
C	1 1-16	$2\frac{1}{4}$	$2\frac{5}{8}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$
D	1 5-16	$2\frac{1}{2}$	$3\frac{1}{8}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$

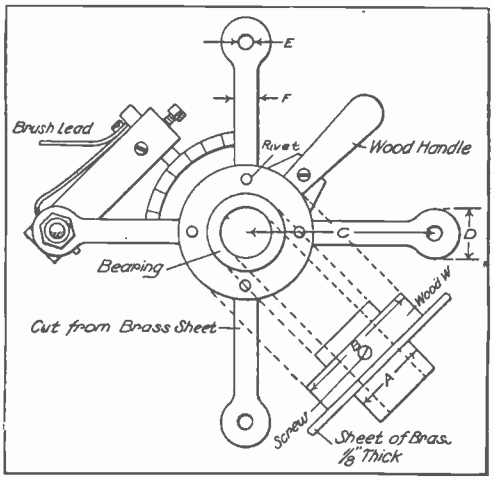
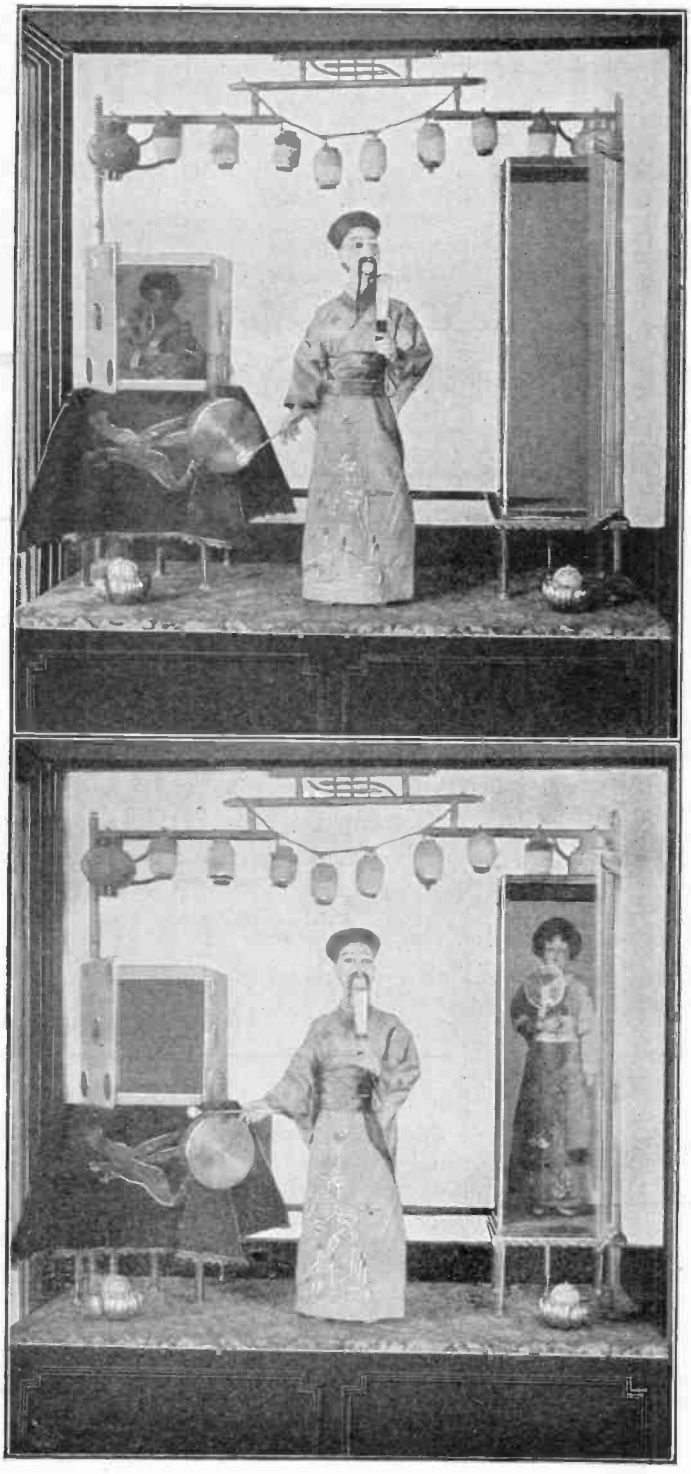


FIG. 20. ROCKER ARM BRUSH HOLDER

washers. For the two pole machine, two brushes will be required; for the four-pole, four.

The rocker arm brush holder, Fig. 20, should be cut to shape and dimensions given in table VIII, and should have fastened to it a block of wood (W) with a hole through the centre the size of the brass bearing tube. This is to support it upon the bearing, and contains a wood screw for tightening it in position.

(To be Continued.)



THE STRANGE DELUSION OF THE VANISHING LADY

The Vanishing Lady

Almost as real as if of flesh and blood instead of wax, this little bright-eyed Oriental magician clad in silk gown and turban and enclosed in a glass case, entertains both the children and grownups as he shows in pantomine that he is about to do something mysterious.

Upon each side of him is a metal cabinet, one oblong, the other a cube, each with hinged doors.

To begin his mysterious act, at his first gesture both doors open, the lamps on the platform light up and the cabinets are seen to be empty. The doors then close as with a nod of cunning the wax wizard turns to his right and strikes a gong suspended at the corner of the table. Immediately the cabinet door opens disclosing a lady seated within clad in a silk kimono, and holding a fan in her right hand. The door closes, then both cabinet doors open, the lamps light, and my lady has vanished. At a wave of his fan toward the oblong cabinet the door opens and there she is found standing up with the fan still in her hand. The door closes and again both doors open. The lady has disappeared and the cabinets are found unoccupied as at first. The scene is made more weird by the light from

eight small lamps within Chinese lanterns suspended over the magician's head and the little folks exclaim in wonderment, "How does he do it?"

A little electric motor and small flasher are located under the platform. The lady in the cabinet at the magician's right eludes the eye by being lowered floor and all into the table which, of course, is covered by a beautiful table cloth, and a false floor above her head comes down, too, covering her up

You might also arrange to have the water trom the overflow pipe move a lever arm and and taking the place of the floor she sits on. Her twin sister who stands up all the time is fastened to a velvet-covered revolving board which the motor by means of wheels and belts quickly turns half round while the door is closed.

This interesting device may be seen in the children's play room on the eighth floor of Marshall Field's, Chicago.

THE YOUNG EDISONS' CLUB

Under this heading will be published letters from readers of the Junior Department. These letters should describe briefly and accurately your experiences in the making and operation of electrical devices and in the performing of electrical experiments. See how good an "engineering report" you can make of your investigations.

The Young Edisons' Club:

Here is a description of a high water alarm designed to be used in a place where you have to pump water from the cellar up into a tank in the attic. It saves you the trouble

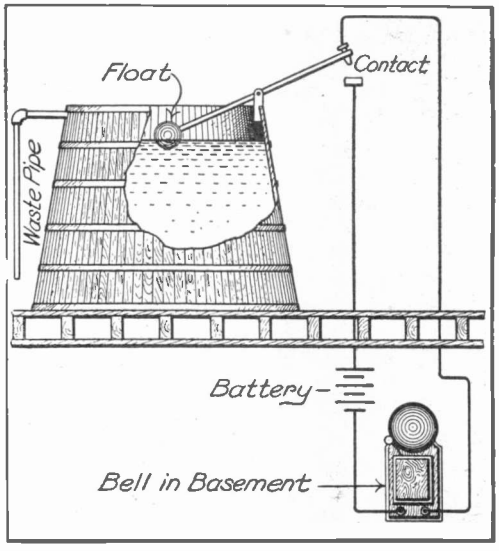


FIG. 1

of climbing up stairs every little while to see if the tank is full.

Pivot a lever arm on the edge of the tank so that one end will tip down into the tank. Arrange a float on the end of the lever so that it will be lifted when the tank is nearly full. Arrange a bell circuit so that the circuit will be closed when the water reaches a certain height (Fig. 1).

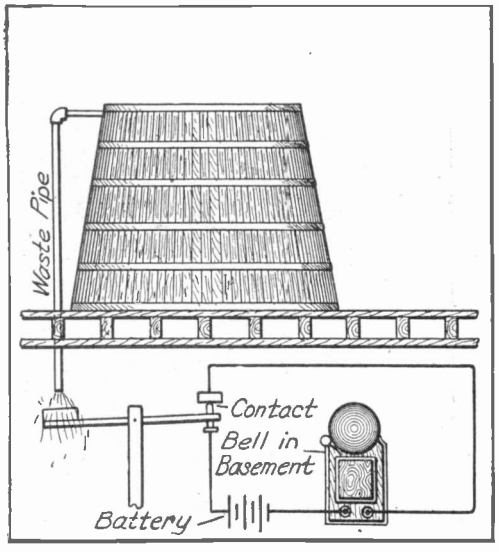


FIG. 2

during shopping hours a crowd of the curious of all ages may be found in front of it.
close the circuit when the water begins to flow from the pipe outside the house (Fig. 2).

HAROLD H. LEWIS.
617 N. Fayette St.,
Saginaw, Mich.

The Young Edisons' Club:

My shop is built of scraps and boxing lumber and is 8 by 10 feet 6 inches. The roof is shingled and I have it whitewashed inside to make it lighter.

My equipment, which I bought outright, consists first of a dynamo (20 volts, 4 am-

peres, 80 watts at 2000 revolutions per minute). This I drive with my 2½ horse-power Shaw motorcycle engine. I put a sewing machine fly wheel on the dynamo to steady it. Besides this I have twelve Edison key sockets, twelve Edison base 14-candle-power lamps, 300 feet No. 14 R. C. wire, 30 feet No. 16 lamp cord, switchboard (soft wood, 24 by 30 inches), one voltmeter 0 to 25, one field rheostat, two switch and fuse blocks, eight four-ampere fuses, one single pole switch and one double pole switch.

For tools I have two screw drivers, one compass saw, one hand saw, one hack saw, four bits (¼, ⅜, ¼, .1), three drills (3-32, ¼, 5-32), one brace, one cold chisel, one punch, one hammer, one rivet set, one soldering copper, one pair tin snips, two awls and two planes.

My library consists of one "Physics," one "Easy Experiments in Electricity," one "Amateur Mechanics," POPULAR ELECTRICITY and *Popular Mechanics*.

When I get my wireless I will have a nearly complete shop. I have already made two telephones, I have one in the shop and one in the house. These were made from so-called worthless parts. But I found only a little labor would make them as good as new.

F. R. STERLING.

Box 772,
Hartington, Nebr.

The Young Edisons' Club:

My experience with electricity is of course only as an amateur, but I will first tell you how I first became interested in electrical matters. When I was attending High School, I boarded with a fellow student who studied physics. He became interested in making an electric bell and of course I was anxious to learn what kind of a thing an electric bell was and to help him. After a good deal of experimenting and studying we made a contrivance which would buzz, but not ring, as we did not have the facilities for putting the bell part on. The magnet was about three and one-half inches long and two inches wide across the poles. We had wound the magnet with No. 28 magnet wire, which as you know is too fine for an electric bell to be operated by batteries. It worked fairly well, however, on three cells. It was an awkward looking affair, with a wooden base about ten inches in length and seven in width. We didn't even have a then cover for it to keep the dust out.

Our success with the electric bell of course made us more anxious to make some more apparatus; so we decided to make a spark coil, but our lack of finances would not then allow it.

About two months later I purchased a half pound of No. 16 magnet wire and a quarter of a pound of No. 29. I used the No. 16 for the primary and the No. 29 for the secondary and constructed an induction coil which would give a good shock when run on two or three dry cells. I used to have lots of fun with my induction coil with my friends as I could give them good smart shocks when they were least expecting it. I also made a good shocking coil out of an ordinary telephone induction coil, by simply winding more wire onto the secondary.

I have never bought any new batteries. Instead I would get the worn-out batteries from the telephone office and renew them. This I would do by cutting the zinc open on one side and removing it, being careful not to break the paper or pasteboard on the inside. Then I would scrape the zinc clean and sandpaper the outside, then place it carefully on the carbon element again, tying it in place with a cord. Then I take a quart fruit jar or bottle and remove the top in the following manner: Wrap four or five thicknesses of string around the top just above where you intend to take it off, saturate it with kerosene, light it and it will usually break off just above the string; if it does not, dash it into cold water, top first, which will generally take it off. Now place the cell in the jar and fill the latter with rain water and add enough sal ammoniac to make a good strong solution. After the cell stands for a few minutes it is ready for use. I have two of these cells in operation now and they do fine work on my "Little Hustler" motor and doorbell. Of course more cells could be "fixed up" in this way, but I think I would connect them series-multiple so as to get more current. One of these cells has been in operation more than two weeks and I can't see that the zinc is consumed a bit yet.

Do not pay any attention to anyone who tries to make fun of you for "monkeying" with "electrical things."

ORLO MUTCHLER.

202 Herkimer Ave.,
Allegan, Mich.

POPULAR ELECTRICITY WIRELESS CLUB

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

A High-Power Wireless Equipment

By ALFRED P. MORGAN

PART XII.—POTENTIOMETER; FIXED CONDENSER

The action of the electrolytic detector has already been explained in detail, but in order more fully to understand the purpose and usefulness of a potentiometer it may be well to recall that when the positive half of the wave is passing, the voltage of the high frequency currents is sufficient to break down the film of gas on the Wollaston wire point and permit the battery current to flow.

The purpose of the potentiometer is to lower the voltage of the battery to such a point that it is insufficient of itself to break down the film of gas but still is strong enough to quickly reform the film of gas after it has been broken by the high frequency currents and the latter have ceased to pass.

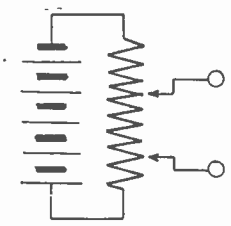


FIG. 132. RESISTANCE IN PARALLEL

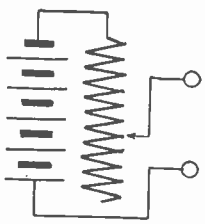


FIG. 133. RESISTANCE IN SERIES

In construction, a potentiometer is merely a variable resistance shunted across the terminals of the battery as in Fig. 132. If placed in series with the battery as in Fig. 133, it would serve merely to regulate the current strength in the circuit. When connected in parallel with the source of current it is the voltage which is varied.

In order to understand this action, which is the principle of the Wheatstone bridge, the fall of potential along a wire must first be explained. If any electrical circuit connected with a source of current supply is carefully examined, it will be found that the

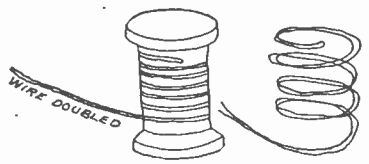


FIG. 134. NON-INDUCTIVE WINDING

potential falls off as the distance away from the source of current becomes greater. In other words, the voltage drop between two points in a circuit is proportional to the resistance between the points.

Potentiometers are made in two forms, the first employed usually by makers of amateur wireless telegraph instruments, wherein the resistance is in the form of a graphite rod or a hard rubber rod wound with German silver wire and having a ball bearing slider or wheel rubbing over it. The second is more often used in connection with commercial apparatus and the resistance consists of a number of coils of wire variable by means of a multi-pointed switch.

I have chosen this latter type to describe because it is not only more satisfactory but also because it is more in keeping with the remainder of the apparatus.

The resistance units consist of coils of German-silver wire wound carefully in the non-inductive manner shown in Fig. 134. The wire forming each coil is doubled back on itself before being wound in order to avoid self-induction and not unbalance the detector circuit whenever the adjustment of the potentiometer is changed.

The coils number 22 all told. Eleven coils have a resistance of 35 ohms apiece and the other eleven 33 ohms together or three ohms apiece.

The table given below shows the length of wire for several sizes required to form each coil. The proper lengths should be measured off and cut and then rolled up in the manner stated.

GERMAN SILVER WIRE—18 PER CENT

NO. B.&S.	LENGTH OF WIRE IN 35 OHM COILS	LENGTH OF WIRE IN 3 OHM COILS
30	18.5 feet	1.6 feet
32	11.9 "	1.0 "
34	7.3 "	0.6 "
36	4.5 "	0.4 "

The case of the instrument is $\frac{3}{8}$-inch mahogany, built so as to form a box whose outside dimensions are 6 by $4\frac{1}{2}$ by $2\frac{3}{4}$ inches. The top and bottom of the case project slightly beyond the sides so as to improve its appearance.

The details of the contacts and the switches are shown in Fig. 135. The contacts are

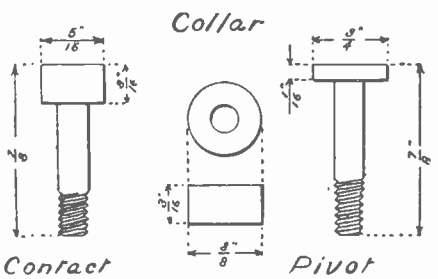


FIG. 135. DETAILS OF CONTACTS AND SWITCHES

turned out of 5-16 inch brass rod and are threaded with an 8-32 die at the lower end. They are $\frac{7}{8}$ inch long over all and 3-16 inch high above the top of the case. They are set equidistantly around the circumference of two circles each $1\frac{5}{8}$ inches in diameter.

A hexagonal brass nut having an 8-32 thread is screwed on the lower end of the contact so as to hold it firmly in place. After all the contacts are in place the resistance units are fastened in the bottom part of the case by gluing around the sides. Connections are established to the lower ends of the contacts by soldering.

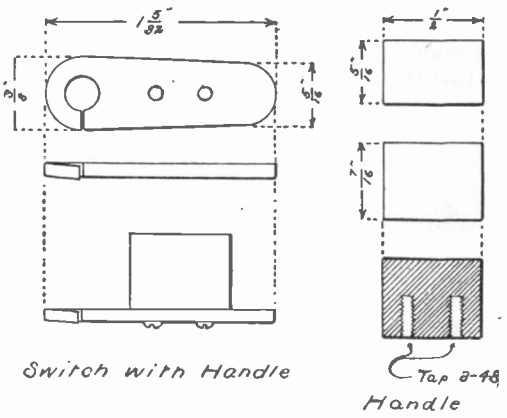


FIG. 136. DETAILS OF SWITCH ARMS AND HANDLE

All of the 35-ohm coils are connected in one group and all of the three-ohm coils in the other.

The switch arms are cut out of 1-16-inch hard sheet brass as shown in Fig. 136. The pivoted end of the switch is cut and bent down so as to form good contact with the pivot at all times. A brass collar $\frac{3}{8}$ inch in

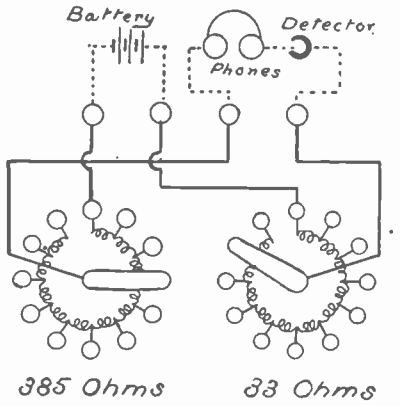


FIG. 137. CIRCUIT DIAGRAM

diameter and 3-16 inch thick is placed under the switch so as to bring it level with the tops of the contacts.

The handles are formed of two small hard rubber blocks $\frac{1}{2}$ inch long, 7-16 inch high and 5-16 inch thick. They are polished in a

buffing wheel charged with wet pumice stone or tripoli powder. Two 3-48 brass screws passing through the switch from the under side into each block hold them in position.

The connections are shown by the diagram in Fig. 137. The heavy wires leading from the resistance units lead to two binding posts which are connected to the battery. The two switch arms connect to two other

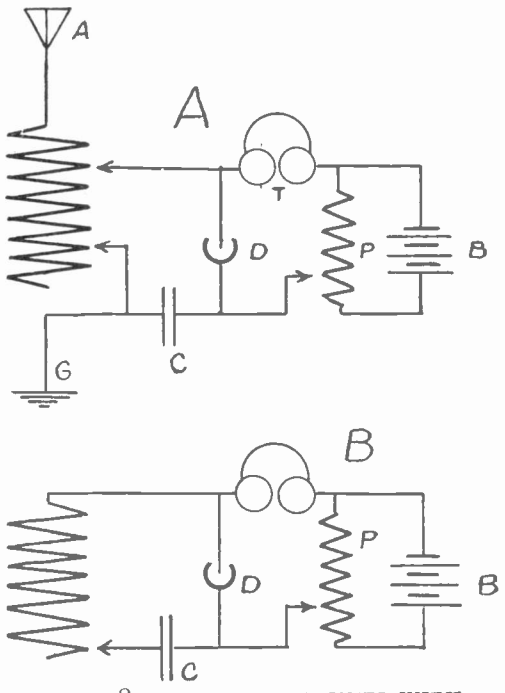


FIG. 138. RECEIVING CIRCUITS WITH FIXED CONDENSERS

binding posts which in turn are connected to the detector and to the telephone receivers.

FIXED CONDENSER

Condensers for use in the receiving circuit of a wireless telegraph installations may be divided into two types, those which are adjustable or variable and "fixed" condensers whose capacities may only be altered in steps. To the former class belong the rotary plate, sliding plate and sliding tube types which have air as a dielectric. Those are used exclusively for tuning purposes and therefore may be dismissed from our attention at the present.

Fixed condensers usually employ paper, mica or thin glass as a dielectric. They are necessary in the receiving circuit in order to prevent the turns of the tuning coil which are included in the closed circuit from forming a short-circuit around the battery and the telephone receivers. This will be readily understood from the two circuits shown in Fig. 138.

The first one (A), represents the arrangement of an ordinary "close" coupled double slide tuning coil while the second (B) illustrates the secondary circuit of a "loose" coupled system.

The proper capacity for a fixed condenser is dependent upon conditions peculiar to each receiving set. It is something which if the best results are desired it is impossible to predetermine. I always prefer to build several condensers of varying capacity and pick out the best one by experiment. If the capacity is too small it will weaken the sig-

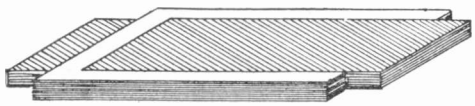


FIG. 139. FIXED CONDENSER, "BUILT UP" TYPE

nals while if too large the signals will sound "mushy". The proper capacity will render the signals sharp and clear.

The most desirable fixed condenser for receiving purposes is that type known as a "built-up" condenser and which consists of a large number of small sheets alternately paper and tinfoil laid one on top of the other as opposed to the roll condenser which consists of a smaller number of large sheets rolled up so as to occupy a smaller space. It has been found that a roll condenser cannot charge and discharge as rapidly as a "built-up" condenser.

In making a condenser for this purpose it is sometimes a good plan to divide it into several units and then by connecting the units in various ways several values of capacity may be obtained. Two condensers of equal capacity connected in parallel have twice the capacity of one, while in series they will have only one-half the capacity of either.

The condenser described below will be found to be as nearly suited to the average receptor as it is possible to obtain without experiment.

It is composed of sixteen sheets of tinfoil 1¼ inches wide and three inches long. The

paper is a good grade of linen .005 inch thick carefully prepared by dripping in a molten bath of clean paraffin until all bubbles cease to rise. It is hung up to dry and then cut into strips, 1½ inches wide and three inches long. The paper and tinfoil strips are piled up alternately allowing about 5-16 inch on each tinfoil strip to project beyond the paper as shown in Fig. 139, alternately, first on one side and then the other.

Place the condenser between two flat boards which may be squeezed together with

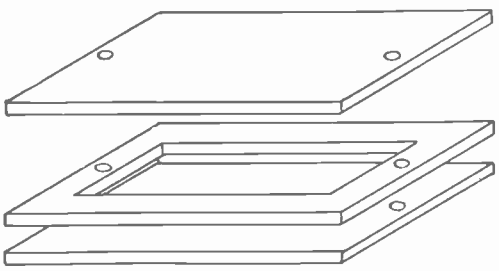


FIG. 140. CONDENSER CASE

a clamp and put them in an oven which is hot enough to melt the paraffin. As soon as the paraffin on the paper has thoroughly softened, tighten up the clamps and set the condenser away to cool.

As soon as cool it may be removed from the clamps. It should be firm and hard enough to hold together.

The tinfoil strips are bunched together at each end and soldered to a stranded copper wire.

If desired the condenser may be placed in the base of the detector or mounted in a case of its own. If the latter, the scheme shown in Fig. 140 will be found to be very effective. A rectangular hole 3½ inches long and 1¾ inches wide is cut and is the centre of a piece of hard rubber 3-16 inch thick, 4¾ inches long and 2¾ inches wide. The corners are rounded so as to give a finished appearance to the case.

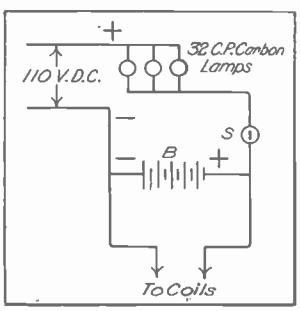
The sections may now be fastened together by two brass machine screws which pass through at both ends as shown in the illustration. The condenser is placed in the case and connections established to the screws. These may be passed through the sides of the potentiometer box or the detector case and secured on the under side with a hexagonal unit, making a neat and compact unit.

(To be Continued.)

Operation of Spark Coils on 110 Volts

Many letters have been received of late requesting information as to how spark coils may be run on 110-volt electric light circuits. Most coils used by experimenters are designed to operate on from six to twelve volts, and a well designed coil should not consume more than eighteen watts per inch of rated spark length.

The use of an electrolytic interrupter in series with a battery spark coil on 110 volts is often the cause of the insulation of the secondary winding breaking down. The prime reason for this is that there is no electrolytic interrupter on the market at a low price which will operate satisfactorily unless a current of 20 amperes or more is passing through it. If this combination is used in connection with a circuit of 110 volts pressure, 2,000 watts or more are being used in the coil, depending upon the resistance of the electrolyte used in the interrupter and the amount of surface exposed at the "point." Since the coil was made to consume from eighteen to 75 watts, depending upon its size, the use of an electrolytic interrupter as described greatly overloads the coil and causes considerable heating of the windings. Moreover, the voltage produced in the secondary of a coil connected in this way is many times higher at the moment the current is broken by the interrupter than that for which the coil was designed, and consequently many breakdowns occur.



SPARK COIL ON 110 VOLTS

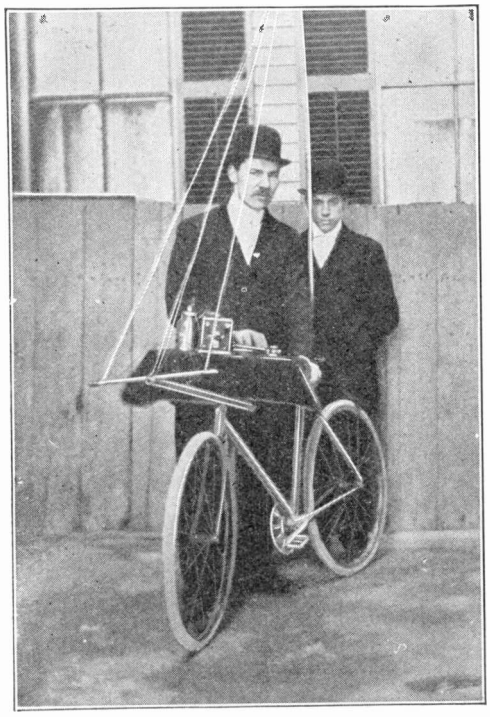
One of the most satisfactory ways to operate a battery spark coil on 110 volts D. C. is illustrated. The battery (B) may be a set of dry cells connected in series, or a storage battery of the proper voltage for the coil. As many 32-candle-power lamps should be connected as shown as will give the number of amperes the coil consumes. The battery acts as a voltage reducer and will last almost indefinitely if switch (S) is "on" while the

coil is being used, and "off" at all other times. This method does not cause flickering of the lights in the house when the key is depressed and the coil cannot possibly be damaged. In connecting be sure that the positive (carbon, in the case of a dry battery) is connected to the positive wire of the electritic lght circuit.

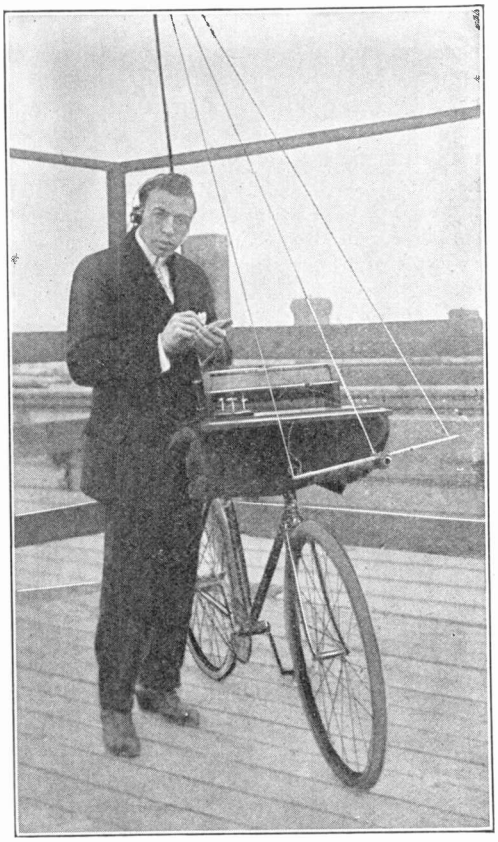
One of the most satisfactory and safe ways to operate a battery spark coil on a 110-volt A. C. circuit is to revolve the adjusting screw of the vibrator until it cannot operate, and to connect the coil in series with two ten-inch gas lighting spark coils. These coils consist of one winding of wire. The spark coil then acts as an open core transformer, and the gas lighting coils act as a reactance. The spark produced by the coil with this method is short and thick, like that of a transformer, and large spark gap terminals should be used to prevent their overheating. It will also be found that a larger condenser connected in the secondary circuit will be needed. A. B. COLE.

Wireless Without a Ground

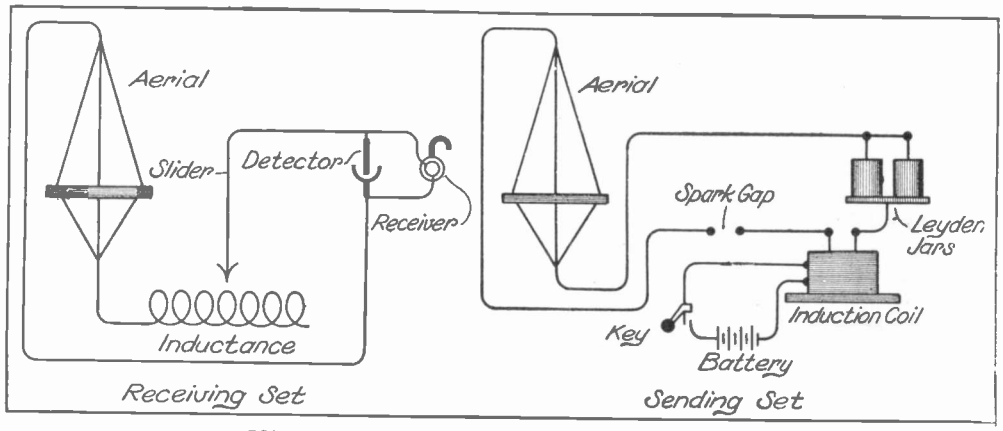
The sending of wireless messages through space without a ground at either station has been demonstrated by the inventors, Messrs. Jonescick Bros. of Cambridge, Mass., and I. Wolff of Roxbury, Mass. The experiment was made by means of a complete sending and receiving set of apparatus mounted on bicycles including the aerial, as seen in the photographs. No ground wire was used, as the rubber tires prevented any con-



SENDING SET



RECEIVING SET



CONNECTIONS OF BICYCLE WIRELESS OUTFIT

nection or leak of the high frequency oscillating currents to escape through the frame and wheels.

The sending apparatus of the set consisted of a three-inch spark coil, two high tension leyden jar condensers connected in multiple, a spark gap, and an operator's key. The entire set was mounted rigidly on a board 8½ by eighteen inches. A set of six dry cells which operated the coil was placed underneath the board, and the complete station fastened to the handle bar of the bicycle. The operator would guide the bicycle with one hand and operate the set with the other.

The receiving apparatus of the set, which was operated by Mr. Wolff, consisted of a large inductance coil equipped with a sliding contact so as to provide accurate tuning when necessary, a sensitive piece of silicon used in a high tension adjustable mineral detector holder, a switch and one 2,000-ohm double pole laminated core magnet receiver, wound with copper wire, held on the head by means of a head band. The entire set was mounted on a board and fastened to the handle bar of the bicycle as seen in the photograph, and operated in the same manner as described in the sending set.

The aerials of the two sets were equivalent. Each was made up of a ten-foot pole (a bamboo fishing rod ten feet long) fastened to the back of the seat on the bicycle, and three wires each 12½ feet long of phosphor bronze. These were constructed in the shape of a cage, connected at top and looped in one at the bottom, which was suspended on a cross bar as shown in the photographs. All connections were permanent and rigidly clamped so as to prevent trouble.

The lack of space for a helix in the sending circuit compelled the construction of a double wire spread in the aerial used by Mr. Jonescick in his sending set.

Where both sets were to be used as one, the clear space on the board, as shown to the right of the photograph representing the receiving set, was left for placing the sending apparatus.

A distance of about 2½ miles was covered with great success, on the evening of February 4, 1911, at 10:30 p. m., and the distance of about 3½ miles on the morning following at 2 a. m. When covering the last distance one of the operators was situated at the foot of the N. Harvard St. Bridge and the other at the foot of the Cambridge Bridge along the banks of the Charles River. Boston, Mass.

H. FRANK.

Solder for Detector Crystals

Most of the articles published on detectors recommend ordinary solder for holding the crystals in the cups. For one who is willing to take the trouble to get the bismuth, the alloy here described is better. Its convenience lies in its low melting point, which is very near the temperature of boiling water. The composition of the alloy is as follows: Bismuth two parts (by weight); lead one part; tin one part. The lead is first melted and the tin added, then the bismuth put in and stirred, the temperature being kept only high enough to keep the alloy melted, otherwise the tin becomes oxidized and forms a scum.

J. H. STEWART.

Hints on Increasing Efficiency

By GEORGE F. WORTS

There is hardly any portion of the amateur's transmitting set that is not susceptible to improvement of some kind. Leakage and incorrect capacity are about the commonest faults. In insulating wireless sets, it should be borne in mind that though rubber and glass rank high as dialectrics their surface leakage is extremely high. Where a great difference of potential exists across a small area, such as in a helix or spark gap, fibre, though ranking low as a dialectric, should be used as its surface leakage is low as contrasted with rubber and glass. Slate will nearly always be found to contain metallic veins that are conducting paths for high voltage currents and therefore undesirable for all but low voltage insulation. Wood may be used on most all high voltage insulation as it appears to hold up very well under most conditions.

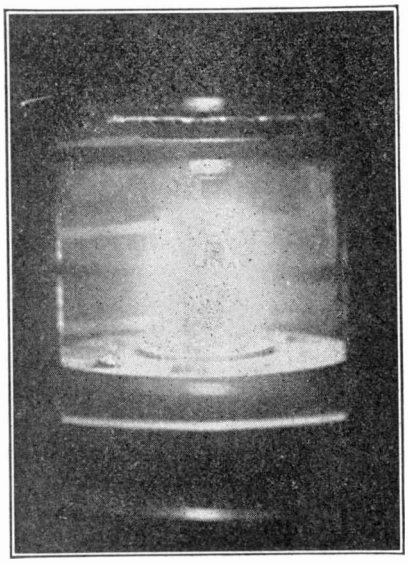
Connecting wires should lead in as straight a line as possible to the instruments as sharp corners incur leakage, while numerous turns introduce extra inductance and will possibly unbalance an otherwise well synchronised circuit.

The induction coil has been gradually superseded by the closed core transformer, which is much more efficient, cheaper to build and costs less to run. Experiment has proven that the type of closed core transformer in which the primary is wound upon one side or "leg" and the secondary upon the other side, is practically as efficient as the type in which part of the primary and secondary are wound upon each leg and is cheaper to build.

Of late, amateurs have awakened to the fact that high voltage transformers will send considerably farther than those of low voltage. The commercial companies have realized this for several years and consequently use transformers producing 25,000 to 50,000 volts. It is impossible to use this high voltage on low power, amateur wireless sets, as the amperage of a 250-watt transformer is so low if over 15,000 volts is used, that it will not charge condensers satisfactorily. However, the amperage at 15,000 volts of a properly designed, 250-watt transformer will, with condensers, produce a fat spark about ⅜ of an inch in length, that has marvelous powers for sending. Without condensers a worm-like flame will jump between points about ½ inch apart. It may be easily drawn out to 1½ inches.

A ½ K. W. transformer wound to give 20,000 volts on the high side will charge condensers rapidly enough to give a working spark of over one inch, see illustration.

The use of the high voltage transformer makes possible the use of the high speed rotating gap, the advantage of which lies in the sharp and even spark that results from its use. A high pitched tone may be also produced by a series gap. A satisfactory experimental series gap can be made by driving a row of copper tacks in a well



SPARK FROM A ½ K. W. TRANSFORMER

seasoned board. Their heads should protrude ⅛ inch and be separated 1-32 inch. The number will depend, of course, on the voltage. The tone at the receiving end is clear and almost musical. Tests have proven that the sensitiveness of high resistance wireless receivers increases with the increase in the height of the pitch of the tone. Fessenden and Stone, observing this, have brought out their well known singing spark

apparatus that has about revolutionized wireless commercially. The cost of high frequency generators which are necessary in this type of transmitter, prohibit its use by amateurs. However, by the use of a series or revolving gap with a high voltage transformer and condenser, a fairly high pitched tone may be produced that is suitable for most amateurs' requirements.

In designing high voltage transformers, the insulation enters as a prime factor. Primaries should be well insulated between consecutive layers and all secondary windings should be subjected to an impregnating process in slowly boiling refined paraffin for a long period. If the secondaries are wound pancake style, which is a much more efficient though difficult method of construction than that entailed in the block secondary type, each section, after impregnation, should be well taped with oiled linen or muslin tape ¾ inch in width. This tape should be cut diagonally from large sheets of the material. If it is cut or torn lengthwise, it will break easily. Varnished muslin cloth, owing to its stiffness, is not well adapted for sharp turns or small diameters.

Oiled muslin has a greater flexibility and longer life under heat conditions, its insulating base being the best quality of linseed oil in which no varnish or drier is used. If bias tape is desired the raw material should be first prepared before going through the insulating process and then cleanly and evenly cut to the width desired, thus eliminating any rupture on the oiled insulating films. This tape may be purchased in the yellow color of oil, although black varnished tape is sometimes used. The average puncture test of oiled muslin is one thousand volts per mil.

Windings should be insulated from the iron to withstand a direct puncture test of 100,000 volts. This can be obtained with ten layers of ten mil cloth. If transformers are to be immersed in oil, it should be pure linseed oil, as inferior oils will do much more harm than good to transformers.

The condensers used in converting the secondary current into a live, effective discharge will differ materially from those used on low voltage sets. The usual descriptions of sending condensers depict a lug of tin foil fastened by shellac between photographic plates. A condenser of this type will actually "burn up" when connected across the secondary of a transformer of over 15,000 volts. Even two sheets of the aforementioned dialectric are insufficient. It is advisable to construct the condenser in units with two plates between each lug and the group of units connected in series multiple. For a one K. W. transformer 200 eight by ten photographic plates, connected in this manner, will suffice.

In using a high voltage transformer, if an ordinary gap is used, it may be of silver, copper, brass, zinc, aluminum or steel, though zinc will be found to give results a trifle superior to the others. The electrodes should be about the size of pencils and rounded at the ends. These electrodes will do for any transformer under five K. W. capacity.

Transmitting loose couplers (oscillation transformers) are not efficient on small aerials. If a helix is used, its diameter should be no less than twelve inches as a smaller diameter will cause the tuning to be too sharp at the receiving end. Commercial companies wind their helices, on sets as low as one K. W., fourteen inches in diameter. This causes the tuning to be coarse even at a great distance which is an important consideration in commercial work. The usual ineffectiveness of amateurs' aerials calls for some counterbalance which is found at least partially in the use of a helix of large diameter. The turns should be spaced over one inch apart and should be well insulated from the wood helix frame by heavy fibre strips.

An efficient set with a good aerial *under all conditions* should cover one mile for every ten watts of energy expended. A ½ kilowatt set should cover 50 miles; a two kilowatt set, 200 miles, etc. Actual tests have proven that most stations will send considerably farther than this under good operating conditions.

Prescription by Wireless

The captain of a tramp steamer in the Gulf of Mexico was taken ill with ptomaine poisoning. With death staring him in the face on account of inadequate medical aid he decided to call, by wireless, for assistance from the physicians at a naval station 100 miles distant. A liner 700 miles farther away heard the wireless call and the ship's surgeon made haste to reply with the necessary prescription which was then filled from the tramp steamer's medicine chest.

Three Slide Tuning Coil

BY A. B. COLE

The three slide tuning coil is preferred to the loose coupled tuner by many experimenters for several reasons. A first-class loose coupled tuner is expensive as compared to the ordinary straight tuner, but is much more selective, enabling the operator to pick out one station from a number, provided that their wave lengths are quite different.

This very selectivity is, however, a disadvantage at times, for if the tuner is set for any one wave length, it is highly probable that signals from a distant station of a different wave length will not affect the detector sufficiently to attract the attention of the receiving operator, and the distant station will have difficulty in making itself heard.

The well known double slide tuner is not nearly so selective as the loose coupled type, and while better adapted to all around work for the reason stated above, is not satisfactory where there is much interference.

The three slide tuning coil combines the advantages of both the above mentioned types, and it can readily be made by the experimenter. It may be well to show how this tuner operates.

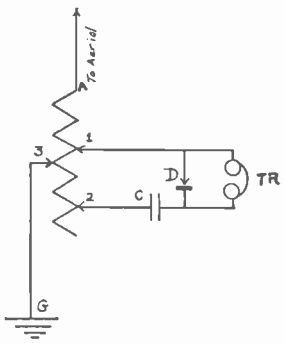
In both the double slide tuning coil and the loose coupled variety we have a number of turns of wire in series with the aerial and the ground, and variation of the inductance of this circuit is accomplished by cutting in or out more or less of the turns of wire, generally by means of a sliding contact.

In both these tuning coils we also have a circuit of variable inductance containing turns of wire on the tuner, the detector, and a condenser. In the case of the double slide tuner, this circuit generally contains turns of wire on the tuner which are common to the aerial, tuning-coil ground circuit, whereas in the loose coupled tuner the detector, tuning-coil condenser circuit includes turns of the secondary winding, which are separated from the primary turns by an air gap.

In both types of tuning coils the inductance of the aerial, tuning-coil ground circuit and that of the detector, tuning-coil, condenser circuit may be varied independently of each other, but in the loose coupled tuner we can also vary the distance between the primary and secondary windings, and thereby effect a greater selectivity.

Referring to the figure, it will be seen that the three-slide tuner acts as both a straight tuner and a loose coupled tuner. The aerial-tuning-coil ground circuit is (A-3-G). The detector, tuning-coil, condenser circuit is (D-1-2-C). The inductance of these circuits can be varied by moving sliding contacts (3), and (2) and (1) respectively. So far we have the general characteristics of the straight tuner.

Beyond the above variation we have another,—that of changing the distance between the two circuits. By leaving slider (3) fixed, and the distance between (1) and



CONNECTIONS OF THREE SLIDE TUNING COIL

(2) constant, it will be observed that the distance between active turns (A-3) and active turns (1-2) can also be varied by moving sliders (1) and (2) down. Thus we combine the actions of the double slide and loose coupled tuning coils and increase efficiency for all around working, for while the three slide tuner is not quite so selective as the loose coupled tuner, it is generally sufficiently so, especially if condenser (C) is variable and of large maximum capacity.

It will be found that there is a general position for the sliders, where nearly all stations can be heard, and after a little practice the experimenter will be able to find this without difficulty.

The general position may be found more readily than in the loose coupled tuner because the three slide type is not so selective, as we have stated above, due to the fact that the two circuits are common to the same wire, and not separated by an air gap.

The writer has used this type of tuner for about a year in a location where there is considerable interference, and the results have been very satisfactory.

WIRELESS QUERIES

Answered by A. B. Cole

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

Location of Aerial; Effect of High Mountain

Questions.—(A) For a station located in a valley, would an aerial 65 or 70 feet high be satisfactory? (B) When electric waves from a wireless telegraph station meet a high mountain, will they pass over it, or will they die out? (C) If my aerial were on the farther side of the mountain could I receive messages from the above transmitting station?—R. J., Vancouver, Can.

Answers.—(A) Yes.

(B) Part of the waves will pass over the mountain and down the other side, and part will be reflected in the same way as would a beam of light thrown against the mountain.

(C) You could receive from the transmitting station, but more sensitive instruments would be needed than if your aerial were located on the nearer side of the mountain, since the reflected energy is lost, as far as your station is concerned.

Lightning Rings Telephone Bell; Aerial and Wireless Waves

Questions.—(A) Why do the bells of a country telephone line ring during a thunderstorm, even if it is at a distance? (B) Are the waves in wireless telegraphy similar (but on a larger scale) to the magnetic lines of force about a conductor or magnet? (C) Explain how an aerial catches or receives these waves. (D) In what way will an aerial assist in sending the waves?—B. C., Fairview, Mo.

Answers.—(A) Because at some point the line is near a place where there is a lightning discharge. If the line is not struck, the ringing of the bells is probably due to its potential being increased, on account of its capacity as a condenser.

(B) Yes, there are two component parts of electro-magnetic waves, the electric and the magnetic. These latter act very much like magnetic lines of force.

(C) The cutting of the electro-magnetic waves by the aerial sets up a current, or oscillations, in the aerial, in the same way as lines of force cutting a conductor set up an electromotive force in it.

(D) The aerial has at least two distinct properties, that of capacity, and that of height. The first allows it to store up a large amount of energy and to radiate it, and the second allows the waves sent out to pass over most obstructions.

Spark Muffler; Use of Ammeter; Anchor Gap

Questions.—(A) What is a "spark muffler"? (B) What is an ammeter used for in tuning, and how is it connected? (C) What is an anchor gap used for?—E. S. W., Plainfield, N. J.

Answers.—(A) A spark muffler consists of a tube of glass or some other insulating material, surrounding the spark gap. The only advantage of having a muffler is that it diminishes the sound of the spark. The spark gap terminals should be cooled as much as possible, and when a muffler is used, it is well to arrange for a circulation of air around the gap terminals, as otherwise they will be heated considerably, and the efficiency of the station will be lowered.

(B) A hot wire ammeter is used to determine when the maximum amount of radiation by the aerial is being obtained, and consequently to show when the transmitting instruments are properly tuned. The meter is connected in series with the helix and aerial, and when a helix is not used, is connected in series with the spark gap and the aerial.

When the instruments are in tune, the reading on the scale of the meter is the highest.

(C) An anchor gap is used wherever it is not desirable to run the high tension currents through the aerial switch. It is used with the loop and umbrella aerials, and prevents the oscillations from passing through the transmitting instruments while receiving.

Wireless and Telephone

Question.—We have a telephone line which is grounded on the same water pipe as our wireless station. When we call up on the telephone and press the key of the wireless set, we can hear the signals in the telephone receiver. What is the trouble?—W. C. A., Chicago, Ill.

Answers.—The telephone line acts as an aerial, and the water pipe is the ground. The carbon grains in the telephone transmitter act as the filings in a coherer. You have, therefore, a wireless outfit in the telephone instrument. There is no way to prevent the disturbance of the telephone line by the wireless set.

Enameled Wire on Tuning Coils

Question.—What is the effect of enameled wire in tuning coils?—H. S. B., Lansing, Ont., Can.

Answer.—A greater number of turns, per inch length of core, can be placed on a coil using enameled wire than when cotton-covered wire is used. Considering two consecutive turns of wire separated by enamel insulation on each wire, we have a condenser effect, the two copper wires acting as conductors, the enamel as an insulator. This condenser or capacity effect acts so as to give a greater wave length per turn of wire on the coil, and since the number of turns per inch of enameled wire is greater than with cotton covered wire, tuning is far less accurate. However, enameled wire has its advantages. The coil needs no further finishing after the wire is in place, the copper wire is hard drawn and so does not wear away so readily under the slider as does the cotton covered soft copper. Lastly, the slider makes a better path for itself through the enamel than through the copper. By reducing the diameter of the coil the capacity effect is somewhat decreased and closer tuning is possible.

Behavior of Wehnelt Interrupter

Question.—I made a Wehnelt interrupter to use in series with a ½-inch spark coil on 110 volts. As soon as I turned the current on I heard a pop and saw a flash, accompanied by a loud buzzing. When I examined the interrupter the platinum wire had disappeared along with the sealing wax which I had used to fasten it in the glass. Can you account for this?—G. B., Washington, D. C.

Answer.—Either there was too much of the platinum wire immersed in the solution, or the percentage of acid in the solution was too great. It may be well to note that German silver wire will give almost as good results as platinum for this purpose. The percentage of acid should be about ten, that is, one part of acid (sulphuric) and nine parts of water.

See article on page 1127.

Aerial Insulation Test; Receiving Current

Questions.—(A) How is a galvanometer used in testing the aerial and lead-in wire insulation? (B) When receiving two miles, how much current is coming through the aerial? When receiving fifty miles?—H. H. K., Wheaton, Ill.

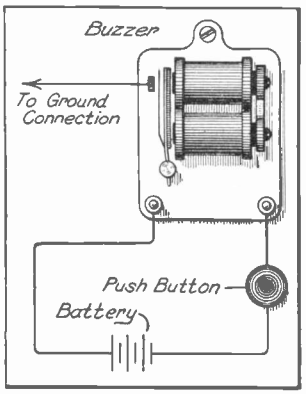
Answers.—(A) Connect the galvanometer in series with two or three batteries, the aerial, and ground, previously disconnecting all instruments from the aerial. The galvanometer should show only a slight deflection. The higher the insulation, the less the deflection.

(B) The amount depends on the power of the transmitting station, the height of both aerials, the methods of connection, and several other factors. In any event, only a small fraction of an ampere is received.

Buzzer Test

Question.—Of what does a buzzer test consist?—F. A. U., Brooklyn, N. Y.

Answers.—This test consists in making use of the electro-magnetic waves set up at the contact points of a buzzer to determine whether the detector is in adjustment or not. The diagram shows the connections. By completing the buzzer circuit by pressing the push button the buzzer is set in operation, and a buzz will be heard in the receivers



CONNECTIONS FOR BUZZER TEST

if the detector is properly adjusted. The more sensitive the detector, the louder the sound.

Sensitiveness of Loose Coupled Tuner

Question.—Is a loose coupled tuner with the primary wound over the secondary, the secondary divided into sections, with a slide on the primary, as sensitive as one in which the secondary is drawn out from the primary?—H. F. D., Saratoga Springs, N. Y.

Answer.—No, because one of the essential advantages of the loose coupled tuner is that the primary and secondary can be separated. In an ordinary tuning coil of the single or double slide types, the detector circuit and the aerial-ground circuit are dependent upon each other, that is, if the inductance of one is increased, the inductance of the other is also increased. In the loose coupled tuner, the inductance of these circuits can be varied independently, but for best results, it should also be possible to vary the distance between the windings, thereby varying their mutual inductance.

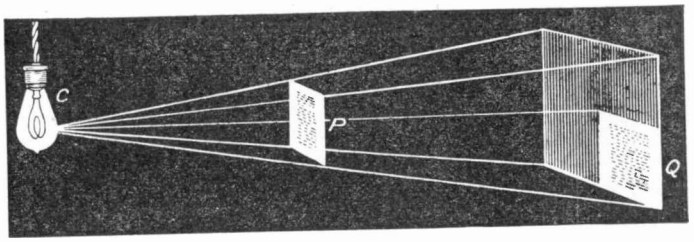
QUESTIONS AND ANSWERS

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

Intensity of Illumination; Mercury Arc Rectifier

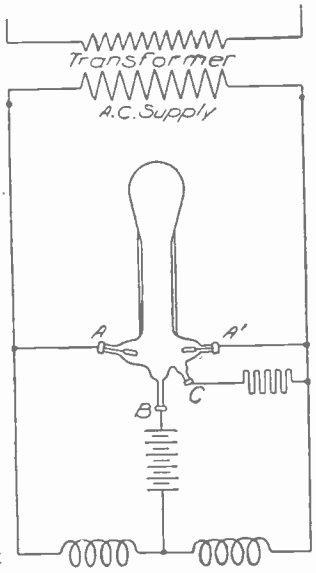
Questions.—(A) A surface 60 feet from a source of light will receive how intense an illumination as compared with the light on a surface 20 feet from the source of light? (B) State briefly the principle of the action of the Mercury Arc Rectifier —F. H. S., Los Angeles, Cal.

Answers.—(A) The intensity of light on a surface varies inversely as the square of the distance of that surface from the source of light. The drawing will help to understand this law. Suppose the distance from a light source (C) to a given surface (P) is 1. Then assume another surface (Q) at a distance 2 from (P). As light travels in straight lines a glance at the drawing, even without a knowledge of geometry, will show that the area (Q) is four times the area (P). If the surface (P) were removed, surface (Q) would receive the same amount of light as (P) received, but this light being distributed over four times the area would be only $\frac{1}{4}$ as intense as on (P). If the surface (Q) were three times as far from (C) as (P) the light would be distributed over an area at (Q) nine times as great. The intensity of illumination would then be only one-ninth as great, and so on, hence the law of inverse squares. Applying the law to the given case in hand, the intensity of light on a surface 60 feet from the source is to the intensity on the surface 20 feet distance as 20^2 is to 60^2. Or in other words is one-ninth as great.



ILLUSTRATING THE LAW OF INVERSE SQUARES

(B) If current is made to flow in one direction between two points through mercury vapor in a glass tube exhausted of air, and the direction of flow be suddenly changed, making what was the negative electrode, positive, the current will cease to flow because mercury displays the characteristic of opposing the change in direction and the formation of a new negative electrode. Using this phenomenon as a basis the mercury vapor rectifier is built on the principle shown in the drawing. There are two electrodes (A) and (A′) entering the tube as shown. Below is a third electrode (B). (C) is simply an arrangement for vaporizing the mercury in starting and is automatically cut out as soon as the tube is in operation. Now the current in the alternating supply wires is constantly



SHOWING THE PRINCIPLE OF THE MERCURY RECTIFIER

reversing. Therefore it tends to enter at (A) and leave at (A′) and to enter at (A′) and leave at (A) many times per second. But this it cannot do because of the fact that the current will flow in one direction only through a single electrode as above stated. Therefore the only action which can take place is for one impulse to enter at (A′) and pass down and out at (B). The next impulse, of opposite sign, can not enter at (A′) but does enter at (A), going out also at (B). Therefore we have current flowing out at (B) always in the same direction, or direct current, which is capable of charging a storage battery, as shown, or performing any other work requiring direct current. The two coils down at the bottom of the diagram are choke coils. These choke coils stop alternating current but allow direct current to flow through them. If it were not for these coils a wave coming down and entering (A′), we will say, could also divide and part pass on down and up into the tube at (B), meeting the other part of the divided wave and neutralizing it.

Lamp Circuits

Questions.—(A) How can I wire up a circuit to turn off lights from two points by a switch at each

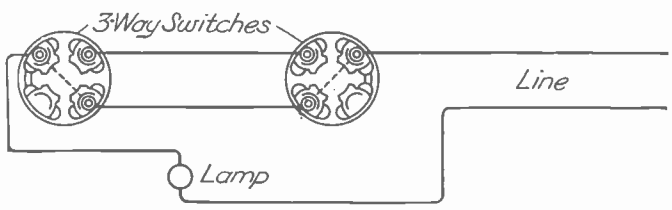


FIG. 1

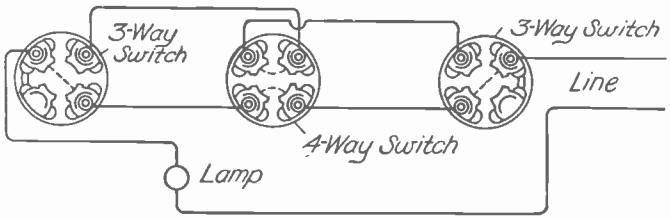


FIG. 2

place? For example, I want to turn on a light located at the top of the stairs while I am at the bottom and turn it out again when I reach the top. (B) How may lights be turned on or off from any one of three points?—N. B. K., Erie, Pa.

Answers.—(A) See diagram No. 1.

(B) See diagram No. 2.

Transformer Windings; Alternator and Ampere Turns Defined

Questions.—(A) When winding transformers, must the primary and secondary coils be wound in the same direction? (B) What is an alternator? (C) What is meant by "ampere-turns"?—F. J. S., Etna, Pa.

Answers.—(A) It makes no difference as to their direction with reference to each other. However on a closed core transformer the two parts of the same coil on each leg must be connected so that flux produced by one coil will not oppose the flux produced by the other.

(B) An alternator is a dynamo constructed to generate alternating current.

(C) A term applied to magnet coils and specifying the product of the number of turns of wire multiplied by the number of amperes flowing in the coil. Thus, a magnet wound with a coil of ten turns of wire carrying two amperes would be regarded as affected by twenty ampere-turns.

Underwriters' Rules

Questions.—(A) How many sixteen-candle-power 110-volt carbon filament lamps do the underwriters' rules allow on a branch circuit? (B) On cleat work, how far apart should the cleats be placed? (C) What size fuse plugs should be used on a circuit carrying eleven sixteen-candle-power lamps?

Answers.—(A) The rule reads, "Automatic cut-outs (fuses) must be so placed that no set of incandescent lamps requiring more than 660 watts, whether grouped on one fixture or on several fixtures or pendants, will be dependent upon one cut-out." This rule allows, then, practically twelve sixteen-candle-power, 110-volt, carbon filament lamps upon a branch circuit.

(B) Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least every $4\frac{1}{2}$ feet. If the wires are liable to be disturbed, the distance between supports must be shortened. In buildings of mill construction, wires of not less than No. 8 B. & S. gauge, where not liable to be disturbed, may be separated about six inches, and run from timber to timber, not breaking around.

(C) Use six ampere fuses.

Application and Proceedings for Reissue

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

APPLICATION AND PROCEEDINGS THEREON.—*In General.*—The proceedings to obtain a reissue are governed by the rules of the patent office. The application must set forth the facts upon which the right to a reissue is based, and must be accompanied by an oath in conformity to the rules of the patent office. Evidence is admissible in support of the averments of the application. The original patent must be surrendered. In a proper case, the granting of a reissue is a matter of right, the commissioner having no discretion. Where a reissue is improperly refused the applicant has a remedy by bill in equity.

TIME OF APPLICATION.—*In General.*—As a general rule, a patent may be surrendered and reissued at any time during the life of the patent, though the right to a reissue may be lost by unreasonable delay or laches, and the reissue if granted may then be held void.

DELAY IN APPLYING FOR ENLARGEMENT OF CLAIMS.—A reissue with enlarged claims will not be allowed where there has been unreasonable delay or laches in making the application, especially where in the meanwhile other devices have gone into use which will be affected by such a reissue. Where the error is apparent on the face of the patent, delay in applying for a reissue is especially apt to prove fatal. A delay of more than two years in reissuing in analogy to use prior to the application, requires special circumstances to excuse it, or it will be deemed an abandonment of the new matter to the public. The rule of laches should be strictly applied. Such lapse of time as indicates, under the circumstances, a want of due diligence is fatal, and the reissue if granted is void.

DELAY WHERE CLAIM NOT ENLARGED.—The correction of a patent by a reissue, where it is involved or inoperative for want of a full and clear description of the invention, is not attended with such injurious results to the public as follows from the enlargement of the claim, and hence a reissue may be proper though a longer period has elapsed since the issue of the original patent. But though a greater degree of diligence is required where the claims are expanded than where they are narrowed or simply made more specific and certain, due diligence is required in all cases.

REISSUE IN DIVISIONS.—The commissioner may, in his discretion, cause several patents to be issued for distinct and separate parts of the thing patented on demand of the applicant. Thus a patent may be reissued in division for a process and its product. Such divisional reissues are treated as a single patent with several claims.

IDENTITY OF INVENTION IN ORIGINAL AND REISSUED PATENTS—NECESSITY OF IDENTITY.—The statute only authorizes a reissue for the same invention as the original patent. Accordingly, a reissued patent for a different invention is void.

NEW MATTER IN SPECIFICATION—AMENDMENT.—By express provision of the statute no new matter may be introduced into the specification of the reissued patent. Nor, in the case of a machine patent, may the model or drawing be amended, except by each other. But when there is neither model nor drawing, amendments may be made upon proof satisfactory to the commissioner that such new matter or amendment was a part of the original invention, and was omitted from the specification by inadvertence, accident, or mistake. The power to surrender and reissue patents implies that the specification may be corrected to cure the defect and supply the deficiency.

WHAT CONSTITUTES IDENTITY.—*Questions for Court and Jury.*—Whether or not the reissued patent is for the same invention as the original patent is ordinarily a question of fact for the jury. But whenever the question can be determined solely from the face of the patents by mere comparison, without the aid of extrinsic evidence to explain terms of art or to apply the descriptions to the subject-matter, it is one of law for the court.

In an equity case the question may always be determined by the court.

Inclusion of Disclaimed, Rejected, or Abandoned Matter.—A reissued patent cannot be sustained where it contains claims that have once been formally disclaimed by the patentee, or have been rejected and he has acquiesced in such rejection in order to

obtain his patent. Claims for matter clearly included in the original application and subsequently abandoned cannot be included in a reissue. But if a disclaimer, withdrawal, or abandonment of a feature of the original invention was caused by mistake or error of the patent office, such features may be included in a reissue.

Enlargement of Claims.—It is well settled that upon reissue the specification cannot be substantially changed so as to enlarge the invention as intended to be originally claimed. But, as has been seen, this does not prevent the reissue of a patent with claims broader than the claims of the original patent, where such original claims were too narrow to cover the actual invention made and intended to be claimed. But what is dedicated to the public by description and failure to claim in the original cannot be claimed in a reissue. Where a claim has been limited by amendments in the patent office it cannot be afterward broadened by reissue of the patent.

Narrowing Claims.—The inventor is always at liberty in a reissued patent to omit a part of his original invention, thereby dedicating it to the public.

Substitution of Equivalents.—The substitution of equivalents will not be permitted in a reissue, except, perhaps, in such a clear case that the court could decide as a matter of law that the ingredient substituted is an equivalent for the one withdrawn, and was well known as such at the date of the original patent. In any case, however, it is held that the substituted device should be alleged to be an equivalent of the one stricken out.

Combinations.—An original combination claim reissued for a greater or less number of parts is void because not for the same invention. So a reissue claiming the elements separately and not as a combination is void, as is a combination of different or new elements. But sub-combinations may be claimed on reissue.

Machine, Process and Product.—A patent for the invention of a machine cannot be reissued for the purpose of claiming a process or a product, or *vice versa*, because not for the same invention. But if one is the result of the other, and they are so related that the invention of one involves the invention of the other, it seems that a failure to claim all may be cured by reissue.

NEW BOOKS

STORAGE BATTERIES. By A. E. Watson. Lynn, Mass.: Bubier Publishing Company. 1911. 160 pages with 63 illustrations. Price $1.50.

In this work the author has aimed to cover the theory, construction and use of storage batteries in a brief but clear way so that the man who is not acquainted with the subject is able to find out what he wants to know without assistance. The lead cell is the basis of the treatise, modern cells of various makes being described. A chapter is devoted to "How to Make," and one to "Switchboard Arrangements," while all the essential facts which the practical man looks for have been given consideration.

MANAGEMENT OF DYNAMOS. By G. W. Lumis-Patterson. New York: Norman W. Henley Publishing Company. 1909. 285 pages with 117 illustrations. Price, $2.00.

This book was first published thirteen years ago. The present (fourth edition) has been brought up to date by eliminating descriptions and illustrations of obsolete types of apparatus. Present day machinery is illustrated and described. The volume is prepared with a view to meet the wants of mechanics, engineers, students and others who may have to know about or care for dynamos. After explaining the principles of electricity and magnetism the book sets forth their application in the dynamo, helping the dynamo tender by giving space to such subjects as: "Shutting Down Dynamo," "Freeing Commutator," "Failure to Excite," "Erecting Dynamos," etc.

WINDMILLS AND WIND MOTORS. HOW TO BUILD AND RUN THEM. By F. E. Powell. New York: Spon and Chamberlain. 1910. 78 pages with 76 illustrations. Price, 25 cents.

The author has endeavored to interest all classes of readers in his subject. The book treats on the construction of small windmills for pumping water, generating electricity, or driving small machines. An American type windmill, diameter of sails three feet, is described; also a small working windmill large enough to drive a 30-watt dynamo, and later a 10-foot mill rated by the author to develop $\frac{1}{4}$ horsepower in a 16-mile breeze. The final chapter treats on "Production of Electricity by Wind-power."

ON POLYPHASE SUBJECTS

Index to Volume III

A great many of the regular subscribers to POPULAR ELECTRICITY keep all the numbers and bind them up in a volume at the end of the year. To them a comprehensive index of the contents of the twelve numbers is of great value in using the magazines for reference. It has been our custom in the past to print such an index and one will be printed this year for Volume III. Previously, every subscriber received an index with the last number of each volume (April issue). But our mailing list has become so large, and the index this year being more voluminous than ever, it seems a pity to send out so many thousands when a certain percentage will be wasted on those who do not make a practice of keeping back copies

Therefore we are going to ask those who desire an index this year to write and ask for it, inclosing a one-cent stamp to pay the postage. A sufficient supply will be printed to meet the requests. The index will be ready about April 1st.

On Questions and Answers

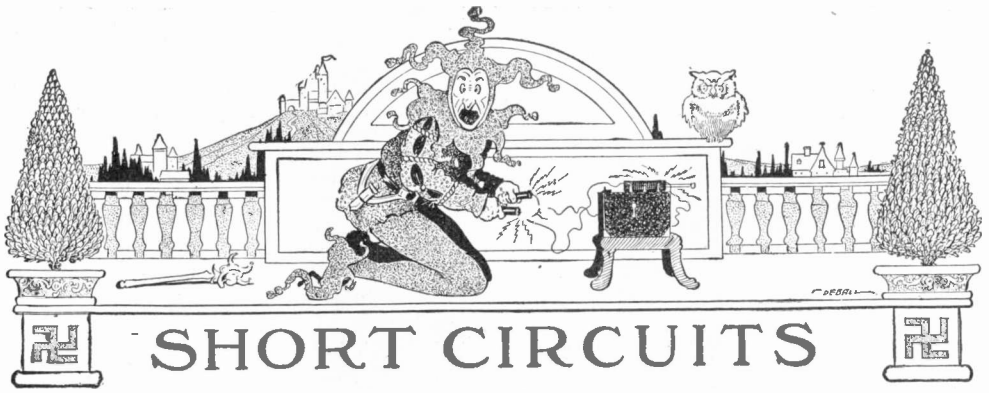
From the very beginning it has been our policy to answer the questions on electricity which our readers may ask. The Question and Answer Department we believe to be one of our most important aids in making friends for the magazine. But the business of answering questions is not altogether holiday work and we cannot refrain from unbosoming to those who make use of the service some of the troubles which it brings to us.

As we have explained before, the number of questions answered in the magazine is small in comparison to the number we answer by mail. Every day brings scores of letters of this sort, all of which are taken care of if they comply with the regulations printed at the head of the Question and Answer Department. This is done at a heavy expense. We ask in return that those who ask questions make our work as easy as possible. State your questions as concisely as possible and try to limit the number to a reasonable extent. Some go so far as to ask a dozen to fifteen questions in a string, carelessly written with a lead pencil on both sides of several sheets of paper. Try to bear in mind that it is hardly fair to us to sit down and dash off a lot of questions that we have repeatedly answered in the magazine or the answers to which you could easily obtain from some elementary book to which, likely as not, you have access.

Do not ask foolish questions. The other day we received a letter in which the writer calmly asked us to tell him how to build a submarine. If he had expended one-tenth of the energy in thinking that he did in writing the letter he would have realized that our Question and Answer Department could not be expected to furnish plans for submarines, warships, skyscrapers and kindred objects—especially for the price of a two-cent stamp.

Still others send letters asking for an immediate answer but forget to give their name and address. These letters are referred to "no address" file. Shortly we receive an inquiry sometimes quite emphatic asking why we do not answer. Relieved from embarrassment we reply after consulting the "file of mystery." Don't fail to let us know who you are and where you live.

It is our desire to do all in our power to assist our readers who are interested in and making a study of electricity. We want them to feel free to come to us when they are really "up against it," to use a slang expression which seems to fit the case. In return we feel that it is only fair that they should take the pains to try and dig out the information for themselves first and only come to us as a last resort. When it is really necessary to write, the questions should be as few as possible to cover the point, they should be clearly stated, they should be neatly and legibly written on one side of the sheet and this sheet should be mailed, care of the Question and Answer Department without containing anything for other departments, and with a two-cent stamp included.



SHORT CIRCUITS

Just before the boat left on its return trip, a big, rosy German came straggling down the pier to the ticket gate.

"Ticket, please," said the keeper.

"I don't got a teckit—I'm der drummer mit der band," replied the German.

"But you must have a ticket."

"Veil, I hat one but I loose him."

"You must have it, I tell you," persisted the gate-keeper; "you couldn't lose it."

"Vat!" shouted the bandman. "I couldn't loose dat little teckit? Mein Gott! I haf loose my bass-drum!"

* * *

She was a beautiful statuesque blonde who had changed her residence from New York to Philadelphia and secured a position as stenographer in the office of a staid, dignified citizen of good old Quaker descent. On the morning of her first appearance she went straight to the desk of the boss.

"I presume," she remarked, "that you begin the day over here the same as they do in New York."

"Oh, yes," replied the boss, without glancing from the letter he was reading.

"Well, hurry up and kiss me, then," was the startling rejoinder. "I want to get to work."

* * *

A young person of Tomahawk Bluff
Carried pistols to make him look tough.
When they asked "Do you chew?" he replied,
"Yes, I do,
I'm a wegular wetch of a wough."

* * *

"Now, Johnny," said the Sunday-school superintendent, "can you tell me what it was that caused the prophet Elijah to go up?"

"Yeth, thir," said Johnny, 'it wath the Payne tariff bill."

* * *

Two Peoria women boarded a street car the other day and sat opposite each other in perfect silence. Both wore the wastebasket style of hat. They rode downtown oblivious of each other's presence and got off at the same corner. The first looked up as she descended and gave a start of surprise.

"Why, is that you dear?" she exclaimed. "I wondered who is was, but I didn't recognize your feet."

* * *

"Why does a dog hang his tongue out of his mouth?" asked the teacher.

"Yes, my boy," he said to a bright looking lad who held up his hand, while the light of genius was in his eye.

"To balance his tail!" shouted the bright boy.

* * *

"That nephew of yours is a little wild, I'll admit," said Uncle Jerry's neighbor, trying to comfort him, "but he'll reform as he grows older. Leave him to time and nature."

"Time and nature!" snapped Uncle Jerry. "It's time and nature that make Limburger cheese what it is."

Artist—"Madam, it is not faces alone that I paint it is souls."

Madam—"Oh, you do interiors, then?"

* * *

Rastus: "For the love of heben, Sambo, what fer you got you 'alls pants turned wrong side beforemos'?"

Sambo: "Sh! Don't talk so loud. You see, I's invited to a swell reception to-night and I's gettin' de bulge out'n de knees."

* * *

Opie Read, the novelist, appeared as entertainer for a switchman's convention in Peoria.

"It was a very enthusiastic audience," said Mr. Read. "They laughed heartily, but they didn't applaud much. You see there were so many one-armed men there, that they had to applaud in pairs."

* * *

In the first act he tied the beautiful heroine to a railroad track just as the limited was due. In the second, he lured her into an old house, locked her in an upper room and set the place on fire. In the third, he strapped her under a buzz saw and set the machinery in motion.

In the fourth act he started to make love to her. She shrank from him.

"Why do you fear me, Nellie?" he asked.

* * *

A man looking for a position was walking along the banks of a river when he heard cries for help. He stopped, and found it to be a friend of his who was employed in a nearby factory. The man was about to save his friend, when a quick thought came to him, and he said:

"No, I'll get his job." So he went to the factory and said to the manager, "I came to apply for the position of the man If just saw drowning." "You are just five minutes too late," said the manager; "the man that pushed him in was here first."

* * *

Stubbs was feeling his way to the kitchen range in the dark, when he fell over the coal scuttle.

"Oh, John," called Mrs. Stubbs, sweetly, "I know what you need You should get what they have on battleships."

"What's that?" growled Stubbs, as he rubbed his shins.

"Why, a range finder."

And what Stubbs said about woman's wit was plenty.

* * *

"Say, Waiter, that lobster is without one claw. How's that?"

"You see, sir, they're so fresh, those lobsters, they fight with each other in the pantry."

"Well, take that one away and bring me the winner."

* * *

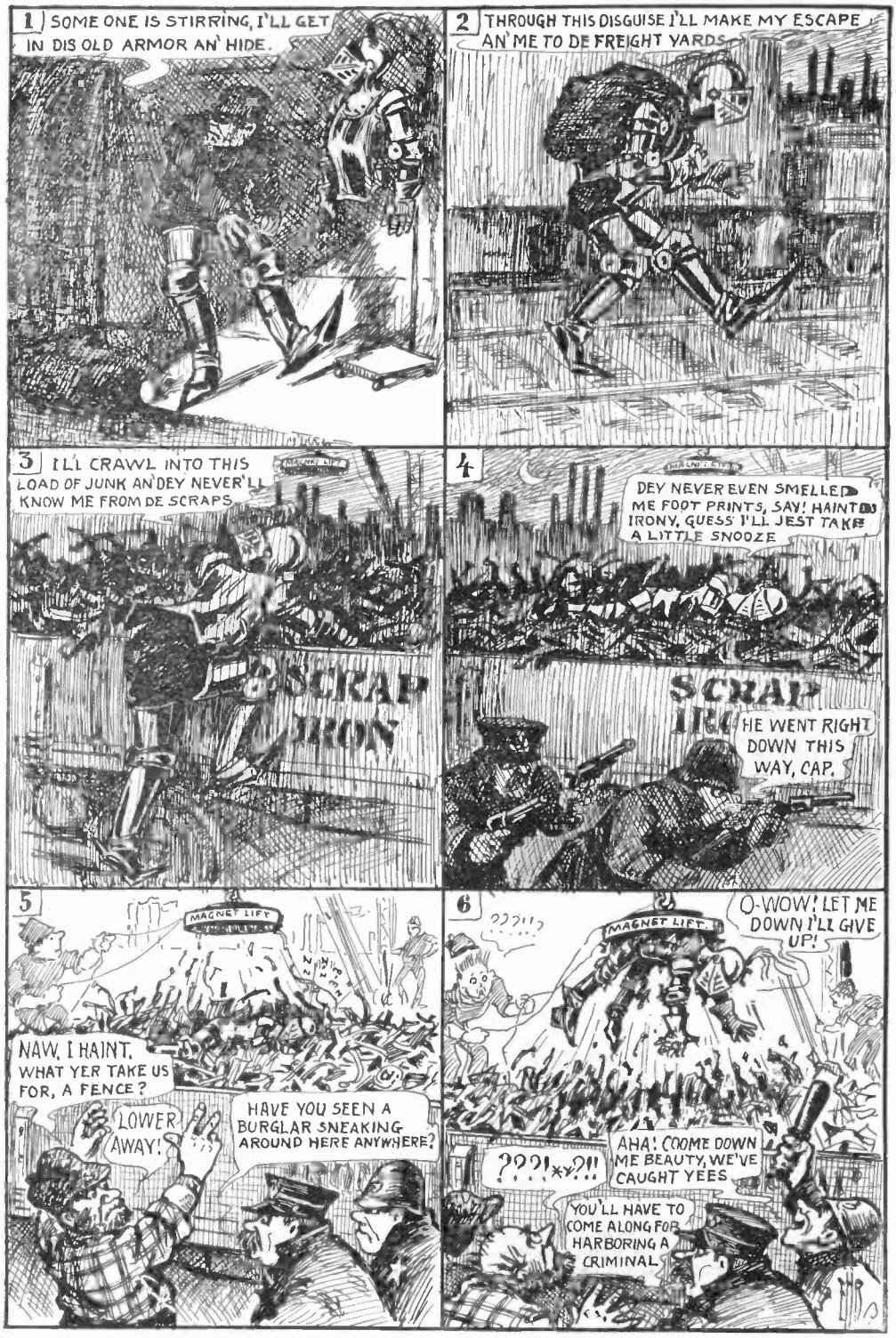
"It was Satan," said a mother to one of her children, 'who put it into your head to pull Elsie's hair."

"Perhaps it was," replied the little girl, "but kicking her shins was my own idea."

* * *

A girl who was wearing a hobble,
While carefully treading the "cobble,"
Dropped her new diamond brooch,
But she just couldn't "scrooch,"
And a gutter snipe captured the bauble.

The Magnetic Burglar



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.

CONTROLLER.—A device operated by the motorman of an electric car by means of which the motor is controlled, resistance being cut in or out of the circuit. In the Thomson-Houston system of automatic regulation of current, a magnet controlled by the main circuit current, thus operating with every change of strength of current and so keeping this current practically constant.

CONVERTER.—A term sometimes used instead of transformer.

CO-PHASAL ALTERNATIONS.—If two alternate current generators are "in step" their alternations are co-phasal.

CORED CARBONS.—An arc lamp electrode having a center of charcoal or soft carbon around which is moulded hard carbon.

COULOMB.—The quantity of current that would pass in one second through a circuit of one ohm resistance and under a pressure of one volt. Called after the scientist of that name.

C^2R LOSS.—An expression for the loss of energy ot a current passing through a conductor, this loss being due to the fact that the conductor offers a resistance. The expression is derived as follows: The number of watts flowing in a circuit equals the current times the volts or $W = C \times E$. But from Ohm's law $E = C \times R$. Substituting for E, $W = C \times C \times R = C^2R$, watts lost.

COUNTER ELECTROMOTIVE FORCE.—A voltage or pressure opposed to the main voltage in a circuit. A motor develops counter electromotive force which opposes to a certain extent the voltage impressed upon the motor. In the electrolysis of water, one electrode becomes covered with bubbles of hydrogen, the other with bubbles of oxygen; this creates a counter E. M. F. of polarization. In the carbon arc the heating differentially of the two carbons develops counter E. M. F.

COUNTER INDUCTIVE EFFECT.—A current produced in a second circuit by induction from the first, this second current opposing the regular flow of current in the first.

COUPLE.—Used in electricity to designate a galvanic or voltaic cell consisting of two electrodes and one or two liquids. The Daniell cell is an example.

C. P.—An abbreviation for candle-power. Also applied instead of the words "chemically pure" with reference to chemicals used in electric batteries.

CRATER.—The hollow in what is usually the upper or positive carbon in the arc lamp. This crater emits most of the light and averages .04 inch deep by .2 inch across. This is the hottest part of the arc and attains a temperature of approximately 3500° C.

CREEPING.—The solution in a battery jar will always rise a little above the level of the liquid, evaporation takes place and the salt dries on and affords a path for more of the solution to "creep" through it. This action, termed "creeping," continues until a layer of the salt is formed up over the edge of the vessel. To prevent creeping paraffine may be applied to the edges of the jar or oi may be poured over the battery solution.

CRITICAL CURRENT.—The current produced by a dynamo at what is called its critical speed which if varied slightly causes a great difference in the voltage.

CRITICAL RESISTANCE.—That resistance of the external circuit of a series wound machine which if raised beyond a certain point will cause the machine to refuse to excite itself.

CRITICAL VOLTAGE.—Used in wireless telegraphy to denote the voltage at which a detector commences its action. In an electrolytic detector it is the voltage at which the thin film of gas that collects on the "bare point" breaks down.

CROOKES' DARK SPACE.—If an electric current is caused to pass through an exhausted tube provided with electrodes, the space about the negative electrode is dark, this darkness going farther into the tube as the vacuum is increased. If the vacuum be made very high the dark space will extend almost the entire length of the tube.

CROSS ARM.—A cross piece of wood or iron fastened horizontally to a telegraph, telephone, or light and power pole to support insulators and wires.

CROSS-MAGNETIZING EFFECT.—The current flowing in the armature of a dynamo or motor develops lines of force approximately perpendicular to those from the field poles. The resultant of these two sets of lines is a somewhat distorted field between the poles.

CROSS-OVER.—A device used where two trolley car lines cross each other to prevent the trolley from jumping off the wire and from arcing.

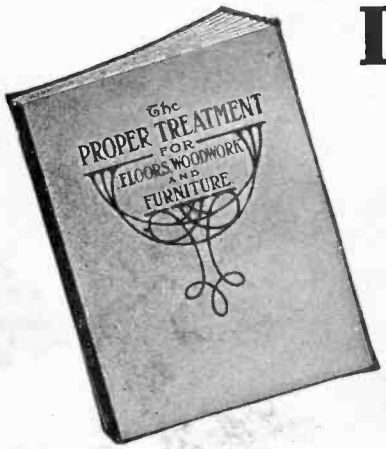
CROSS TALK.—A transfer of current between two or more telephone circuits by induction or crossed wires so that conversation intended for one line is heard upon another line or lines.

CROWFOOT BATTERY.—See Battery. Gravity,

CRUCIBLE, ELECTRIC.—A crucible in which the heat produced by an electric arc is used to obtain high temperatures in reducing ores, forming alloys and performing difficult fusions.

CRYSTAL DETECTOR.—A device used in wireless telegraphy for rectifying the electrical oscillations or Hertzian waves that the aerial gathers, enabling them to pass as an electric current through a telephone receiver in which they produce sound. The detector consists of two crystals so held as just to touch each other, or of one crystal and a metallic point lightly adjusted to its surface. The crystals used belong principally to the carbon and sulphur groups and have the peculiar property of passing current better in one direction than in the other. Some of the more common crystals are: Carborundum, fused silicon and iron pyrites.

CURRENT.—A term used to designate the transference of electrical energy from one point to another over or through a conductor. A rough analogy is to liken it to the flow of water through a pipe connecting two tanks of different level.



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HERE'S the best book ever published on artistic wood finishing, the work of famous experts, illustrated in five colors. For a limited time, we will mail it FREE, postage paid, together with samples of

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Yes! You—yourself—can beautifully finish or refinish all furniture, woodwork or floors in the latest and most artistic shades—in little time—at small expense—with

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If you are interested in craftsmanship—if you want the correct finish on a new piece of furniture—if you are *building or remodeling* — if you want to brighten up or change the color of any piece of furniture or of woodwork or floors—either hard or soft wood—if you are interested in basketry—get this expert Instruction Book and the FREE SAMPLES at your leading paint dealers.

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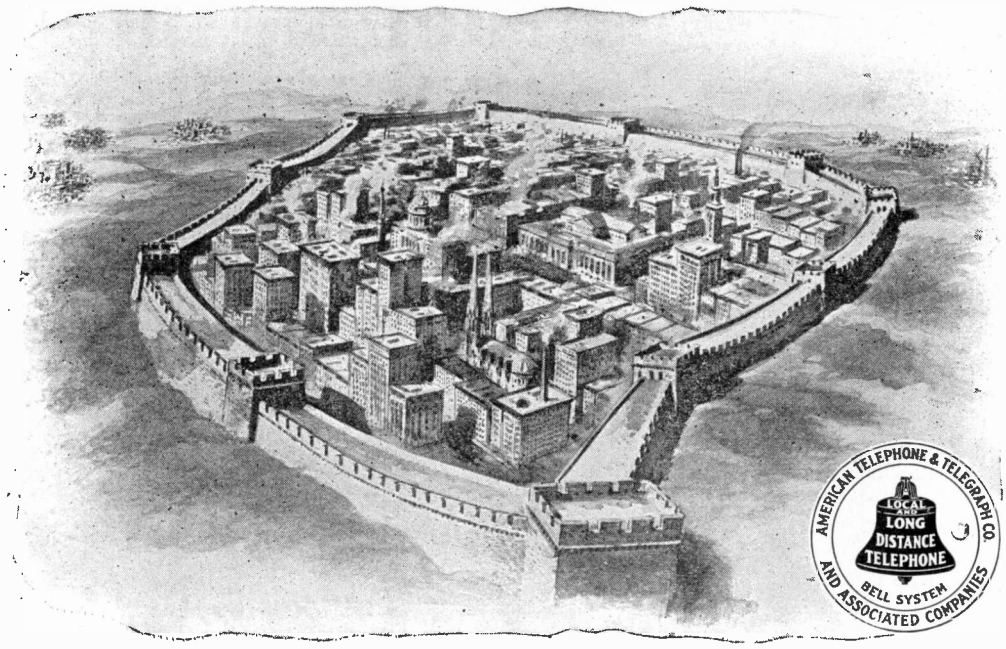
Under-Lac is a thin, elastic spirit finish very much superior to shellac or varnish. It dries hard in less than an hour. Under-Lac is just what you want for your linoleum and oilcloth; it brings out the pattern making it bright and glossy like new, protects it from wear and makes cleaning easy. It dries so the floors may be walked on in an hour.

We want you to try Johnson's Wood Finishes so we are supplying all leading paint dealers with samples for their customers' use. If your dealers haven't samples of our Wood Dye, Under-Lac and Prepared Wax and the Instruction Book—we will send them to you postpaid for the name of your dealer in paints. In writing us mention the shade of dye you prefer and Instruction Booklet, edition P. E.-4

S. C. Johnson & Son, *"The Wood Finishing Authorities"* **Racine, Wis.**



A MEDIAEVAL CONDITION

Telephone Service—Universal or Limited?

TELEPHONE users make more local than long distance calls yet to each user comes the vital demand for distant communication.

No individual can escape this necessity. It comes to all and cannot be foreseen.

No community can afford to surround itself with a sound-proof Chinese Wall and risk telephone isolation.

No American State would be willing to make its boundary line an impenetrable barrier, to prevent telephone communication with the world outside.

Each telephone subscriber, each community, each State demands to be the center of a talking circle which shall be large enough to include all possible needs of inter-communication.

In response to this universal demand the Bell Telephone System is clearing the way for universal service.

Every Bell Telephone is the Center of the System

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

This is a reduced reproduction to show detail. The actual height of the machine is 12 inches.

One Dollar

Puts the "RICHMOND" Suction Cleaner in Your Home

ONE Dollar forever frees you from brooms, mops and dusters—and the backaches and drudgery they bring.

One Dollar forever stops the expense and the nuisance of Spring and Fall housecleaning.

One Dollar enables you to do, *easily*, by electricity, the *worst work* a woman has to do.

And One Dollar is the only cash outlay.

It will bring you the "RICHMOND" Suction Cleaner complete—ready for instant use.

The balance you pay for month by month out *of the actual money you save.*

For Vacuum Cleaning is the greatest of all household economies.

YOU see here the lightest and simplest suction cleaner *ever designed.*

1.—Is the motor—not a "stock" motor, but one built expressly to operate the powerful suction fan to which it is directly connected, under

2.—a suction fan which embodies the best of all that was learned in two years of steady, scientific experiment.

3.—Is the suction nozzle which is pushed over the surfaces to be cleaned—or to which can be attached a twelve-foot hose for high wall, drapery and upholstery cleaning.

The "RICHMOND" Suction Cleaner enables you, now for the first time, to clean by electricity without lugging a 60 to 80 pound machine from room to room—upstairs and down.

It represents as great an advance over heavy weight vacuum cleaners as these cleaners represented over brooms and carpet sweepers.

But light weight and easy operation are but two of the "RICHMOND'S" exclusive superiorities. There are many more.

The vibrating brush, which taps the caked dirt out of otherwise uncleanable rugs and carpets—the hair-drying and pillow-renovating attachments—the seven special tools which make the "RICHMOND" the most complete cleaner ever offered.

You are paying the price of a suction cleaner, *right now*—whether you have one or not.

You are paying its price out in twice-a-year house cleaning alone—for a "RICHMOND" makes housecleaning needless.

You are paying its price out—many times over—in the hard labor of sweeping and dusting which the "RICHMOND" makes unnecessary

You are paying its price out again and again in the damage which dust does to your furniture, to your carpets, to your hangings, to your clothing—to YOU.

You are paying the price of a "RICHMOND" when a single dollar would save the waste.

Manufactured exclusively for the RICHMOND SALES CO. by

THE McCRUM-HOWELL CO.

103 Park Ave. and 41st St., New York

Five Factories: Two at Uniontown, Pa.--One at Norwich, Conn. One at Racine, Wis.---One at Chicago, Ill.

MANUFACTURERS OF "RICHMOND" Boilers and Radiators, "RICHMOND" Enameled Ware, Bath Tubs, Sinks, Lavatories, "RICHMOND" Suds Makers, "RICHMOND" Concealed Transom Lifts, and "RICHMOND" Stationary Vacuum Cleaning Systems

Inquiries regarding built-in-the-house Vacuum Cleaning systems should be addressed to The McCrum-Howell Co., New York and Chicago.

Limited Offer

The Dollar Offer is limited. It is made to show our unbounded confidence in the "RICHMOND"

But by its very liberality, it is bound to swamp the factory. And when the limit of factory output is reached, the offer must be withdrawn.

So send the coupon today while the opportunity is still yours! Don't wait. Do it NOW.

THE RICHMOND SALES CO.
Dept. 74, 103 Park Ave. New York

DOLLAR COUPON

THE RICHMOND SALES CO., Dept. 74, 103 Park Ave., N. Y City

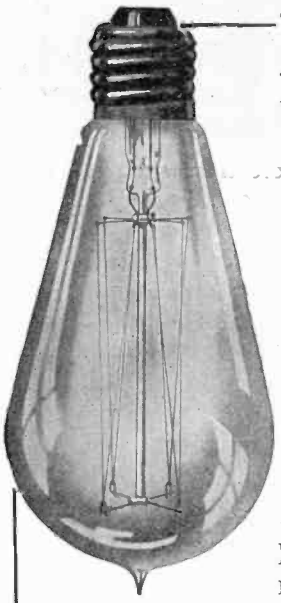
I hereby order one "RICHMOND" Suction Cleaner, complete with the following attachments:

- 1 Hose Attachment Shoe
- 1 12-ft. covered Suction Hose
- 1 Book and Wall Brush
- 1 10-in. Drapery Tool
- 1 3-in. Suction Tool
- 1 Felt-Faced Floor Tool
- 1 Adjustable Wall Brush
- 1 30-ft. Electrical Cord
- 1 Complete Hair Drying Attachment

—for which I agree to pay to your order, $1.00 herewith, and $6.00 on the first day of each of the next 12 consecutive months. Title to be given me when full amount is paid.

Name.....

Address.....



The *Mazda Lamp* may be *substituted* for *any electric bulb* which you are now using, with these results:—

Saving in Electric Current
Increasing Beauty and Value of Light

These lamps will fit any socket and burns at any angle; they produce 2½ times the light of an ordinary electric lamp.

Electric light is now cheaper than any other practical illuminant. Cleanliness and healthfulness, beauty and safety are four characteristics possessed by electric light in greater measure than any other illuminant. Electric light is most desirable; *it is least expensive* now that the Mazda Lamp cut the cost of electric light to less than half its former prices. Electric lighting will increase the value and comfort of your home.

Use Mazda Lamps and have all the light you want at no increased expense. Your lighting company or the nearest electrical dealer can supply you with these lamps. Stop in and discuss the lamp and its performance with them and try one lamp in your home.

National Electric Lamp Association
CLEVELAND

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¶ Advertisements in this section of Popular Electricity will cost 5 cents per word with 5% off for 3 times, 10% off for 6 times, 15% off for 9 times and 20% off for 12 times, cash with order.
¶ In order to secure the proper classification, advertisements must be in this office the first of each month preceding date of issue.

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BLERIOT MONOPLANE — GUARANTEED Flyer 25c. Antoinette Two-foot; three wheels, thrust bearing; Rubbers, Mailed K. D. 50c. Reberts, 344 Cumberland, Brooklyn, N. Y.

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See what I say under "Typewriters." ATCHISON

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DON'T ACCEPT AN AGENCY UNTIL YOU get my samples and particulars. Money-makers. Address SAYMAN, 706 Sayman Bldg., St. Louis, Mo.

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AGENTS—SALARY OR COMMISSION—Portable fountain bathing apparatus, plain or electric, for every home, only $6.00. State right for sale. Electric Bath Co., Findlay, Ohio.

PICTURE AGENTS! PORTRAITS, 25c, Frames 14c, Pillow-tops 35c. Photographic China Plates, 65c. Our new "Negro Angel" and Jack Johnson pictures get the coin. Samples and catalogues FREE. Berlin Art Association, Dept. 301, Chicago.

AGENTS MAKE BIG MONEY—BIG PAY, NO experience, no capital required. 5,000 new art specialties, photo pillow tops 25c, portraits 30c, bromides 25c. New 1911 catalog and samples free. Write. Daniel H. Ritter Co., Madison St., Chicago, Ill.

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BULLY! GREAT! IMMENSE!—THAT'S WHAT all our agents say after selling our attractive 1911 combination packages of soap and toilet articles with valuable premiums. 100 to 300 per cent profit. One Michigan agent made $65 in 47 hours; another $21 in 8 hours; another $22.50 in 10 hours; ACT NOW—NOT TOMORROW. Davis Soap Co., 27 Union Park Court, Chicago.

I WANT A GOOD MAN TO ACT AS GENERAL agent and District Manager, and appoint sub-agents for the sale of my Florida land. No experience necessary. I pay the general agent $50.00 spot cash on every sale. My terms of $5.00 a month for a 10-acre farm (no interest, no taxes) makes it possible to sell nearly everybody. $200.00 IN GOLD free every month to my best men. Also one Grand Prize of $1,000 in GOLD COIN. No capital required, but man must have a standing in his community and be willing to work. If you think you can fill the bill, send for my "Confidential Circular to General Agents," and "Selling Manual." Both free if you are the first to apply from your locality. E. C. HOWE, 31 Hartford Building, Chicago, Ill.

AGENTS WANTED

AGENTS—BIGGEST MONEY-MAKER known. The new Canchester Incandescent Kerosene Lamp revolutionizes old lighting methods. Burns air, not money. Six times brighter than electricity, gas or acetylene at 1-10th cost. Burns with or without mantle. Burner fits any lamp. Saves 75 per cent oil. No trimming wicks. Showing means selling. Territory going fast. Write today. Handsome outfit furnished. Canchester Light Co., Dept. P. E., 4, Chicago.

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MEN WANTED—EVERY RAILROAD COMpany wants signal engineers. We absolutely guarantee every graduate enrolled with us before August 1st, 1911, a well paid position at the start. Send for free catalog No. 60 for full particulars. The School of Railway Signaling, Utica, N. Y., U. S. A.

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Dan Riley
President Orlando Florida Farms Company.

This Book Tells You of an Opportunity to Secure a Small Farm in the Proven Protected Grapefruit, Orange and Truck Farm Section of Florida

I want you to send to-day for **"A NEW DOMINION."**

This is the name of a book on Florida which I consider the most enlightening of any ever issued from the press.

"A NEW DOMINION" will tell you all about my new Florida project. It tells all about what is probably the **most magnificent tract of Florida land** ever opened up to the public.

This tract starts **within about three miles of Orlando** — the busiest, prettiest and fastest growing city in Florida. It is in the very heart of Florida's greatest producing section.

This land has never before been sold in small tracts. For the first time I am in position to offer this land in 5, 10, 20 and 40 acre allotments. Here is land located in the **proven, protected orange and grapefruit section** of Florida; here is land also that is in the soil belt which produces the greatest returns in the growing of vegetables for the winter markets of the North.

Orlando is a city of over seven thousand people, and is the county seat of Orange County. Orange County may be truthfully called the **real banner county** of the State of Florida.

In the production of citrus fruits, such as oranges, grapefruit, tangerines, etc.; this county leads the State; in the production of celery, lettuce, cabbage and other trucking crops it is not approached by any other section of Florida.

Send for this Great Free Book To-Day! Fill out the Information Blank Below and it Will be Sent You Postage Paid Without any Expense or Obligation.

The truck growers of Orange County are realizing right now anywhere from $250.00 to $1,000.00 per acre clear profit each year. The owners of grapefruit and orange groves are taking off crops that realize from $600.00 to $1,200.00 per acre.

The tract of land which I am offering in 5, 10, 20 and 40 acre farms extends from the towns of Gabriella and Golden Rod on the north, to some few miles south of Orlando. Right through the center of it flows the Econtockhatchee River, a stream that is navigable for quite a distance for boats and launches. This land lies about one hundred feet above sea level, and the climate, both summer and winter, in this section is incomparable.

I am going to sell this land at $25.00 per acre, and on terms of $1.00 per acre per month.

I AM GOING TO GIVE YOU A FULL HALF YEAR FOR EXAMINATION AND INVESTIGATION!

I have confidence in this land and know that any one who once sees it will be satisfied and delighted. This is the reason that I can offer to give you **plenty of time** to go down there and look over your purchase. All that I want you to do is to send for my new book, **"A New Dominion."** This book tells you how on five or ten acres men can achieve **independence for life in Florida.**

It is handsomely illustrated from actual photographs showing you orange and grapefruit groves and truck farms right in the heart of this land. This book may be the stepping stone to a glorious future for you and your loved ones. It costs you nothing. I am going to send it to you **free** along with maps and other literature showing the exact location of these magnificent farms.

Fill out the information blank below and it will be sent you by return mail without any cost or obligation whatsoever.

DAN RILEY, President
Orlando Florida Farms Company.

FREE INFORMATION BLANK

Orlando Florida Farms Company,
Fisher Building, Chicago, Ill.

Please send me, postage paid, and without any obligation on my part whatsoever, your free book on Florida entitled "A NEW DOMINION," map showing location of the Orlando Florida Farms, and all information concerning this land.

Name .....

Town .....

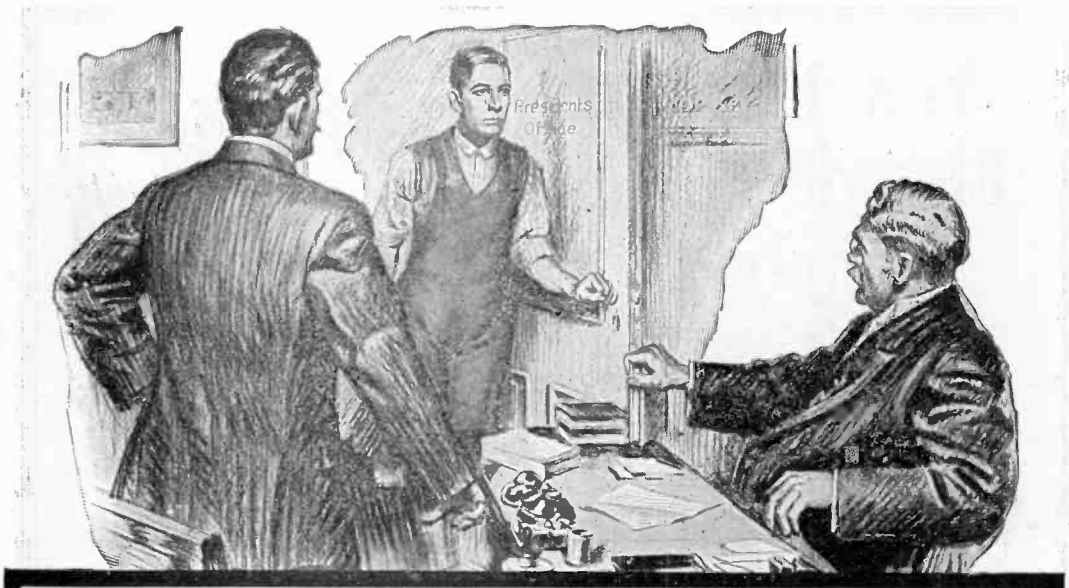
State .....

R. F. D. .....

(No letter necessary with this blank.)

Address your envelope this way:

ORLANDO FLORIDA FARMS COMPANY,
305 Fisher Building, Chicago, Ill. P.E.



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Will YOU be chosen as the right man when the big opportunity comes? Are YOU better prepared to rise from the ranks than the men beside you?

Could you fill satisfactorily a position requiring knowledge of "hows" and "whys"? Could you direct the work of others so as to get the best results? Would any employer be safe to trust your planning and figuring and doing?

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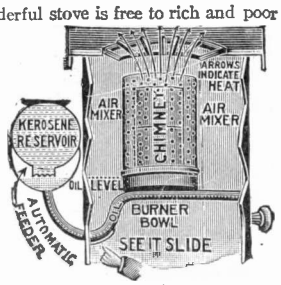

Sectional Cut of Generator

automatically generates gas from kerosene oil, mixing it with air.

Scientific test proves it uses **395 barrels of air** to **one gallon** common kerosene oil.

CHEAPEST FUEL—SUMMER COMFORT. Intense heat but **concentrated** under cooking vessels and absorbed by articles being cooked—not thrown out to **overheat** your kitchen.

To operate—turn knob—oil runs into burner—touch a match; it generates gas, which passes through air mixer, drawing in about a barrel of air to every large spoonful of oil consumed. **That's all.** It is self-regulating, no more attention. Same heat all day or all night. For more or less heat, simply turn knob. There it remains until you come again. To put fire out, turn knob, raising burner—oil runs back into can, fire's out. As near perfection as anything in this world. **Ideal for summer use.** Not dangerous like gasolene. No dirt, soot or ashes. No leaks—nothing to clog or close up. No wick—not even a valve, yet heat is under perfect control—**kitchen always cool. D. CARN, IND.,** writes: "It costs me only **4 1-2 cents a day for fuel.**" **L. NORRIS, VT.,** writes: "The Harrison Oil-Gas Generators are wonderful savers of fuel, at least **50** to **75 per cent** over wood and coal." **E. ARNOLD, NEB.,** writes: **"Saved $4.25 a month for fuel** by using the Harrison Oil-gas stove. My range costs me $5.50 per month, the Harrison **$1.25** per month." **THOS. VINCENT, WIS.,** "My wife never had anything she enjoyed so much as her stove. It is very quick, no heated room or dirt. Surpasses anything we ever saw."

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NOT LIKE THOSE SOLD IN STORES, Ideal for roasting, cooking, baking, ironing, canning fruit, picnics, cottages, camping. **In Winter** use Radiator for heating houses, stores, rooms, etc. No more carrying coal, kindling, ashes, soot and dirt. **No hot firey kitchens.** Absolutely safe from explosion. Not dangerous like gasolene. Simple, durable—last for years. Saves expense, drudgery and fuel bills.

ALL SIZES, PRICES LOW—$3.25 AND UP. Sent to any address. Give this stove a trial. Send no money—only send your name and address. Write today for full description, thousands of testimonials. Our 1911 Proposition, Circulars FREE.

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Most of these things were bought in midwinter, when makers had to sell.

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We sell for cash or credit at an equal price. We have charge accounts with 600,000 homes. They take, on the average, a year to pay—a little each month.

You are welcome to such an account if you wish it. There is no interest, no security, no red tape or publicity—just an open charge account. We gladly trust people who buy things for the home.

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On these fair lines we have built up here the largest trade in our line in the world.

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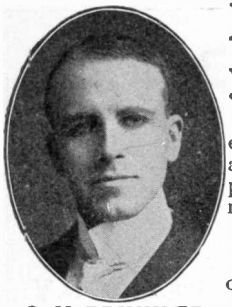

G. H. BRINKLER
Food Expert
WASHINGTON, D. C.

DO YOU KNOW how to combine your daily foods to produce HEALTH?

DO YOU REALIZE the striking difference in the properties of foods? For instance, eggs and flour may be used to make paste, firm enough to fasten up your wall paper, and their adhesive properties are powerful for nourishing the system when they are properly combined with other foods. When wrongly combined they clog the human machinery. But meat, green vegetables and fruit cannot do this.

I Have No Foods To Sell

I CAN TELL YOU, without technical terms, the best combinations and proportions of the different foods for your condition.

THE NEW BRAINY DIET CURE of ordinary foods in daily use, first taught by S. Leppel in England, is an exact science based on experiments published in Dr. Bellow's Standard work, "The Philosophy of Eating."

Striking Effects of Different Combinations and Quantities of Foods

An excess of starchy and fatty combinations of food will make you sluggish; it will give you dull, splitting headaches, lack of memory and concentration, drowsiness and inertia. A complete change to "digestible" brainy foods, suitable meat, game, fish and dairy foods, combined with suitable vegetables and fruits according to the new brainy diet plan, will produce the most marked improvements in a few weeks.

One dropsical consultant lost 18 pounds of over-weight in the first week, and returned to business.

Another, a thin man, after being out of work nearly a year through weakness, was restored in three weeks to hard work as a carpenter at full pay. In such cases the change from a clogging, death-producing diet to energizing foods, caused a literal transformation.

Another patient, deaf in the right ear, owing to a discharge caused by an excess of mucus-making foods, (cream, butter, cheese, etc.), was completely cured of deafness and catarrh by taking correct combinations of foods.

A case of kidney and bladder trouble of ten years' standing was saved from a surgical operation, and the objectionable discharge cured within ten days, because the loss of control was due entirely to the constant irritation from certain irritating foods and drinks.

A chronic sufferer, weighing 415 pounds, reduced over 150 pounds (in public life under many witnesses), gained strength, and firmer flesh, and lost rheumatism. Many well-known diseased persons have been taught how to cure themselves by brainy foods during 23 years, by S. Leppel in England. (See the Leppel "Bulletin") and during 9 years by the writer in America.

Eat for Health, Energy, Brain Power, Good Looks and Success

Here are a few curative principles: suitable meats, dairy foods, etc., generate vitality and nourish the brain and nerves; starchy foods feed the muscles, aud furnish staying power, etc.; tomatoes and lemons are solvents for impurities, foreign elements and waste matter—the cause of disease; green vegetables purify the blood, dislodge, disperse and carry off the waste products, and keep one comfortable in hot weather, **provided** all other foods are properly selected and combined for individual requirements.

Indigestible, irritating foods and the retention of their waste matter are the cause of homliness (double chin, dull eyes, bad skin, fagged face, etc.), dullness and disease. **The foods which cause expectoration, catarrh, cough, constipation, tumors, etc., are specified in the free booklets.** Wrongly combined foods either ferment, cause gas, poison or kill. They produce such complaints as gastritis, appendicitis, tonsilitis, appoplexy, etc.

No Manufactured Foods, nor Fasting, Privations, Exercises nor Drugs

During thirteen years of personal experience in co-opperation with S. Leppel, and others, I have learned to produce in myself various diseases, each by eating certain wrong foods for a few days or weeks. They are: **Rheumatism, catarrh, sore throat, tonsilitis, constipation, double chin, swollen glands, kidney troubles, shortness of breath, rough scaly skin, dandruff, sores, boils, pimples with white pus, blackheads, rash, dry hair and numerous other symptoms, AND I CAN CURE THESE SYMPTOMS OF ILL HEALTH IN A FEW DAYS BY CORRECT FOODS.** I am willing to give public demonstrations to show the rapidity with which different sets of foods operate throughout the whole body for good or bad. As far as I know, I am the only man who can produce these changes in a short time methodically. My experiments were begun when a student at Cambridge University, England, with the idea of increasing mental endurance. I advise all ambitious students to investigate the **BRAINY DIET SYSTEM.** They will find a correct application of its principles to be the foundation of health, energy, good looks and success.

Brainy Diet

A chronic sufferer, weighing 415 pounds, unable to exercise, took correct combinations of ordinary daily foods and reduced over 150 pounds (in public life under many witnesses) gained strength with firmer flesh, and lost rheumatism.

Remarks about the four booklets:—

"A suggestion from your booklet relieved my catarrh in two weeks and gave me confidence in your methods."

"The government should investigate and teach the Brainy Diet System for the good of the nation."

"My brain power and general efficiency have been about doubled this year by taking brainy foods. I have made a fortune in real estate and the credit is honestly yours."

"The hints in booklet No. III, on foods for curing congested liver, nourishing the brain, etc., are worth untold dollars, although the books are free."

(1) TESTS OF BRAINY DIET (3) EFFECTS OF FOODS
(2) DIET VERSUS DRUGS (4) KEY TO LONGEVITY

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Send the addresses of your sick friends to

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Special Reduction Price

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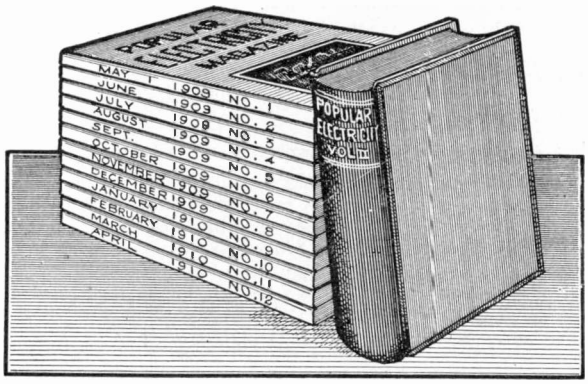

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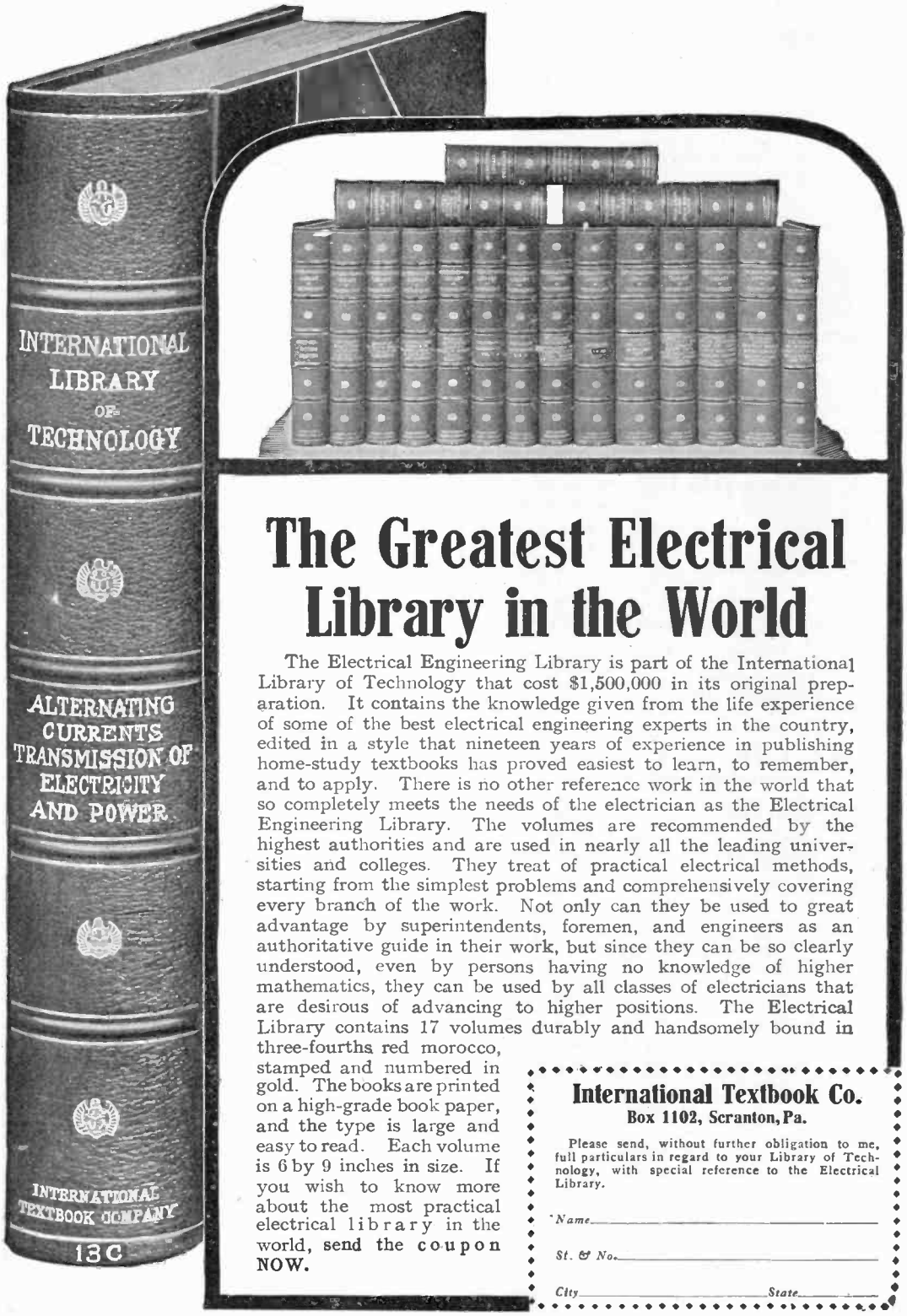

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Mechanic's Special with Twist Drill Grinding Attachment

Luther Diamond Tool Grinder The Perfected Carborundum Sharpener

25 times faster than grindstones

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25 Times Faster Than Grindstones

This **Luther Grinder** — the standard of the world — with its wheels of the wonderful abrasive **carborundum,** is 25 times faster than grindstones. It cuts the hardest steel as emery does copper. One man with the Luther does the work of 20 men with any other sharpening device. Does not draw temper. No need of hard pressing — just a light touch — the hard, sharp carborundum crystals of the wheels peel off steel in tiny shavings. No water needed.

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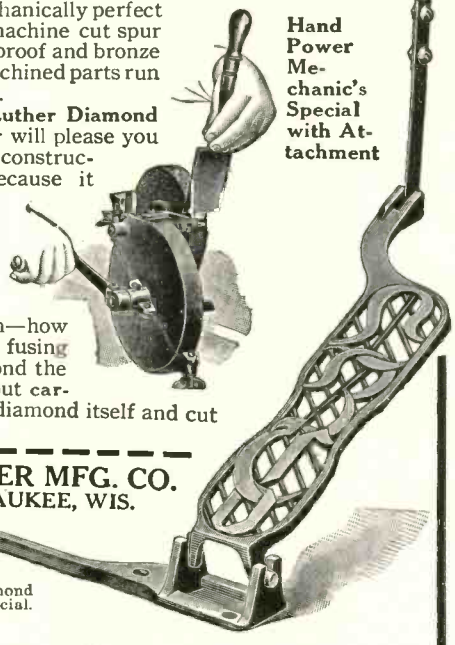
Luther Diamond Tool Grinders are the standard grinders of the world. In addition to their wonderful carborundum wheels, that never need dressing, they are mechanically perfect machines—machine cut spur gears—dust proof and bronze bearings—machined parts run in bath of oil.

In short, a **Luther Diamond Tool Grinder** will please you by its solid construction, and because it makes it easy to have keen edged tools without drudgery.



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Send for our 6 months' free trial offer—we will also send you free a booklet telling the interesting story of the discovery of carborundum—how a scientist, attempting to make artificial diamonds, and fusing the elements of diamonds in an electric furnace, hot beyond the measurements of science, discovered, not the diamond, but **carborundum**—the wonderful abrasive that will scratch the diamond itself and cut steel as emery does copper.

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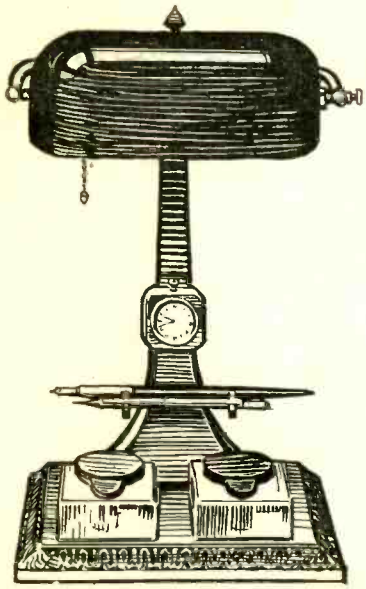
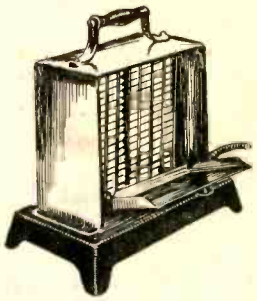
An Ideal Lamp for the Office Desk



This is a very popular lamp because it combines, at a moderate price, the utmost practicality with a very pleasing appearance. The standard is in Statuary Bronze, with green relief. Its base, 7 x 9 1-2 in., contains two ink-wells. A pen-rack and a watch (a good time keeper) are attached to standard. The shade is of green plated-glass outside, with white opal glass inside. The lamp lights an area 48 in. wide by 36 in. in front of base. Complete with 6 foot silk connecting cord and plug, price $18, f. o. b. Chicago.



To Make Delicious Toast At the Table

The Electric Toaster is intended for use on the dining table. It toasts bread, two slices at a time, as fast as required for three or four persons. The toast comes out piping hot, crisp and brown outside, tender inside. The cost for electricity is about one cent per dozen slices. Price complete with connecting cord, $4.80 f. o. b. Chicago. (See foot-note below.)

An Electric Flat Iron Saves Time and Strength

There is no changing of cold irons for hot. No walking back and forth between the range and ironing-board. An Electric iron stays hot; uniformly so from point to heel. Always bright and clean, it does better work than stove heated irons. Can be used in any room, or on the back porch in summer by extending the connecting cord. Price $4.25, f. o. b. Chicago. (See foot-note below).

Note:—In ordering the Toaster or Flat Iron, ask your Central Station what voltage you should specify.

ELECTRIC SHOP Michigan and Jackson Blvds. **CHICAGO**