DEC. 1918
20 CTS.

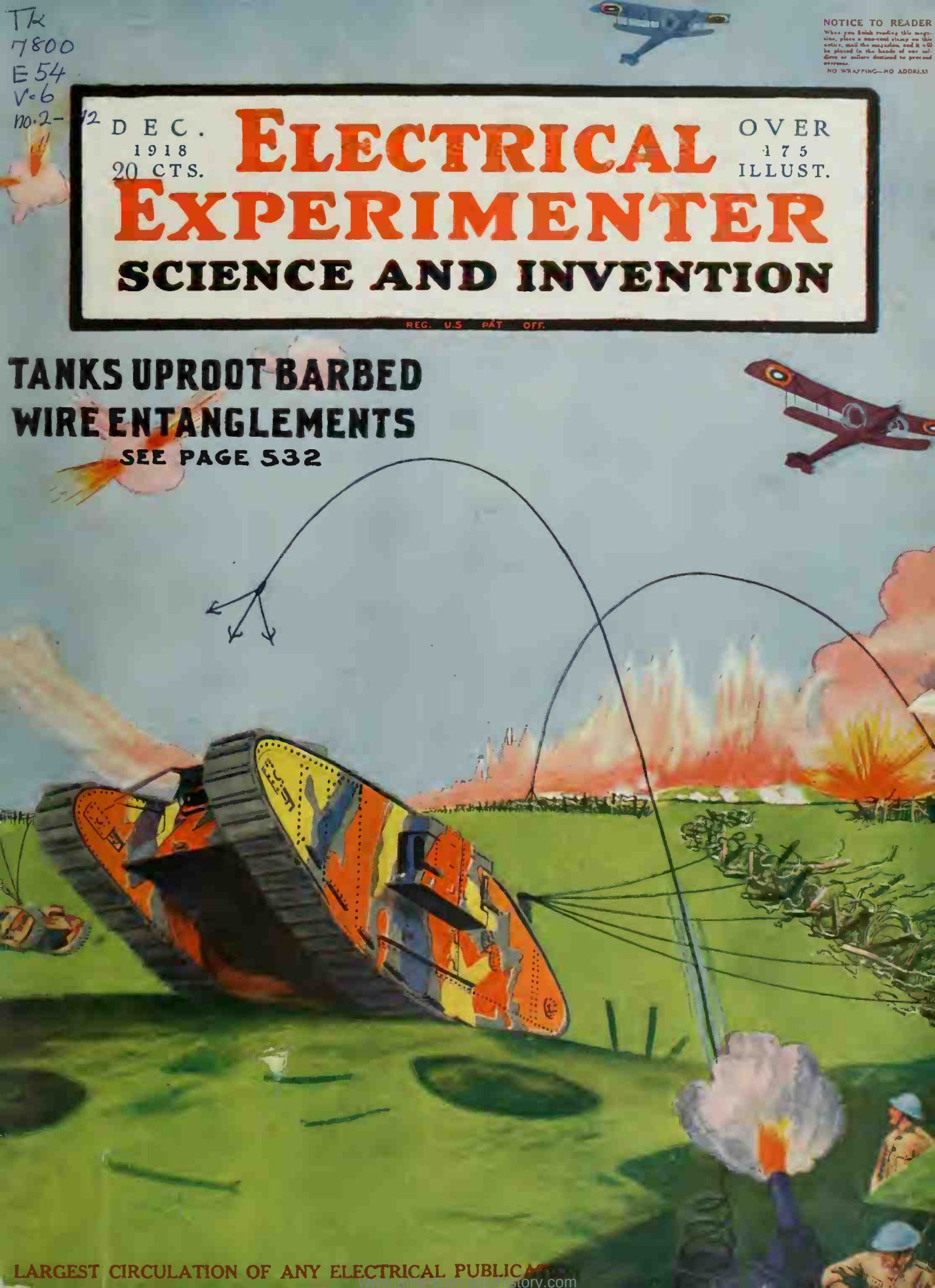
ELECTRICAL EXPERIMENTER

SCIENCE AND INVENTION

OVER 175 ILLUST.

TANKS UPROOT BARBED WIRE ENTANGLEMENTS

SEE PAGE 532



Learn Electricity

In the Great Shops of

COYNE

Trade and Engineering Schools

Dept. 20Y, 39-51 E. Illinois St., Chicago, Ill.

PRACTICAL INSTRUCTION

FINISH IN 3 MONTHS

Thousands of skilled Electricians are needed. The demand is becoming more urgent every day. The Government is employing every one they can get which is causing a great scarcity throughout the country and big salaries are being paid everywhere. Right now is *your* big opportunity. Make up your mind now to prepare for one of these big jobs and then get here as quick as you can for your training.

Earn $100.00 To $300.00 A Month

In the Electrical business. Come here where you will be trained in these great $100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position. We now have more positions than we can fill. Think of it.

PREPARE TO SERVE YOUR COUNTRY

War Demands Have Taken Thousands of Men from this Profession. Men *Must* be Trained to Fill their Places. Prepare *Now* for a Big Paying Position.

These courses are thorough, short and practical. All instruction given on the actual equipment. Each man is trained individually and stays until thoroughly trained. Start any time—day and evening classes.

Our graduates are in great demand. We are continually receiving letters, telegrams, and telephone calls from contractors, manufacturing firms, etc., seeking our graduates to fill responsible positions. We have now more positions than we can fill and the demand is steadily growing. Every comfort is given our students while here. They live in comfortable homes in the most beautiful section of Chicago—on the lake.

DRAFTED MEN READ THIS

It will only be a short time until you are called into service. This is a war of skill, brains, and machinery. Uncle Sam must win this war and must have tens of thousands of men skilled in modern trades and professions such as Electricity, Drafting, Plumbing, and Sanitation. Such men will be quickly recognized and given an opportunity to rise. It is not too late for you if you act at once.

In most cases those of our students in the draft, who have been called before completing their course, have been given an extension of time by their board sufficient to finish their course, owing to the great need of trained men in these lines in the Government Service.

LEARN DRAFTING

Skilled Draftsmen are always in demand. Our courses are thorough—short—practical, preparing a man fully to hold a position of responsibility. We have more positions than we can fill. We also have thorough practical courses in Plumbing and Heating, Motion Picture Operating and Bricklaying.

EARN YOUR WAY

Many students earn their living expenses by doing a little work in their spare time. Our employment dept. furnishes these positions without charge.

MAIL COUPON FOR FREE BOOK NOW!

COYNE TRADE AND ENGINEERING SCHOOLS

Dept. 20Y, 39-51 E. Illinois St.

Chicago, Ill.

Please send at once your big Free Book—I am interested in

[ ] Electricity [ ] Drafting [ ] Plumbing

[ ] Motion Picture Operating [ ] Bricklaying

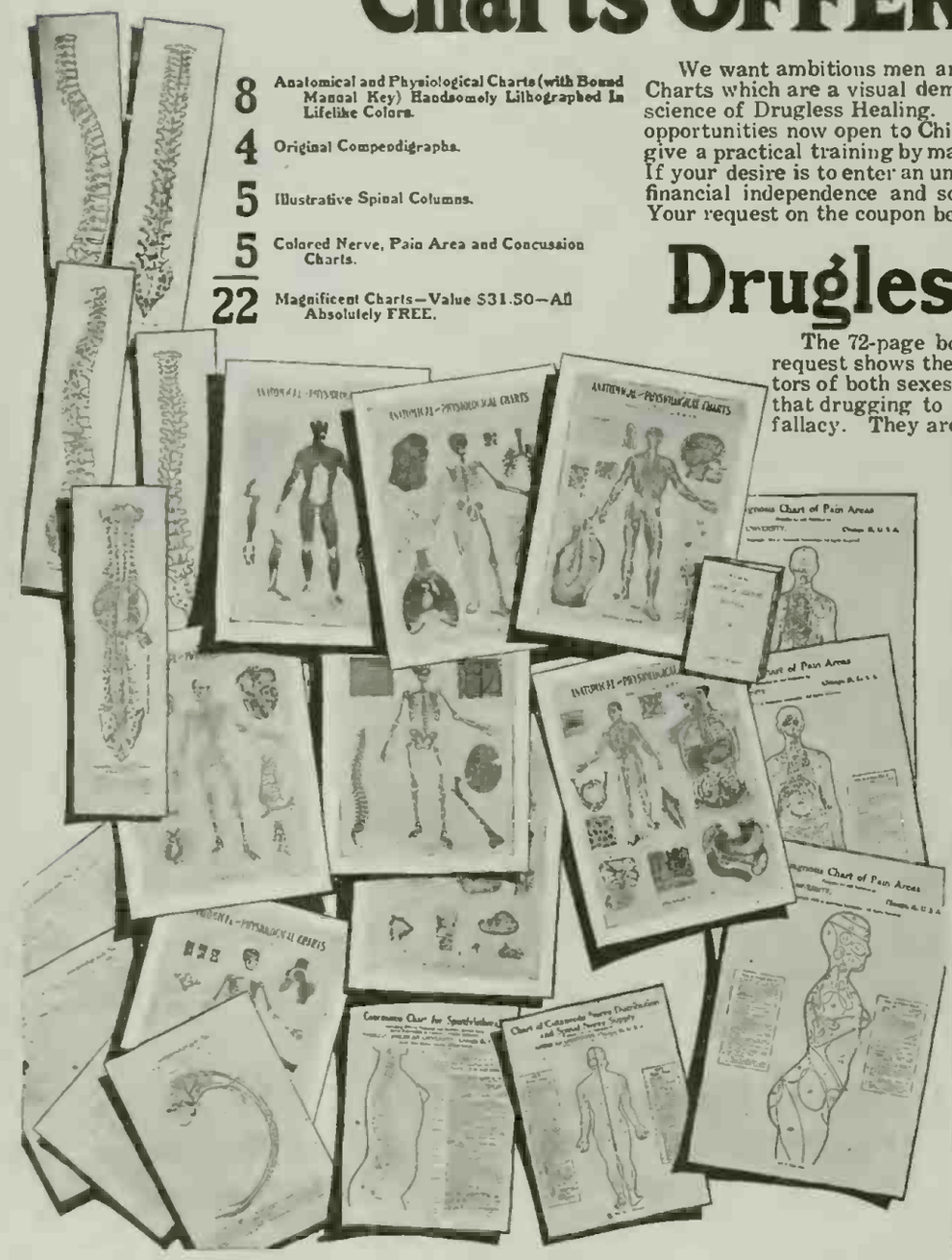
(Check trade interested in)

Name.....

Address.....

[Entered as second-class matter March 1, 1915 at the post office at New York, N. Y., under the Act of March 3, 1879 Experimenter Publishing Co., 233 Fulton St., New York, N. Y.

Remarkable *FREE* Charts OFFER



8 Anatomical and Physiological Charts (with Bound Manual Key) Handsomely Lithographed In Lifelike Colors.

4 Original Compendigraphs.

5 Illustrative Spinal Columns.

5 Colored Nerve, Pain Area and Concussion Charts.

22 Magnificent Charts—Value $31.50—All Absolutely FREE.

We want ambitious men and women to have these remarkable Charts which are a visual demonstration of Chiropractic, the new science of Drugless Healing. This offer is now made to show the opportunities now open to Chiropractors. We also explain how we give a practical training by mail in this dignified, paying profession. If your desire is to enter an uncrowded field—if you want to achieve financial independence and social standing, at least investigate. Your request on the coupon below is all that is necessary.

Drugless Healing

The 72-page book and other literature we send on request shows the immense possibilities for Chiropractors of both sexes. The public is awakening to the fact that drugging to cure disease is in many instances, a fallacy. They are ready to welcome the practitioner who relieves and heals without nauseous dosing. The Charts show how the science of Chiropractic is applied. They reveal facts about the human body, instructive to the layman. You should obtain them without fail.

$3000 to $5000 a Year

Many Doctors of Chiropractic earn $5,000 a year and more; some upwards of $10,000. Dr. M. D. Moore of Ky., reports an income of $9,000 a year. Dr. L. H. Roche, New Jersey, $5.500; Dr. Hanna of Florida, over $5,000 yearly. What others are doing you should be able to do. A diploma gives you the same opportunity—is evidence that you are master of a profession of dignity, prestige and influence.

Our Lessons Teach You

how to make Spinal Adjustments for speedy relief of

Headache	Neuralgia
Indigestion	Neuritis
Lumbago	Catarrh
Epilepsy	Fevers
Pleurisy	Jaundice
Constipation	Dyspepsia
Rheumatism	Paralysis
Asthma	Etc., Etc.

Be a Chiropractor Learn At Home

By the American University system of instruction, you can become a Doctor of Chiropractic by studying in spare time at home or in class at the University. You do not require special talent or advanced education. A common school education and the ambition to succeed are all that is necessary. You will be trained under the direction of Chiropractic specialists who will teach you thoroughly the principles and practice of the profession. You will graduate with the degree of Doctor of Chiropractic.

Mail the Coupon

This coupon will bring full information about this new, interesting and profitable calling which any intelligent man or woman can readily master by our method—also information on how you can get these 22 instructive Charts. Send coupon for this free offer.

AMERICAN UNIVERSITY
Manierre Bldg., Dept 323 Chicago, Illinois

Free Charts

AMERICAN UNIVERSITY
Manierre Bldg., Dept 323 Chicago

Gentlemen: Without cost or obligation, send me by mail, your new illustrated, 72-page book and your Free Charts Offer.

Name .....

Address .....

City .....

Electrical Experimenter

233 FULTON STREET, NEW YORK

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer;) 233 Fulton Street, New York

Vol. VI Whole No. 68 DECEMBER, 1918 No. 8

EDITORIAL

Wireless Around the World

ON October first, 1918, the Marconi Radio Telegraph station at Carnarvon, Wales (England), establisht direct wireless communication with Sydney, Australia, a distance of 12,000 miles.

This is the first time that a complete radio message actually enveloped the entire earth in every direction. In other words, when the towers at Sydney in Australia were receiving that message, the waves came in on it from *every* direction of the compass, as a moment's reflection will make clear. Furthermore, in addition, the waves actually tumbled onto the towers from the sky, as well as from beneath the towers, thru the earth—a remarkable phenomenon, if we stop to think of it. For the etheric waves do not travel snugly around and over the earth, but a very considerable distance above it, as any airplane or dirigible with radio receiving instruments on board can readily testify to. On the other hand, every terrestrial station has its "return circuit" grounded to the earth for better results. Thus while the Wales-Australia radio waves were speeding *around* the globe in all directions, they traveled as well thru the entire breadth of the earth, a minimum distance of 7,912 miles.

But if the waves traveled 12,000 miles around the earth, they probably traveled just as high above it, and perhaps very much further. We already know from experience that atmospheric conditions are the bane of the radio operator. Ionization of the air and barometric, as well as electric disturbances of the atmosphere often make radio-communication impossible. Experiments and our present day knowledge of physics, on the other hand, convince us that if there were no atmosphere at all, radio transmission would be not only infinitely better, but the distance covered with a certain amount of power, could be increased very considerably. Radio waves, the same as light waves, belong to the same family. Both are electro-magnetic manifestations of the ether. Both are equally hampered by the terrestrial atmosphere. Thus the best astronomical observatories are located on the loftiest mountain peaks. In such a position the astronomer can see much better, tho only one or two miles nearer his object, which, as for instance the planet Mars, may be 35 million miles distant! But the astronomer looks thru only about 30 to 40 miles of air—this being the estimated thickness of the terrestrial atmosphere. On the other hand, our radio waves traveling around the Globe, must speed thru 12,000 miles of atmosphere. Naturally, there is an enormous amount of absorption of energy, while the waves travel thru such a wide blanket of air; hence our suspicion, that as there is no such obstruction skywardly, the waves will travel infinitely farther into the free space where there is no atmosphere, once the paltry 30 to 40 mile air layer at Carnarvon is traversed. That these radio waves therefore, reach the moon, altho the latter is 238,850 miles distant, seems probable after these deductions.

The outstanding feature of this globe-encircling wireless is, that the power used to accomplish the result is much less than was used years ago to send a message across the Atlantic. The answer is found in our modern radio receiving instruments, and their enormously increased sensitiveness. Electronic valve receptors, coupled to a six-step amplifier for instance, amplify a given signal over *one million times!* Such results were undreamt of even five years ago. It must be obvious that as receiving instruments become more and more sensitive from year to year, we require less and less power at the sending station. Just as the astronomer sees a hitherto invisible star, because of his more powerful telescope, so does the wireless range increase with a more sensitive receptor. The day is not far when we will be able to send a radio message around the world using only a few dry cells for the total power at the sending station.

H. GERNSBACK.

The ELECTRICAL EXPERIMENTER is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $2.00 a year in U. S. and possessions, Canada and foreign countries, $2.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 20 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. A green wrapper indicates expiration. No copies sent after expiration.

All communications and contributions to this journal should be address to: Editor, ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been inclnded. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

ELECTRICAL EXPERIMENTER. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered U. S. Patent Office.

The ELECTRICAL EXPERIMENTER is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris.

Electrical Experimenter

H. GERNSBACK - EDITOR
M. W. SEIGOR - ASSOCIATE EDITOR

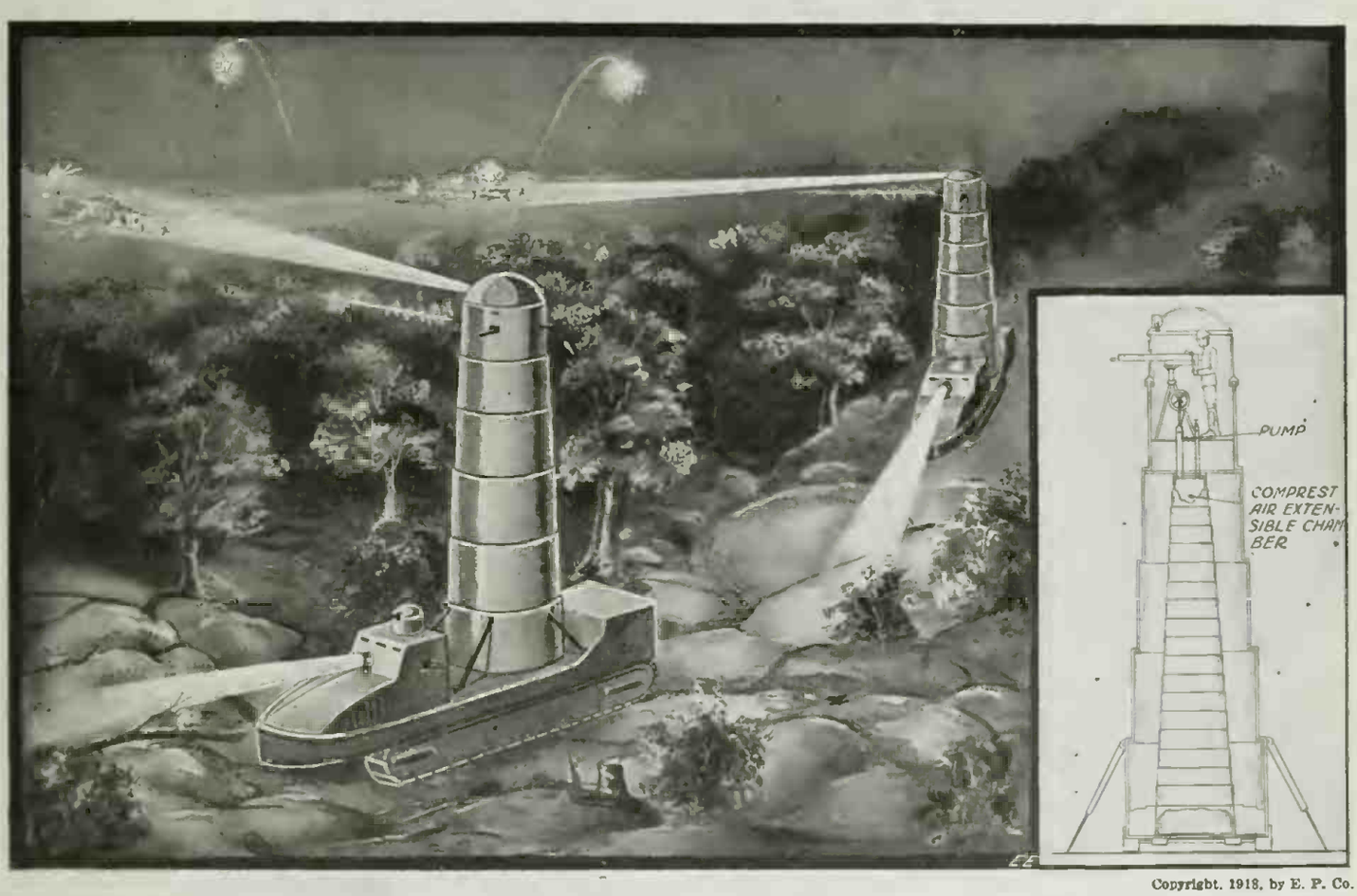
Vol. VI. Whole No. 68 DECEMBER, 1918 Number 8

At Last the Super-Tank!

HERE at last we have the super-tank. It was recently thought out and patented by one Anton Krzan of Chicago. This military device has considerable possibilities, and its field of activities is a wide one. It may be mounted on a powerful automobile truck or chassis, so as to be kept rolling over the country at high speed, and the while hurling forth streams of machine gun bullets, not to mention liquid fire and gas. This armored telescopic tank may carry searchlights for use at night. It can also be used as an observation post for the Signal Corps.

Of course, this armored tower could be well camouflaged so as to be hardly discernible even a few hundred yards away.

The inventor describes one way of elevating the steel tower, whenever so desired, by the use of comprest air. He states that one man can elevate the tower section by simply turning the handle on a small air pump which compresses air at atmospheric pressure and forces it into a flexible chamber, which, as more and more air is pumped into it, naturally causes the tower sections to rise correspondingly. Where the super-tank is mounted on an automobile chassis, several other methods at once become available for elevating the tank as often as required. One of these is to connect it mechanically with the automobile engine thru suitable clutch mechanism and gearing. Another method is to have a separate gasoline engine unit, just to raise the tower section of the tank—and still another way is to have an electric motor inside the tower base, the motor receiving electric current to operate it from a storage battery charged from the automobile engine. A further scheme for such a power plant would be that involving the use of the automobile engine to drive a



At Last the Super-Tank! A Yankee Genius Has Developed This Telescopic Armored Tank for Use in Ferreting Out the Enemy, Making Observations, and Breaking Up Airplane Attacks Close to the Ground. Equipt with Wireless Telephone, Searchlights, Machine Guns, and a High Speed Tractor Chassis, These Fighting Giants Should Prove Quite Formidable.

NEW YORK'S NOVEL $6,000,000,000 LIBERTY LOAN SIGN.

One of the most spectacular features of the Fourth Liberty Loan campaign was the manner in which the big Wrigley Gum Electric Sign in Longacre Square was adapted to accommodate an enormous scale giving the total figures subscribed each day.

This sign, the largest electric sign in the world, occupies the roof of a building on the west side of Broadway from 43rd to 44th Street. The sign is 200 feet long by 50 feet high, and is an artistic design, comprising more than 15,000 electric globes.

Mr. Wrigley donated the sign for the use of the Liberty Loan during the campaign and the concern who built the design designed and donated the Electric Scale which recorded the total subscriptions until the six billion was reached.

The scale occupied the center of the sign and is 66 feet in length. In fact, it is a small section of an enormous dial, which if completed would be *132 feet in diameter*. The arrow is 14 feet long, and the letters "BUY LIBERTY BONDS" are 5 feet high. The arrow was set electrically several times during the day, according to figures received on the long distance 'phone from Washington, and busy New Yorkers found it of great convenience to watch the progress of the subscriptions to the Fourth Liberty Loan by simply glancing at this huge sign.

Spectacular Electric Sign One Block Long Which Kept Track of the "Fourth Liberty Loan" for New Yorkers. The Illuminated Needle Moved Slowly Across the Dial as the Loan Progrest.

There was a sign at the bottom of the big display stating that the space was donated by Wm. Wrigley, Jr., Company, and this caught the eye of a little girl, who walked thru Longacre Square the other day with her mother—in excited tones she turned to her mother and said: Oh, Mamma, look! Mr. Wrigley has donated over a billion dollars for Liberty Bonds." *Photo courtesy O. J. Gude Co.*

NONSILVERABLE CONTAINERS FOR SILVERING MIRRORS.

In the ordinary process of silvering glass mirrors by chemical decomposition (*e. g.*, Brashear's method) the metal is deposited upon the glass container. In this manner a great deal of silver which might have added to the thickness of the mirror is lost. This is an important item when silvering mirrors 25 cm. or more in diameter, says Wm. W. Coblentz in *Science*.

The object of this note is to call attention to the usefulness of ordinary, "granite ware," enamelled iron pans, which do not attract the silver and hence increase the supply of material available for deposition on the mirror. During the past year the writer has had frequent opportunities to verify this observation and to apply it in producing thick deposits of silver on glass.

---

dynamo, and the dynamo to operate the electric motor. This corresponds to the steam-electric drive now fitted to many of our new ships, and there is also at the present time an automobile on the market having this form of drive. One of its principal features and characteristics is greater flexibility owing to the wide range of speed available wherever an electric motor is used. This cannot be said of any steam or gasoline engine power unit, where the power is taken direct thru gears, or other more or less jerky mechanical means.

Not only does this super-tank have a steel tower, but it can be raised and lowered as it speeds along, and the tower may be rotated as desired. For this purpose the upper section containing the machine gun or other ordnance is mounted on roller bearings, so as to turn easily and quickly. A portable wireless outfit may also be carried in this tank, which often times would be of invariable assistance in carrying out difficult maneuvers and battle formations, owing to the fact that the observer is elevated above the ground and thus has a clear view of the enemy lines. At first thought it might seem that considerable power might be required to raise a telescopic steel tower such as this, especially when it might be expedient to raise and lower it quickly for the purpose of keeping the enemy gunners guessing, if they should happen to get a "bead" on the moving, highly camouflaged super-tank. But such is not necessarily the case, for the telescopic steel mast can be properly arranged with suitable balance weights in the same manner that our apartment house and office building elevators are, so that very little power would be required to raise the tower to its full height in the fraction of a minute. The balancing weight connected to these sections would be nearly equal to the weight of the sections themselves, so that when the clutches are released to collapse the tower, the weights will weigh just sufficient to allow the tower section to overbalance them and descend.

ARMY ENGINEERS' CORPS A GIANT OF EFFICIENCY.

The wartime organization of the Army Engineer Corps was revealed for the first time on June 27, by Major General William M. Black, chief of the corps, in an address before the American Institute of Electrical Engineers. General Black outlined the extent to which modern warfare is an engineering problem and illustrated his address with screen views of the activities of the engineers in France.

General Black said the present corps organization is composed of 8,000 commissioned and 200,000 enlisted personnel. New units created, he said, most of which are now in France, included: Five corps regiments, consisting of sapper, searchlight and sound-ranging troops; 43 sapper regiments and trains; 2 mounted battalions and trains, 5 pontoon trains, 4 inland waterway companies, 40 railway regiments and battalions for construction and operation of standard and light railways, 1 railway transportation corps, 1 highway regiment, 1 gas and flame regiment, 1 gas training service, 5 foresty and auxiliary forestry regiments, 1 surveying and printing battalion, 1 military mapping service, 2 supply and shop regiments, 1 water supply regiment, 1 quarry regiment, 1 mining regiment, 1 electrical and mechanical regiment, 2 crane operating companies, 1 camouflage battalion, 18 truck and auto companies and 44 depot detachments.

General Black, who accompanied Secretary Baker to France and personally inspected army engineering projects there, said the majority of these units were serving with American troops, altho some were attached to the French and British armies. He pointed out that 20,000,000 square feet of floor space are required to store 90 days' supplies for 1,000,000 soldiers and double that amount of open space. At one port of debarkation, he said, 375,000 square feet of wharf space had been provided to accommodate incoming troops and supplies, and he estimated that the transportation services which had to be constructed and maintained must be able to handle to the front *25 pounds per man per day.*

RADIUM IN MEXICO.

A concession has been granted by the secretary of industry and commerce in Mexico for the exploitation of a deposit of gold, uranium and radium at Guadalupe, in the mountains of the state of Chihuahua. All the machinery necessary for thoro and extensive operation will be introduced. The government will receive 5 per cent of the gross output in return for the permission granted. This is the only deposit of these minerals so far discovered in the republic.

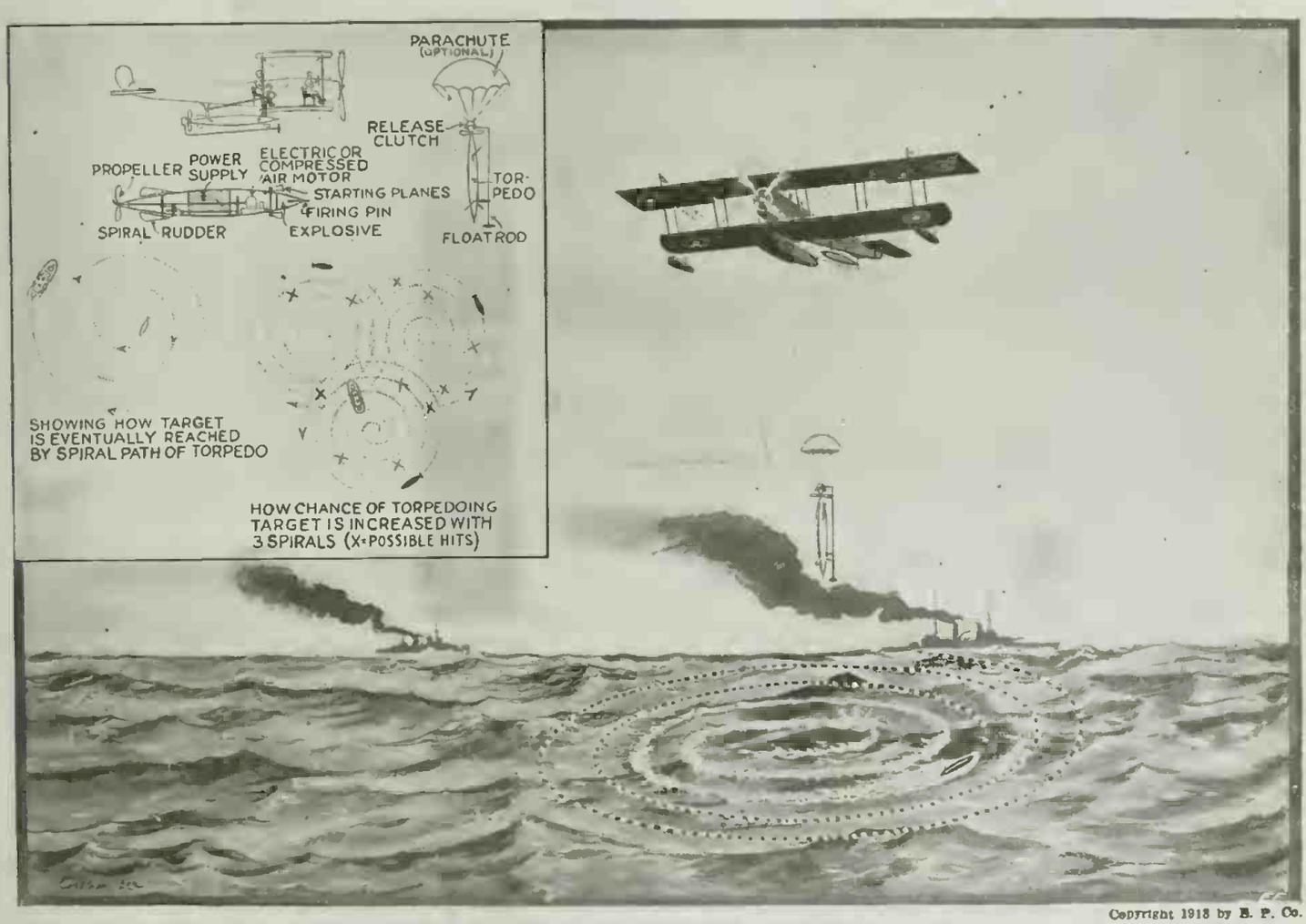
Almost automatic in its operations is a new cabinet for quickly developing X-ray photographs for dentists' use.

A Deadly Spiral Course Torpedo

DROPPING a missile from an airplane with sufficient accuracy such that it will hit a moving ship or other target is a very difficult matter at all times, and as may be readily supposed the number of "hits" registered under marine conditions is but a very small proportion of the missiles dropt. Therefore, a Yankee genius, Edward D. Priest, of Schenectady, N. Y., has taken out a patent on a clever spiralling course once it starts moving under its own power, to follow a *spiral* path of ever increasing radius.

As the accompanying illustrations will make clear, it is only a mater of time when such a torpedo is bound to "get" you. Of course, if the torpedo should be near the end of its range, such as on an outside lap of the spiral and traveling somewhat slower in speed, the argument might be raised that the vessel could easily side-step

As the details of the illustrations herewith tend to show, these torpedoes are slung beneath the fuselage or body of the hydroplane, so that the bombing officer can release them as desired, either all together or one at a time, by simply pulling on a lever. The torpedo may be fitted with a small parachute, so that it will travel at reduced speed as it nears the surface of the water, and thus alight without diving too far below the surface. Also the torpedo is provided



Something Real New in Torpedoes—A Spiral Path Torpedo, Which After It Is Dropt from a Seaplane Starts Spinning Around a Circular Path of Ever-Increasing Diameter. It's Bound to "Get" You, Eventually; and When Several of Them are Dropt in the Vicinity—Zowie! You Sure Need Friends.

torpedo, for just such requirements as this, where the torpedo may be dropt from an airplane to hit such targets as submarine destroyers and larger vessels.

It does not take a mathematician to figure out what chance an aviator has of hitting the target with an aërial bomb if he is at any considerable altitude, when the target is such a small affair as a submarine or submarine destroyer. Also it does not take much figuring to see that if we have a torpedo which will start moving under its own power as soon as it strikes the water after being dropt from an airplane, that this torpedo can under normal conditions only proceed in *one* direction or another, and not in any number of directions. Therefore, as the inventor points out, there is practically only one reasonable solution to such an ambitious problem as he has set himself, i.e., to devise an automatic torpedo which will cover a certain prescribed area thoroly and effectively, and that is to have the torpedo, the onrushing torpedo. But this proposition takes on another color, when one stops to think that several of these spiralling torpedoes may be dropt in the water from a hydroplane at the same moment. Here we are confronted with a perfect maze of torpedoes spinning around in the water in ever-increasing circular paths, which cross and re-cross each other, and, as becomes obvious, it will be extremely uncomfortable for any vessel so situated. The modern automobile torpedo moves at a very high velocity, or at a speed of between forty and fifty miles per hour. We recollect only one case in which a gunner on an armed merchantman ever succeeded in hitting a traveling torpedo with a shell, and most probably that was more a case of luck or chance than anything else. In this direction it is well to remember that the torpedo does not skim along on the surface of the water, but travels at a depth of fifteen feet on the average.

with a disengaging striker which hits the water just before the nose of the torpedo, releasing the parachute, and in the next instant two specially devised rudders strike the water, and these are pushed upward; this action causes the propelling motor circuit to be actuated, and the propeller starts spinning. At the same time an electrical device begins functioning, which causes the rudder to slowly turn, which then forces the torpedo to follow a spiral path of gradually increasing radius. It is evident that if this were not done, and the rudders set at a given fixt angle, then the torpedo would proceed to follow a circular path of the same or constant diameter.

The torpedo is preferably propelled by comprest air, actuating a comprest air motor, the same as in the standard naval type of automobile torpedo of the Bliss-Leavitt pattern. The inventor provides for causing the torpedo to travel either partially submerged or on the surface, as desired.

3,000,000 Fish an Hour Without a Hook

"ANY luck?" asks the habitual human machine gun. You can only answer him and say, "Yes, several thousand bites from our mutual friends the mosquitoes, but not a bite from the wily fish." It is the same old story, but not so with the new Giant Fishing Machine, designed and originated by one Captain N. A. Lybeck, a sturdy follower of the sea from coast to coast. While on one of his numerous adventures of the deep, he was thrown into close relationship with an unknown specie of deep sea fish that had a searchlight eye with the properties of "mesmerismic" influence. After his safe extradition from this catastrophe he evolved the idea that this fish must exercise a hypnotic influence over its prey and here was the birth of his great idea,—namely, a giant fishing machine which would "hypnotize" the fish with powerful electric searchlights and a scooping device which would run in the fish to the sorting tables; in other words, an electro-mechanical fisherman on an enormous scale.

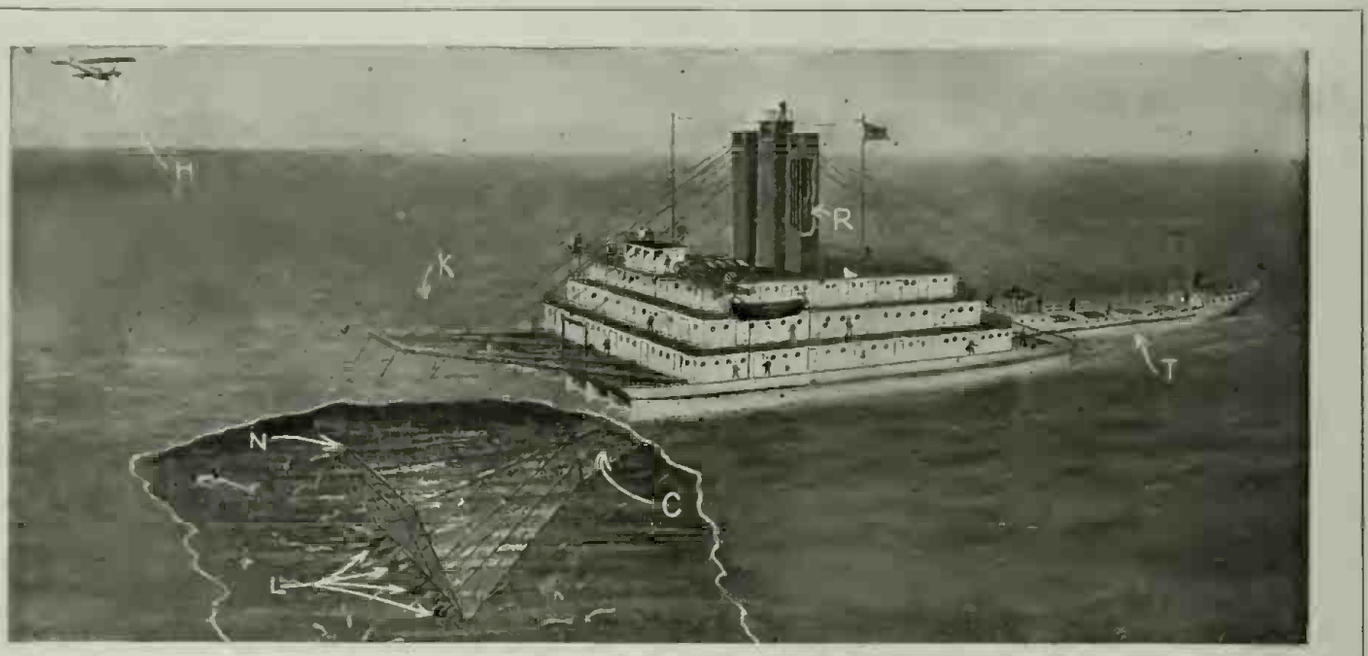
How successful he has been can be judged from the illustration of his monster Fisherman. In action its operation can be described as follows:—When the engines are working and forging the boat ahead at the rate of ten miles an hour, this forward motion causes fish to be carried into the scoop and thence thru the throat of the scoop onto the electric conveyor, which carries the fish to the electrically operated sorting machine, where the different varieties and sizes are sorted, separated and sent on to the different respective packing bins.

The best of the selected fresh food fish are immediately, while still fully alive, frozen into solid blocks of ice in an electric refrigerating machine. The Government Bulletin that has been issued on this subject of cold storage lays stress on the fact that either the packing of a perishable article in ice or the refrigerating of the same by a cold producing machine will positively preserve the article in its exact condition at the time of refrigeration. Therefore if the fish are absolutely fresh when they are placed into the ice-making machine and frozen, then they necessarily must be absolutely fresh when the boat is landed and the fish unloaded for consumption by the public.

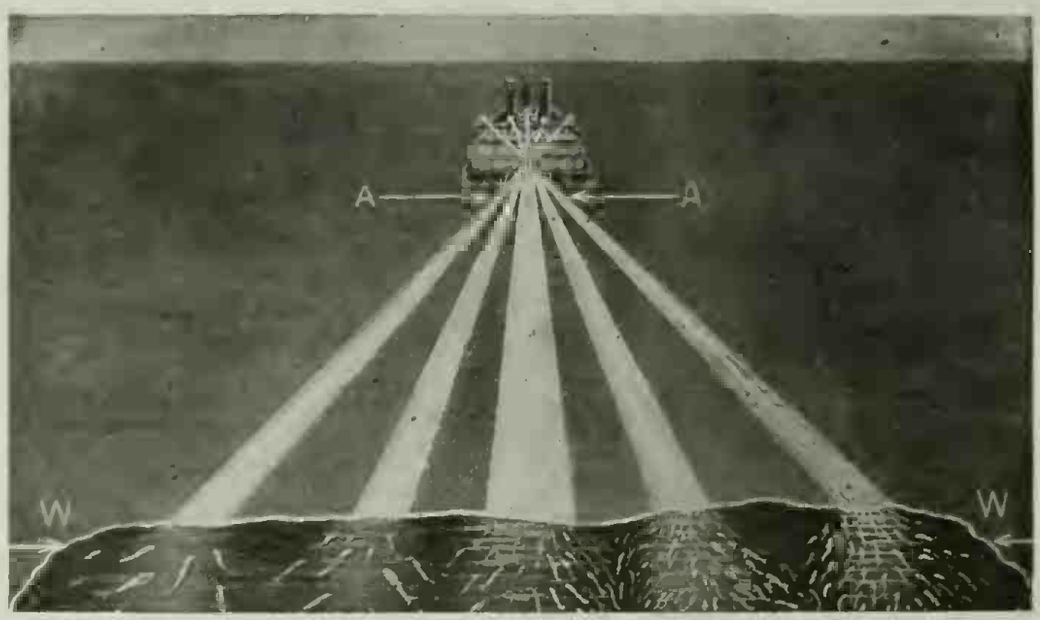
All fish that are of desirable qualities but are too small for use are allowed to pass uninjured back into their native element, where they may increase in size and numbers. This is made possible by the construction of the fishing machine and its scoop. The fish are caught and carried forward without any sort of injury; therefore if they are not of the kind that are wanted or are diminutive in size they can be returned and none the worse for their experience.

The hulls of the boat are tunnelled and streamlined so as to eliminate any disturbance of the water, which in some way or another gives notice to the *sixth* sense of the fish, if they have such a sense, that danger is lurking nearby. For that very reason you could have killed Towser when you brought him on that last fishing trip and while comfortably smoking your favorite meerschaum he started to bark and run up and down the bank of the stream, scaring all of the fish away from your

(*Cont. on page* 584)



Catching 3,000,000 Fish an Hour, Without a Hook! Sounds Impossible. Doesn't It? That's What We Said Until We Saw the Machine Work. It First Hypnotizes the Fish, Millions of 'Em, by Its Powerful Electric Searchlights; the Advancing Scoop-Net Whirls the Finny Victims Up to an Electric Conveyor and Sorting Machine.

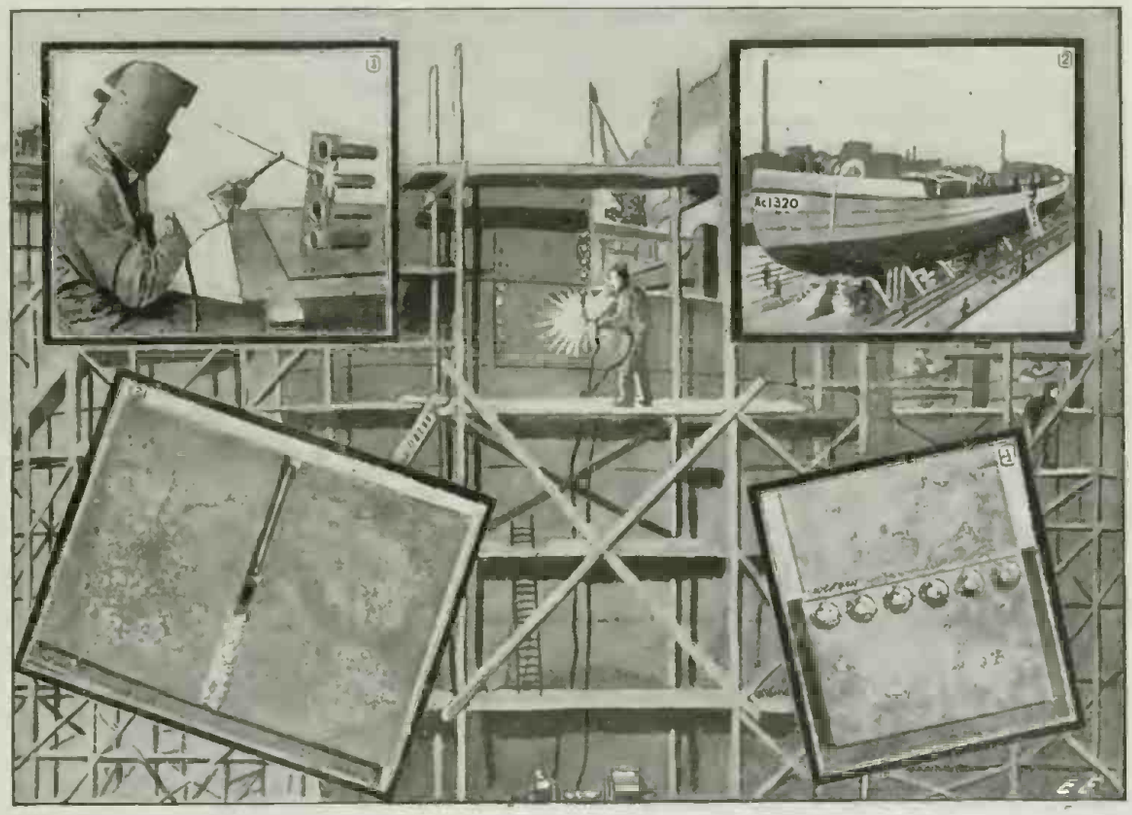


Head-on View of the Giant Electric Fisherman, Its Powerful Searchlight Hypnotizing the Helpless Fish, Preparatory to Gobbling Them Up in Its Scoop, Measuring 150 Ft. by 100 Ft.

How Ships Are Welded by Electricity

IT is reported that Charles M. Schwab, Director General of the Emergency Fleet Corporation, is considering the construction of a totally electrically welded ship at an early date. It is undecided whether to make the initial experiment with a five thousand ton vessel or a barge. But in any event, the Emergency Fleet Corporation, which is now building vessels by the hundred for Uncle Sam, thus placing the American flag in every port of the world after the war, will undoubtedly adopt this form of building ships, if not altogether, at least to a large extent. For many years, and in fact as long as steel ships have been built, the plates on the hulls of these boats have been lapt over one another, and then held permanently together by passing red hot iron rivets thru perforations near the edges of the plates, the heads of these rivets being swaged over, either by hand with a sledge hammer or else with a pneumatic riveting tool while hot. Some idea of what a tremendous job this riveting problem is may be gained from the fact that a typical day's record in riveting at Hog Island, America's newest and greatest shipyard, is 116,000 rivets per day.

The Emergency Fleet Corporation has thought so well of electric welding of steel ships, as followed by the English shipbuilders in a small way, that they have appointed an Electric Welding Committee, which board has looked into the technical details and problems connected with the application of electric welding on such a gigantic scale as is required in welding the plates together on a five thousand to ten thousand-ton ocean grey-hound, measuring five hundred feet long and standing sixty feet high on the ways—from keel to deck.



Arc Welding Instead of Riveting Ships. No. 1.—Arc Welding Boiler Flues. No. 2.—Totally Electric Welded Barge Built in England. No. 3.—Partially Completed Arc Welded Seam—Notice the "Tack Welds" at Center and Top to Hold Plates Together. No. 4.—Arc Welding Around Rivet Heads to Prevent Leakage. Current is Usually Supplied from a Special Motor-Generator Set Fitted with Regulating Reactance Coils to Govern the Amount of Current Consumed by the Arc.

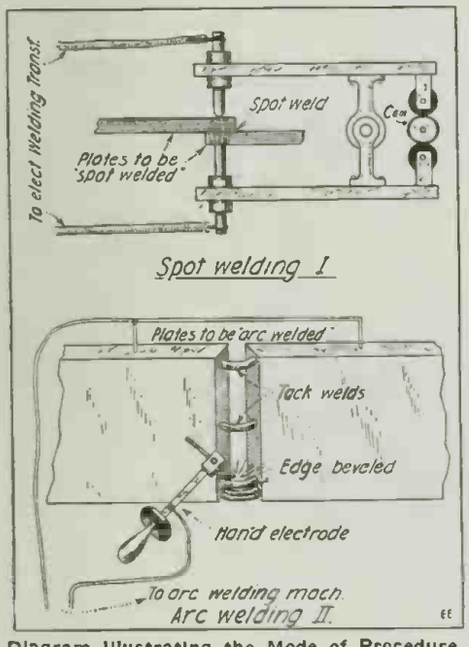


Diagram Illustrating the Mode of Procedure in Making a "Spot-Weld" by Electricity I and Manner of Making an "Arc-Weld" at II. The Intense Heating Effect of the Electric Current is Harnest to the Job in Either Case. The Electric Arc is One of the Most Powerful Sources of Heat Known.

Briefly, there are two forms of electric welding which are being experimented with, and these are *arc* welding and *spot* welding. Arc welding gives great promise in the shipbuilding field, and has been largely used abroad and also to some extent in America, especially in railroad repair shops where a heavy direct current was easily obtainable. It was thus discovered that the process of arc welding was much cheaper and could be performed more rapidly than by any of the gas welding methods. Spot welding is now used extensively in many different industries, and has been employed considerably for the welding of bonds on street car rails. "It is interesting to note here the difference in practise between Great Britain and the United States," says Mr. H. A. Hornor, in a recent paper presented before the American Institute of Electrical Engineers on the subject of electric welding of ships. Mr. Hornor is a member of the Electric Welding Committee appointed by the Emergency Fleet Corporation. As he has pointed out—"Great Britain, knowing little or nothing about spot welding, had the practise and application of arc welding well under way, while conversely American engineers, on the other hand, had highly developed spot welding, even to the point where elaborate welding machines for this class of work performed their task automatically day after day, making successful welds at the rate of several thousand per hour.

What are spot and arc welding and what is the difference between them? That is the question which interests not only the layman but many electricians as well, for this branch of electrical science is indeed quite new, very little having been publisht concerning it. The accompanying diagrams, figures one and two, show the two different processes of electric ship welding in a clear manner. To produce a *spot* weld, two heavy copper electrodes, water cooled in the heaviest machines, are placed on opposite sides of the material to be welded together, such as two steel plates. The joint is a lapt joint, and machines are now available that will make two and more spot welds at one time. The details of the operation, which requires but a few seconds for each weld, are as follows:

The electrodes are brought into contact with the material to be joined, and current is supplied sufficient to give the required heat. Pressure is then applied; the current and pressure are then removed,—the spot weld is then complete, and is usually as strong as the base metal which has been welded. The spot weld operator has a perfect indication of making a good spot weld by the use of a button placed under the electrode, and by observing it he knows exactly the proper timing of the operation. There is therefore no question as to a good, poor or indifferent spot weld.

Arc welding, which gives much promise of being rapidly adopted in steel shipbuilding at an early date, is carried out in the following manner: One side of the electric circuit is connected, as Fig. 2 shows, to the material to be welded, the shank material

(*Continued on page* 572)

New Yankee War Inventions

By H. WINFIELD SECOR

WARTIME inventing has become more or less a profitable game in the past few years, and of late the electrical inventors of America have busied themselves in perfecting new schemes with which to overcome the Teutonic armies. Some of the more recent and interesting of these patents which have been taken out are herewith described and illustrated.

The first invention is that of an electrically operated machine gun. This is a very interesting scheme indeed. Where a source of electric current is available, such as from a storage battery or from feed wires carried up to the front line trenches, this electric machine gun should prove of considerable efficiency. It has a very positive drive for the belt containing the cartridges and the firing pin mechanism is also positively controlled by the electric motor actuating the cartridge belt, etc. The machine gun is fitted with a safety switch, which is connected in series with another switch mounted within the rear hand-grip as clearly shown in the illustration. The cartridge belt is provided on its underface with a series of teeth adapted to mesh with the teeth of the gear wheel working thru the lower wall of the chamber, and projecting upward into the same, so as to fit into the teeth formed in the belt. The belt is designed to be made in a number of sections, or it may be made in one continuous length with its ends detachably connected together. The cartridges are placed in the tubular containers secured to the belt.

In operating this electrical machine gun the gunner simply grasps the hand-grip, after having closed the safety switch. The electric motor then starts up, causing the cartridge belt to move, and the cartridges are brought one at a time into the firing chamber. During the adjusting of the cartridge in the chamber the firing pin is thrown back, and the next instant a powerful spring throws the firing pin forward, striking the closed end of the cartridge, exploding it. This action is rapidly repeated, and a thousand or more cartridges fired per minute. A patent on this machine gun was issued to Luis M. McManus of Houston, Texas.

The second electrical military scheme was recently patented by Colonel Willis P. Coleman of the United States Army, and appertains to improvements for use in connection with the instruction of recruits, and particularly rifle marksmen, especially with regard to the proper method of holding the rifle and pulling the trigger without disturbing the line of sight. As Colonel Coleman states the case—"It is necessary to hold the rifle in a vise-like grip during the operation of *squeezing* the trigger, if one is to shoot a military rifle with any degree of accuracy." To bring the recruit to the realization of the necessity for the "hold and squeeze" is the most difficult part of the instruction, says the inventor. Heretofore there has been no satisfactory method of concentrating on this particular part of the recruit's instruction.

The invention here illustrated provides a very simple scheme for overcoming this seemingly difficult problem, and it comprises nothing more than a dry battery or two, a small electric bell of the common garden variety, and a metal contact mounted on an adjustable rod, which also supports a miniature target, all of which is arranged in the manner depicted by our artist. In practise the rifleman has to hold the piece so that the electrode-pin projects a short way inside the barrel. The instructor watches him while he goes thru the movement of loading and pulling the trigger. He must be able to pull the trigger while sighting on the small target attached to the instrument without moving the gun barrel sufficiently to bring it in contact with the central rod, which will cause the bell to ring. No bullets are used in this maneuver of course. The invention is of wide application and extremely simple to adopt, and is, moreover, well-suited to training riflemen for shooting in any position, either prone, kneeling or standing.

The third idea, on which Mr. George Fleming of Princeton, Texas, has taken out a patent, is that of an electrical shot-gun. The object of the invention, so he states—"is to provide a trigger-operated gun, which will close an electric circuit and immediately upon contact with the shell, to create a spark for igniting a combustible fluid or material thru the medium of which the shot is projected."

As the illustration indicates, a small flashlight battery is placed in the stock of the gun. By means of an insulated trigger and the necessary contact plates an electrical circuit is closed thru the cartridge or shell whenever the trigger is pulled. The shell is preferably adapted to contain powder, gas, or any other suitable combustible fluid or material which will impel or project a bullet from the barrel of the gun. The shell has a spark-plug mounted therein, so that contact of the trigger with this spark-plug will close the electrical circuit, and cause the contents of the shell to be ignited, and thus project the bullet out thru the barrel. Normally, a spring holds the trigger out of engagement and out of contact. For certain classes of shells, particularly small gas shells and the like, this idea is well adapted.

An Electro-Gasoline Cannon is illustrated in the fourth figure. This cannon or gun is intended to hurl forth projectiles by means of the same force as that employed in the automobile engine cylinder, i. e., by the explosive force produced when a gaseous vapor, such as that composed of gasoline and air, is suddenly exploded by an electric spark. Thus no powder is necessary with such a gun. As the diagram and illustration show, the cannon is loaded thru a sliding breech-block in which the shell is placed. The gasoline and air mixture is obtained by means of a vaporizer, built on the order of a carburetor, and this mixture is injected into the chamber back of the shell by means of a force pump. This is necessary in order to properly compress the mixture, and it is ignited by means of an electric spark produced by means of a spark coil and battery. The inventors, John L. Anthony and William S. Bradford of Haynes, Arkansas, claim that perfect control of the fire is readily attained by the use of their gun, simply by variation of the amount of the charge. Moreover, they point out that a crew can fire such a gun with little danger from explosions and overheating of the piece. Moreover, the cost of operating a gun of this type is said to be much less than the cost of operating a gun from which the projectiles are fired by means of powder explosives. It may be interesting to our readers to know that a similar gun has, to our best knowledge, been used successfully in France, and also there has recently been developed a machine gun of this type which can fire three thousand shots per minute.

When the birdmen soar to lofty altitudes it becomes extremely cold, as is well known. A particularly effective, electrically warmed aviator's shoe has been invented by William W. Lillard of Irvington, N. J. Mr. Lillard mentions that his electrically warmed footwear is particularly useful for all those who may be exposed to extremely cold weather, including aviators, drivers of street cars, automobilists, etc. His scheme is particularly interesting in that the inner sole containing the heating element or grid may be used and attached to any footwear, whenever desired.

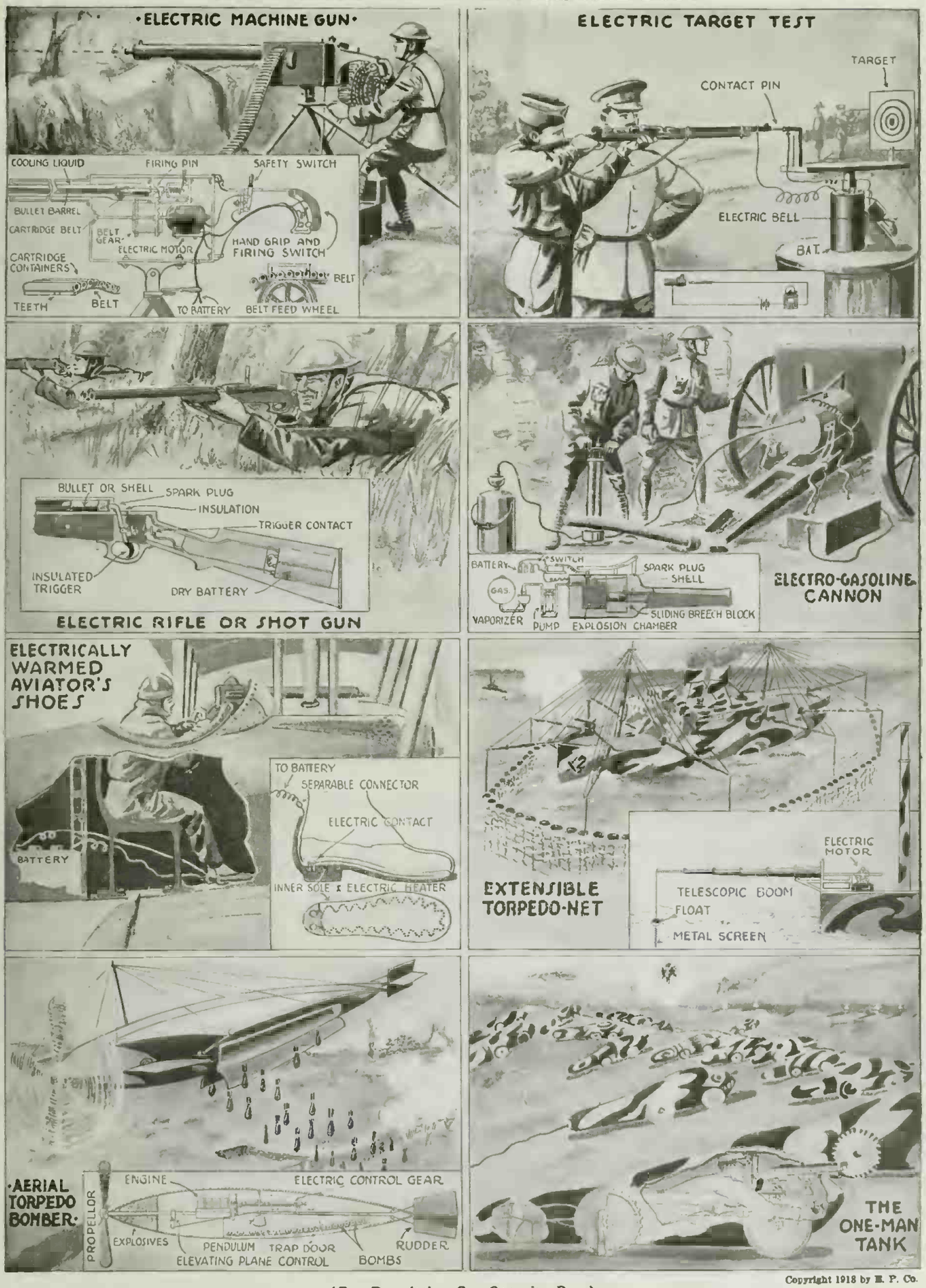
An electric insole is used in both shoes, and electric conductors extend thru the heel of the footwear to the outside thereof. A set of contacts in the heel and also in the insole are in detachable engagement with each other. The contacts and conductors leading thru the heel and up thru the leather pocket attached to the outside of the shoe at the rear, connect with a storage battery or other source of electric current. It is thus evident that the electrical contacts in the heel and the sleeve covering the conductors leading up from the heel, may be quickly attached to any regular footwear, whether they be shoes or boots. Electrically heated helmets and clothes have also been used very successfully by the Allied forces.

The sixth idea is a suggestion for naval and marine engineers, in the form of a quickly collapsible net to be used as a protection on ships against torpedo attacks. As the illustration herewith shows, the inventor, Mr. John Wosinski of Detroit, Mich., provides for a series of telescopic tubular steel arms which can be rigidly supported about the vessel when necessary. These arms may be quickly extended by means of comprest air, by a hand-operated gear, or, better yet, by means of an electric motor. Each telescopic boom is supported by cables from the masts so as to help sustain the weight of the net and floats. It is just possible that this idea may work out and prove available for the purpose for which it is intended. The net protector for ships, you know, is taboo in all naval discussions on torpedo defense, notwithstanding the fact that English warships have used them with success many times. Therefore, it is possible that Mr. Wosinski's invention may find acceptance in shipping circles, the principal objection to these torpedo nets heretofore having been that they reduced the speed of the ship and otherwise handicapped the quick handling of the boat.

One of these fine nights "Kaiser Billiam" and the "Clown Prince" will be highly surprised when their headquarters and perhaps a few of the family castles are bombarded by a gigantic flock of aërial torpedo bombers, of the type invented by a Nebraska genius, Sherman S. Benson. This aërial torpedo is devised so as to be set to automatically drop a shower of bombs or other explosive missiles at predetermined points over the enemy's positions. Also by a clever arrangement of trap doors in the shell of the torpedo and their releasing mechanism, the doors may be caused to open one after the other, at any desired

(*Continued on page* 584)

UNCLE SAM'S WAR INVENTORS ARE BUSY



(For Description See Opposite Page)

Tanks Uproot Wire Entanglements

By H. GERNSBACK

ONE of the most formidable barriers that the armies in the field contend with is the modern barbed wire entanglement. As is well known, it is almost impossible for charging infantry to move over the intervening no-man's-land when the latter is elaborately equipt with barbed wire. First of all, the advancing men are ready targets for the enemy, and once they come up close to the barbed wire, there is no way of getting over it without the enemy spotting the men, when they can be easily picked off by means of the enemy's rifle fire. In the past, many schemes have been suggested and are in operation, to either clear the barbed wire or else to destroy it. Perhaps the most efficient is the modern barage which levels and shatters to the ground all entanglements, blowing them to atoms. The objection to this method is that the enemy is served notice of what is coming and immediately concentrate reserves of infantry behind the attacked area, thus defeating the object gained by destroying the entanglements.

Another favorite method originated by the British, is to have tanks run over the entanglements, crushing poles and wire to the ground, but again this method gives notice to the enemy, and while not as much as if the barrage were used, still notice is given. Also one tank or even fifty tanks cannot break down a large area of wire, for it stands to reason that each tank can only crush down an area equal to the width of the tank itself, which usually is not more than ten to fifteen feet wide.

Recently a Yankee colonel devised an original method whereby use was made of ordinary chicken netting interspersed with thin steel rods. A number of such wire rolls are unrolled over the entanglement and the soldiers found little trouble in walking over this improvised bridge, but, of course, many casualties resulted by the Huns picking off the Americans with gun or rifle shot. All the methods cited above have one great objection, and that is that they leave the barbed wire on the ground in some form or other, and even if the poles and barbed wire have been crushed down, they still make very unpleasant walking as may be readily understood.

The writer wishes to advance an idea which has none of the objections cited above, while at the same time no new machinery is necessitated or will be necessary to carry out the plan. Our front cover as well as the accompanying illustrations depict the idea clearly.

By means of regulation trench mortars, we fire a steel wire in the direction of the enemy's trenches, the end of the wire being equipt with hooks or grapples, as our front cover shows. The firing of a cable of this kind is nothing new, nor is it untried. A similar method was used by the Italians repeatedly in the Alps, and in one case where a connecting cable broke and left a considerable force isolated on the peak of a mountain, communication was again establisht by firing a steel line over the heads of the marooned men.

After our steel wire has been shot over the barbed wire, all that is necessary for our men to do will be to pull the wire towards them till the hooks become firmly enmeshed in the barbed wire entanglements. After a number of wires, spaced say, twenty to twenty-five feet apart, have thus been shot over the entanglement, our men leave their trenches and attach the free end of the wire cable to the tank, as shown in our illustration, which tank may be some considerable distance behind our own lines at any point which is best suited for the requirements at the moment. When all lines are made fast, it is only necessary for the tank to start moving backward, when a considerable section of the barbed wire entanglement will be bodily uprooted and pulled out of the way. The entire tangled mass of poles and barbed wire wreckage can then be pulled somewhere to the rear, where it is out of the way and will not harm our advancing infantry. It goes without saying that by using a number of tanks and by shooting over a sufficient amount of lines, almost any section of barbed wire can be cleared in this manner. This system would work, of course, where there is a double, triple, or even quadruple line of barbed wire entanglements, one behind the other. In this case, all our men have to do is to grapple the nearest line facing the enemy, and once our tanks begin pulling, the first line of entanglements will invariably become enmeshed with the second, third and fourth line, and uproot them all. It is merely a problem of having a big enough tank or tanks with heavy enough wire cable and grapples.

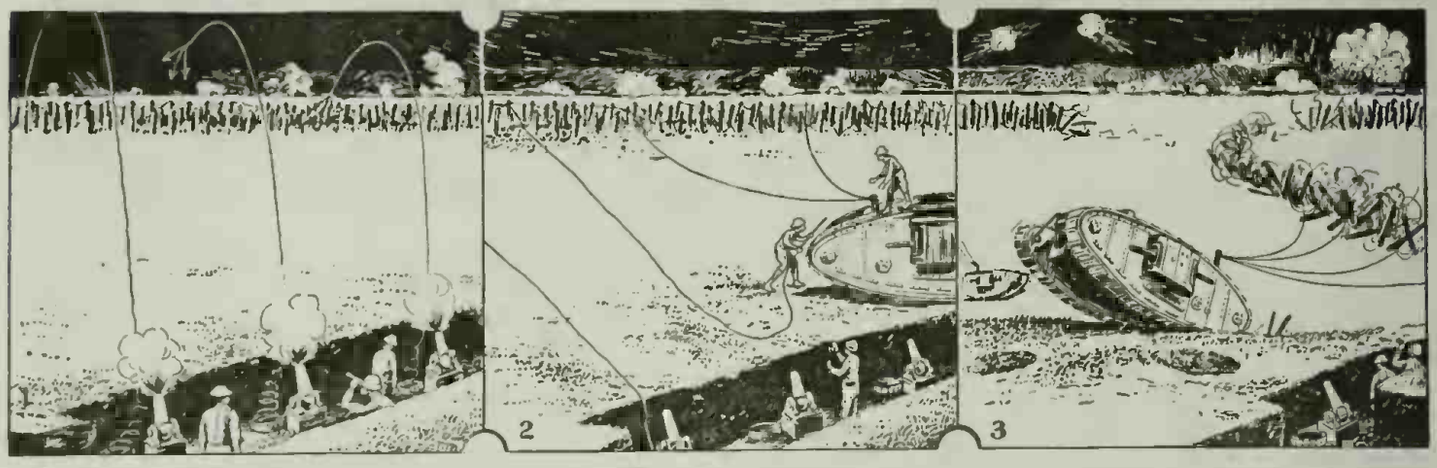
It also goes without saying that the tank which we have illustrated can be replaced by either heavy automobile trucks, or otherwise compound hand tackles (chain blocks), if it is not advisable to use either tanks or automobiles.

In order so as not to give the enemy any information as to what is coming, the trench mortars can be fired in the evening or early morning, and the object can be successfully camouflaged by sending over ordinary trench bombs at intervals. Thus the enemy will have no notice of what is happening, and will take the firing from the trench mortars to be nothing more than the usualy daily trench bomb bombardment.

Then at dawn, about half an hour preceding the attack, the tanks can get busy uprooting the barbed wire entanglements, making a wide breach in the defensive system, and within a few minutes after thus clearing an opening, our infantry can advance thru the open gap. The enemy will at most have a few minutes notification, which will not be sufficient to call in his reserves.

It would seem that the advantage of this idea lies in the fact that a wide breach can be made at small expense to human life, for it is obvious that no human being need be near the barbed wire, unless, of course, volunteers should elect to place the grapple cables into the barbed wire by hand during the night, thus even dispensing with trench mortars. This can be done by sending out the men in no-man's-land during the night to fasten the lines to the barbed wires.

There are, of course, many other variations to this scheme which will immediately suggest themselves to the men in charge of this work at the front and who are best qualified to handle such matters.



Three Views Depicting a Novel Idea How to Uproot Barbed Wire Entanglements. Fig. 1 Shows Thin Wire Cables to the End of which Are Attached Hooks or Grapples, the Cables Being Shot Over the Entanglement by Trench Mortars as Shown. Fig. 2 Shows the Other End of the Wire Cable Attached to a Tank By Our Men. Fig. 3 Shows the Tank Uprooting the Barbed Wire Entanglements, the Hooks or Grapples at the Other End Holding the Cables Fast to Entanglement.

PRESIDENT'S REPLY TO GERMANY FLASHED BY RADIO FROM ARLINGTON.

President Wilson's reply to Germany on October 23rd was sent broadcast to the world from the Arlington naval radio towers on the night of October 24th, after the official text had been put on the cables. If not picked up directly by the German station at Nauen, it was undoubtedly relayed from other points in Europe in time to reach Berlin in the morning.

Preserving Organic Substances by the Use of X-Rays

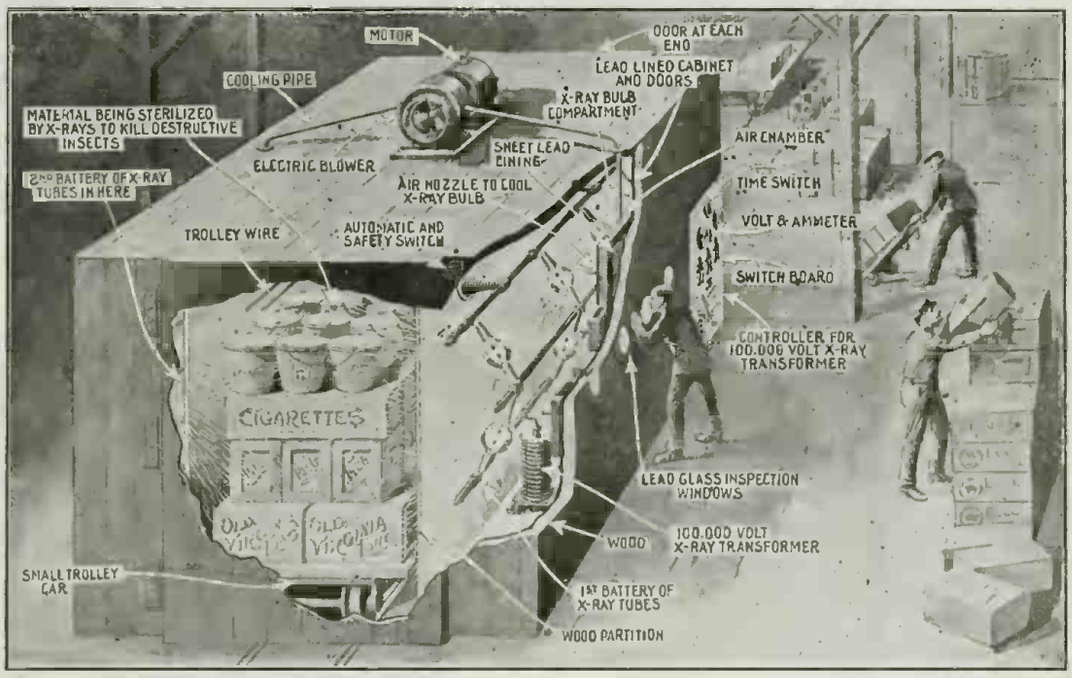
THE apparatus here illustrated was recently developed for the purpose of utterly destroying insects or other animal life that would tend to destroy perishable articles, such as tobacco, certain foods, etc., or else to sterilize and prevent further propagation of the species, and also to destroy any eggs that the insects have already laid.

In certain instances, such as in the treatment of furs, woolen articles or feathers, it is desirable to destroy the moths or other destructive insects before they can do the damage. With other perishable articles, such as grains, the few weevils or other insects that may be found initially in the grain will do little damage to the grain, provided their powers of reproduction are annihilated or destroyed, and further that the eggs already laid be sterilized.

Again it is well known that trichinæ, which infest raw pork, are in themselves harmless to human life; but that the second generation, when bred in the human system after eating raw pork, becomes very dangerous to human life. Therefore, in the case of the raw pork or of the grain, it is only necessary to destroy the fertility of the original insect, to in a large measure prevent any material injury from the presence of such insect. Therefore, a Florida inventor, Mr. David Collins Gillett, devised the special X-ray "oven" here shown.

Mr. Gillett has provided a number of novel electrical features in working out this idea to the best advantage, and for one thing he greatly reduces the length of time required to thoroly sterilize such articles, by providing a battery of powerful Coolidge type X-ray bulbs on either side of the oven. The compartment into which the cars containing the materials are rolled is partitioned off with wood or non-metallic sheeting. The outer wall of the X-ray cabinet is composed of wood or other suitable material, and the entire inside surface of the outer wall, including roof and doors, are lined with sheet lead, about one-eighth inch thick, to prevent the X-rays from passing thru the walls and exerting deleterious effects on the attendants. Special connecting racks are provided, so that the batteries of X-ray bulbs can be quickly replaced or reconnected and exchanged at any time. A milli-ampere meter is provided for each battery of bulbs which registers the amount of high tension current passing thru them.

An electric motor connected to a high efficiency air blower on top of the cabinet creates a strong draft of air, which passes down into two air compartments placed against the outer walls and inside of each X-ray tube compartment in the manner shown. Opposite each X-ray tube there is provided a pair of nozzles thru which this air can escape in a direct stream on to the tubes, thus helping to keep them cool. The X-raying compartment is provided with a standard high tension transformer for operating the bulbs, and develops a potential of about one-hundred-thousand volts at the secondary. The low-potential, filament heating current for the bulbs is provided by two stepdown transformers. All of the apparatus is readily controlled from the switchboard on the exterior of the cabinet, which panel carries the usual ammeter and voltmeter, necessary switches, circuit-breaker, etc. Two safety switches are provided on the door frames, so that as the door is closed, as shown, the shunt circuit connected to the circuit-breaker on the switchboard will be automatically broken. A time switch, which may be set for any given length of treatment extending from a fraction of a minute up to several minutes, depending upon the class of materials being sterilized, is used.



New "X-Ray Oven" for Treating Tobacco, Meats, Besides Other Foods and Substances Liable to Contain Animal Life or the Eggs Laid by Insects, thus Sterilizing Them and Effectually Preventing their Propagation.

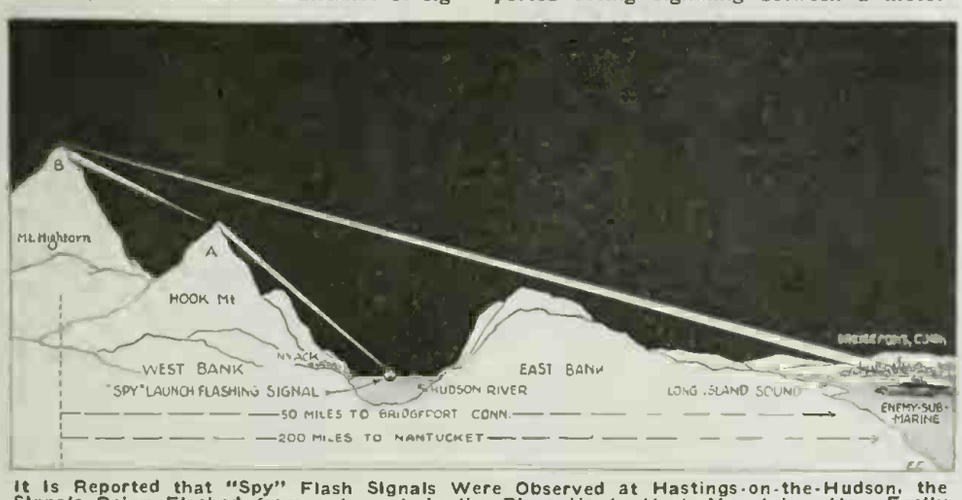
SAW "SPY" SIGNALS IN THE HUDSON.

Following the military order forbidding "suspicious lights and signaling" along the Hudson, the first observed instance of signaling was reported recently by Captain Frank Crossman of the Hastings-on-the-Hudson Home Guards.

Captain Crossman said that his men reported seeing signaling between a motor launch and a post on the top of Hook Mountain, back of Nyack, at 9:30 P. M. one evening, again at 11:30, and the last time at 3 o'clock in the morning. Capt. Crossman said that at 3 o'clock one of his guards observed a low-built launch, of the racer type, slow down off Hook Mountain and, using a light hung at the masthead, flash a code message. The blinking of the lantern was kept up for about five minutes, and then three short flashes winked from the mountain top.

The guardsmen, warned by the two earlier visitations, had a launch ready to go out to the suspicious craft. Before the guard boat could get within hailing distance of the stranger, however, the latter sped downstream toward New York.

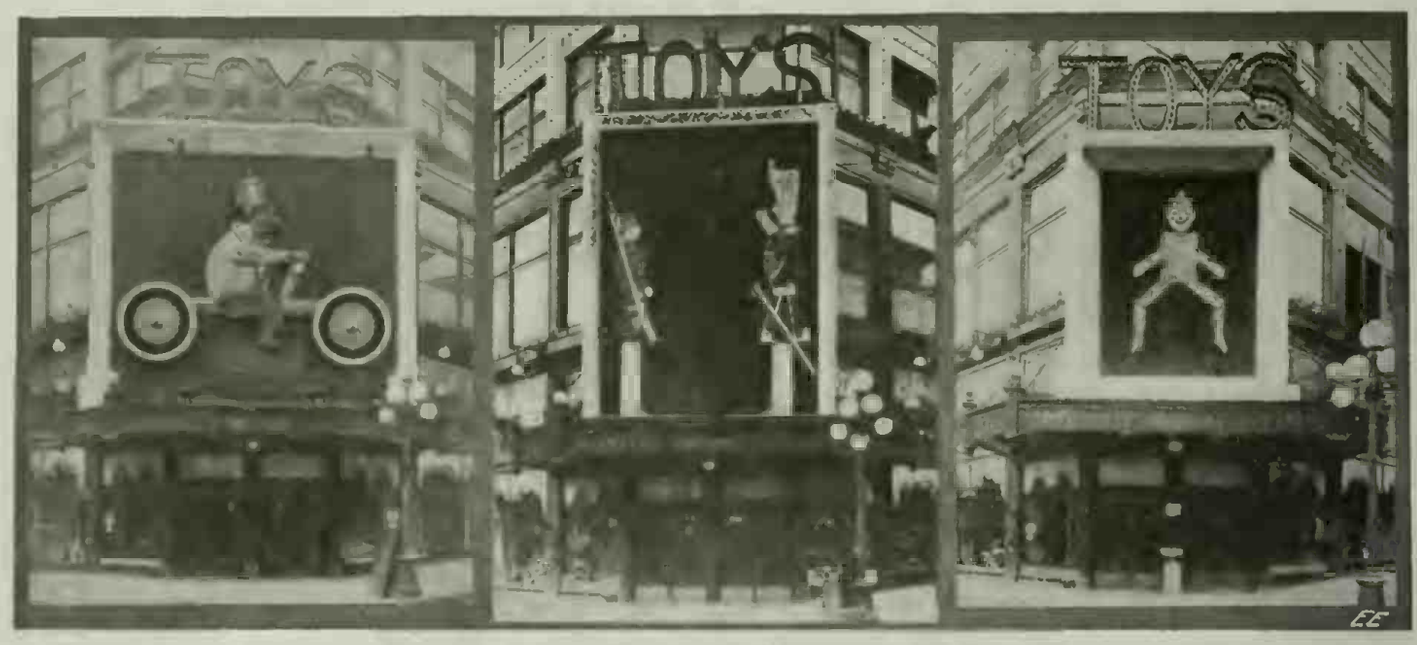
Members of the Home Guard pointed out that from the top of Hightorn, in the Ramapos, back of Hook Mountain, Revolutionary officers thru spy-glasses used to watch the movements of the British in Long Island Sound as far west as Nantucket. Guardsmen said that a powerful signal on Hightorn could be caught by a U-boat lying off Nantucket. Home Guardsmen said that from Hook Mountain spies armed with strong fieldglasses could sweep Camp Merritt, near Cresskill, N. J.



It Is Reported that "Spy" Flash Signals Were Observed at Hastings-on-the-Hudson, the Signals Being Flashed from a Launch in the River Up to Hook Mountain. How Easily these Signals Could be Relayed to Mount Hightorn, and Thence to a U-Boat in Long Island Sound Is Made Evident.

Huge Electric Toys

These photographs show the unique electric display of toys made by a Seattle, Wash., toy concern. The immensity of the toy figures made the public gasp for breath. fantastically colored in typical "monkey pose," so familiar to everyone. The huge moving figure is mounted in a *shadow box*, which produces a most spectacular lighting effect at night. Behind the black background is concealed the intricate electrical mechanism which makes the monkey's head, arms and leg move, and the contented smile on the monkey's face shows his satisfaction at creating such a disturbance among the children as well as the grown-ups of the city. The idea is an original conception, nothing of its kind ever having been attempted before, and the oddity, immensity and originality of the huge moving figure caused widespread notice and created a perpetual grin to be seen on the scores of faces which continually watched the fantastic movements of the clever monkey.



Huge Electric Toys Erected in Front of a Seattle, Wash., Store to Amuse the Kiddies as Well as Grown-Ups. At Left, a Giant Monkey Riding a Bicycle; Center, a General and a Private from Toyland's Army—the "Gen" Looks Suspiciously Like the "Clown Prince"; at Any Rate, They Both Have Wooden Heads; and at Right, the Electrically Lighted and Actually Jumping Jack, Standing Fifteen Feet High.

The big home-furnishing store produced many widely-talked-of displays for every sort of occasion, but they reached what seems to Seattle folk the limit in spectacular and unique effect in this wonderful monkey bicycle rider display. The enormous figure of the bicycle-riding monkey is a clever reproduction of a popular toy

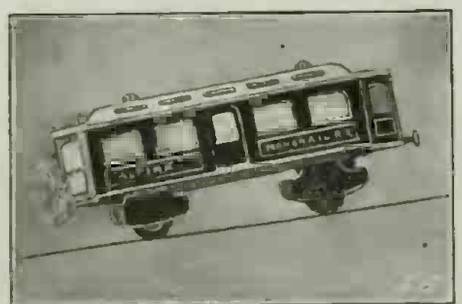
The electrically lighted jumping jack was 15 feet high. The gaily uniformed General was 22 feet, while the Private stood 19 feet in height. Looks like "Papa Billiam" abdicating to the "Clown Prince."

THE AERIAL MONOFLIER IN THE AUGUST "E. E." WORKS!

Our readers will undoubtedly remember with interest the proposed "Aerial Monoflier of the Future", illustrated and described in color and diagram in the August, 1918, issue of this journal. Many letters of criticism were received, saying that this apparently wild dream was a real impossibility and would not work. Some of the writers objected to the support of such a large car on top of a cable by means of a stabilizing gyroscope, claiming that a gyroscope capable of doing this would have to be larger than the car itself, etc., etc.

So, all hail the advent of a real monoflier, shown in the accompanying photograph! We just recently came across this toy monoflier, and purchased one to try it out. It worked admirably and would run along a cable or string in fine shape. A small, lead wheel gyro, about two and one-half inches in diameter by one-quarter inch thick, is geared to one of the two traction wheels under the car, so that when this wheel is spun by drawing the car across the floor, the gyro spins at high speed and the car takes on all the features of the gyroscope itself, i.e., it manifests a remarkable stabilizing power in the vertical plane. To give an idea of the powerful stabilizing effect of this small but rapidly spinning gyro, it may be mentioned that the metal car measures nine and one-half inches over all, stands four inches from top to bottom and measures two and one-quarter inches in width.

Of course, it is a simple matter to arrange a car of this type with an electric motor, supplying the necessary current to the motor thru a trolley arrangement on top of the car. Also a similar sized car was tried out with an electric motor fitted into it and driving two propellers, in exactly the same manner as that proposed for the aerial monoflier described in the August issue, and the car rode up an inclined cable very successfully. Truly, it may be said that "Science moves in mysterious ways, its wonders to perform"—to paraphrase the famous biblical passage.



Up She Goes—the Real Gyro-Monoflier Imported from Toyland. The Metal Car Measures 9½ Inches long, 4 Inches High, and 2¼ Inches in Width. The Small Revolving Gyroscope That Stabilizes It, as It Rolls Along a Cable or Single Track, Is But 2½ in Diameter. Fitted With Propellers, Such a Car Ascended an Inclined Cable in the Same Manner as Proposed and Described in the August Issue.

NEXT! WOMEN ELECTRIC WELDERS.

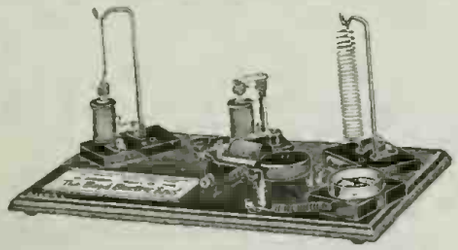
Women electric welders are the latest in shipyard news. Hog Island won the honors on the one hand and three girls who are making good at their new work, on the other. There's riveting, rigging, bossing, and a lot of others, and we'll see how much longer men will hold out against willing women.

Several weeks ago Miss Sarah A. Erwin applied at Hog Island for a job, and they told her they had a chance for her in the electric welding department. The novelty of it was pictured so alluringly that Miss Erwin became the first electric welder of her sex in the world, so far as is known. Not long afterward Miss Anna Kenneste applied for a try at the new work, and she and Miss Erwin both developed skill so rapidly in the training school that they were soon turned over to the production department. Number three is Miss Mary Dunn, also of Philadelphia, who is still in training.

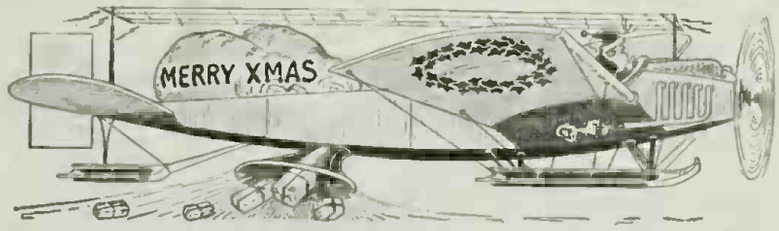
JAPAN TO HAVE ATMOSPHERIC NITROGEN.

According to a bill past by the last diet the government of Japan has decided to establish a laboratory for the study of the fixation of atmospheric nitrogen. The demand of ammonia for fertilizer amounts to nearly 20,000,000 yen each year, and up to now this has been supplied solely by import. It is hoped to make this a local industry in the near future.

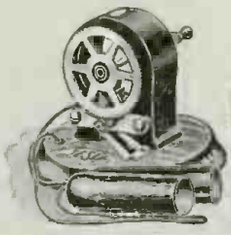
ELECTRIC XMAS SUGGESTIONS



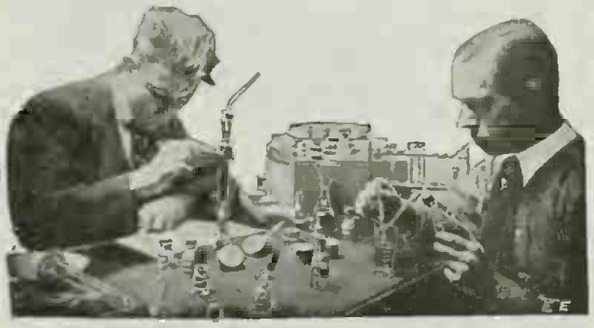
Electrical Apparatus Made With Boy's Electric Toys Outfit. Book of 100 Experiments Comes With It.



Submarine Chaser Model. It Is Available in Electric or Spring Motor Drive. A Present That Will Tickle the Heart of Every American Boy.

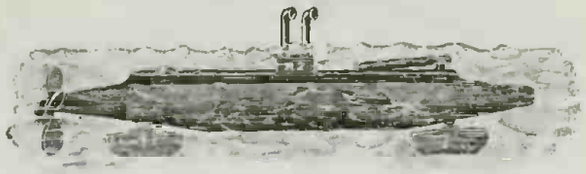


The Tesla Magneto Dynamo. It Gives a Dandy Shock, Besides Chasing Rheumatic Pains Away.

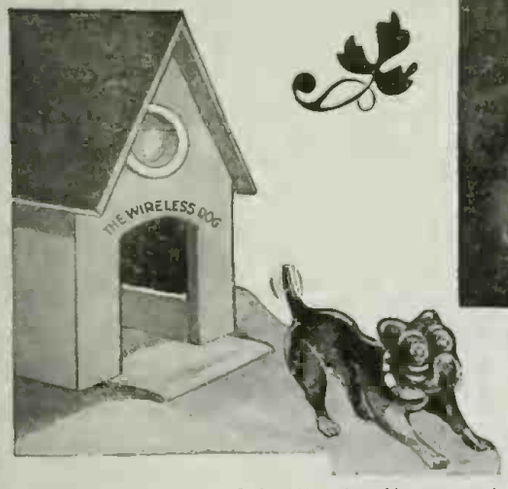


Experimental Chemistry for the Boys. This Complete Outfit Gives a Good Education in Chemistry. Instruction Book of 100 Experiments and Tables Tells How.

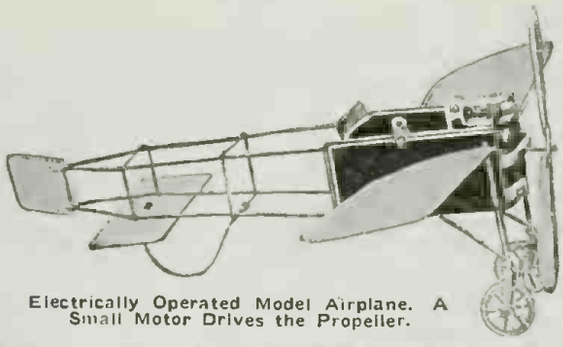
For Your Soldier and Sailor Friends. The Electric Shave-light.



And Here's the Submarine—Available With Electric or Spring Motor Drive. It Submerges, Speeds Along and Fires a Torpedo.

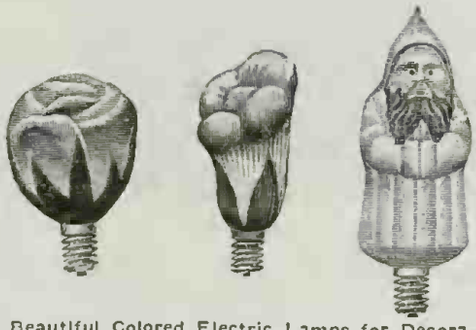


The Wireless Pup! Call Him by Name, and Out He Pops, Delighted!



Electrically Operated Model Airplane. A Small Motor Drives the Propeller.

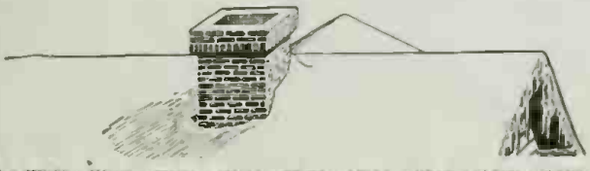
The Electric Windmill-Pump. Works Just Like the Big Power Windmills. Operates on Battery.

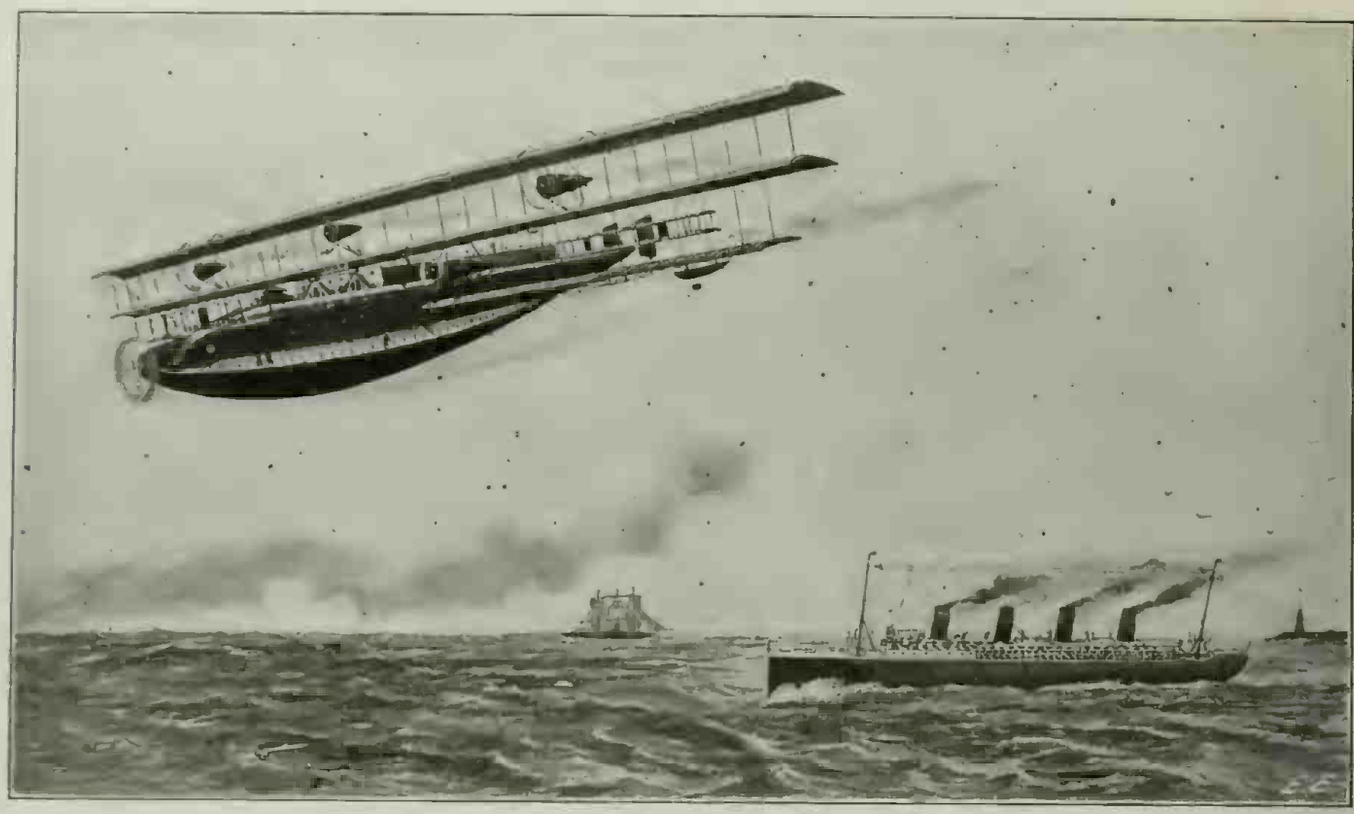


Beautiful Colored Electric Lamps for Decorative and Xmas Tree Lighting. Tungsten Filament, 2 Candle-power, 14 Volt Type.

The Electric Questioner—It Answers Your Questions by a Signal From a Buzzer. Whenever Fortune Causes the Right Connection.

New Electric Decorative Lamp in Form of a Cross.





The Palatial Trans-Atlantic Aerial Liner "Etheric" Nearing New York Harbor. Sandy Hook Lies to the Right of the Picture. Equipt with a Powerful 10,000 Horsepower Engine Plant, Radio-telegraphy, Aerial Sounding Signals and Sleeping and Eating Accommodations, This Wonderful Craft Makes the Trip from London to New York, a distance of 3,456 Miles, In the Remarkably Short Time of 31 Hours. Steamships Cannot Much Improve on a Four-day Trip Across the Atlantic, No Matter How Powerful the Engines with Which the Vessel Might Be Fitted. A Speed of 100 Miles Per Hour Is Common Nowadays for Airplanes.

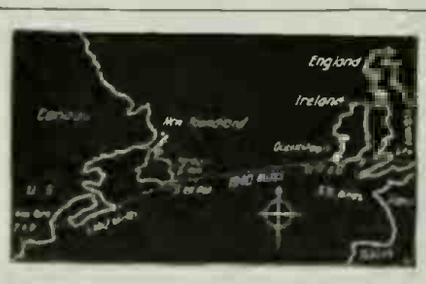
A Trans-Atlantic 10,000 Horsepower Aerial Liner

By W. EDOUARD HAEUSSLER

IN the very near future one may expect to see such a placard posted in a conspicuous place and past with only casual interest, as it will have become commonplace. Likewise the daily appearance of a monstrous aërial flier such as the "Etheric" would not cause excitement —perhaps just a slight interest as to her passenger list.

"All aboard for London!"—Then amid the roar of the big sirens and that of the six gigantic motors, aggregating in all some ten thousand horsepower, the noise of which is deafening, the last passenger steps aboard, the small wooden stairs are removed, and the gigantic machine starts to rise rapidly into the air, bound from *New York* to *Harbor Grace, Newfoundland*—one thousand one hundred and forty miles distant, the first lap of her trans-Atlantic journey.

The city beneath appears to be dropping away from under you, the buildings and tall skyscrapers become a mere jumble of vari-colored squares, interwoven by a mass of threads resembling a net, which in reality, are streets, and the "flies" that you perceive moving about in them are the rushing masses of *New York's* busy populace. Your attention is drawn to a small winding thread, and when you follow it with your eye, you notice that it extends and disappears into the horizon. This, you are informed, is the Hudson River. After the flier has gone several thousand feet higher, you become interested in the apparent widening of the circle of land and water within the horizon. This is due to the height, for as our altitude becomes greater, so also does the area of land beneath you increase in size. This holds true to a certain altitude, above this limit of height the expanse of the horizon again decreases in diameter. You chat for a few moments with a fellow passenger, when of a sudden, you notice the lack of turmoil and the noise of the city, which has been replaced by a noticeable and complete calm.



Map of Trans-Atlantic Aerial Route.

TRANS-ATLANTIC AERIAL TIME TABLE.

Leave Battery Park, New York City 7 A. M.
Arrive at New Foundland.....5:20 P. M.
Leave New Foundland.....5:40 P. M.
Arrive at Queenstown.....11:40 A. M.
Leave Queenstown .....12 noon
Arrive at London.....3 P. M.
Mileage .....3,456 Miles
Time of Trip.....31 Hours

Aerial Liners
"Etheric" "Wave Crest" "Silver Lining"
Accommodations limited to 85 passengers.
Baggage—Maximum 20 lbs.
Animals not conveyed.
Trunks and effects forwarded by fast steamship service to destination.

Looking over the rail you are surprised to find that the flier has made remarkable progress and is over the restless waves of the sea. The next to attract your attention is the announcement that a landing at *Newfoundland* is to be made in a short while, and that a period of twenty minutes will be allowed, during which time you can again become accustomed to walking on "terra firma." This time is utilized by the crew to provide ample fuel and provisions for the flight over the 1,940 mile stretch of ocean. The landing station at *Newfoundland* is an imposing structure rising some five hundred feet in the air. There are two large express elevators for conveying the passengers to and from the aërial liners and the streets below. Use is made of the new *magnetic* landing scheme and a *"whirling disc"* starting device, which appeared in a previous issue of this magazine.

After the necessary fuel and provisions have been carefully stowed aboard, the engines are started again and the plane rapidly rises into the air; the sensation and observations are identical with the ones experienced upon leaving New York. The pilot of the "Etheric" heads her straight up into a strata of air about 2,000 feet above the surface of the sea. A noticeable decrease in temperature is the result and a very light-headed feeling ensues. Looking off to the east, that is, straight ahead, a very dark and menacing bank of clouds is observed. Apprehension is felt, as this black appearance will shortly prove to be a severe electrical storm. But the passengers may feel reassured, as their safety has

been provided for by the equipment of the "Etheric" in the form of *lightning rods.* These rods extend on all four corners of the upper plane and a ground is obtained by the dropping of a copper wire to a distance of about 150 feet from the bottom of the plane. Upon the extremity of this wire is placed a torpedo-shaped steel "fish." Should the misfortune occur that the "Etheric" were to be struck by lightning, the discharge would be noiselessly carried from the protruding rods down thru the insulated wire and dissipated into the air below the machine by means of the "dummy" ground.

Our pilot, with expert skill, starts the gigantic airplane on a rather sharp angle and the powerful motors respond quickly, carrying it to a height of 12,000 feet. At this height we are absolutely safe from any danger whatever that might have been in store for us from the approaching thunderstorm. The speed of the plane heading directly into the tempestuous area carries us above it in a very few minutes. The roll of the thunder is ear-splitting; we fail, however, to see any lightning discharges as we are above the storm; and therefore our feeling of insecurity soon passes off.

By referring to the chart that is placed amidship on either side of the cabin deck, we discover that we have traveled some 600 miles since leaving Harbor Grace. A fellow passenger is heard to remark that he is beginning to feel rather chilled. A plane-hand, overhearing the remark, informs him that the heat in the cabin has been turned on and he will find comfort below. We are skeptical—for who ever heard of heat in an airplane? Being Americans, we are naturally inquisitive and our curiosity gets the better of us, so we descend the stairs in order to prove and find out for ourselves if what we were told is true or was merely mentioned to give us a "psychological" warmth. Going downstairs we notice a perceptible increase in temperature and a feeling of well being once more enshrouds us. It is getting to be somewhere around the hour of twelve, noon, a fact of which we were made aware by the rumblings of our stomachs. An electric gong starts to ring vigorously and as we have heretofore learned it is the ever-welcome signal that "dinner is served." The menu is not very extensive, but the food is wholesome and satisfying. It consists mostly of canned goods, due to the lack of room and the ever-present need for light weight in the cargo. However, it suffices to allay our appetites until we shall make a landing at Queenstown and there take our fill of good old Irish "spuds." Soon night falls and we retire in our tiny cabins, where we are soon lulled asleep by the musical vibration of the "Etheric's" motors. Our sleep is undisturbed.

About noon next day the summer sun brings out the highlands of Ireland in bold relief and as we drop to a lower altitude in order to affect a landing, we begin to realize that the populace in the cities of the country which we are to visit must necessarily be perspiring in this sweltering heat. We are made very comfortable by the thoughtfulness of the steward, who in the round of his duties has found time to look out for our comfort, even to the turning on of the four electric fans in the lounging room.

Despite the intense heat (note rapid change in temperature), we are all crowding to the rail in order to see where and how we are going to again come back to Mother Earth. Our unuttered question is very quickly answered when the machine comes to rest on a landing stage, an exact duplicate of the one we left at Newfoundland. There are two things that attract our attention and in which this place differs from the Harbor Grace terminus—one of which is a slightly smaller size airship, built practically on the same lines as our ocean-going planes and which is marked in very large letters designating that it will carry us to London if such is our intention and destination. The second object of interest is a large observation balloon suspended at an elevation of 1,000 feet above us; in which we can faintly see two men waving their 'kerchiefs at us. Upon inquiry as to what this type of balloon is used for, we are given the information that this is the "meteorological station," operated by the Trans-Atlantic Airplane Company and by means of which the various nautical and air observations are determined and reported. Under this heading we might state that the temperature, visibility, time, tide and kindred other computations are made.

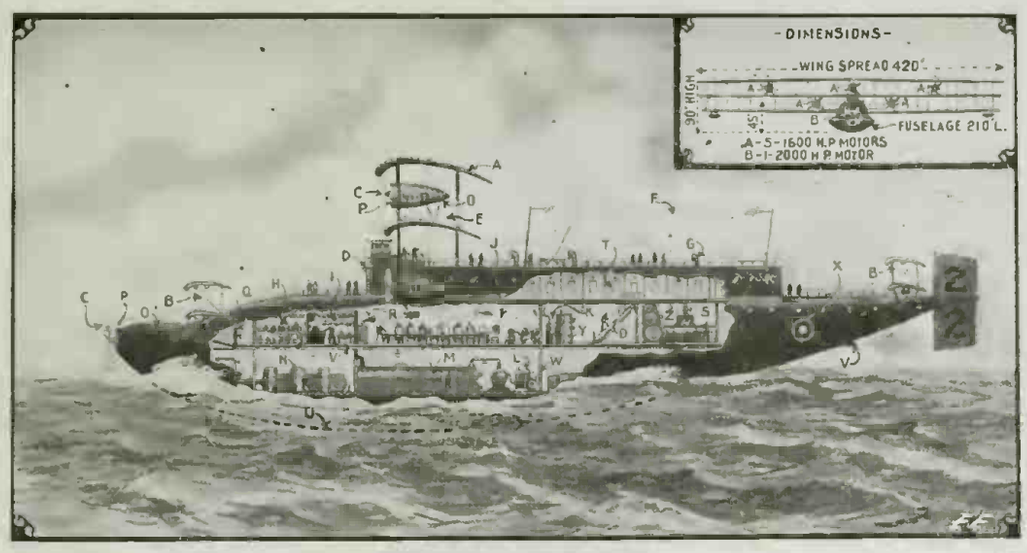
Arriving on the street we are overwhelmed by a crowd of curious peasants, hucksters and market people. After finally disengaging ourselves from this human net, we arrive at the cab station. Our "flivver" consists of an Irish jaunting cart drawn by a one-mule-power animal, "Mike" by name, who looks at us in his lazy way and seems to say, "You came over, up in the air, and you will again go up in the air trying to make me pull you and all of your infernal luggage." Climbing into this contraption, with some feeling of insecurity, we finally arrange ourselves comfortably and our hackman starts to bawl out at his "bony" mule, and once more we are under way and about to visit the splendors and beauties of the picturesque Irish landscapes.

* * * * * * *

This story of a trans-Atlantic trip is not an idle fancy, but a logical forecast of the remarkable progress in aviation, the materialization of which will be found not many years hence.

The proposed mammoth Aërial Liner here pictured will be constructed along the following specifications, according to logical figures which have been past upon by competent authorities. It will have a wing span of four hundred and twenty feet, a fuselage length of two hundred and ten feet, and a height of ninety feet from upper to lower planes. The planes, three in number, will extend horizontally from the hull of the ship to a width of two hundred and ten feet on either side.

The hull, containing the passenger compartments, is built on a stream-line basis, resembling that of a sulfur-bottomed whale, and is arranged to accommodate eighty-five people besides a crew of fifteen men, a total of fifteen thousand pounds, allowing seven thousand pounds for supplies and fuel for the 18 hours' run; seventeen hundred pounds of this reserve capacity would be available for baggage.



Cross-Section of the 10,000 H. P. Trans-Atlantic Airplane. From Stem to Stern:—A, Main Planes; B, Fore and Aft Stabilizing Planes; C, Four-bladed Propellers; D, Stairways; E, Braces, Strussing and Stays; F, Aerial for Wireless Apparata; G, Ventilating System; H, Baggage Compartment; I, Kitchenette, with Muffler Stove Heated by Exhaust from Motors; J, Combined Lounging and Dining Room, Also Used As Main Cabin and Saloon; K, Forward Water Ballast Tank; Z, Rear Water Ballast Tank. As the Fuel is Consumed from Tank M, the Water from Tank Z is transferred to Tanks K, to Preserve a State of Longitudinal Equilibrium; L, Compress Air Pump and Reservoir for Use in Forcing Fuel to All Motors Under Pressure; M, Petrol Fuel Tanks; N, Lubricating Oil Containers; O, Motors in Armored Nacelles; P, Radiators of Motors; Q, Fuel Supply Lines with Stopcocks; R, Graphophone or Music Box; S, Drinking Water Tanks; T, Staterooms; U, Hull; V, Main Exhaust for All Motors; W, Partitions of Light Fiber-wood Composition; X, Insignia or Flag of Country Under which Plane is Flying; Y, Master Carburetor and Ignition System to Insure Synchronized Action of Motors and a Proper and Constant Mixture of the Explosive Agent at All Times.

The motive power is derived from six high-powered gasoline motors. The three motors situated on the upper tier and the two on the lower tier of the planes are of *sixteen hundred horsepower each.* The central motor built on the forward section of the hull is of *two thousand horsepower;* in all the stupendous total of ten thousand horsepower, weighing in the neighborhood of twenty thousand pounds.* The horizontal and vertical stabilizers are of dimensions in proportion to the rest of the machine, as are the rudder and elevator.

The upper side of the wings will be designed to take advantage of the upward suction. It might be well to state that 66 per cent of the lifting power is due to the *suction on the UPPER surface* of the wing panel, while only 33 per cent can be credited to an *actual pressure of air on the UNDER surface.*

The lifting capacity of these three planes will be 45 per cent for the upper, 20 per cent for the middle, and 35 per cent for the lower plane. Figuring their angles to be 4°, the propellers will be of four blades to

(*Continued on page* 594)

*The total gross weight will be 120,000 lbs., or 60 tons, and a useful load of 22,000 lbs., or 11 tons.

Electrical Testing Engineers Made to Order

By C. M. RIPLEY, of the General Electric Co.

CAN you imagine the delight in the heart of a young man when he goes to his post of duty on a battle-ship, cruiser, destroyer or submarine, in Uncle Sam's navy, and finds that he has charge of some machines, similar to those which he himself tested and adjusted in his student days? He knows just how they are built, he knows their performance under different circumstances, he knows how far they can be driven, overloaded, overheated. They respond to his touch, they know his language, and in a way, they are partners in the great work.

Hundreds of young men who have graduated from the electrical testing course conducted by one of the large electrical manufacturing companies are now officers and chief engineers in our Navy. Uncle Sam wanted practical men—men who are not afraid of overalls or a flannel shirt—and who fully understood the design, manufacture, construction, operation and all the characteristics of electrical machinery. And Uncle Sam found these men—hundreds of them—in this great electrical school.

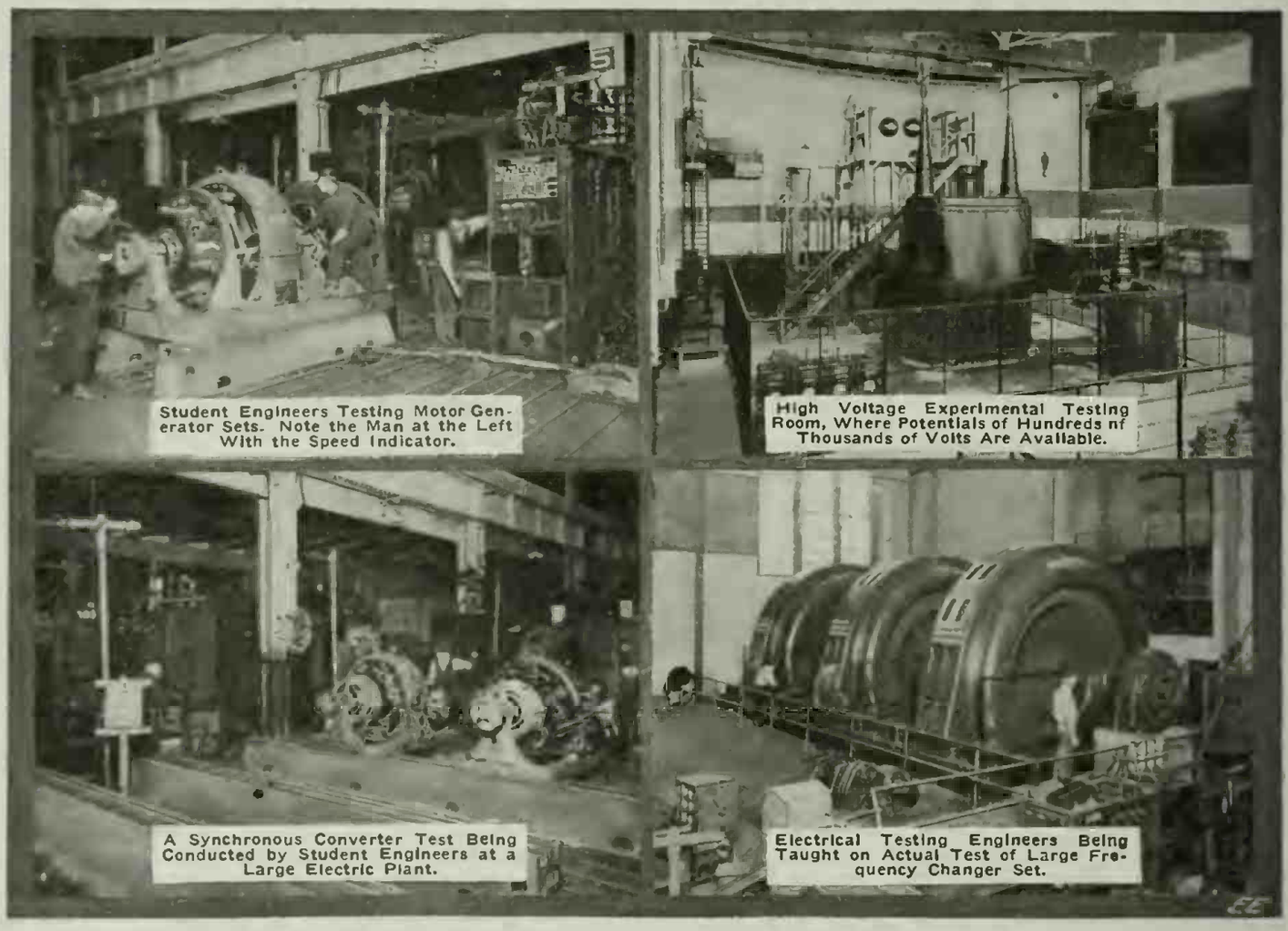
In this great war, there are many different kinds of activities which a man with a thoro electrical training can undertake; and whether he be a sales manager, or a college professor, whether he direct a great research laboratory or have charge of 20,000 men in a factory—in all of these activities—he must be a 100 per cent man.

But work in the Navy and in the Army is not the only kind of work that Electrical Engineers are doing and will continue to do for centuries to come—for electricity is useful in peace as well as in war. In fact electricity is necessary to American industry, and the wider and wider America uses electricity in the future, just so much more efficient will she be in battling for the markets of the world.

Men from all over the world meet on common ground in the Testing Department of this electrical concern—a department which occupies 732,000 sq. ft. of space. This area in downtown New York would cover nearly 15 city blocks, each the size of that occupied by the Equitable Bldg., which is bounded by Broadway, Nassau, Cedar and Pine streets. This space is 29 per cent greater than the entire rentable area of the Woolworth Bldg.

One reason why the Testing Department is the best department for a young man to start his career in, is because it takes him into so many different buildings and permits him to handle so many different types of apparatus. Hence, it is ideal for developing his knowledge of all types of electrical machinery.

The apparatus is tested where it is manufactured. The rough castings are received at one end of the building, machined, assembled at about the middle of the building, are then tested, and at the farther end of the building they are painted, boxed and loaded on the railroad cars to be carried later on mule back into the Andes mountains, on dog sleds into the heart of the Yukon, hauled by mules or by human carriers in China or by elephants in India.



Student Engineers Testing Motor Generator Sets. Note the Man at the Left With the Speed Indicator.

High Voltage Experimental Testing Room, Where Potentials of Hundreds of Thousands of Volts Are Available.

A Synchronous Converter Test Being Conducted by Student Engineers at a Large Electric Plant.

Electrical Testing Engineers Being Taught on Actual Test of Large Frequency Changer Set.

Would you believe it possible that this concern has set aside and reserved merely for testing purposes, 250,000 k.v.a. of electrical apparatus? This statement is the result of a careful census and a conservative one, since it does not include any of the power stations—a certain portion of which are used for testing purposes.

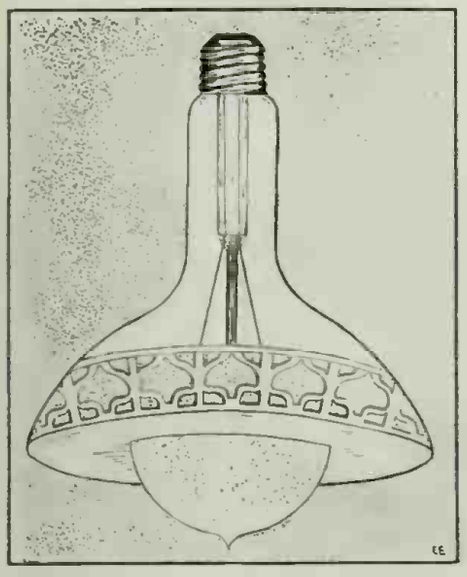
At one of the plants the power station has only 1/10 the capacity of the Testing Department equipment. The total capacity of apparatus reserved for testing in each factory is greater than the capacity of its power supply. This situation is largely due to the "feeding back" method by which two motors, both under test, are used for testing each other—one running as a generator and the other as a motor. This saves floor space, saves power and lessens the generating capacity. The feeding back method permits testing to be done on an enormous scale with the use of a comparatively small amount of coal, as the machines being

(*Continued on page* 590)

A NEW GAS-FILLED LAMP AND SHADE IN ONE.

The accompanying illustration shows a unique ornamental gas-filled lamp recently developed by a large lamp concern.

It is claimed that this lamp produces an indirect non-glare light which will not injure the eyes. The lamp is interesting in



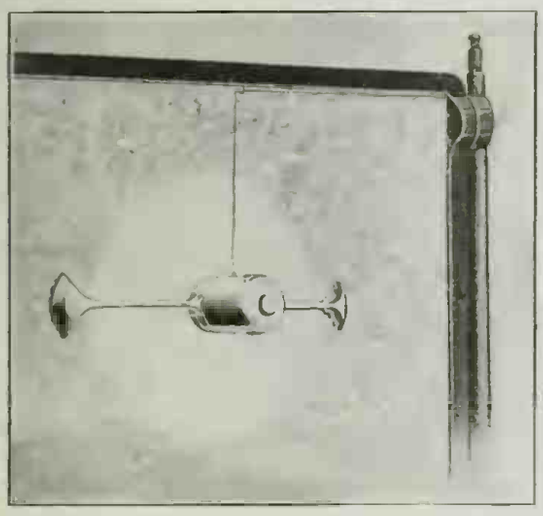
This Lamp Produces An Indirect Non-Glare Light Which Will Not Injure the Eyes, and Moreover the Lamp Combines a Gas-Filled Bulb With An Ornamental Shade.

that it combines an ordinary gas-filled bulb with an ornamental lamp shade. The lamp, known as the "Liberty," is made of plain white glass with ornamental decorations in green, gold, blue and other shades that will harmonize with chandeliers or room decorations.

A NOVEL ELECTRIC WINDSHIELD CLEANER.

Altho simple in construction and easily attached the new electric windshield cleaner illustrated, manufactured by a Philadelphia concern, is attracting considerable attention in scientific circles, having been exhibited for the first time only recently.

A plate-glass disc, set in the windshield of any make of motor car or truck, is whirled at 2,000 r.p.m. on fine ball bearings by a tiny electric motor, the centrifugal force throwing off rain, snow, sleet, mist or dust, thereby keeping the vision area clear in every kind of weather.



A Tiny Electric Motor Spins This Windshield Cleaner For the Autoist. The Motor Whirls a Seven-Inch Glass Disc on Which Snow, Sleet or Mist Cannot Lodge.

The small motor is driven by current from the car's regular batteries, the makers claiming that its operation costs less than that of a single headlight. Perfect balance and scientific precision of the instrument, it is explained, makes the high speed possible with minimum power consumption, there being no frictional wear and tear. A push button, installed in a convenient place on the regular instrument board, controls the current.

No repairs are necessary, it is claimed, the entire device requiring no cleaning or polishing. The motor is weather and rustproof while its ball bearings are of a special type of fine alloy steel.

The diameter of the standard size plate-glass disc is seven inches. All parts, except the glass, are of white metal, heavily plated with nickel or black gloss.

Altho made especially for use on motor cars and trucks, the device also is adaptable for use on battleships, submarines and aeroplanes. While the standard size is seven inches, larger diameters are obtainable.

LACING SHOES BY ELECTRICITY.

By Frank C. Perkins.

The accompanying illustration shows a machine which performs with remarkable rapidity and perfect accuracy the operation of *shoe lacing* which, prior to its introduction, was purely a hand one and inaccurate. It is absolutely required wherever fine shoemaking is attempted to lace the shoes at the throat with thread prior to the lasting process. The demand for lacing with thread or twine has long been limited only by the number of operators who could be trained for this work, requiring as it does exceptional skill and experience to do even passable work.

It is pointed out that lacing with thread is practically the one method by which the eyelets and uppers of shoes can be protected from injury and which allows the upper to be drawn closely down to the last—considerations which are of the utmost importance in fine shoe making. The operation of the machine is very simple, all that is required of the operator being the bringing of the two sides of the shoe tops into position, so that the corresponding eyelets are back to back, and placing them over spindles on the machine.

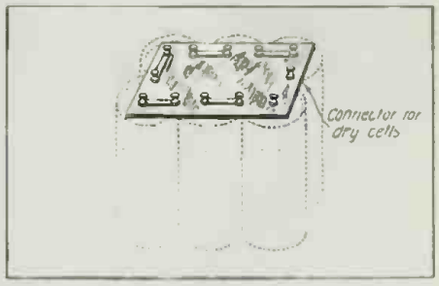
A slight pressure of the foot lever starts the machine in operation and the thread is quickly past thru the eyelets and tied in a hard, unyielding knot, after which the properly laced upper is removed from the spindles, when the machine is ready to repeat the operation. A simple adjustment makes it possible to vary the location of the knot, so that uppers may be tied to allow any desired spread at the throat.

It is stated that as the stretch or the thread used is uniform, one or two simple tests are all that are necessary in regulating the placing of the knot to secure the desired result; and, once this is determined, the machine will continue to do the work with absolute accuracy, one upper being the exact counterpart of all others laced at the same adjustment. A chart on the machine places constantly before the operator definite instructions regarding the spacing.

Wherever Good Shoes Are Made—There Also Shoes Must Be "Laced" Before Being "Lasted." Once, Skilled Humans Performed This Job; Now a Machine Does It—Accurately and Quickly.

A HANDY CONNECTOR FOR DRY CELLS.

A connecting board for use with a number of dry cells is shown in the accompanying illustration as developed and now being



A Very Handy Connector Board For Dry Cells. The Six Cells Can Be Joined Up In Series In a Jiffy.

made by a Boston company. This connector consists of a sheet of red fiber 6½ in. long and 4 in. wide, in which brass eyelets are provided with brass connecting strips so as to connect six dry batteries in series, as shown in the accompanying illustration.

Turning Air Into Bread—Nitrates from the Air

By ROBERT H. MOULTON

IF anyone came along and remarked offhand that air could be turned into bread he would at once be considered a fit subject for a commission in lunacy. Nevertheless this very thing is being done today, and what is more, Nature has been doing it every day for millions of years. The explanation is this: Nitrogen is drawn from the air and turned into nitrat of lime. Nitrat of lime is a rich plant food and when put into the soil makes a wonderful fertilizer. The fertilizer makes wheat grow where none grew before, so that finally, by a devious process, air actually is turned into bread.

The Above View Shows the Gigantic Hydro-Electric Generating Station for the Fixation of Atmospheric Nitrogen at Rjuken, Norway. The Great Power of this Station can be Appreciated by Noting the Large Number of High-Pressure Water Pipes Leading Down to the Electric Generating Station, and Which By-Pass the Necessary Water From the Large Waterfall. The Station Is the Largest In the World and Develops 250,000 Horse-Power.

The largest natural deposits of nitrates are in Chili, South America, from where, up to the time of the present war, 1,800,000 tons were exported annually to fertilize the farms of the other parts of the world. But the Chilean nitrat deposits can not be depended upon with certainty, even after peace shall have come. It has been calculated that the Chilean deposits will be dangerously reduced by 1955, and inside of a score of years later the supply will be exhausted.

For these reasons the discovery of a practical method by which the inexhaustible supply of nitrogen in the atmosphere can be utilized, is of the greatest possible moment to the entire world.

To two Norwegian scientists, Professor Birkeland, of the University of Christiana, and Samuel Eyde, an engineer of the same city, is due the credit for discovering this method. They are now taking nitrogen from the air, solidifying it and preparing it for application to the soil. And, whereas the method of Nature requires an entire season to do this, the method of the two Norwegian scientists requires only a few days!

The plan in a nutshell is as follows: The air is drawn thru oxidation towers and is then forced thru electric arcs, where a terrific heat is maintained. The oxygen and carbon dioxid in the air are consumed, leaving the nitrogen. This is precipitated in the form of nitrous oxid. This nitrous oxid is then conveyed to immense porcelain towers 75 feet in height, where it is condensed and allowed to settle in vats of limestone. The chemical action then results in the production of nitrat of lime.

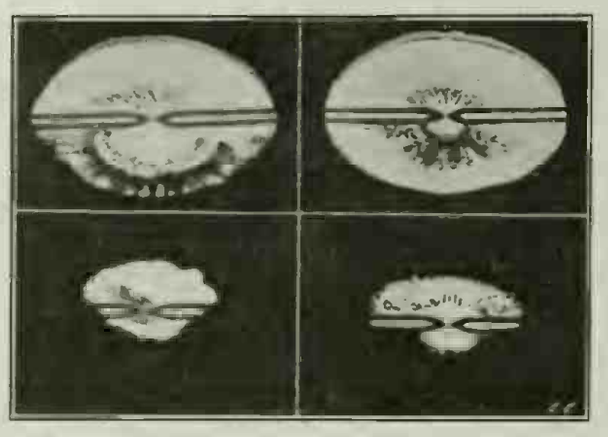
For several years a nitrogen making plant has been in operation near Rjuken, Norway, where *250,000 horsepower* are drawn from the falls. Working day and night these quarter of a million water horses manufacture, out of the air, *200,000 tons of nitrat of lime per annum.* But this is only about one-seventh of the amount required by the world for fertilization purposes. It is estimated, however, that Norway can develop water power to at least 5,000,000 horsepower, which would make all the nitrates required.

In order to explain the Birkeland-Eyde method scentifically, it is necessary first to describe the electric flames consisting of powerful arcs of light, which are used in the electric furnaces.

The formation of the flame occurs by an arc of the electric flame being formed between the points of the electrodes, which are close to each other. By this means a movable and flexible current is establisht in a highly magnetic field. The electric arc that has been formed moves on account of the magnetic field with great velocity perpendicularly to the lines of force, and the electric arc's foot draws back from the points of the electrodes. When the length of the electric arc increases, the electric resistance becomes greater and the tension increases, until it becomes so great that the new electric arc starts from the points of the electrodes.

To regulate the current, an inductive resistance is used in series with the flame. With alternating current all the arcs are formed alternating in opposite directions and appear to the eye to be circular discs. This flame provides a powerful technical means for the oxidation of the nitrogen of the air.

The electrodes are thick copper tubing, thru which the water passes for cooling purposes. See photo of arcs herewith. The chamber in which the flame burns is circular, of only a few centimeters width, and about three meters in diameter.



These Four Photographs Show What the Powerful Electric Arcs of the Large Furnaces, Used for the Fixation of Atmospheric Nitrogen, Look Like When In Full Activity. The Electric Arc Spreads Out Between the Electrodes, Breaks and Starts all over Again Many Times Per Second, the Air Being Past Thru the Arc, Which Action Decomposes the Air.

The interior of the furnaces is lined with fire-clay brick, thru the walls of which the air is admitted to the flame. The nitrous gases formed in the flame escape thru a channel made along the casing of the furnace, which, like the flame chamber, is furnished with fireproof bricks.

In order to supply the furnace with the amount of power desired, each one is furnisht with an inductance coil, by means of which the power is regulated as required. The inductance coil serves, moreover, to keep the flame in the furnace steady and even while working.

The temperature in the flames at the Rjuken plant exceeds 3,000 degrees Centigrade. The temperature of the escaping gases varies between 800 and 1,000 degrees. The furnaces are made of cast steel and iron, the middle of the furnace being in the form of a circular flame chamber. The electrodes are led radially into this flame chamber. By the aid of

centrifugal fans the air is brought into each furnace thru tubes from the basement.

When the air in the flame chambers has been acted upon by the electric flame the nitrous gases formed pass out thru pipes, which convey the gas to steam boilers, in which the temperature, which was approximately 1,000 degrees Centigrade, is reduced. The gases pass on from the steam boilers thru an iron pipe into a cooling house, and complete the cooling begun in the steam boilers. Each cooler consists of a large number of aluminum tubes, over which cold water runs, while the hot gases pass thru them. In these tubes the temperature of the gas is considerably reduced. From the cooling chambers the gases pass to the oxidation tanks. See diagram in continuation.

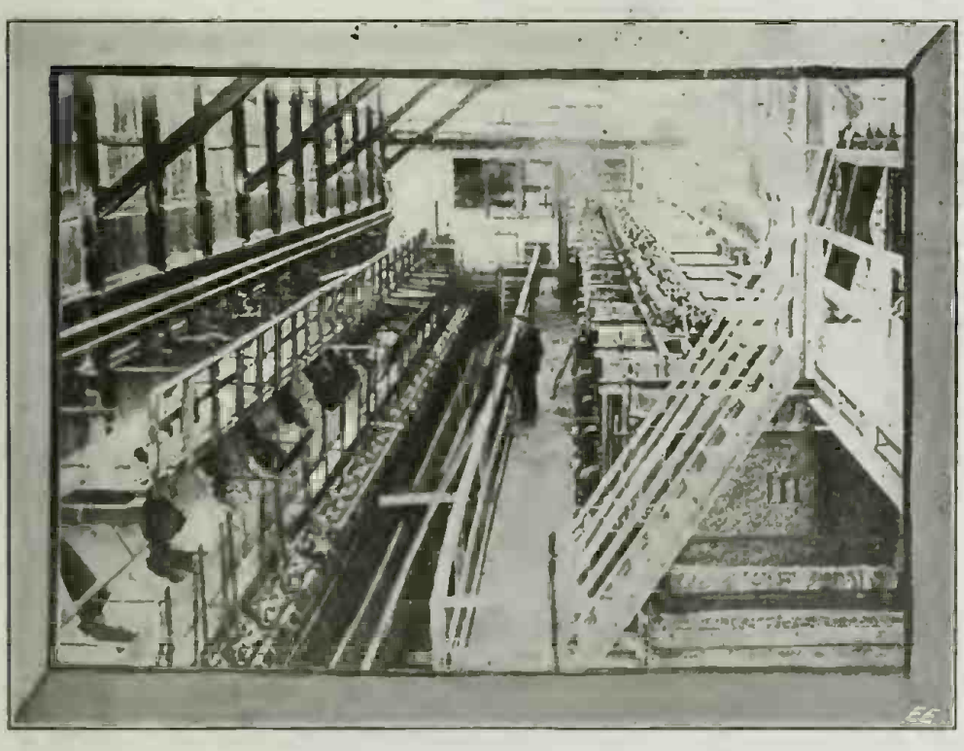
These oxidation tanks are vertical iron cylinders, lined with acid-proof stone. The object is to give the cooled gases a sufficient period of repose, in which time the oxidation of the nitrogen oxid may occur. The necessary amount of oxygen is present in ample quantity in the air which accompanies the gases from the furnaces. From the oxidation tanks the gases are led by blast engines into the absorption towers.

The towers are filled with broken quartz, which is affected neither by nitrous gases nor nitric acid, and thru them there is a continual trickle of water. The water absorbs the nitrous gas and when the liquid has become nitric acid of sufficient strength (30 per cent.) it is collected in cisterns, and from them again into vats filled with limestone.

There is considerable noise then, as the nitric acid displaces the carbonic acid of the limestone. The result of this is a watery solution of nitrat of lime. It is pumped into the vacuum evaporating apparatus, heated by steam from the boilers which are kept hot by drafts of fresh gas from the furnace. When evaporation is complete the solution contains 13 per cent. of nitrogen and it is past into chambers where it is solidified into a hard crystalline mass. Later this is taken thru crushing machines, reduced to a coarse powder, and put into casks holding 100 kilos each. This powder is the finished *nitrat of lime*. The air has now been converted into fertilizer ready for application to the hungry soil. The U. S. Government is now preparing to erect powerful nitrogen fixation plants.

(*Continued on page* 592)

Ladies! Would You Like to Visit Your Near-by Zoological Park? Perhaps You Tire of Walking Around to See the Various Lions, Tigers and Polar Bears, in which Case, you Can, if Visiting the Bronx Zoo in New York City, Follow these Two Ladies in One of the New Electric Chairs Available for Visitors at this Park.



Herewith We Have an Interior View of the Great Rjuken, Norway, Electric Plant, Employed for the Fixation of Atmospheric Nitrogen. Such Plants as these, Many of which are Now in Use Thruout the Larger European Countries Including Germany, have Solved the Problem of Where to Obtain Nitrates, a Predominant War Factor, and a Necessity which has been Heretofore Supplied by the Extensive Chilean Nitrat Deposits. We Americans will Soon See the Day When Great Electric Plants Such as these will Arise Thruout the Country. The Demand for Nitrates is not only Increasing Rapidly, but is Imperative.

LADIES! SEE THE ZOO FROM AN ELECTRIC ROLLING CHAIR.

Pleasure can now be mixt with knowledge at the New York Zoo by those who go there to study the animals. No more will it be necessary to walk miles upon miles to study all the exhibits on display in the greatest menagerie in America. Just get your electric roller chair—make believe you are on the board-walk at Atlantic City—and see all that is worth seeing in Bronx Park. A twist of the hand lever and away you spin on your trip to see the lions, polar bears, giraffes, and monkeys. A storage battery concealed within the car body furnishes the electric current to actuate the motor which propels the vehicle. Electric headlights are provided for night travel, as well as an electric siren to warn pedestrian traffic.

WOMEN AS ELECTRICAL ENGINEERS.

The Rolin Chemical Company, with a plant at Charleston, W. Va., is hiring women to serve as electrical engineers because of their inability to secure men. Fifty-two will be employed.

A Belgian machine for digging canals will eat its way thru the ground at a rate of 100 yards an hour.

NAVAL CONSULTING BOARD CHANGES ADDRESS.

Suitable space having been provided for the Naval Consulting Board in the new building of the Navy Department, at Washington, D. C., the preliminary examination of inventions, which heretofore has been conducted in the New York office, has been transferred to Washington, where it will be directed by Mr. David W. Brunton.

All correspondence relating to inventions should be addrest as follows:

NAVAL CONSULTING BOARD
NAVY DEPARTMENT
WASHINGTON, D. C.

Popular Astronomy

THE TOTAL SOLAR ECLIPSE OF JUNE 8, 1918

By ISABEL M. LEWIS

Of the U. S. Naval Observatory

TOTAL eclipses of the sun and the advent of comets are two celestial happenings that have always been observed by mankind with the liveliest interest. If the advance of astronomical knowledge had accomplisht nothing more than to free the nations of the world from the hysterical fear formerly aroused by these two phenomena it would be worth all that it has cost.

Photograph, Taken at Green River, Wyo., by the Yerkes Eclipse Expedition Showing Inner Corona and Prominences. All the Finer Detail Appearing on Original Negative It Is Impossible to Reproduce. The More Conspicuous Prominences (Those on the Eastern and Western Limbs) Average Fifty Thousand Miles in Height. Notice that the Crests of the Prominences on the Eastern and Western Limbs Curve Toward the Solar Equator as if Strong Currents Were Blowing in this Direction. The Top of this Photograph is East. The Prominences Are Blood Red, the Corona Bluish-White.

Only two hundred years ago a total solar eclipse in England was predicted in a pamphlet, entitled "The Black Day or a Prospect of Doomsday. Exemplified in the great and terrible Eclipse, which will happen on the 22nd of April, 1915"! Predictions of total eclipses of the sun still continue to be issued in the form of pamphlets, but instead of direful prophecies they now contain carefully prepared information and enlarged maps of the regions traveled by the path of totality to facilitate the successful observation of a phenomenon that is now considered to be of such scientific importance that expeditions from many nations have at times been sent thousands of miles to observe it.

It is now a matter of universal knowledge that eclipses of the sun occur when the moon passes directly between the sun and earth and temporarily conceals the sun from our view. Since it is only at the time of *new moon* that the moon can pass between the earth and sun, eclipses of the sun must always occur at new moon and can occur at no other time. On the other hand eclipses of the moon occur only at the time of *full moon*, for this is the only time when the earth can come between the sun and moon and cast its shadow over the moon. Since the earth is much larger than the moon its shadow is much larger than the moon's shadow and as a result the moon becomes entirely emersed in the earth's shadow during a total eclipse of the moon, while during a total eclipse of the sun the moon's shadow just about reaches to the earth. In fact the apex of the moon's shadow cone comes between the earth's surface and its center during a total solar eclipse, *There are times when the apex of the moon's shadow falls short of the earth's surface.* Then an annular eclipse of the sun occurs. That is, the moon's disk just fails to cover the sun's bright disk, giving the effect of a bright ring or annulus of light surrounding the dark body of the moon, whence the name annular eclipse of the sun. So near is the apex of the moon's shadow to the earth's surface during eclipses of the sun that occasionally an eclipse may be annular in one part of its course and total in another, the apex just grazing portions of the earth's surface and totality lasting but a few seconds at the most. The width of the shadow path then shrinks almost to zero. The average width of the path of total eclipse is about sixty miles and its length something like eight thousand miles. The greatest width attainable by any shadow path of the moon is one hundred and seventy miles and this can only occur under a most exceptional and favorable combination of circumstances.

The moon's shadow trails over the earth's surface in the form of a narrow band of great length. If earth and moon were stationary the shadow would appear as a small dark ellipse on the earth's surface, but owing to the motion of both bodies and chiefly to the earth's rotation on its axis the shadow sweeps over the earth in a long narrow strip bringing successively for a few brief moments the phenomenon of a total solar eclipse to all located within its path. The average duration of the total phase of an eclipse at any one point in the path is only three or four minutes. Under the most favorable combination of circumstances totality may last seven minutes and fifty-eight seconds and it varies in length from this value down to zero, according to the circumstances of the eclipse. When the apex of the shadow fails to touch the earth's surface, passing either above or below it, there may still be visible a small or large partial eclipse of the sun, the magnitude depending upon the distance of the

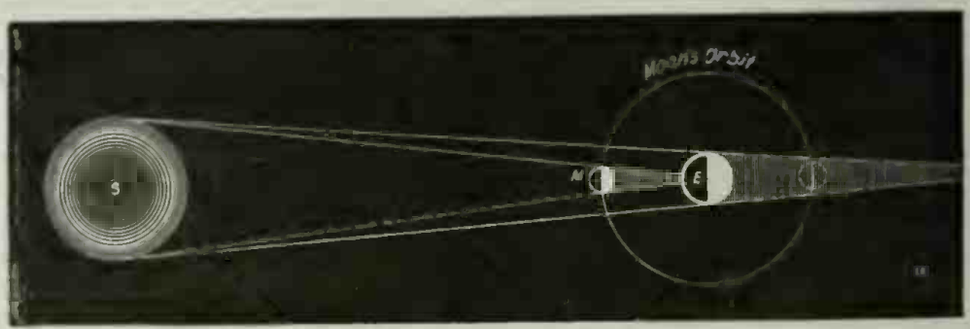
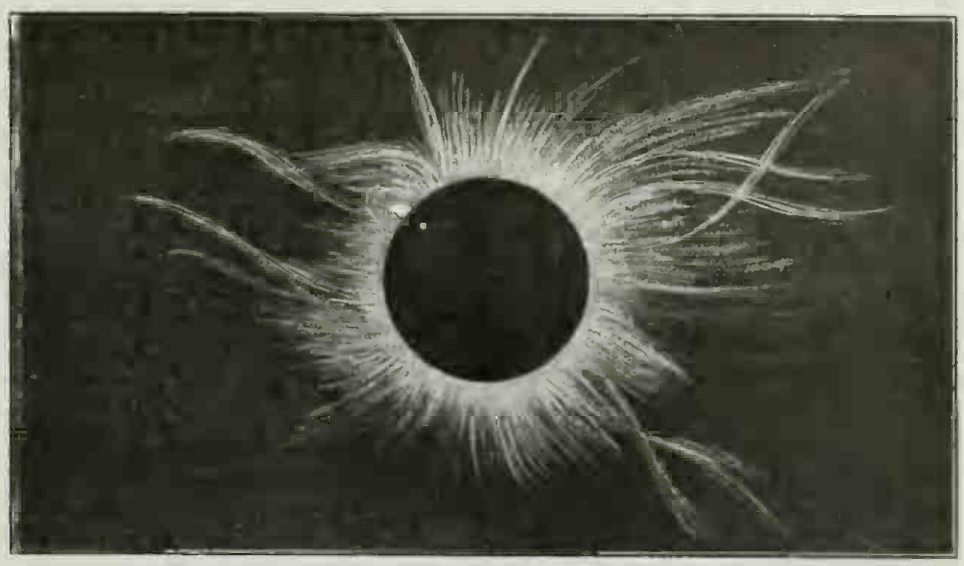


Diagram to Show Positions of Sun, S; Moon, M, and Earth, E, at the Time of Total Eclipses of the Sun and Moon. Every Year There Must Be at Least Two Eclipses of the Sun and There May Be as Many as Five. There Can Never Be More Than Three Eclipses of the Moon in a Year and Some Years There May Be None. The Greatest Number of Eclipses Solar and Lunar Combined That Can Occur in One Year Is Seven. Some of These Are Only Partial Eclipses.

central line of the shadow cone from the earth. Also whenever there is a total eclipse of the sun upon the earth's surface the partial phase is visible for hundreds of miles on either side of the central line of the shadow, the magnitude of the partial phase decreasing as the distance from the path of totality increases. Partial solar eclipses are quite common occurrences, but so narrow is the path of total eclipse that hundreds of years sometimes elapse before a certain town or district is visited by a total eclipse of the sun. Every total eclipse of the moon on the other hand is observable from the entire night side of the earth since the earth's shadow is so extensive that the moon passes entirely into it during the total phase. So it is that all of us have seen total eclipses of the moon, which unfortunately have little scientific value, while very few of us have had the good fortune to observe one of the most impressive scenes that nature affords, a total solar eclipse.

On the eighth of last June a narrow strip of territory within the United States lay in the path of the moon's shadow cone while the partial phase of the eclipse was visible to a greater or less extent over the entire North American continent. The axis of the shadow cone first touched the earth near Japan. After crossing the Pacific Ocean in less than two and one-half hours it reached the western coast of the United States at the mouth of the Columbia River in the afternoon, crossed diagonally across the country reaching Florida forty-seven minutes later and two minutes afterwards past off the earth at sunset near the Bahama Islands. The frightful velocity with which the moon's shadow travels over the earth can be judged from the fact that it journeyed from Japan to Florida in a little over three hours. The longest duration of the total phase for any one point in its path was two minutes and twenty-three seconds. Within the United States the duration was even less, averaging about one and a half minutes. The width of the path in the United States averaged fifty miles. Short as was the duration of the totality of June 8th the eclipse was observed with great success by expeditions sent out from the leading observatories of the United States and, if the World War had not prevented, expeditions from many European nations would doubtless have traveled to the Western States to observe the phenomenon. As it was, many astronomers in our own country who had planned to observe the eclipse were unable to do so owing to the urgency of war work.



The Corona, from a Negative by Edison Pettit. Top Is North, Left East. The Two Large Prominences on the Eastern and Western Limbs Are 56,000 and 45,000 Miles High Respectively. The Corona Streamers Themselves Reach Hundreds of Thousands of Miles Above the Surface of the Sun. The Little White Spot, Right Under the Eastern Prominence Represents the Actual Size of the Earth. It Gives a Good Idea of the Immensity of the Prominences.

The Lick, Yerkes, Lowell, U. S. Naval and Mt. Wilson Solar Observatories sent

Photo by Yerkes Observatory

A Composite Picture of the Sun's Disc, and the Prominence in the Light of Calcium Ray H.

expeditions to favorable locations near the central line, as well as a number of college observatories; nearly all of these expeditions obtained photographic and spectroscopic results of great value to science. Clouds brought suspense to practically all expeditions and to observers stationed at Denver, the largest town within the shadow path, they brought a completely overcast sky and the keenest disappointment. At Goldendale, Washington, the Lick observers were kept in uncertainty until the last moment, but were rewarded by a surprising break in the clouds, perfect seeing, at the critical time and a rich harvest of valuable photographic plates. A number of eclipse parties at Matheson, Colo., met with exceptional success as did also the U. S. Naval Observatory expedition to Baker, Oregon. The Yerkes and Mt. Wilson Solar Observatory expeditions at Green River, Wyoming and the Lowell Observatory expedition near Syracuse, Kansas, were hampered, but by no means defeated, by clouds and some remarkably fine views of the eclipse were secured at these stations.

The most important feature of a total eclipse of the sun is, of course, the corona. It can be seen at no other time. It is now possible to study with the aid of suitable instruments, such as the spectroscope and spectroheliograph, all the complex features of the solar atmosphere with the exception of the corona, i.e., the outermost solar envelope. Its light is excessively faint and so is invisible to the human eye except when the moon acts as a screen for our eyes and permits us to glimpse the exquisite beauty and intricate form of the coronal rays and streamers for a few valuable moments. At such times photographs of the corona are obtained and records of its spectrum as well, for use in later careful investigation of the nature of the light and the causes for the peculiar changes of form of this strange appendage of the sun.

It has been found from studying and comparing a long series of photographs taken during different total solar eclipses that the form of the corona is extremely intricate and that it undergoes periodic changes that are associated in some unknown way with the period of sun spot frequency. When sun spots appear in greatest numbers on the solar surface the corona is very brilliant and its streamers are quite evenly developed in all solar latitudes. It is then a sun spot maximum type of corona. As the sun spots decrease in frequency the form of the corona gradually changes. It becomes less brilliant and more

(*Continued on page* 590)

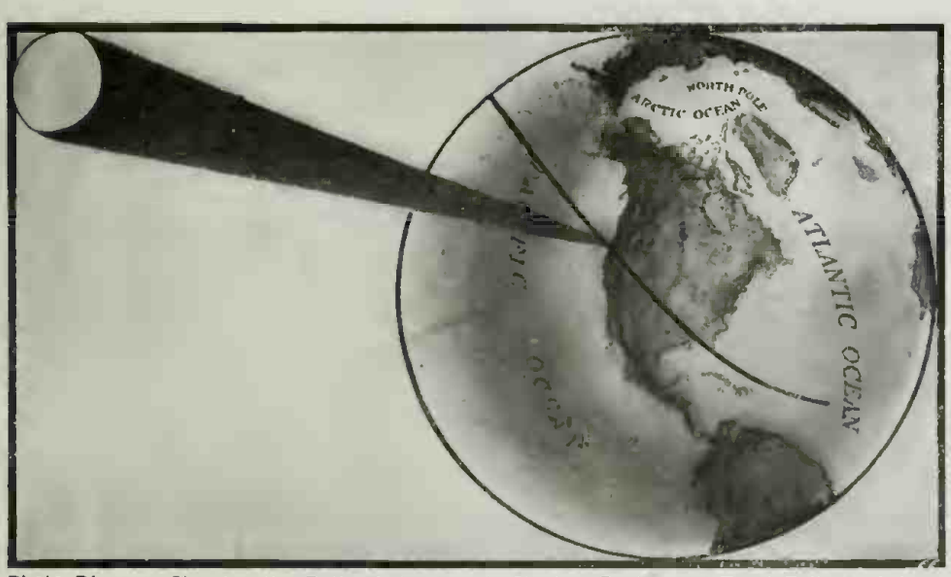


Photo Diagram Showing the Path of the Moon's Shadow During the Total Eclipse of June 8th. The Eclipse Started in the Pacific Ocean Near Japan. The Moon's Shadow then Swept Diagonally Over the United States. The Eclipse Ended 4 h. 19 m. Later in the Atlantic Ocean.

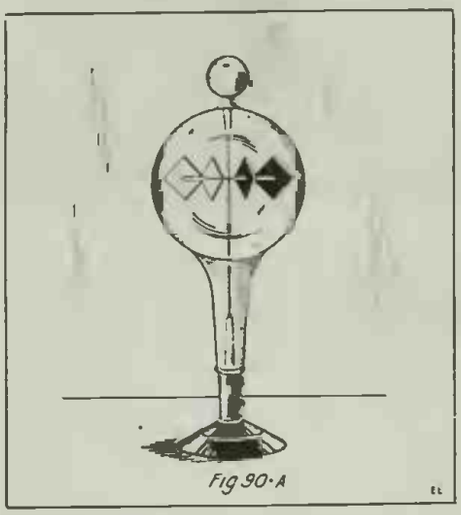
Experimental Physics

By JOHN J. FURIA, A. B., M. A., (Columbia University)

LESSON SEVENTEEN

Radiation—Experiment 99.

IN the lesson on *Light*, we learned that light comes to us from the Sun by means of *Ether waves;* and it was pointed out that waves in general originate by vibrating bodies. According to the Molecular Theory elucidated in the



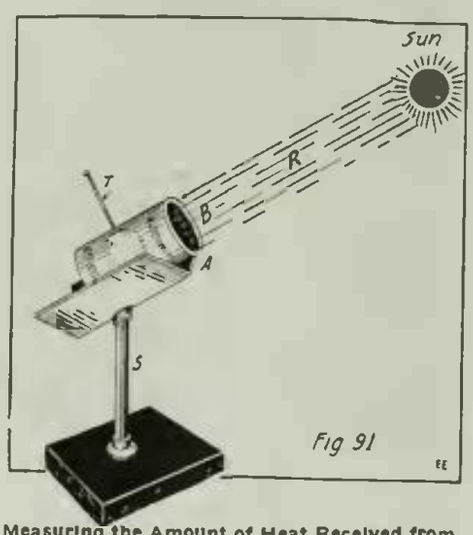
Standard Type of Crooke's "Radiometer." When Brought Into a Light Beam the Delicately Poised Vanes Will Rotate. The Simplest Solar Motor.

lesson on Gases, bodies consist of moving small particles called molecules. We can easily imagine that heat is the result of the vibration of these small particles, and these vibrations originate waves. Everyone is familiar with the fact that on approaching a light, *heat* is felt; also when a body is heated more and more light is eventually given off, if the heat is intense enough. Therefore, if light and heat are not the same, they are very closely related. Heat and Light are both wave motions, originating at a vibrating source. The effect on the human senses may be different, but as far as Physics is concerned *they are slightly different phases of the SAME thing.*

Hold the hand in ice water for a few moments; then plunge the hand immediately in water that has been standing for about fifteen minutes (and is consequently at room temperature): the hand will feel warm. Dry the hand and place it in water as hot as you can bear, for a few minutes; now plunge it again in the room temperature water; the water will feel cold. THE SAME WATER HAS FELT BOTH WARM AND COLD ALTHO AT THE SAME TEMPERATURE BOTH TIMES. When two bodies are at different temperatures and are brought near, the cooler *absorbs* heat from the warmer and the warmer *radiates* heat to the cooler until both bodies are at the same temperature; when brought in contact the same exchange takes place with more speed. The human sense of *feeling cold or warm simply indicates whether a body is losing or gaining heat respectively,* which explains why the water in this experiment felt warm and cold without its temperature changing (the temperature of the hand rising in the first case, and falling in the second case) Prevost's theory of exchanges states—WHEN A BODY ABSORBS FASTER THAN IT RADIATES, ITS TEMPERATURE RISES; WHEN IT RADIATES FASTER THAN IT ABSORBS, ITS TEMPERATURE FALLS. Newton's law adds the quantitative statement that the *rate of cooling of the water body is proportional to the difference in temperature of the two bodies,* i. e., the greater the difference in temperature, the greater the rate of exchange. These laws are very important in quantitative heat experiments, since they enable us to make corrections for the loss or gain in heat during the progress of the experiment and thus not necessitating tedious and difficult methods of controlling the temperature of the apparatus.

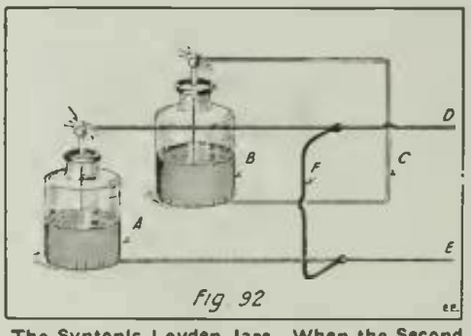
Experiment 100.

On photographing a spectrum such as was discust in the lesson on light, we find that the photographic plate is affected beyond the limits of the shortest visible violet ray. These are known as the *ultra-violet* rays (meaning beyond the violet); they have been photographed and measured, having wave lengths as small as .000005 of an inch. The longest of the rays visible in the extreme red have a wave length about ten times as large. Delicate instruments however reveal *infra-red* (heat) rays *five hundred times longer than the longest visible red ray.* HEAT AND LIGHT DIFFER ONLY IN THE LENGTH OF



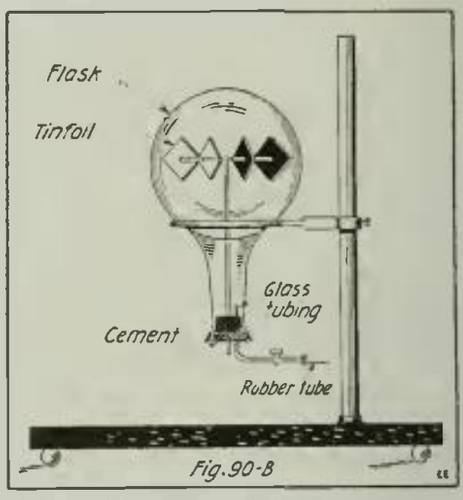
Measuring the Amount of Heat Received from the Sun by Means of a Tin Can, a Thermometer and a Wooden Stand "S," to Act as a Non-Conductor of Heat.

THEIR RAYS. THE SMALL RAYS HAVE GREAT ACTINIC VALUE (measured by the action on a photographic plate): THE LONG RAYS HAVE GREAT HEAT VALUE. The *Radiometer* is a fairly sensitive little instrument for



The Syntonic Leyden Jars. When the Second Jar "A" Is Put In Resonance With the Charged Jar "B," a Spark Will Appear In Gap on "A," When the Jar "B" Is Discharged.

measuring radiations, can be bought reasonably, and can be easily made by those having access to a vacuum pump. It consists of four delicate, very light vanes fastened to the ends of a delicate cross arm of aluminum wire, mounted so as to rotate easily about the vertical axis inside of a glass bulb which has the air mostly pumped



A Home-Made Form of "Radiometer" Constructed from an Erlenmeyer Flask, Some Glass Tubing, a Ring Stand and a Few Pieces of Tinfoil or Aluminum

out. The vanes are blackened on one side and highly polished on the other side. When the instrument is brought into a beam of sunshine, near a gas flame or electric bulb, the vanes rotate rapidly. The writer has found it good sport to make a radiometer (see Fig. 90B) using an *Erlenmeyer flask* for the glass bulb and tin foil blackened on one side for the vanes. We require aluminum wire for the cross and upright, cork stopper, glass tubing, pinch cock, and rubber tubing, and DeKotinsky cement for making the connections airtight. (It is found necessary, because of leaks, to evacuate the flask from time to time.) The action is simple. We notice that the direction of rotation is such that the black side moves *away* from the *heat* source. The black surface absorbs practically all the heat striking it, while the shining surface reflects practically all the heat radiations it receives. Hence the black sides become slightly warmer. A freely flying molecule striking the black side according to Prevost acquires some heat, and its vibrations are strengthened. On leaving the vane the reaction on the vane, according to Newton's third law of motion, is equal to the action of the leaving particle. A freely moving particle striking a shining side (colder) vane has its strength of vibrations lessened, hence its reaction on the vane is less than the reaction of the particle on the blackened side. There being more force on the blackened side than on the shining side, the set of vanes move in the direction —from the blackened side to the shining side—away from the source of heat.

Experiment 101.

Transfer the insides of a can of your favorite peaches to your own inside. Punch a hole thru the can A and insert a thermometer T. Solder a circular piece of tin B at the open end of the can, and blacken it with soot. Fill with water thru the thermometer hole, and place on a wooden.

(*Continued on page* 588)

Why Use Tungsten Lamps?—Ask Uncle Sam

Inefficient Electric Lamps to be Eliminated. Why Carbon Filament Lamps Must Be Substituted by Tungsten Filament Lamps

A PLAN to save electricity and, thereby to save fuel by the elimination of *inefficient* incandescent lamps has been adopted by the United States Fuel Administration, effective on and after September 15, 1918. The plan contemplates the gradual elimination, except in a few rare instances, of the inefficient types of incandescent (carbon and metallized filament) lamps and the substitution therefor of the more efficient tungsten lamps.

Conservation Program

The following program is recommended by the United States Fuel Administration:

1. The elimination of unnecessary types of standard carbon lamps and of carbon lamp types for special applications as follows:

The standard 60-watt multiple carbon lamp 100-130 volt range.

The standard 20-watt S-14 bulb multiple carbon lamp 100-130 volt range.

The 120-watt standard multiple carbon lamp 100-130 volt range.

The complete elimination of standard 30-watt and 60-watt round bulb, multiple carbon lamps, and all other types of 100-130 volt range multiple carbon lamps with standard base used for decorative purposes.

2. The complete abandonment by central station companies of the installation and renewal of *carbon incandescent lamps* of all sizes and discouragement of their use by their consumers and the public for any use or application for which *tungsten* lamps can be substituted; this policy to go into full effect not later than Sept. 15th, 1918.

3. The gradual abandonment of the installation and renewal of *metallized filament* (GEM) lamps of all sizes by the Central Station companies and discouragement of their use by their consumers and the public for any use or application for which *tungsten* lamps can be substituted.

Under special and unusual conditions where it is absolutely necessary to use lamps with exceptionally robust filaments owing to rough handling or excessive vibration, the use of *carbon* lamps is recommended so that the *metallized* filament (GEM) type may be completely eliminated. This policy to go into full effect not later than November 15th, 1918.

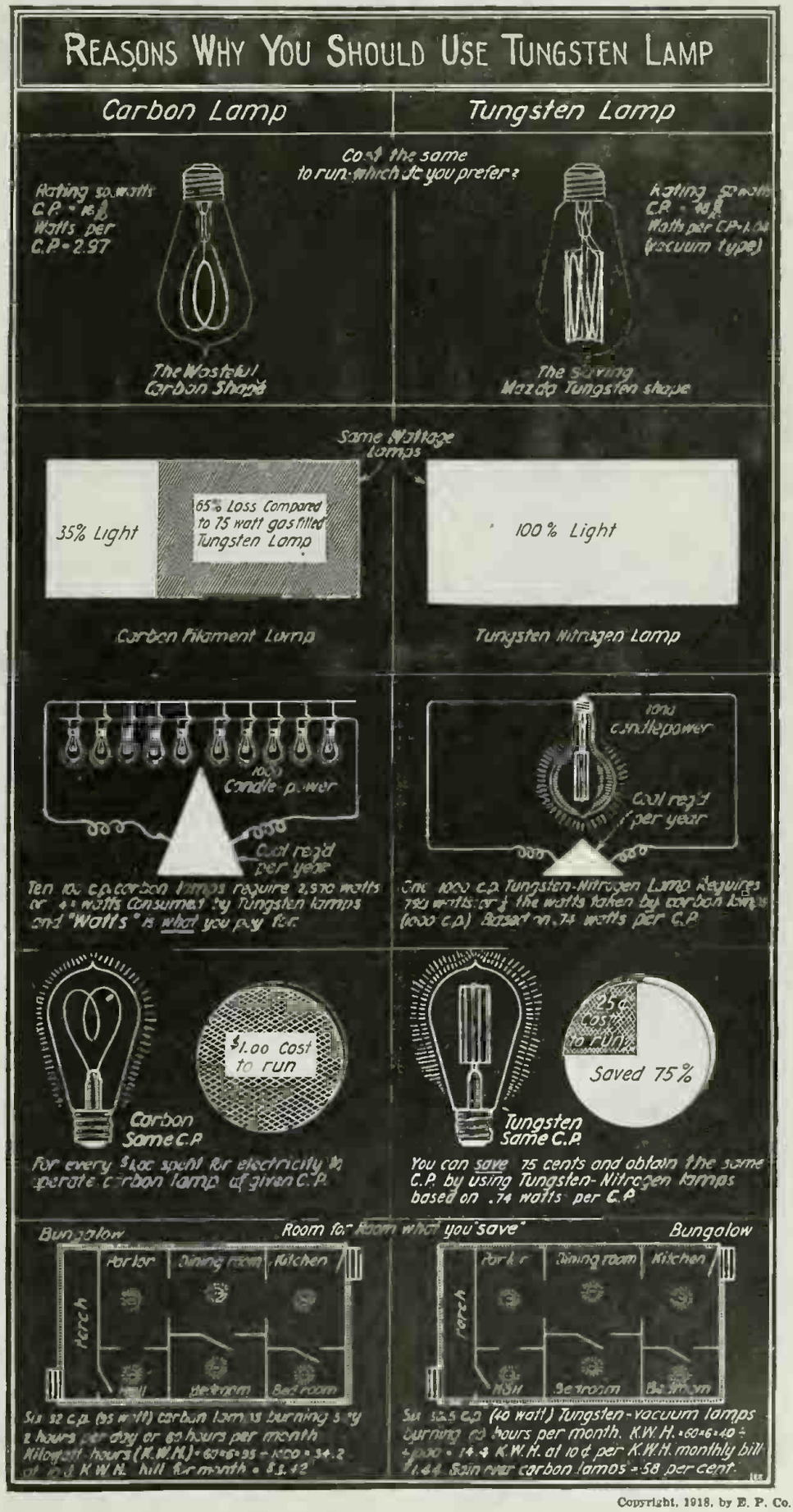
4. It is recommended that the use of considerable numbers of the smaller sizes of lamps for commercial and industrial applications be eliminated where it is practicable to substitute for them *large, single gas-filled lamps* of highest efficiency in a smaller number of lighting units.

5. It is recommended that the use of plain *vacuum tungsten* lamps in *sizes of 100 watts and over* be eliminated and whenever practicable *gas-filled tungsten* lamps (nitrogen bulbs, etc.) of highest efficiency substituted therefor.

6. It is recommended that the Central Station Companies be requested to urge upon their customers and the general public in the advertising in the daily press, company house organs and in all promotion literature the importance of selecting lamps of sizes which do not provide an amount of illumination beyond what is strictly necessary, the exercise of due care in extinguishing all lamps which are not needed and the elimination of all extravagant and wasteful use of light.

It is also pointed out that tungsten lamps of the *smaller* sizes have filaments which

(*Continued on page* 587)



Cold from Electricity

Since publishing our Editorial "Cold From Electricity" in our September issue, we have been in receipt of hundreds of letters from interested subscribers who were looking for more information on this interesting subject. Many readers state that they have tried to obtain the cold effect from Peltier's Cross, but have failed to get results. Many questions were asked of us, such as the dimensions of the antimony and bismuth bars, purity of the metals, surface conditions, current density required, how and to what extent the solder is flowed into the joint, kind of solder used, etc. These are some of the outstanding questions and the present article is intended to clear up these points.

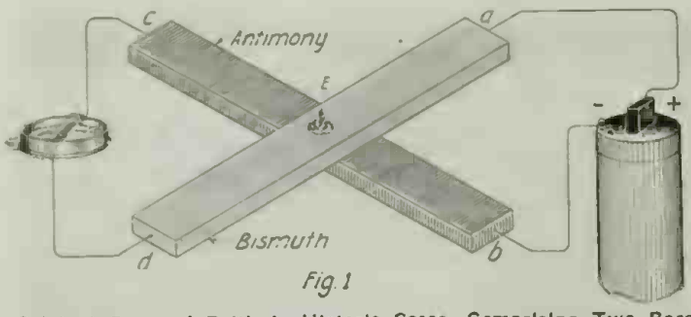


Fig. 1

Original Form of Peltier's Historic Cross, Comprising Two Bars of Metal, One of Antimony and One of Bismuth. Cold Is Produced When the Current Is Past from + Bismuth to — Antimony.

Our illustration shows the original form of Peltier's historic Cross. The two metal bars may be about six inches long, one inch wide and about one-eighth inch thick, altho the dimensions do not play a great rôle in the success of the experiment, as long as the dimensions are so that the two metal bars have not too high a resistance. Both antimony and bismuth have high resistance, as the following table will show. If copper is taken as 1, then the two metals in question will have a resistance as follows:

Antimony	18.07
Bismuth	64.52

Thus it will be seen that the specific resistance of bismuth is sixty-four times larger than that of copper. Accordingly, unless the bars of Peltier's Cross are made of a sufficient cross section, there will be generated a certain amount of heat by the passing of current, if this current is sufficiently powerful. For that reason the cross-section should be large enough. Both antimony and bismuth are refractory metals and are both exceedingly brittle. For that reason the bars must be cast.

The material does not exist in sheet form and is difficult to obtain even in the form of bars in the open market. Both metals can be melted in a crucible with a moderate amount of heat, and can be cast in a sheet iron form or mould. This is the method which the Editor of this publication used some years ago successfully. The two bars are then well cleaned where they cross and soldered along the four corners with the ordinary half and half solder. The purity of the metals does not play a very great rôle, altho before casting into bars, all the dross should be carefully skimmed off for best results.

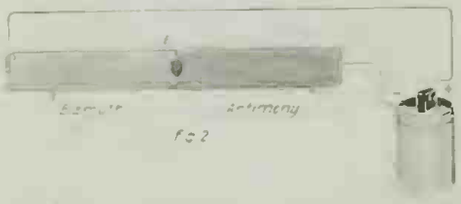


Fig. 2

Modified Form of Peltier's Cross, In Which a Bar of Antimony and One of Bismuth Are Soldered Together With a Depression Drilled at the Juncture. A Temperature Fall of 4.4°C. or 8°F. Was Observed by Lenz.

Our Fig. 1 shows the original historic form of Peltier's Cross, and it works as follows: After the bars have been crossed and soldered as shown, we connect a dry cell, or a single Daniell type copper sulfate battery to points a and b. It will be seen that the current flows from (positive) bismuth to (negative) antimony. In other words in the direction a, E, b. If the tip of a thermometer is placed into the shallow hole E which can be drilled with an ordinary machine drill, it will be found that the junction has been cooled to several degrees lower than the surrounding temperature.

READ THESE ARTICLES IN THE JANUARY "E. E."

Cold Light—Do you know all the present sources? Then read this timely article on the "light" of the future.

Solar Motors—an interesting illustrated article on the largest one ever built in America. It uses Sun Power direct.

An All-Electric Hot-Air Balloon—it does not use hydrogen gas.

Mt. Wilson's Hundred Inch Telescope.

An Electric Furnace Regulator for the residence.

"Odd Photo" Contest—a rare collection of wonderful photos—everything from sun-spots to ball lightning!

Winter-time Uses for the Electric Fan, by Pauline Ginsberg.

The Secret of the Magnet Poles, by Walter E. Keever.

Experiments in Radio-Activity. Part 1, by Ivan Crawford.

The Great Lakes Radio Training School, with Photos.

How to Build a Vertical Type Long Wove Loose Coupler, by Joseph H. Krauss, Jr.

Popular Astronomy—Seventh Paper, by Isabel M. Lewis.

As well as the Usual Departments, including "Experimental Mechanics," Physics, and Chemistry.

In further proof of this experiment, Peltier connected the points c and d to a galvanometer. As soon as we interrupt the current from the battery, either at a or b, a thermo-electric current will circulate thru c E d.

In order to still better show the cold effect of the electrical current, Lenz made the following experiment: He used the form of Peltier's Cross, as shown in our illustration, and drilled a shallow hole as indicated at E. The entire apparatus was then placed in *melting* snow, and the depression E was filled with water. When the metal cross had taken on a temperature of 0° Centigrade (32° Fahrenheit) Lenz connected a Grove battery (1.8 volts) to the cross, the current traveling from bismuth to antimony. Five minutes afterwards the water in the depression right over the point where the bars were soldered together, was not only frozen completely, but he found by actual measurement a temperature of — 4.4° Centigrade (24.07° Fahrenheit).

Of course, it is not necessary to use the original Peltier's Cross in order to make the purely cold producing experiments, the same results even on a much better scale are obtained by the device shown in Fig. 2. Here we have an antimony and bismuth bar soldered together as shown; a depression E can be drilled right at the juncture of the two metals. When passing a current thru the direction from bismuth to antimony, the junction will be cooled quite considerably.

The Editors will be glad to hear from readers who have worked along these lines, and shall be pleased to hear of any new experiments or of any new or original work in this direction.

ELECTRICAL DOLLS RAISE FUNDS FOR AIR SQUADRONS

These two electrical dolls are the only two of their kind in existence. They walk, talk, dance, bow, roll their eyes, move their arms, lead the orchestra, move about and appear to be virtually "alive."

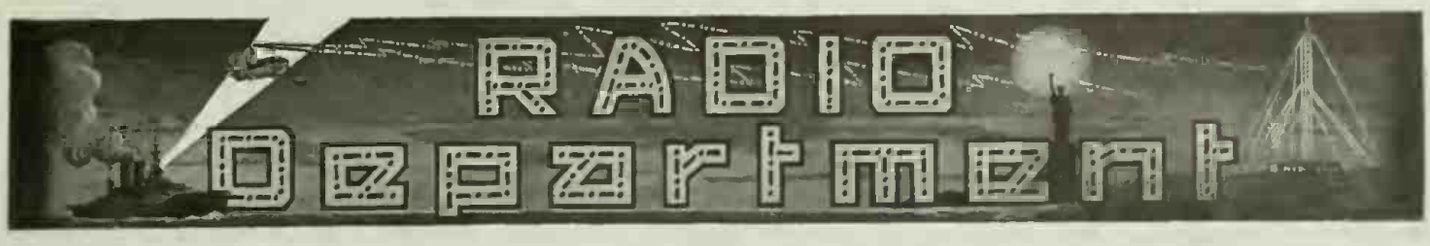

Photo © Underwood & Underwood

A Wonderful Electric Doll That Talks, Walks, Moves Its Arms, Rolls Its Eyes, and Everything. Small Electric Motors Operate This Interesting Automaton.

They have been loaned to the National Aeronautics Committee to raise funds for the air squadrons going overseas, to supply them with a full athletic equipment, consisting of medicine balls, boxing gloves, baseballs and bats and the like. The dolls are mounted on small wheels and are fitted with small electric motors. A flexible cord conducts current from a lamp socket or battery to the motors.

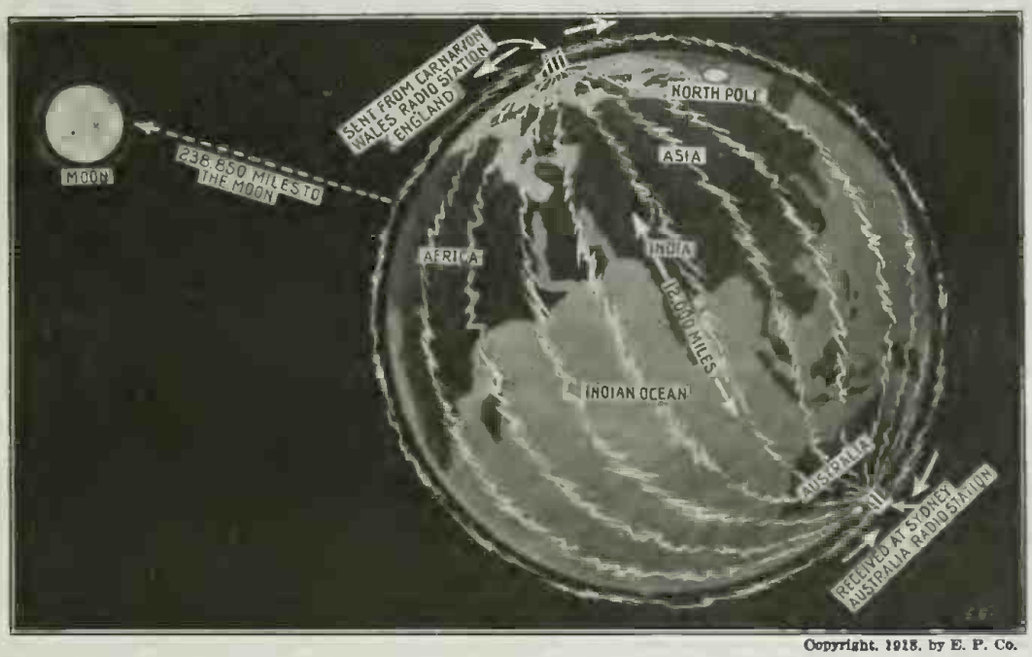
BOCHES USE SHELL TO BEAR MESSAGES

What next?!! Now the boche is using a *message-bearing* shell, says a recent British report. This new messenger shell is being used by the Germans to convey messages to isolated units or from forward to rear lines, and one of them was recently shown to an American press correspondent. It has a head which can be unscrewed, into which the message is inserted.



Radio Around the World

ON October first, a radio mesage was transmitted and received over a distance of twelve thousand miles. The message had been flashed from the powerful Marconi wireless station at Carnarvon, Wales, B. I., to a receiving station located at Sydney, Australia. While wireless experts were not surprised at learning that wireless messages had been received in Sydney, Australia, from Carnarvon, Wales, a distance of 12,000 miles, they pointed out that this was nearly double the distance that messages had been previously sent. It was on Tuesday, October 1, that Premier Hughes and Sir Joseph Cook of Australia, who were then in England, sent two messages from the new Marconi station at Carnarvon, Wales, to the Amalgamated Wireless Company's plant at Sydney; thus these messages enveloped the earth, for Hertzian waves move equally in all directions, as the accompanying illustration shows. This may or may not have been a *freak* radio transmission, said a Marconi engineer, but in any event it marks a new era in long distance radio-telegraphy. In fact, it actually brings true the dream of Nikola Tesla and many other great scientific minds, who some years ago predicted that the day would come when wireless waves would encircle our globe. As we know that wireless waves spread out equally in all directions just like the ripples in a pond of water when a stone is dropt into it, thus these powerful radio oscillations emanating from the antenna at the Carnarvon radio station, radiated in all directions, east-west-north and south; and eventually, at a point approximately half-way around the globe, or at Sydney, Australia, where a suitable apparatus had been erected, these same etheric wave vibrations were again picked up and interpreted.



Copyright, 1918, by E. P. Co.

Illustrating How the Latest Radio Transmitting Record, from Carnarvon, Wales, to Sydney, Australia, Caused the Whole Globe to Be Enveloped in Radio Oscillations. If a Sensitive Receiving Set Were Used, They Could Undoubtedly Be Heard on the Moon.

Many interesting and revolutionizing developments have been and are taking place in the realm of high-speed long-distance radio-telegraphy. Among other interesting happenings in the field of commercial and governmental radio-telegraphy, we find for one thing that the forms of transmitters for this work have been changed in a number of cases with very gratifying results. For instance, it has been found that the Goldschmidt (German) type of radio-frequency reflecting alternator which was formerly used at Tuckerton, N. J., was so sensitive that it practically required an operative to stand alongside of it all the time in order to constantly adjust the various electric circuits and to keep the speed of the machine constant. Besides, it had a number of delicate mechanical features which required the utmost skill in the operating personnel.

Another form of transmitter which has accomplisht some really remarkable work in long-distance radio transmission in the hands of skilled engineers and operators, is the high-power oscillating Poulson *Arc*, such as supplied by the Federal Telegraph Company and other concerns. The United States Government has used a large number of these Arc transmitters, and is negotiating for a number of them at the present time in both large and small sizes for various requirements. A number of the larger wireless stations, including the trans-Atlantic station at Sayville, L. I., have used a high-power Arc for transmitting. Both the Goldschmidt *Alternator* and the Poulson *Arc* are foreign inventions, and while they have shown some very excellent results in many ways, it is gratifying to note that they have both developed undesirable characteristics in operating, which have given way to an American form of high power radio transmitter of the radio-frequency alternator type, and upon which many hundreds of thousands of dollars have been spent in research by one of the largest electric companies in America. Some of the best transmitting records ever made, both with regards to the clearness of the signals received and also their strength, have been transmitted across the Atlantic Ocean from one of the large American trans-Atlantic radio stations by means of the *Alexanderson* radio-frequency alternator.

A few years ago the radio-frequency alternator was considered more of a laboratory device than anything else by electrical engineers, and even by the radio engineers themselves. But at the present time the high frequency alternator in question has been developed to such a perfect degree that it really represents a remarkable stride in engineering design and technique. At present there are being used two large units of this type, one rated at 50 k.w. and the other at 200 k.w. Once upon a time these machines, in order to produce a frequency of 50,000 cycles a second, had to revolve at the tremendous and very dangerous speed of 20,000 r.p.m. (revolutions per minute) and up to 30,000 r.p.m or more, but at the present time they have been so perfected in design as to requie a rotation speed of but 5,000 r.p.m. Therefore, one of these machines can be operated without any greater attention than is required in the operation of any commercial dynamo or motor. It is possible to instruct radio operators in the handling of a plant of this type, it is said, within a few days. These machines are under perfect control at all times, and their regulation and operation either for telephone or telegraph wireless transmission is beautifully and accurately effected by means of a novel magnetic amplifier, which keeps the load on the driving motor constant, and also the frequency of the output current constant. The windings and magnetic sections are water-cooled.

For trans-Atlantic or trans-continental transmission, it has generally been thought that nothing else would do than a high steel mast with which to support the antenna, or else the employment of a series of tall steel masts extending over a distance of a mile or so, such as one finds at New Brunswick, N. J., or Honolulu. Something entirely new in the wireless field is the fact

(*Continued on page* 588)

Harvard Hails the Naval Radio Man

HARVARD, scion of American college and university life—renowned for its classic halls and dormitories, where thousands of America's greatest engineers, lawyers and captains of industry have been educated for generation upon generation—has capitulated to Uncle Sam's naval radio men, whom we see busily at work mastering the intricacies of wireless telegraphy in the three accompanying views recently taken at the Harvard Radio School, where several thousands of the Nation's finest are being given intensive training in Radio.

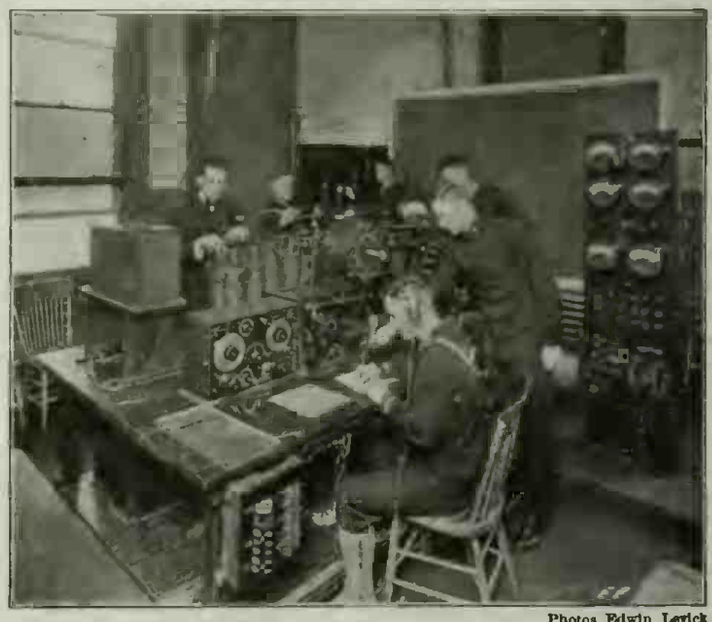
Once these classic halls resounded to the why and wherefore of the gerund and gerundive and why Nero burnt Rome. Now all one hears is the steady all-day drone of the five-hundred cycle buzzers as the keys tap-tap and the sailor boys learn how to take down a message at the rate of forty words per minute, more or less—usually less, at least for the first few weeks.

Fig. I of the accompanying view shows a portable radio field set equipt with manually driven dynamo and tripod, being demonstrated before a squad of junior naval operators. It is an unwritten law that the Navy is out to beat the Army when it comes to radio matters, and judging by the great interest evinced by all of the students present at the various classes, it seems that the Jackies will at least give the Doughboys a hard tussle, when it comes to solving the various phases of angular impedance and the logarithmic decrement. The portable field radio set, shown at Fig. 1, has a range of about forty to fifty miles, and is intended for use with a collapsible aerial, which is supported when in use from a telescopic steel or wooden mast, about seventy-five feet high. The receiving instruments and transmitting apparatus are all contained in a cleverly designed water-proof case resembling a large dress-suit case. It is surprising how quickly the boys are trained to set up and dismantle one of these sets, and as a matter of fact, they have often set up such a radio station and had it in operation in less than two minutes.

The view of the instrument laboratory, Fig. 2, illustrates some of the excellent equipment available at the Harvard Radio School. At the right of the photograph is seen a switchboard controlling the transmitting apparatus, this panel containing an A. C. volt and ammeter, a D. C. volt and ammeter (for motor-generator set) as well as *frequency* and *power factor* meters. The hot wire radiation ammeter is mounted just over the spark gap in the center of the photograph. The receiving set in front of the student seated at the table with the head 'phones on, is of the de Forest type, with calibrated dials which indicate the wave length being received directly in meters. Three electrode vacuum valves are used practically all together in both the Army and Navy sets, and the receiving set here shown employs vacuum valves. A naval officer is seen in the foreground instructing the operator seated at the instrument table. In the background may be seen the large-sized oscillation transformers of the spiral copper ribbon type, while at the left the copper plated Leyden jar condensers may be observed. In the extreme rear corner of this laboratory there is mounted a complete, magnetic type, automatic starter for the motor-generator set.

If you want to see an interested class of radio students, just glance at Fig. 3, which shows a class in "Radio Theory" at the Harvard Radio School. A Naval petty officer is acting as the instructor to this class, and we are glad to say that the Navy Department has succeeded in enlisting some of the best radio men in the country for this purpose. Some of the classes are very large and contain several hundred students. Unlike the average collegiate course in radio or electrical engineering theory, these future naval operators are taught theory hand-in-hand with actual practise. This is proven by the fact that wherever there is a blackboard at this school there is also invariably a more or less complete set of apparatus such as used in practise. Note the close interest manifested.

Fig. 1.—Demonstrating a Portable Radio-Set equipt with Hand-driven Exciting Dynamo Before an Interested Class of Harvard Naval Radio Students.



Photos Edwin Levick

Fig. 2.—In the Receiving and Transmitting Apparatus Laboratory Where the Future Naval Radio Men Are Thoroly Instructed in the Handling of Modern Apparatus.

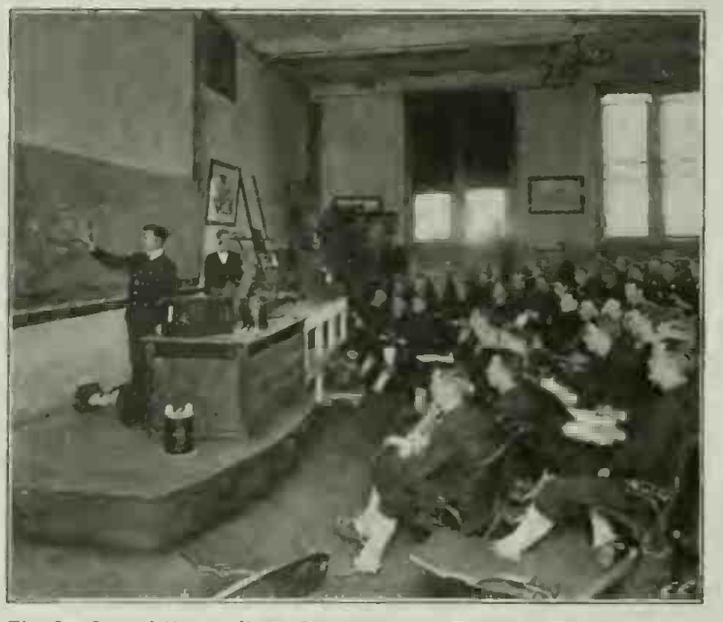


Fig. 3.—One of Harvard's Radio Classes in "Theory"—The Exact Relation Between Radio Theory and the Apparatus Itself Is Taught By the Aid of Blackboard and Instruments.

The Code-Numerals Get "Theirs"

By THOMAS REED

ADJUTANT-GENERAL McCAIN, in discussing the publication of war-casualty lists, makes this statement in regard to the transmission of numerals by telegraph: "More mistakes are made by telegram companies in transmitting *figures* than in transmitting anything else."

Groaning business men everywhere crowd forward to testify that this statement is only too true.

For many of the errors in telegrams there exists efficient first-aid. The over-speeded telegrapher, losing a word, replaces it with a nice fresh one from his own vocabulary, fully as long as yours, and as stout and serviceable in every way; and this honest practice answers very well, the context usually enabling you to restore your correspondent's original word, if for some reason you like it better.

For straightening out proper names, you rely on the wonderful insight of the elevator man, who after years of practice is able to recognize a patronymic even when severely disfigured—such as "Oake" for Baker."

But for the poor hard-working numerals there is no "timely succor" anywhere in the community. Every little figure has a meaning of its own; and, loyal as the digits may be to their corps, it is impossible for one of them to "take another's place and do the best he can." Remember what happened to the porter who put off at Buffalo the man in lower six, instead of the one in lower five, who'd requested the favor?!!

A wounded numeral is a "dead" numeral. But because he's the most vulnerable doesn't explain why he's the oftenest hit.

Hush now, hush! for me purpose is to invade the guarded enclosure, and attack the sacred cow. Is it possible that the complex numerical code-signs themselves are partly to blame?

What, as a matter of fact, is the objection to using simply:

. = 1	..... = 6
.. = 2	..... = 7
... = 3	..... = 8
.... = 4	..... = 9
..... = 5	—— = 0

—a scheme which would have occurred to Father Adam, if he'd received a telegraph-set along with his animals?

I assure you I'm trying to handle this subject with the tender circumspection a mother accords her child, or a bomber his bomb; for it's a "common-sense" suggestion, and nothing infuriates people like one of these, I've found.

I'll never forget my experience with a worthy lady, a neighbor of mine, who was troubled with the rain soaking in around her window-frames. She had carpenters on the problem, and plumbers, and masons, and I guess most every profession but undertakers, and they applied shingles, and tin, and tar-paper and cement and bad language, without effecting a cure, or relieving the "soakage" in the slightest degree.

Becoming involved as a last resource, I suggested that the rain, beating in thru the wire screen, was backed up on the window-sill by the lower frame of the screen, forming a pool, from which water could leak by gravity into cracks, while the sloping sill, if free, would carry it off.

Now I'm telling you the truth: that neighbor, a perfectly intelligent and good-natured lady, and up to that time a great friend of mine, absolutely repudiated my idea, not with indifference, but with violent peevishness, and flatly refused to "try such a useless experiment" as lifting the screen. She must have tried it eventually, because I heard (tho not from her) that my guess was right, and that now in a driving storm her screens are raised an inch, and all is well with her. But she hates me, and the plumber and mason and carpenter hate me; and I thank God the undertaker wasn't there!

Why! oh why! do people feel that way toward the "common-sense monger?" It's simply a curious trait in human nature—any further contact with which I aim to avoid, except with my retreat carefully covered.

The man who invented the numerical code-signals is probably dead by now, but I'll bet that as long as he lived he prided himself on their etherial beauty:

.---- = 1	-.... = 6
..--- = 2	--... = 7
...-- = 3	---.. = 8
....- = 4	----. = 9
..... = 5	----- = 0

See how pretty! All of them different from the letter-signals, and with such a natural progression—prefixing dots in regular order, then knocking them off till you're out of dots again.

Some cantankerous users of these perfect products consider them just near enough alike to be confusing. But that isn't all; plumb in the middle of this dream of complex symmetry, what meets the eye? Horors! As I live, five dots for the figure "5"! Forthwith arise the voices of the Babe and Suckling, inquiring in plaintive tones, "If five dots is good for 5, why in—why in telegraphy isn't six dots good for 6?"

As usual, the Babe and Suckling are easier spanked than answered. The simple series of taps, or any short sounds, represent numbers so naturally that anyone, telegrapher or not, can read them, and read them right. Whatever else a numeral does, it surely ought to "nume"; and the simple ones do, while the code-man's intricate signals don't. He seems to have drest up his cook till she's spilled the beans.

Some say you couldn't count nine quick dots with accuracy. But you can count the quickest-striking clock up to 9, and even to 12. As a closer comparison, take the fire-alarm tappers in the engine-houses and street-boxes. They're quicker than any clock, and furthermore deal in spaced numbers, forming tens and hundreds, as "2–6; 3–8–5"; but I never heard that the firemen often drove half a mile to box 375, for example, miscounting it for box 385, just around the corner. The dot system's good enough for them, and they sometimes betray a regard for holding their jobs at that.

Others say the dots would be mistaken for letters:

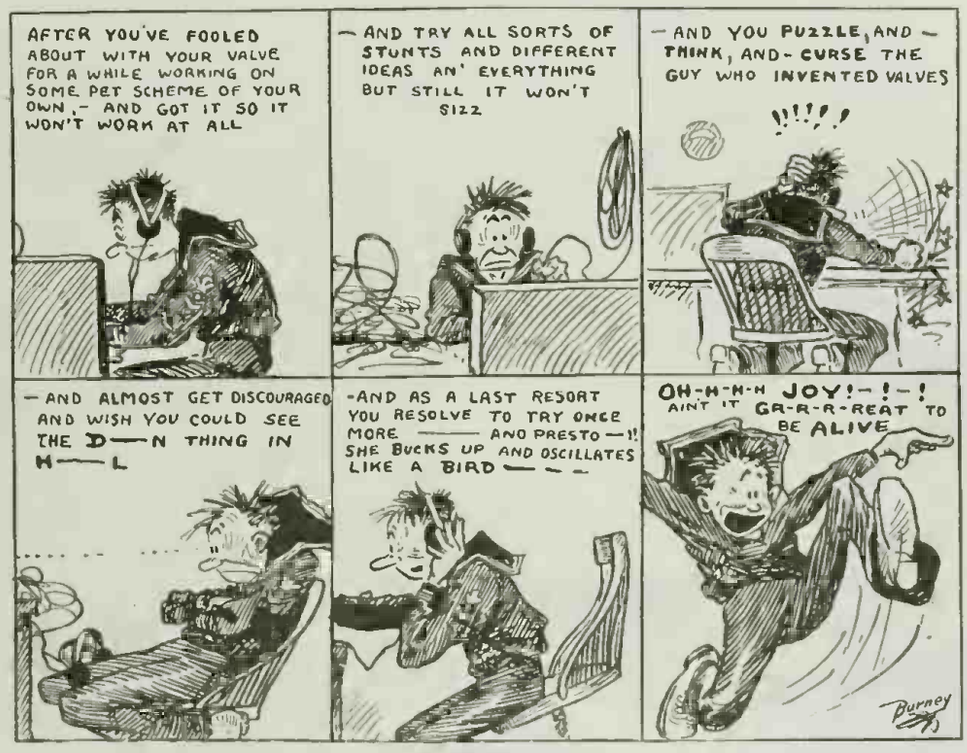
. would be "E" as well as "1"
.. " " "I" " " " "2"
... " " "S" " " " "3"
.... " " "H" " " " "4"

Oh, yes, serious confusion would result: an operator copying "EISH dollars," for instance, might mistake the "Eish" for an accidental sneeze, ignore it completely (as etiquette requires) and inform Jones that Smith "will give you dollars"; and Jones would think his message was the words to a song, a companion-piece to "In the morn I bring thee violets," and perhaps get mad—because some folks don't like music.

But talk about mistaken identity, how about the "abbreviated form" of code-numerals actually in use, where

.- = "1" also "A"
..- = "2" " "U"

(*Continued on page* 585)



Yes—Fellow "Radio Men"—We Know How It Feels! This Is Oscillation No. 2 of "Great Moments We All Have Known," Drawn by R. O. Mr. H. B. Burney, H. M. C. S. Stadacona. Mr. Burney Promises to Become the "Bairnsfather" of the Navy.

A Rotary Quenched Spark Gap

By FRANCIS R. PRAY

THERE are a great many Radio amateurs who find it impossible to join the Service for some reason or other, and realize that the present is an excellent time to make that "perfect" set if for no other reason than the quite obvious fact that raw material will not be cheaper than it is now. Of course you exclaim: "Cheap! Why, it costs more now than it ever did." Well, yes, that may be so, but did you ever stop to think what it will cost after the war?

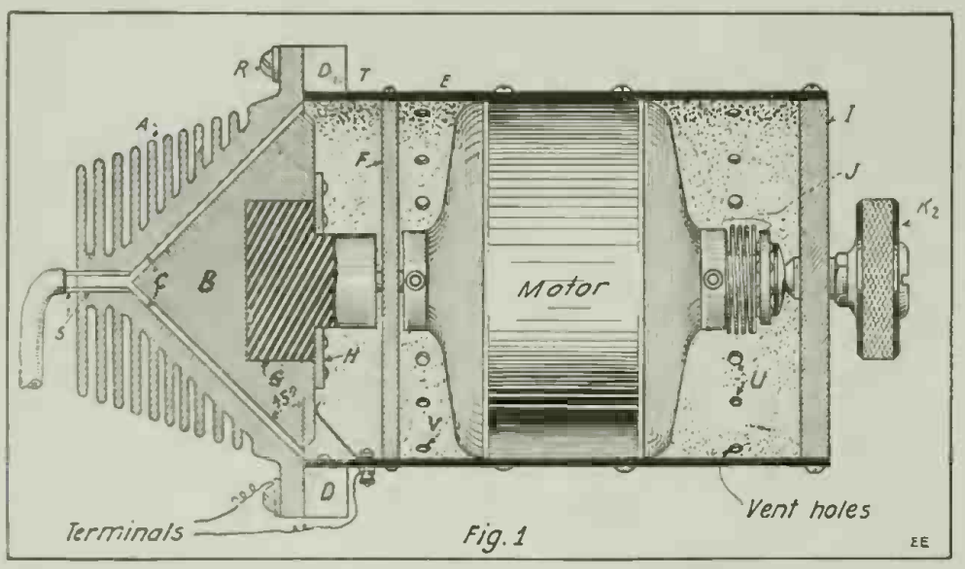
No doubt your next *transmitter* will employ a rotary quenched gap, as that is the most efficient type up to date. Should you be undecided as to the design, allow me to submit the following, as it combines the best features of the gaps on the market, besides several original ones. It is easily made with no other tools than a small bench lathe and slide-rest and the usual experimenter's hand tools. It is so designed as to combine the utmost in ruggedness with the easiest accessibility and the material will not cost much.

Parts "A" and "B" should be of brass or copper, or possibly aluminum, tho the sparking surfaces "C" should be heavily *silver-plated* in order to insure the utmost efficiency, and you know aluminum cannot be plated. Part "A" may be cast solid and the cooling flanges cut in later with a parting tool. Much care should be taken to see that the sparking surfaces are cut at *exactly 45 degrees* and perfectly smooth before silver-plating. The ring "D" may be made of any tough metal, since it carries no current. It is held onto the *Bakelite* tube "E" by eight machine screws. Tube "E" need not have a wall thicker than ⅛ inch.

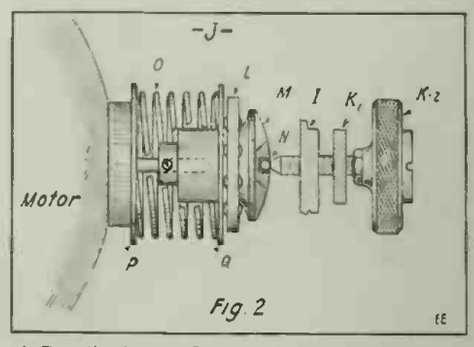
Disc "F" is of Bakelite also, and should be accurately fitted to "E" so as to exclude air. Eight machine screws tapt into its periphery should be sufficient to hold it in place firmly. A whole piece of Bakelite with a cross-section like "G" should be turned on the lathe and fitted into a recess in "B." This hole should be cut first and the 45-degree sparking surface turned last, because this surface should not vary the slightest in its orbit. "G" is held in place by metal washer "H." Four machine screws tapt into part "B" and four in "G" should suffice. Make them all the same distance apart.

It is suggested that the motor be bought first and the various parts built up on it. One of about 1/16 H.P. with a "round" frame is necessary. The feet or base should be broken off and the projections ground down to the surface. It should be securely fastened to the tube "E" by machine screws tapt into the frame. Disc "I" is of Bakelite fastened to tube "E" in the same manner as Disc "F."

A "close-up" of the regulator is shown in Fig. 2. A piece of phosphor-bronze or silicon-bronze is turned with a cross-section as in "M." A hole thru the center is made to fit the motor's shaft and a set-screw is used to fasten it on with. "L" is a ball-bearing unit about the same as those used in bicycle wheels and may be obtained from any of the large bearing manufacturers. The spring "O" is of brass or steel and is used to hold the motor shaft as far to the right as possible. It might be suggested here that if the shaft has no "play" it would be all right to take a little off the motor bearings to *make* some, as the gap's adjustment depends on this feature. "P" and "Q" are large washers. On the right end of part "M" a small recess is drilled just large enough to hold a single ball bearing. Axle grease or vaseline is put in the hole to make the bearing run easily. By turning knob "K2" the sparking electrode "B" is moved to and from the electrode "A." When a satisfactory distance is found by experiment, the lock-nut "K1" is screwed up tight. In assembling the gap, turn "K2" as far up as possible and unscrew the machine screws slightly at "R." The holes for these machine screws in the rim around part "A" should be somewhat larger than usual so that when part "A" is fitted to part "B," "A" may be moved around until it fits cone "B" snugly. Then the screws "R" are tightened and gap is ready for use. If desired, a hole may be bored at "S" and a small tube tapt in thru which gases may be forced for experimental purposes. An outlet may be made at "T." Holes should be bored to ventilate the motor at points "U" and "V" all around the tube.



Well, "Radio-Bugs"—Here's a Good Rotary-Quenched Spark Gap Suitable For Any Experimenter's Transmitter. It Not Only Is Better Cooled Than the Fixt Quenched Gaps But It Gives a Much Clearer and More Penetrating Tone.



A Detail View of Rotary Quenched Gap, End-Play Shaft Regulator.

AIRMEN USE FALL AS RUSE TO FIND HIDDEN WIRELESS.

Residents of Glen Cove, L. I., who a short time ago had been wondering and complaining about the continual flying over their houses of airplanes from Mitchel Field, Mineola, were amazed when it became known that Department of Justice agents have been searching the city for an alleged hidden German wireless plant, said to have been discovered thru efforts of the airmen. The wireless plant is declared to have been located in the chimney of a house in the exclusive Red Springs section of Glen Cove.

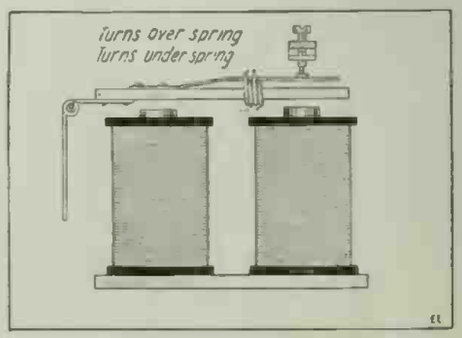
For days airplanes have been hovering over the city. Two machines came to grief, and the pilots were taken into nearby houses. Now it is said that the accidents were deliberate, with the intention of gaining admittance to the suspected house.

After being picked up, presumably unconscious, and carried into a certain house, one of the airmen, while left alone, is said to have found the concealed wireless.

HOW TO MAKE BUZZER GIVE HIGH TONE.

Being in need of a buzzer giving a high pitched tone I took an ordinary call buzzer, removed the armature and ¼-inch from the end of the contact spring I wound two turns of No. 22, B. & S. bare copper wire around the armature under the contact spring, and two turn around the armature and over the spring. Then I twisted the ends of the wires together tightly. When I replaced the armature and adjusted it I had a high tone buzzer, which made hardly any noise to the ear, but using a telephone receiver it almost "raised the dead."

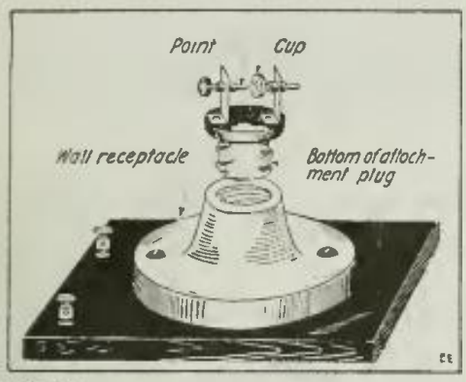
Contributed by
GEO. F. HARRINGTON



A Simple Trick For Making Any Buzzer High Tone.

DETECTOR BUILT ON ATTACHMENT PLUG.

Herewith is a drawing of a "receptacle detector." Any number of detectors can be



The Right Dope in Detector Design—Build it on an old Fuse or Attachment Plug. Detectors So Made Are Interchangeable.

made and different ones screwed in as needed.

The base is made from an old wall type receptacle or other kind of receptacle. The detector container is made from the bottom of an old attachment plug. The plug screws into the receptacle and the detector is then ready for use.

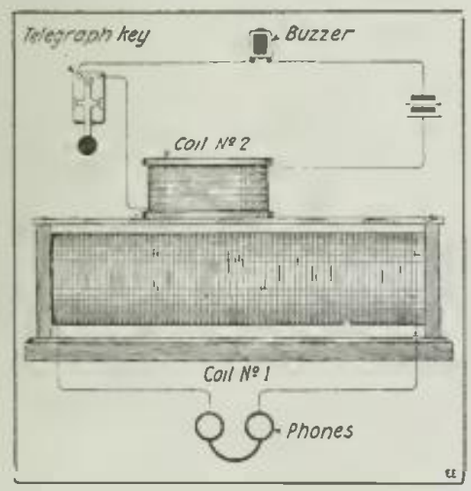
Contributed by E. T. J.

A CLEVER WIRELESS PRACTISE SET.

Take an old tuning coil, remove the sliders or slider and on each corner of the top of the end support tack on two thin wooden sticks, such as kite sticks, and let them project over about 4" at one end. If a tuning coil is used, bring out each end of the winding as shown in coil No. 1. Connect telephone receivers as shown in diagram.

To make coil number 2, take an old curtain pole or a piece of broom handle. Saw off a piece about one inch in length. Now to make the end, take an old piece of heavy cardboard and cut out two circular pieces about two inches in diameter. After finding the exact center of your cardboard, take the round piece one inch in length, and attach the two cardboard discs, one at each end. After completing, wind full of No. 16 or 18 insulated magnet wire and hook up as shown.

By depressing the key the battery is connected with coil No. 2; the magnetic lines



A Good Use for the Present Useless Tuning Coil—Utilize It in Connection with a Small Spool of Wire.—No. 2, to Make an Adjustable Sound, Code Teacher.

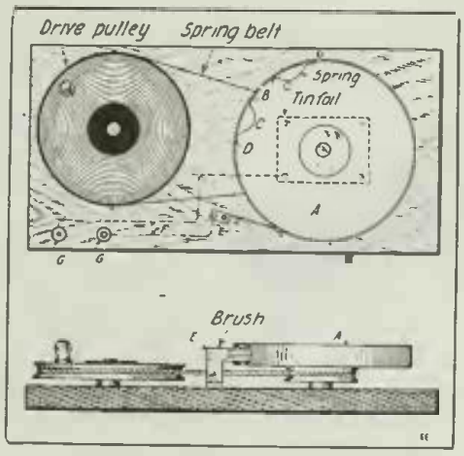
of force travel from coil No. 2 to coil No. 1. By operating the key according to the code, the sound will be heard in the receiver, the same as in long distance wireless receiving. This outfit is fine for learning the wireless code, as the sound produced in the receivers can be varied in strength by shifting the coil No. 2, along the slide strips on top of the coil.

Contributed by T. G. GRANTHAM.

A PERFORATED TAPE CODE TEACHER.

After reading the description of various contrivances for teaching the code, I thought I would try to make one of my own design. Here is a description of it. Referring to the illustrations, A is a tin can cover, the one represented in the figure being 7" in diameter. This will take a record 22" long, or long enough to hold the entire alphabet, minus the figures. It has a grooved pulley about 2" in diameter fastened under it on the center by 4 screws. A hole is drilled centrally thru both pulley and can cover. This had better be done before fastening them together. Procure a base of suitable size, and on one end tack a piece of tin 2" square with a hole in the center. Fasten an insulated wire under one tack and run this to one binding post.

The can cover should have a small piece



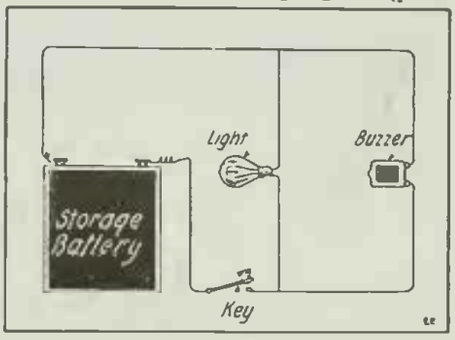
A Simple, Home-made Perforated Tape Code Teaching Instrument. A Tin-can Cover Serves as the Tape Drum Which is Rotated by the Belt and Hand Wheel.

cut out of its edge 1/16 of an inch wide, as at B. Two springs shaped as at C are soldered to the can cover inside at D. The record is a strip of paper about 24" long, with the dots and dashes cut out with a ticket punch. The ends are past thru the cut in cover edge and fastened under the ends of the springs. The cover can now be mounted on the base, over the piece of tin. Put a couple of washers under it, and fasten it down with a screw. Put a washer under the screw head too. The brush is made of spring brass shaped like E. Cut slits in the end so it will be sure to make contact with the can cover thru the dots and dashes in the tape record. A driving pulley is now mounted on the other end of the base. Put washers under this too. Screw a handle on to turn it by and have a hole in the handle large enough to turn freely on screw holding it. Connect this pulley with the small one with a strong belt. Put a piece of rubber band in it so it will always be tight. The pulleys need n t run exactly true. Connect the brush with the other binding post and the code teacher is finished. In making the records repeat the same letter three or four times in some of them, as it is necessary to hear them over and over again to remember them. It is to be remembered that the instrument is connected in series with a buzzer or sounder and battery.

Contrihuted by A. E. HERSEE.

AN IMITATION "STAGE" RADIO.

Having need of an imitation wireless sending station for use on the stage that was to operate in semi-darkness, I hooked up a buzzer and electric light globe (painted blue), so that when a contact was closed it would connect both of them as shown in the diagram. The buzzer represents the noise of the spark discharge and the globe represents the light that the spark throws off. The contact is to be closed by the operator (actor) pressing the key on the stage. The buzzer and the light, of course, are not to be seen by the audience. They may be placed behind a box or some other object on the stage. The buzzer should make the loudest noise possible. When this apparatus is used in the semi-darkness it will prove very satisfactory.



An "Imitation" Radio Outfit for the Stage—The Buzzer Squawks and the Lamp Flashes Each Time the Key is Prest. The Effect is Very Realistic.

Contributed by G. B. PENNEBAKER.

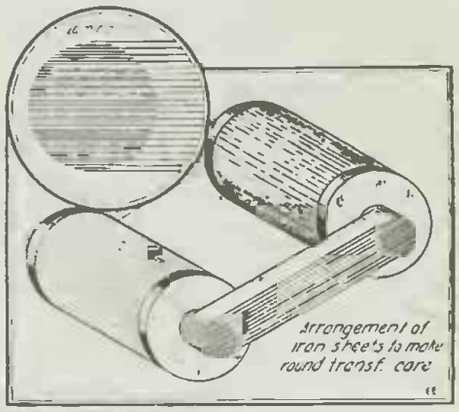
HARD RUBBER PANELS.

Go to the storage battery station in your town and ask for some large size battery jars that have been discarded. These can be procured for little or nothing. Soak these in hot water until they are pliant and then with a hack-saw cut so that the saw cuts two sides at once. If the rubber becomes stiff while sawing, immerse it in the hot water again. After it is washed it can be polished with linseed oil and shellac. It can be drilled with a metal drill. If one piece is not of sufficient thickness, two pieces may be fastened together, rough sides touching, by means of the screws of the apparatus.

Contributed by DONALD HUCKE.

ROUND TRANSFORMER CORES.

In cutting the sheet iron laminations for the "legs" of transformer cores, make them of different widths, i.e., cut them narrower as they get farther from the middle. The



Here's How to Make Round Transformer Cores at Last. Neat, Efficient, and Technically O. K. Thanku, Henry.

legs will then be round, rendering the transformer much more efficient and also easier to wind on the coils.

Contributed by H. G. ASCHBRENNER.

How to Make a Seven-Inch Reflecting Telescope

By LATIMER J. WILSON

THE desire to see the planets thru a telescope of greater power than the one which came within the writer's limited means financially is responsible for his accomplishing the task of making a telescope of considerable efficiency. The grinding, polishing and figuring of a glass speculum is not beyond the average ability, and such an accomplishment is far more satisfactory than the purchase of a refracting telescope of small size. Indeed the service rendered by a home-made 11-inch reflecting telescope has compared favorably with that rendered thru several months' experience with an 11-inch refractor of the best construction.

A Seven-Inch Reflecting Telescope, the Speculum of Which Was Made by the Writer. It Provides Beautiful Views of Mars, the Moon, Jupiter and Saturn, and Equipt with a Terrestrial Eye-Piece, Furnishes a Powerful Telescope for Marine or Land Use.

A seven-inch speculum is less difficult to construct than a ten or an eleven-inch, tho it is powerful enough to disclose details on the discs of Mars and Jupiter, Saturn and the moon, and will present splendid views of the wonders of the milky way. But if one wishes to attempt a larger size he may do so by following the methods described here, increasing in proportion the length of stroke in working and the quantities of material.

The *concave mirror,* or speculum of a reflector performs the same service as the *lens* of the refractor, it brings the rays to a point in the focal plane thus forming a real image of an object. This image in both telescopes is magnified by the eyepiece, various eyepieces being used to furnish different magnifying powers. It is obvious that the quality of the image must be perfect to permit of magnification.

The materials for a seven-inch mirror in 1910 cost about $5, including the glass discs.

There will be needed two discs of common plate glass, seven inches in diameter, one-inch and one-half an inch in thickness respectively. The thicker disc becomes the *speculum,* the other the "*tool.*" The thickness of a glass speculum should be in proportion to its diameter about as 1:8.

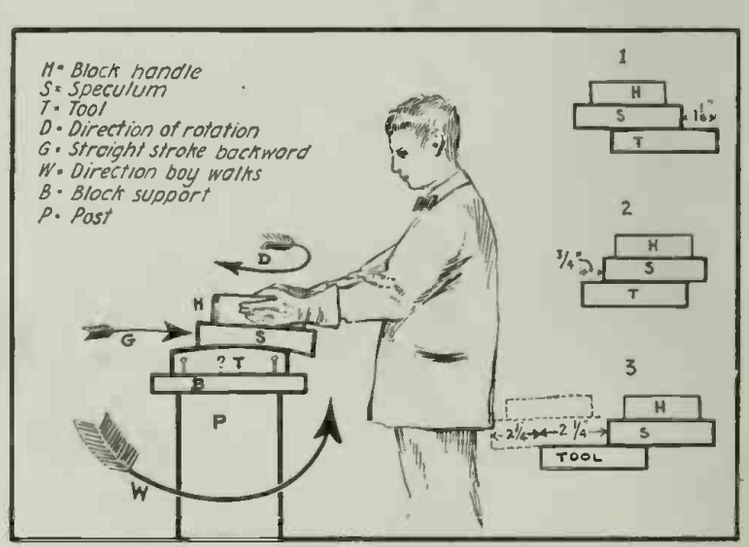
Two or three pounds of carborundum No. 80, one or two pounds of No. 120 and two pounds of Grade FFF will be needed for the grinding. One half a pound of Jeweller's Rouge (iron oxid) and about three pounds of Burgundy pitch, two cakes of beeswax, four ounces of turpentine and a pound of resin are required for polishing. These, with a few chemicals needed for silvering the finished mirror, complete the list of ingredients which one must purchase.

The one-half inch glass disc, edges ground smooth and top edge of the rim slightly bevelled, is cemented with pitch to a wooden block ten inches in diameter. The block is then made fast to a rigid support, a post or a barrel that has been firmly fastened to the floor. The worker must be able to walk freely around the support and must have plenty of room for the necessary arm movements in grinding and polishing. The one-inch thick disc, the future speculum, is cemented with pitch to the center of a circular wooden block six inches in diameter on the top of which is screwed a handle. In manipulating the speculum over the glass tool the hand must at no time come in contact with the glass of the speculum. The heat from the hands is sufficient to produce a perceptible effect in the final curve.

The No. 80 carborundum (or emery) is made damp with a little water and is spread thinly over the tool. The speculum is held by the handle in such a manner that a very slight pressure from the side of the hands is upon the wooden block; it is then moved forward and backward across the tool, the worker rotating the speculum all the time by means of the block and the handle. As the grinding proceeds the worker walks around the support *in a direction contrary to the direction in which the speculum is rotated.* The speculum should be moved forward and backward a space slightly greater than one-half the diameter of the disc. This motion tends rapidly to cut away the center of the upper disc, at the same time cutting away the edge of the tool, making the latter *convex* and the former *concave.*

The amount of concavity necessary for a focus of sixty inches is equal to the arc subtended by a radius of 120 inches. Roughly it can be determined by frequently examining the surface of the speculum in sunlight during the stages of rough grinding. Wet the disc and hold it so the sun's light will be brought to the position of best definition, indicated by the smallest disc of the solar image. When the distance from glass to image measures about sixty inches, the rough grinding is complete.

The successive stages of the grinding are devoted to refining the curve and eliminating the pits and scratches caused by the coarser particles of carborundum. It will be well to subject the No. 120 grade to a series of two washings. Mix the whole of it into a receptacle holding two gallons of



Illustrating the Different Motions Followed in Grinding and Polishing the Speculum. 1—Length of Stroke to Produce Sphere: 2—Short Stroke: 3—Long Stroke, Tending to Produce a Parabolic or Hyperbolic Curve.

water, stir well and immediately pour off all but the sediment. This will be used for the first stage of fine grinding. The portion that was poured off should be allowed to settle for ten seconds and then all but the water and sediment contained in the lower part of the vessel again poured off. These sediments labelled 1, 2 and 3 are to be used in the first, second and third stages of the fine grinding.

The stroke in grinding with the finer grades is progressively shortened. Moving the speculum forward and drawing it backward a space of one-third or one-fourth the diameter tends to keep the curve concave, and gradually to produce a spherical form. Shorter strokes tend to flatten the curve and during the final two or three hours of fine grinding the strokes may be no longer than one and one-half inches.

The FFF Grade of the flour of carborundum is subjected to several washings as follows: (a) the coarsest 3 seconds; (b) 20 seconds; (c) I minute; (d) 10 minutes; and (e) 30 minutes. The particles held in suspension in the washing that is left after standing 30 minutes are so fine that the liquid seems almost to be pure water. Great care should be taken not to permit coarser particles from getting mixed in the fine grades when they are placed upon the convex surface of the tool. Plenty of water must be used during the fine grinding to prevent the disc from binding as it is manipulated over the glass tool.

The final surface when the fine grinding is complete will present an appearance of a thin film of dried milk spread upon a piece of transparent glass. Black type well spaced and lighted one-quarter of an inch in size should be easily distinguishable as viewed thru the ground surface, if the back surface is of polished plate.

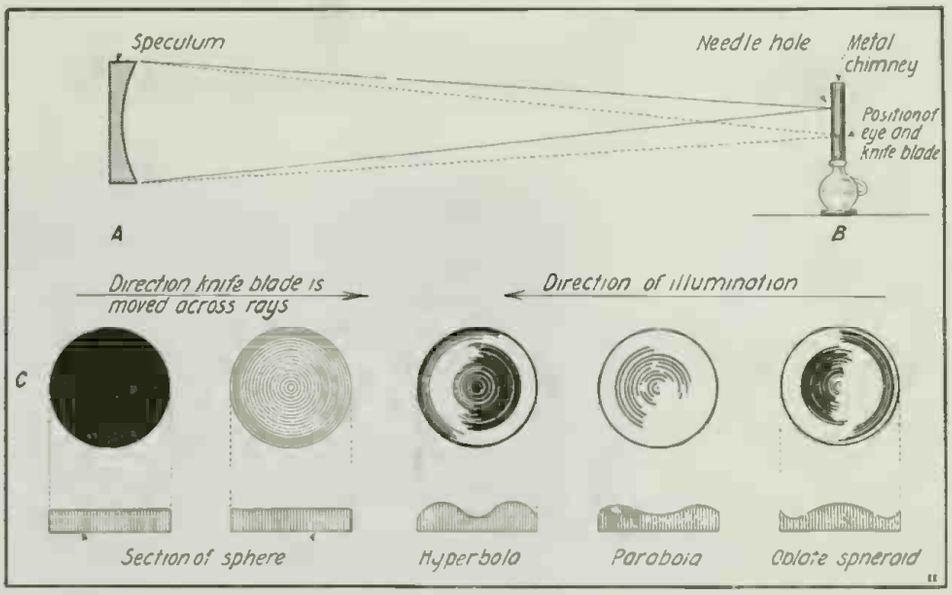
Next the Burgundy Pitch is melted and strained. It is then thickened with resin or thinned with turpentine until when cool (at the room temperature) it permits a slight impression to be made with the thumbnail when prest into it. The grinding tool is cleaned and a strip of surgeon's tape, or lantern-slide tape (paper) is stuck to the glass circumference so that it will protrude about one-quarter of an inch all around above the surface. The melted pitch is then poured on the tool and allowed to set an instant.

The speculum is painted with the rouge, which has been mixt with water and only the top one-third of which has been removed for use, thus assuring only the finest portion, avoiding coarse particles.

It is very important that the speculum be kept thoroly wet with rouge and water when it is placed upon the warm pitch and gradually permitted to rest upon it until the surface of the pitch has assumed the curve of the speculum. The pitch is then reheated by passing a gas flame across it rapidly until it is soft enough to permit squares to be prest into it. These squares must be spaced one-quarter of an inch apart by pressing a wooden foot-rule in lines at right angles, the lines being one inch apart. A square should not come exactly in the center of the tool but should be sufficiently eccentric to allow only one corner to be in the exact center. When the squares are formed the grooves can be cut out very clean with a sharp knife, after which every particle of the debris must be washed off the polisher which is again heated by the gas flame and coated with a mopping of melted beeswax. The speculum is again painted with the rouge and is gently prest upon the semi-warm surface. In a short while it will shape the surface into perfect contact. Then the polishing can begin, the purpose of the squares being to distribute the rouge and to assure even polishing. Frequent application of rouge is necessary.

The strokes are at first long as in the coarse grinding. When a sufficient polish appears the mirror can be subjected to the well-known Foucault Knife-edge Test. Always before testing, the mirror should be permitted to rest for fifteen minutes, until the heat from the friction of polishing has subsided, otherwise a true test of the surface cannot be made.

In a darkened room the speculum is placed in an upright position and directly in front of it at a distance equal to the radius of curvature (in this case 120 inches) is placed a lamp having a bright flame hidden entirely by a metal chimney. Opposite the brightest part of the flame is a needle hole so directed toward the mirror that the light from it will be reflected back to a point within ten inches of the lamp at its side. The brighter the light and the smaller the needle hole the better will be the result. The writer has used satisfactorily a small arc projection lantern having a prism in the path of rays and the light from the lantern reflected from a needle hole in a piece of tinfoil glued to the side of the prism. This enables the worker to make the test at a distance of only a few inches.



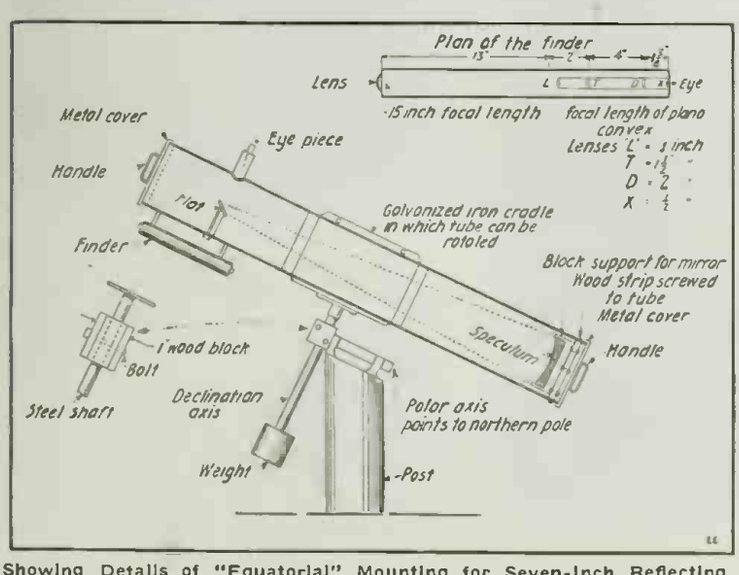
Here A—B Represents the Position of the Speculum and the Light-Source for Testing the Accuracy of the Grinding and Polishing. C—Shows How the Surface of the Speculum Darkens for the Spherical, Parabolic and Hyperbolic Curves, as Seen When the Knife-Blade Screen Is Moved Across the Cone of Rays at the Place of Best Focus.

The light from the needle-hole illuminates the mirror as seen at the principal focus. Inside this focal point the image of the lamp will be seen upright; beyond the point it will be seen inverted, but at the focal point the light from the bright needle-hole will illuminate the disc so that no image will appear except the mirror's bright disc. An opaque object such as the straight edge of a knife blade mounted upright can be past across the cone of rays before the eye. If the shadow advances as a straight line in the same direction as that of the moving knife-blade the blade is too near the mirror; if it comes from the opposite direction it is too far, but if the mirror gradually darkens, the blade is in the best focus and the test can be made.

Imagine the surface of the mirror illuminated from a direction opposite to that from which the blade is moved. If the surface then presents the aspect of a ridge around the edge and a hill in the center, the polishing strokes should be lengthened to cut away the elevations. If the mirror shows a slight depression the strokes should be shortened. If a deep depression is seen and the outer portions of the disc seem turned back, the figure is that of a *hyperbola* and to correct it go back to the grinding, using very short strokes.

A perfect sphere is indicated when the surface darkens evenly. Work first for this effect. Then to produce an approximate curve that will satisfy all demands polish for a very few moments at one time with long strokes until the surface looks like a shallow dinner plate, a very faint trace of a depression in the center. This will produce the approximate parabolic curve, and if not carried too far will result in a *perfect speculum.*

(*Continued on page* 586)



Showing Details of "Equatorial" Mounting for Seven-Inch Reflecting Telescope. Top of Post Is Cut to the Latitude of the Observer.

A Simple Study of Currents and Magnets

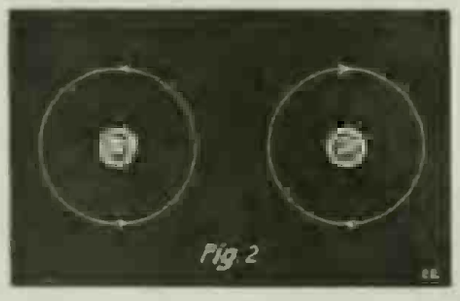
By Prof. E. H. JOHNSON, Dept. Physics, Kenyon College

ONE of the first facts that the investigator in the field of electromagnetism comes to recognize is that there is a "directedness" to the reactions between magnets and current-bearing conductors. The mystery is partly dispelled, however, when he learns that a magnet, whether permanent or due to a current in a coil of wire, can be attracted or repelled only by another magnet—that is, it is acted upon only by a *magnetic field*.

Now the "field" in the sense here used means the entire region thruout which the magnetic force can be detected by any means whatever. Therefore the various portions of the field can be considered to have *direction*, because a force has a direction. And if we try to map out a field of magnetic or any other kind of force on a sheet of paper, we will get a series of lines or arrows, not necessarily having any regular arrangement. Such a map is naturally limited to two dimensions, and so will represent only some one plane arbitrarily chosen in the three-dimensional space field of force we may be studying. These direction lines in the field have been called the "lines of force," and it must be remembered that they are directions only and probably do not exist in any much more real manner, but they do serve to enable us to form a comprehensive idea of the possible causes of the reactions we may actually observe.

To help one to grasp the ideas involved in a clear manner, many simple experiments can be performed, but we will content ourselves with several of the simplest ones, which, tho not new, are well worth close observation by the student.

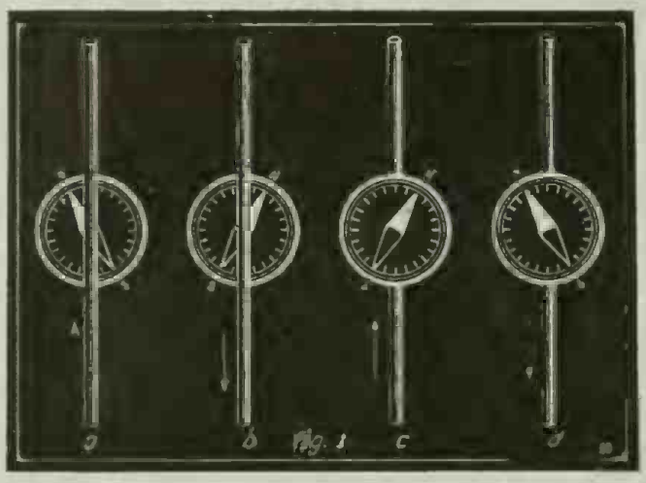
To begin with, we have the fundamental law that LIKE *magnetic poles repel one another, while* UNLIKE *magnetic poles attract one another.* Hence, according to our previous statement that the magnetic force of a magnet, as ordinarily observed



To Produce a "North" Magnetic Pole, the Current Must Pass Counter-clockwise Around the Core as Shown at the Left. A "South" Pole Results from a Clockwise Direction of Current Thru a Magnet Coil.

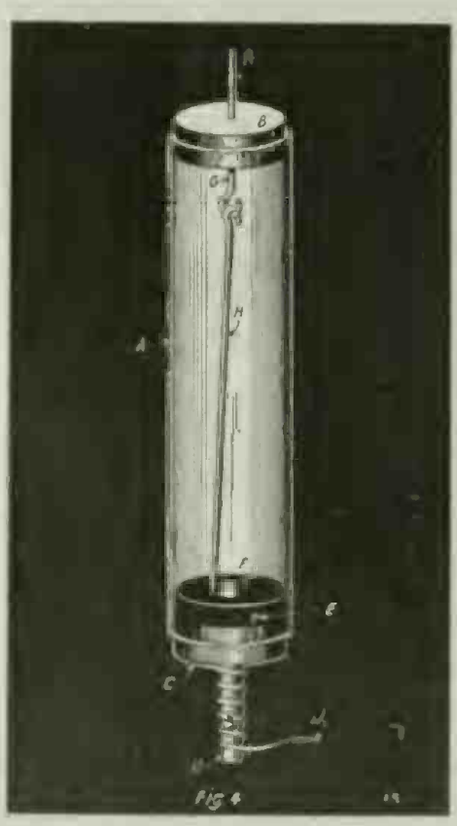
is made evident only in the presence of another magnet, we have to conclude that when a compass needle which is held near a wire bearing an electric current is deflected, some portion of the region containing the wire must contain a magnetic pole, or its equivalent, as the source of the force which affects the needle. Let us try the experiment and then draw our conclusions.

Place a magneto compass on a table where it is not near any other magnetic body, and then, after it has come to rest in its natural North-and-South position hold directly above it and parallel to it, a single wire in which a small direct current is flowing. It will be found that if the current is flowing from South to North above the needle, the North pole of the needle



The "Compass Test" for Determining If a Conductor Is Carrying a Current, and If so, In What Direction It Is Flowing. Reversing the Position of the Compass Reverses the Deflection of the Needle.

will be deflected toward the West, as shown at —a—, Fig. 1. If the current is reversed, the needle will swing to the East, as shown at —b—. Now if the wire is slipt under the compass and the preceding two steps are repeated, the deflections will be changed correspondingly, as indicated by —c— and —d—, Fig. 1.



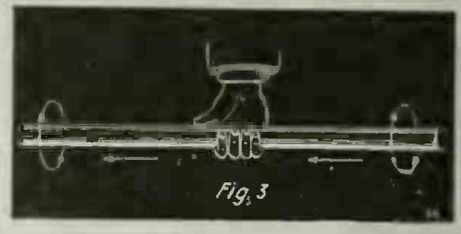
The Earliest Form of Electric Motor Devised by Faraday in 1822. It Is Described Here In Detail so That the Student Can Construct One and Study It.

From this simple experiment we can see that there is a definite relation between the direction of the current and that in which a magnetic pole will move, if free to do so. If one imagines that he can look along the wire, of which the shaded portions in Fig. 2, represent sections, the arrow-heads will show the direction in which a North magnetic pole will move when the current is flowing out from or into the plane of the paper.

Another simple rule covering all of the above cases, is that known as the *right-hand rule*, which states that if the current-bearing wire is grasped in the right hand, with the thumb pointing along the wire in the direction in which the current is flowing, the fingers will encircle the wire in the direction in which a North magnetic pole would be deflected. See Fig. 3. This rule is perhaps the easiest to remember of the many which have been proposed, but it should be clearly seen that they all lead to the same conclusion and that the law they seek to illustrate is perfectly definite and invariable.

So numerous are the experimental possibilities for demonstrating this principle that it is in fact difficult to escape its application in any branch of electrical science. Without it electromagnetic machinery would be impossible. For the present, a few simple constructions will suffice to show how repeated or continuous motion may be obtained instead of single simple deflection as in the case of the compass needle, and altho the examples here given are in the nature of toys long known to anyone familiar with the subject, they will be highly instructive and well worth the time and effort involved in their construction by anyone who is *not* thoroly acquainted with them.

Secure a glass tube or slender lamp chimney (A, Fig. 4) about 6 inches long and an inch or so in diameter. Into its ends fit two corks, B and C. Thru the



The "Right-hand Rule" Which Gives the Direction of the Magnetic Whirls About a Conductor.

lower cork, C, thrust an iron rod, D, about ¼ inch in diameter and 3 inches long. Around the lower half of it wind a couple of layers of insulated wire (any size from No. 18 to No. 24) and carry one end of the wire up thru the cork as shown at E, so that it may be surrounded by a layer of mercury, F, which, in turn, should not quite cover the upper end of the iron rod. Thru the upper cork, B, pass a short length of bare copper wire G, and then hang from it loosely a sufficiently long piece of similar wire, H, to just dip into the mercury. This device can be mounted in an upright position on a block in any convenient manner.

(To be continued.)

Spectroscopic Methods and Spectra

A SEQUEL TO "HOW TO BUILD A SPECTROSCOPE"

By D. S. BINNINGTON

PART II—Conclusion*

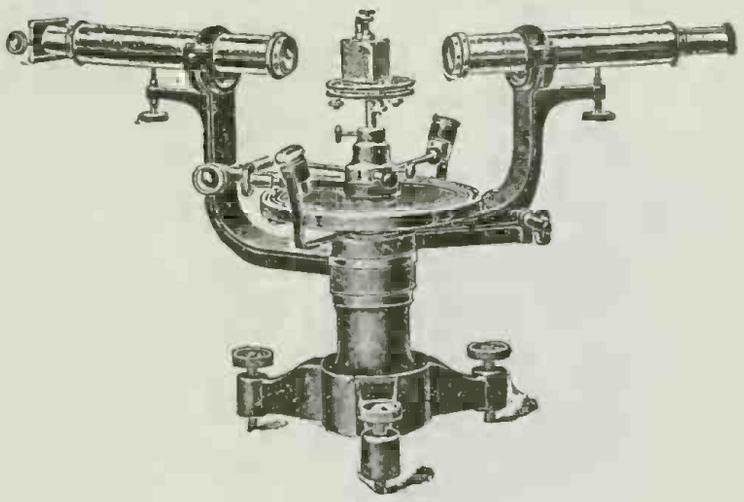
Method No. 1.

THIS method of obtaining the spectrum of a gas, is the only one that can be used, and has several difficulties in the way of home-made apparatus. The principle of the method is, that the required gas is sealed up in a tube in an exceedingly dilute condition, and by means of platinum electrodes, the tube is connected to a spark coil. The tubes are of the shape shown in Fig. 7, and the narrow portion is placed in front of the slit for inspection. These tubes cannot be home-made without special apparatus, etc., but can be purchased from dealers in laboratory apparatus with various gases, such as oxygen, hydrogen, carbon dioxid, etc. The price of these varies somewhat, but the lowest is about $1.50 per tube. They can also be obtained filled with the rare gases, argon, helium, neon, krypton and xenon, but these will not interest the average experimenter as they are only for use with delicate apparatus, besides ranging in cost from $5.00 to $15.00.

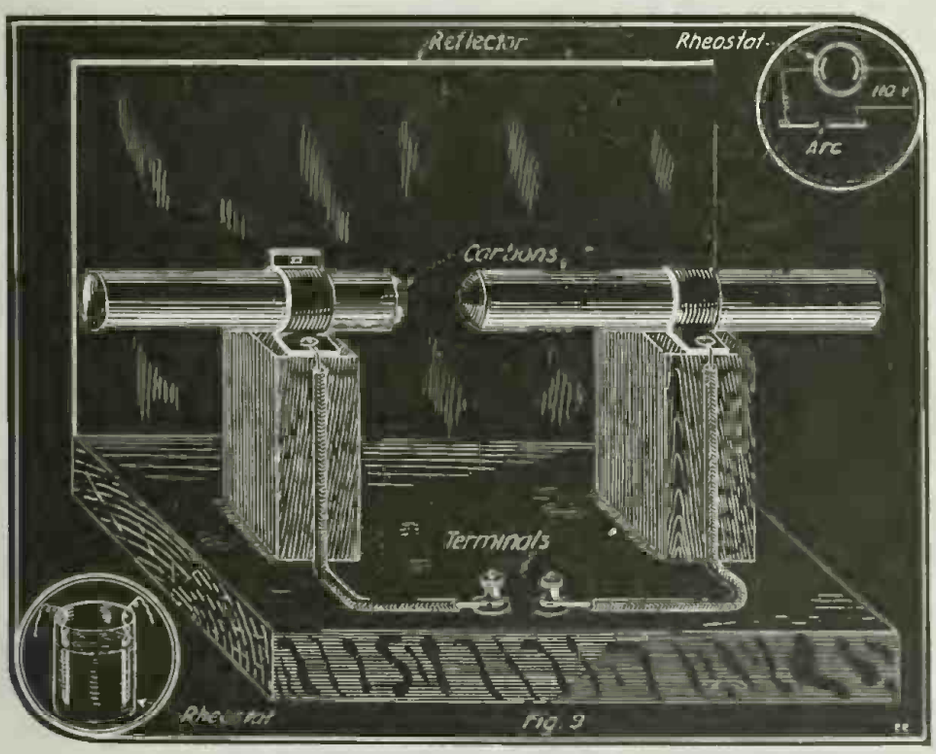
To those who are interested in this branch of the work, however, a tube can be purchased that, coupled with the fittings of a good laboratory, will give excellent results. The tube is shown in Fig. 8. As will be seen it has the two platinum wires sealed into it, and also two glass stop-cocks. For use it is connected to an apparatus giving a steady flow of the required gas, both stop-cocks opened and the gas allowed to flow thru for about half an hour, when both stop-cocks are quickly closed.

The tube is then transferred and connected to a mercury vacuum pump (one such as described in an earlier issue of this magazine) is ideal. The cock leading to the pump is opened and the tube evacuated for a considerable length of time. The stop-cock is then closed and the tube is ready for use. This tube possesses the advantage that it can be filled with any desired gas for one outlay. But care must be taken to exhaust it thoroly, else complications will ensue. It should be noted, too, that all the materials used to prepare the gas must be as pure as obtainable. The gas should be washed with a proper wash liquid, and dried over concentrated Sulfuric acid, Calcium chlorid or other drying agent. These details, however, can best be obtained from a text-book on Chemistry.

This covers the field of work on *gaseous spectra* for amateurs, but, however, hardly touches it from the scientist's point of view, as the subject of gaseous spectra has probably the widest field of all spectroscopical work, and merges to a considerable extent into X-Rays, Radioactivity and similar fields of electrical work connected with vacuum tubes, and basing their theories on electrons, etc. Indeed this subject belongs really to Physical Chemistry, which correlates all that is known from the chemical, electrical and physical standpoints, and places it on a common foundation.



A Standard Spectrometer as Used in the Laboratory. Note How the Prism is Clamped to a Rotatable Table. The Telescope and Collimator Are Adjustable and the Base Has Three Leveling Screws.



Appearance of Finished Electric Arc for Producing Various Spectra. A Water Rheostat Is Used in Series with the Arc on 110 Volts.

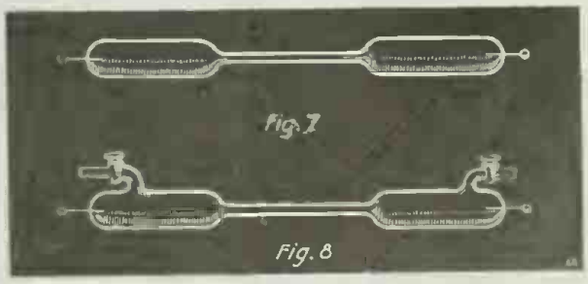
Method No. 3.

This method is really the simplest of all three, but has some disadvantages, however, which eliminate it from certain classes of investigation. It consists, essentially, in vaporizing the material in the electrical arc.

A quantity of carbons about ⅜" diameter should be cut by means of a small saw into pieces 6" long. One end should then be roughly rounded off with coarse sandpaper or a file. It should then be clamped in a vise or between two boards, and a hole drilled in the center of the end about as large as a pencil lead, and about 3/16" to ¼" deep. A mixture of the material to be used and its own bulk of charcoal is then powdered, well mixed and packed into the hole. It is then placed opposite a plain carbon in a horizontal position, and an arc struck between the two. A small amount of the material is vaporized into the arc, the temperature of which is sufficient to vaporize any known material. As, if this method is used, fresh carbons must be prepared, it is convenient to make a small stand to hold them in use and so that they are easily interchangeable.

An apparatus for this purpose has been designed by the writer and is shown in Fig. 9. One carbon is fixt, while a clip is made into which the prepared carbons can

(*Continued on page* 594)



Sealed and Experimental Forms of Glass Tubes in Which Gas Is Placed. The Wires Are Connected to a Spark Coil and the Glowing Tube Examined Before the Spectroscope.

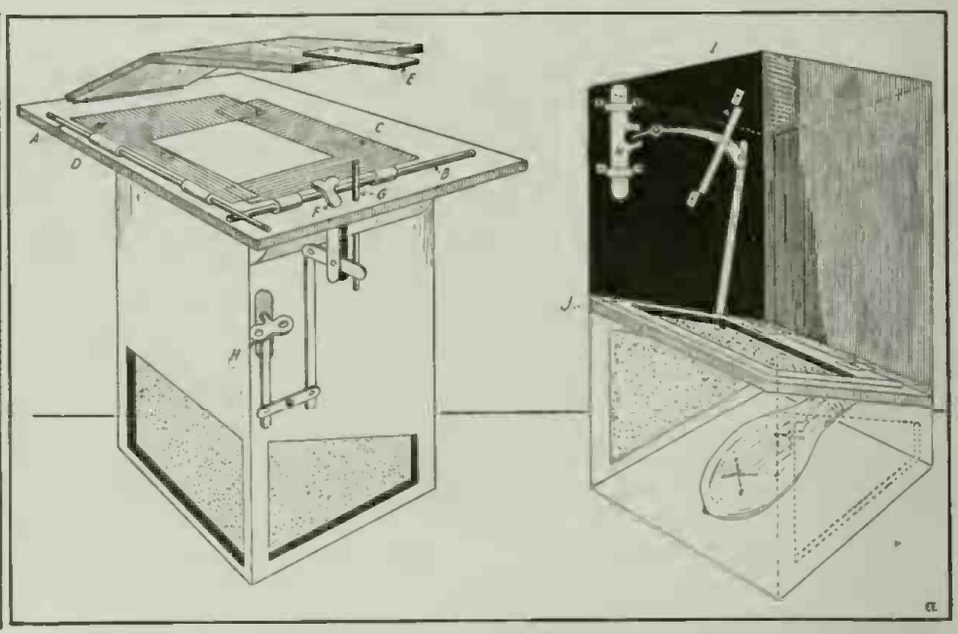
*Concluded from the October issue.

An Electrical Photo Printer

By DR. E. BADE

THE electrical photo printer is made from a wood or metal box eight inches in length, nine inches in breadth, and twelve inches in height. The cover, one inch thick, extends two inches on each side. is made in two parts but it differs from those usually employed in that an iron flange, E, is attached to it, which hooks the presser block and holds it in place at F. The same piece of iron also presses the rod wood and covered with suitable cloth. The screen is in its normal position when it is down. The negative and the paper are placed upon the glass plate and the mask is adjusted. As soon as the press is brought down to hold the picture in place, the rod is pushed down by the flange, the screen lifted by the system of levers, and the light from the bulb will print the sensitive paper. This forty watt bulb, which is constantly lit, is

View of Finished Electrical Photo Printer.



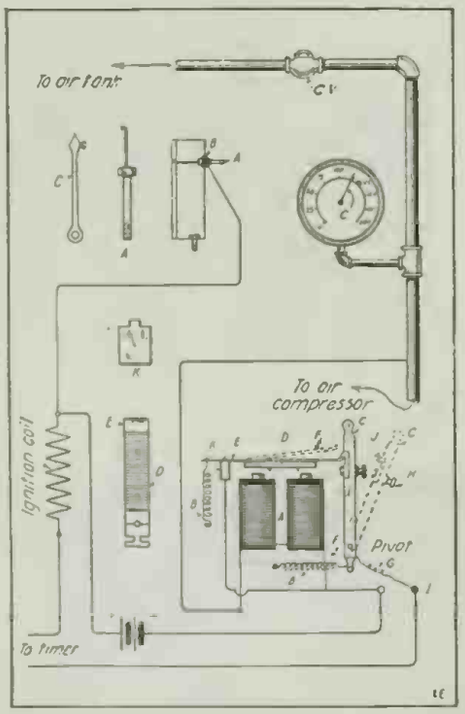
Where Many Photo Prints Are to be Made an Electrical Printing Box Constructed as Here Shown Will Save Much Time and Give Excellent Results.

The center of the box receives the frame of an ordinary printer in which the glass is later placed. On the right and the front of the cover two heavy wires, A and B, are fastened. The movable masks of tin, C and D, slide on them. The hinged presser block G, which, by means of levers, pulls H downward. H fits into another pair of levers within the box which lift the red cloth screen, J. The lever is held in place by the brace.

The screen is made from a framework of fastened to the lower part of the box. Since the bulb is always lit it furnishes light for printing and developing. The printer should stand at the right end of the table and the fixing baths at the left end. Such a printer saves much time indeed.

AUTOMATIC GASOLINE ENGINE "STOP."

This device is used to stop a gasoline engine that drives an air compressor automatically, when the pressure has reached the desired point.



A Handy Device for Stopping a Gasoline Engine, Which Drives an Air Compressor, Automatically When the Pressure Has Reached the Desired Point.

We found it impossible to get a safety valve that would not leak air, so I designed this device and have found it entirely satisfactory. All that is necessary to do is to start the engine and "forget it." When the pressure gets high enough the engine stops.

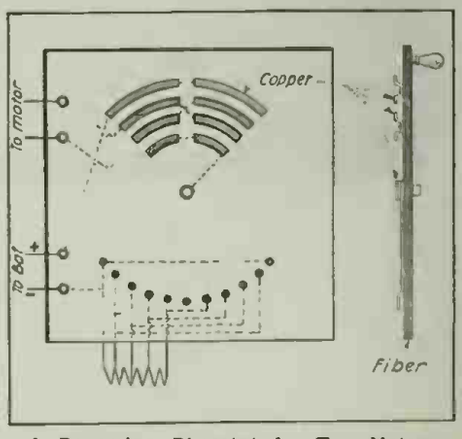
The circuit breaker, A, is made from an old bell. The two springs, B and B, were taken from an automobile tire valve. The switch handle, C, is made of fiber (wood or hard rubber). The armature, D, is riveted to the steel strip E (old hack saw blade). F and F are merely stops to prevent springs from pulling levers too far. G is a pigtail connecting H to I. The hook J is of steel (case hardened) and catches in the steel hook (which is hardened) on the end of E. E is pivoted on the steel pivot K (piece of hack saw blade). The pivot K has a projection which goes thru in E to keep E from slipping out of place.

In regard to the pressure gage it must be placed between pump and check valve. At each impulse of the pump the hand jumps slightly. One of these jumps is enough to close the circuit for an instant. Then the hand falls back a little and prevents start. A small hole must be drilled thru the dial at the desired mark, a corresponding hole is drilled thru back of gage (shown in drawing). The bolt A has a wire soldered to its head. This wire extends thru dial of gage and has platinum point soldered on its side. Bolt A *must* be insulated from gage by means of fiber washers at B. The hand C has a platinum point soldered to it so it will make contact with the point on A. When the point on hand C touches point on A the circuit is closed. The magnets in the circuit-breaker pull armature D down, allowing arm C to fall back, thereby breaking the ignition circuit and stops the engine. To start the engine again the arm C is pushed in again.

Contributed by L. E. PARSONS.

TRAIN REVERSING SWITCH.

If you have an electric train with a permanent magnet field then reversing the current would reverse the motor. I have designed this reverser, which is combined with a variable resistance unit.



A Reversing Rheostat for Toy Motors.

The switch handle is made of fiber or hard wood and the contacts on it are made of copper. The resistance coils can be old shade-roller springs.

Contributed by BURTON McKIM.

Experimental Mechanics

By SAMUEL D. COHEN

LESSON VIII.

LATHE CHUCKS.

ANOTHER form of independent jaw chuck is found useful in chucking irregular work. This has four screw clamps or dogs of the form indicated in Fig. 5, which are bolted by means of a nut to the chuck or face plate. By tightening the large threaded screw against the work, it will be securely fastened for operation.

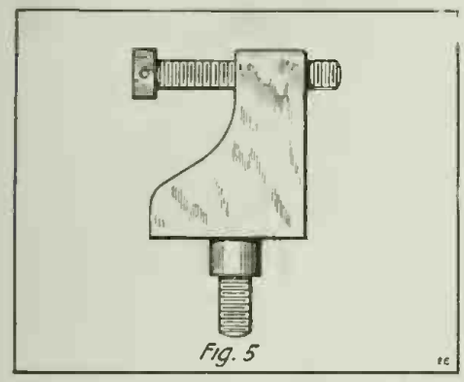


Fig. 5

Individual Lathe Chuck Jaw, Any Number of Which Can Be Secured to a Face-plate or Ring.

A very useful form of chuck which depends upon adjustable screws for holding the work, is the *bell* chuck, and this is shown in Fig. 6. It consists of a casting or forging made in the shape of a bell, C, which is bored and threaded at the back to fit the lathe spindle. The work, W, is held between the screws S,S,S,S, which are placed at regularly spaced intervals around the bell portion of the casting. In the side view of this chuck, two sets of screws are shown, one set behind the other, which enables work of considerable length to be adjusted centrally, while the work is more securely held than by one set of screws.

At times when the work is heavy at one side, or when an angle plate is used in chucking, it is necessary to bolt a counter-balance on the face plate opposite the heavy part. The distance from the center of the lathe to the heaviest part of the work should be the same distance to the center of the counter balance; otherwise the work will run out of center or out of true, and thus will not be round when machined, owing to unbalance.

A drill chuck is usually very handy, and is made much smaller than those described above. It generally contains three jaws. A most common form of drill chuck is shown in Fig. 7. The drill is secured between the jaws by turning the knurled outer shell of the chuck. This operation automatically tightens up all the jaws.

For especially accurate or precision work, another form of chuck is used, which is called a *split-* or *draw-in* chuck. The chuck and method of securing is shown on precision head stock, Fig. 8. The draw-in chuck, I, consists of a cylindrical tube with a hole in the center of proper diameter. One end of this tube is turned conically, and its face split in three equal parts, by three slots. This tube is threaded on the opposite end and fits into a rod, R, protruding thru the spindle, and its end secured to a handle, H. Looking at the construction of the head of the spindle, it will be noticed that by drawing the split cylinder towards the rod, R, and turning the handle, H, that the conical end will be drawn in, thus making the hole of the cylinder smaller. If a rod of the proper diameter were secured in this hole, it would be tightened up and clamped in it. This cylinder with the conical end and split face is called the *chuck*, and the rod, R, is called the *draw-in* attachment of the chuck.

There are a great many sizes of split-face chucks. Each and every one has a definite size hole, and can be used only with work having its diameter approximately equal to the diameter of its chucking hole. This, of course, gives a standard hole, and for this reason is used for precise model and other work, where accuracy and speed in centering is necessary.

In order that the amateur may not be confused with the terms, it may be stated that the word "precision," as applied to the lathe, has several meanings. One of these concerns a lathe, no matter on what principle it is built, which if carefully constructed, is capable of producing precise work within the limits of its type. The real meaning of the word, however, is technically applied to a particular type of tool, which, in addition to being of first-class workmanship, is also constructed on a definite plan, so that precise results are attained mainly from the method in which the machine is set up. A true precision lathe is generally a tool for lighter work. The mandrel is so designed that the bulk of the precision accessories are attached to it by means of a draw-in spindle or rod, and not at all by means of a threaded nose.

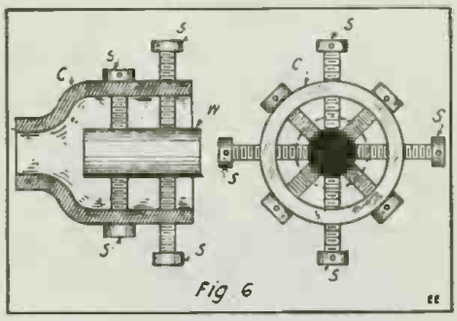


Fig 6

The "Bell Chuck"—It Can Be Made from a Piece of Steel Rod by Any Machinist and Is Handy for Odd Jobs.

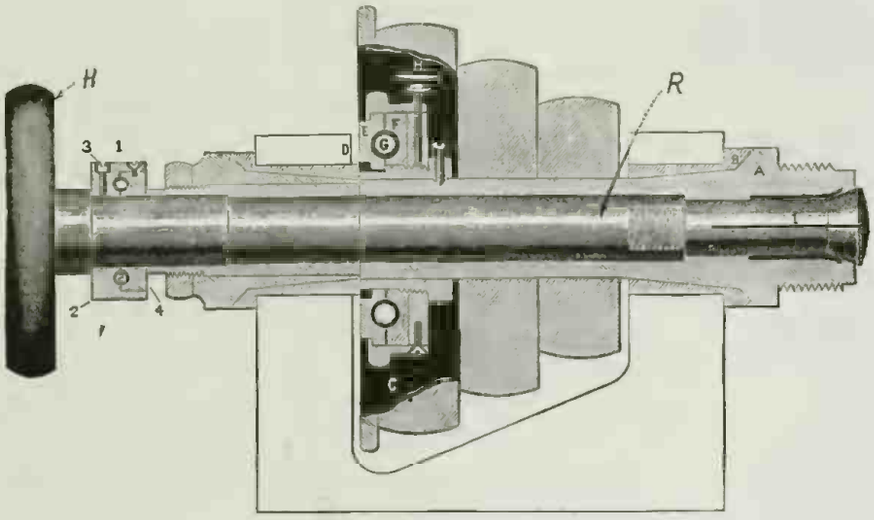


Fig. 8.—For Precision Work In the Lathe the Most Satisfactory Chuck Is the Spring "Split Chuck" Here Shown. It Fits Accurately Inside the Hollow Spindle and Is Clamped by Turning the Hand Wheel at the Left.

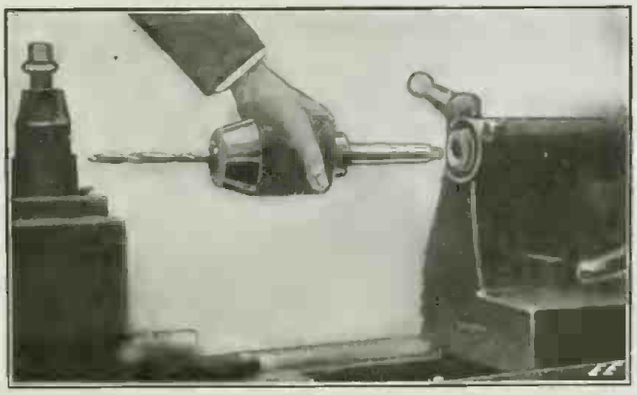


Fig. 7.—Common Form of Small Drill Chuck, the Taper Shank of Which Readily Fits Into the Tail Stock.

It is well to remember, and it is a proven fact, that the screw-on principle of attaching chucks to a lathe is far from desirable from the point of accuracy. However carefully the nose may be screw-cut and the chuck fitted, sooner or later, due to dirt accumulations in the chucks and wear on the thread by continually screwing and unscrewing it, and on the faces of the chuck adapter, the attachments work out of alignment. In addition, the method by which so-called *self-centering* is accomplisht and which was described at the beginning of this lesson, as also the limited wearing area of their jaws, only serves to make matters worse. For most purposes, in small power engineering, at any rate, the usual method of screwing on chucks is quite accurate enough, in view of the fact that it is the usual thing in heavier machine-tool practise. In some classes of work, notably in watch, clock and instrument making, this matter becomes particularly important, and it is here that the want of a true precision lathe results in its production on the lines just mentioned. Also in heavier machine work where large quantities of interchangeable parts have to be made on repetition lathes of the turret-head kind, the split-chuck principle is used. Practically all model shops, especially those turning out instrument parts, are equipt with precision lathes of this type. (*Continued on page* 594)

Experimental Chemistry

By ALBERT W. WILSDON

Thirty-first Lesson

SULFUR: History.

SULFUR was known to the ancients, the alchemists attaching a great deal of importance to it. They thought it was one of two or three primary substances. The Greeks and Romans utilized it as a medicine.

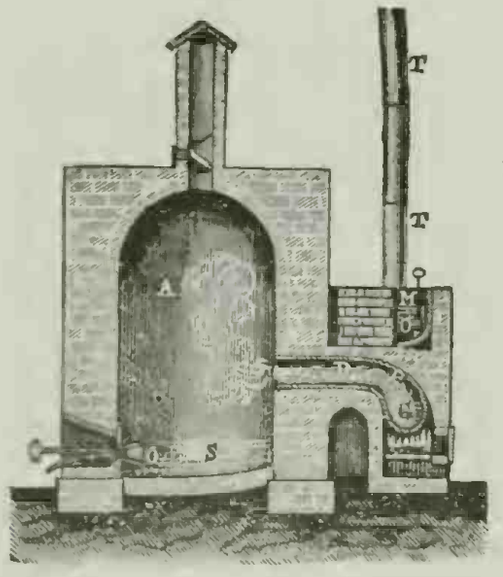


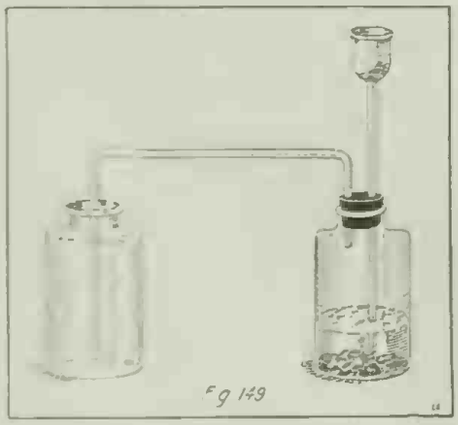
Fig. 152.—Sulfur Is Refined and Made Into "Flowers of Sulfur" by the Process of Sublimation. The Crude Sulfur Is Vaporized In G, Leading Out Thru D Into Chamber A, Where It Sublimes On the Cold Walls. As the Walls Become Heated, the Sublimate Melts, the Liquid Being Drawn Off Thru O, Into Moulds, Becoming "Brimstone."

Occurrence.

Its occurrence in the free state is supposed to be due to Sulfur Dioxid and Hydrogen Sulfid, reacting on each other to form Sulfur.

$$SO_2 + 2H_2S = 2H_2O + S_3$$
$$H_2S + O = H_2O + S$$
$$H_2S + 3O = H_2O + SO_2$$

Its compounds are more abundant than the element. It is combined as sulfides and sulfates, in which forms it is very widely distributed. Some of these metallic sulfides are commonly known as *Blendes* or *Glances*, as, Zinc Blende (Zinc Sulfid, ZnS); Galenit (Lead Sulfid; PhS); this being known to most experimenters as Galena, as used in radio work. Pyrite (Iron Sulfid, FeS_2); Cinnabar (HgS). Stibnit (Sb_2S_3); Realgar (As_2S_3). When combined with oxygen it is found in native sulfates as Heavy Spar (Barium Sulfate, $BaSO_4$); Gypsum (Calcium Sulfate, $CaSO_4.2H_2O$); Kieserit (Magnesium Sulfate, $MgSO_4$); etc. Some mineral springs have solutions of Hydrogen Sulfid. It exists in the animal and vegetable kindgdoms.



Apparatus for Generating Hydrogen Sulfid By the Action of Hydrochloric Acid on Ferrous Sulfid and the Collection of the Gas by Downward Displacement.

Preparation.

The crude sulfur earth and masses of ore are piled with a small amount of fuel in heaps over depressions in the ground. These heaps are then ignited, the Sulfur melts, runs down, and is collected from the hollow beneath. The liquid solidifies and this product is exported.

So that the reader will not be confused by the names *Brimstone* or *Roll Sulfur*, and *Flowers of Sulfur*, it will not be out of place to distinguish between them at this time. *Brimstone*, or *Roll Sulfur*, is the crude unmoulded sulfur, which is used for technical purposes only. *Flowers of Sulfur*, is the so-called sublimed sulfur, which consists of a mixture of the rhombic and amorphous varities (to be described later).

Sulfur is refined and made into Flowers of Sulfur by the process of sublimation. The crude Sulfur is contained and melted in a vat, which leads to retorts, thru which the sulfur is diverted (see Fig. 152). All the air is excluded during this passage, and after reaching the retorts, then vaporized by heat situated directly under the retorts. In this state it is then past into a chamber, on the cold walls of which it sublimes. As the walls of these chambers become heated, the sublimate melts and the liquid is drawn off by means of an outlet situated at the bottom of the chamber, into cylindrical moulds. It is in this form that it is called *Brimstone*.

Sulfur can be obtained from the Calcium Sulfid which is obtained as a waste product in the LeBlanc soda process. This waste product, before removing from the leaching vats, is subjected to a current of air, by which the sulfid is partly converted into sulfite and thiosulfate. The calcium thiosulfate may be used for the preparation of Sodium Thiosulfate ("Hypo") which is used in considerable quantities in photography, or the mixture may then be treated with Hydrochloric acid,

$$2CaS + CaS_2O_3 + 6HCl = 3CaCl_2 + 4S + 3H_2O$$

The recovery of sulfur from the purifiers in the gas works is practised to a large extent in England. The gas, of which Hydrogen Sulfid is a constituent, is past over moist ferric oxid, thus,

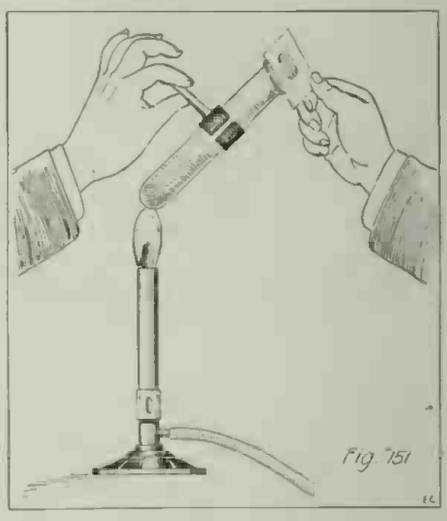
$$2FeS + 3H_2O + 3O = Fe_2O_3 3H_2O + S_2$$

The recovered iron oxid, mixed with Sulfur, is then exposed to another quantity of the gas, and repeatedly regenerated until the mass contains about 50 per cent of Sulfur, the latter being recovered by heating the mixture.

Allotropic Forms.

Octahedral or *Rhombic Sulfur.* This is the form in which it occurs in nature as well as that form in which it crystallizes from Carbon Disulfid.

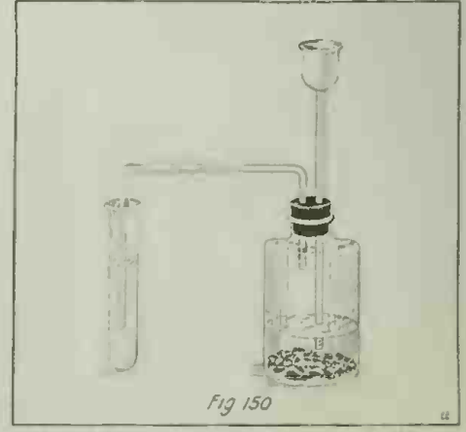
Prismatic or *Monoclinic Sulfur.* This form is obtained from the cooling of fused Sulfur. On heating Sulfur in a Hessian crucible until melted, allowing to cool until a crust forms on the surface, then quickly pouring out the liquid portion, the crucible will be lined with long, brilliant, transparent crystals, having the form of monoclinic prisms, these becoming opaque after twenty-four hours at ordinary temperature. If these crystals are examined under a microscope, they will be found to be made up of minute rhombic crystals. This form has a specific gravity of 1.96 and melts at 120 degrees, and is soluble in Carbon Disulfid.



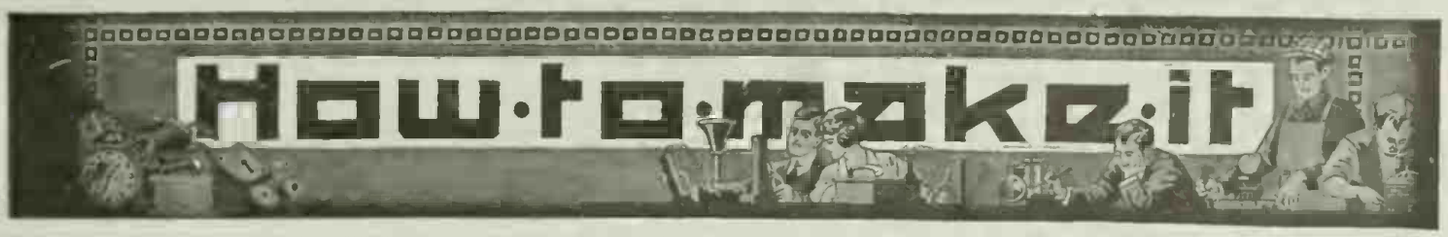
Applying the Lead Acetate Test to Hydrogen Sulfid Gas.

Plastic or *Amorphous Sulfur.* This may be prepared by carefully heating Sulfur to 330 degrees, and then pouring, in a thin stream, into water. The product in this case being an amber-colored, plastic mass, which may be drawn out into threads or kneaded between the fingers. This is called the Plastic variety. The specific gravity of this form in 1.956, which is insoluble in Carbon Disulfid. Due to the fact that it quickly reverts to the rhombic variety with the evolution of heat, no melting point can be assigned to it.

(*Continued on page* 577)



The Apparatus Employed for "Precipitation" By Hydrogen Sulfid.

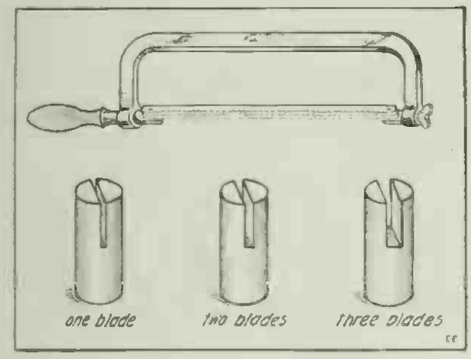


This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

SECOND PRIZE, $2.00

NIFTY SLOT-CUTTING WRINKLE.

To cut slots (which is quite difficult to do neatly with a thin file), hook into your hack-saw frame, instead of the usual single blade, two, three or four blades, according



A Clever Method of Cutting Slots of Any Desired Thickness In Metal Stock with a Hack Saw. Two or More Blades Are Used as Required.

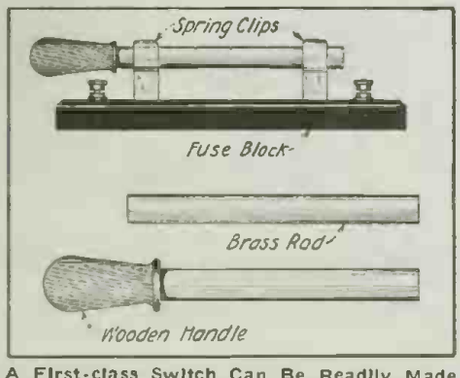
to the width of the slot desired. Be sure to have the teeth of all blades point the same way. A beautiful even slot is the result.

Contributed by THOMAS REED.

MAKING A SWITCH FROM AN OLD FUSE BLOCK.

To make a switch from an old fuse block is an easy matter. All the material that is necessary is the fuse block, a piece of brass rod the right length, and a wooden handle. I used the handle of an old shocking machine. A hole is bored in the handle so as to hold the brass rod snugly. The clips that originally held the fuse are now used to hold the brass rod. Connections are made by running the brass rod in the clips in place of the fuse. When the switch is not in use the rod may be taken off and taken with you, so no one can temper with the switch while you are away.

Contributed by
RUSSEL MAC COMISKEY.



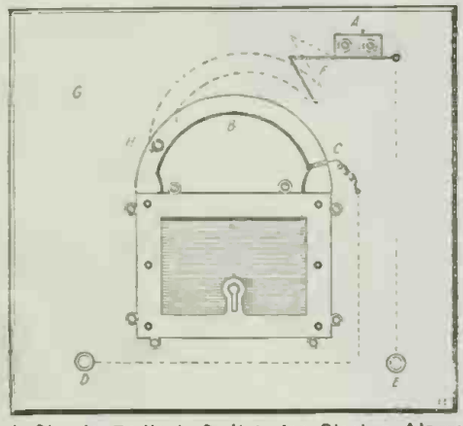
A First-class Switch Can Be Readily Made from an Old Fuse Block, Fitting It with a Brass Rod and Handle as Shown.

FIRST PRIZE, $3.00

A HOME-MADE "LOCK-SWITCH."

Having need for a lock-switch, I made one as shown in diagram. On a base, G, I mounted a padlock, B, with screws. A wire was soldered at C and connected to binding post D. A block of wood was mounted at A and a strip of brass, F, was fastened to it. The brass spring was connected to post E. The strip of brass was bent until a good contact was made when the padlock was open.

To make this switch more effective, a cover should be put over it, with an open-



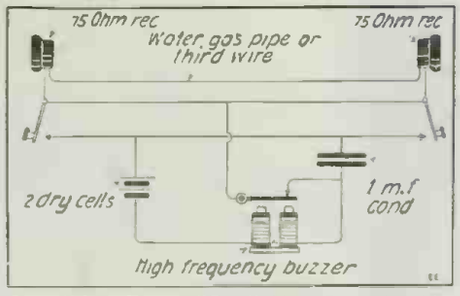
A Simple Padlock Switch for Closing Alarm Bell Circuit Whenever Lock Hasp Is Opened.

ing to insert the key and a pin, H, should project thru the cover so that the lock can be shut.

Contributed by E. D. PAPKEE.

A CENTRALIZED BUZZER TELEGRAPH AND TELEPHONE LINE.

This scheme comprises one buzzer, 2 dry batteries, 2-75 ohm 'phones 1 m.f., con-



Something Every "Bug" Has Been Looking for—a "Centralized" Buzzer Telegraph and Telephone System, Having But One Battery and Buzzer at a Central Point.

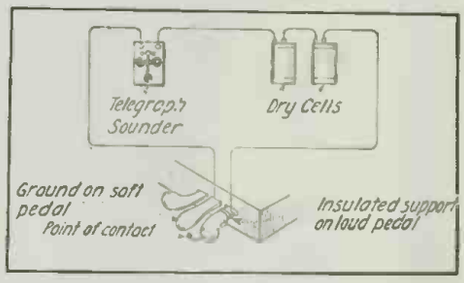
denser and enough wire to connect stations. One twisted pair and gas or water pipe will work all right in lieu of the third wire. The one buzzer works both 'phones at once thru the condenser and they may lay on the table or desk as they respond very loudly. The buzzer battery, and condenser may be connected at either end but at the center of the system preferably. Only one of each is necessary to work both ways. Where two Amateurs reside in the same house or on the same side of the street this will go a great way towards keeping them in trim until after the war. Now, brother experimenters don't wear long faces because you can't use your radio outfit. Hook this up and forget your grouch.

Contributed by
JOSEPH C. HANHAUSER.

THIRD PRIZE, $1.00

TRY THIS STUNT ON YOUR PIANO.

A very unique and entertaining (also sometimes exasperating) attachment may be easily installed by musically inclined experimenters, for their own amusement.



Want to Surprise Your Big Sister—Just Hook Up This Telegrah Sounder Stunt to the Soft Pedal. The Sounder Will Do the Rest.

Procure a telegraph sounder and a few dry cells. Consult the accompanying diagram, and the soft pedal will do the rest.

Contributed by J. J. COPELAND.

HOW TO REMEMBER OHM'S LAW.

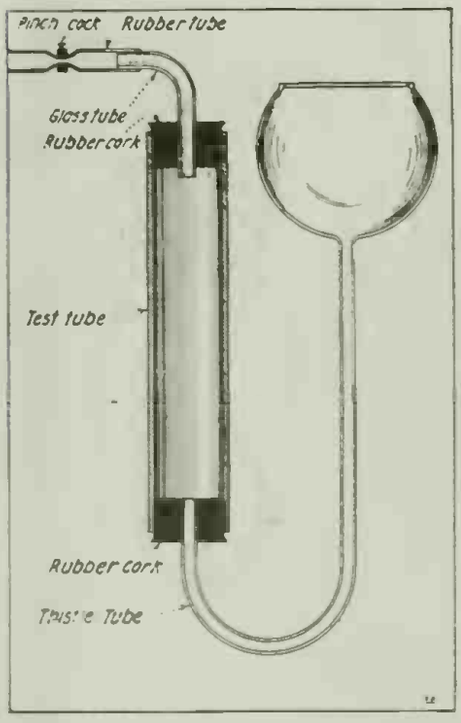
I present herewith a simplified method for figuring Ohm's law which I have never seen in print. It might appropriately be termed "Ohm's Law in a Nutshell." In the formula E represents voltage, A amperes, and R the resistance in ohms. To find any term, cover it with the finger. Thus to find the amperes we have the fraction E over R, or volts divided by orms; to find voltage we have A times R; to find ohms we have the fraction E over A. I find this very easy to remember, and very much better than trying to remember the three formulas.

Simple Ohm's Law Rule.

Contributed by
E. L. STITT.

A SIMPLE KIPP GENERATOR.

The Kipp generator shown in the accompanying drawing can be easily and cheaply constructed. The drawing explains itself, so far as construction is concerned. The test tube should be as large as possible, but



Simple Kipp Gas Generator, Made from Section of Test Tube, a Bent Thistle Tube and Two Rubber Corks.

one 6" by ¾" will do very well. The best way to cut the end off the test tube is to encircle it with a file scratch, wind two strips of wet filter paper around it 1/16" from the mark, and then heat the tube between the strips, when it will crack cleanly.

Such an apparatus, which will deliver a stream of gas at any time, is a great convenience and time-saver in almost any experimenter's laboratory. For generating: Hydrogen, chlorin, carbon dioxid, or hydrogen sulfide, use: Dilute hydrochloric acid (1 : 3) in the thistle tube and granulated zinc, potassium permanganate, marble chips or iron sulfide respectively in the test tube.

Contributed by HAROLD GREINER.

CHEMICAL WRINKLES.

Artificial Amber—Dissolve shellac in an alkaline lye; then mix with a solution of chlorin until the shellac is entirely precipitated. Wash in water and heat gently till it runs clear. It can then be molded.

Artificial Ivory—Four parts sulfuric acid, 50 parts water. Macerate peeled potatoes in the solution 36 hours. Dry the mass between blotting paper and subject to great pressure.

Filler for Wood—Equal parts Japan, boiled linseed oil and turpentine, and one-half that quantity of dry starch. Mix and apply with sponge or flannel. Dry 48 hours and rub with No. 0 sandpaper. Make second application and when dry rub with ticking over a block of wood until the wood is perfectly smooth. Stain and finish up in any desired style. Use no color for oak.

Rosewood Stain—Alcohol 1 gallon, camwood 2 ounces. Set in a warm place 24 hours. Add extract of logwood 3 ounces, aqua fortis 1 ounce. When dissolved it is ready for use.

India Ink—Grind fine lampblack and gelatine, scent with camphor or musk essence and mold in sticks. It can be improved by washing the lampblack with a solution of caustic soda and then straining off the solution or drying it out.

Transparent for Tools—Best alcohol, 1 gal.; gum sandarac, 2 pounds; gum mastic, ½ pound. Place all in a tin can which admits of being corked; cork it tight, and shake it frequently, occasionally placing the can in hot water. When dissolved it is ready for use. This makes a very nice varnish for new tools which are exposed to dampness, etc.

Contributed by ERNEST E. MILLER.

A NOVEL CHEMICAL INDICATOR.

In chemistry an indicator is something which tells whether a substance is acid or basic.

The following is a rather peculiar one:

Place some sulfate of quinin in a beaker and add some water. The sulfate of quinin will not dissolve. Now add dilute sulfuric acid drop by drop until the sulfate of quinin is all dissolved.

To test for a basic reaction add some of the above solution to the solution to be tested. If the solution is basic the sulfate of quinin will reappear as a flaky precipitate. To test for an acid make some of the test solution slightly basic and add solution to be tested. If the solution *clears* the substance is acid.

Contributed by J. C. MORRIS, Jr.

EXPERIMENT WITH CALCIUM CARBONAT.

Place some powdered calcium carbonat in a vessel containing some water. The carbonat is insoluble. Now blow the breath thru the water and the carbonat will dissolve due to the fact that the insoluble carbonat of calcium is transformed by the carbonic acid gas of the breath into the soluble bi-carbonat of calcium.

Powdered or precipitated chalk is a convenient form of calcium carbonat to use.

The reactions which take place are as follows:

First: The carbon dioxid of the breath unites with the water to form carbonic acid, according to the equation:

$$H_2O + CO_2 \longrightarrow H_2CO_3$$

Second: The carbonic acid unites with the calcium carbonat, according to the equation:

$$Ca\,CO_3 + H_2\,CO_3 \longrightarrow Ca\,(HCO_3)_2$$

If the solution of the bi-carbonat is heated the carbonat of calcium will again appear as a precipitat because the bi-carbonat of calcium is broken up by the heat, according to the equation:

$$Ca\,(HCO_3)_2 \longrightarrow Ca\,CO_3 + H_2\,CO_3$$

This latter fact is made use of commercially in the purification of water.

Contributed by J. C. MORRIS, JR.

IS POTASSIUM FERRICYANID POISONOUS?

Editor ELECTRICAL EXPERIMENTER:

In the September number, on page 325, is an article on "How to 'Steel-Plate' Parts", contributed by A. Mencher, in which it is stated that "Potassium Ferricyanid is one of the most deadly poisons". That is news to the 77-year-old writer who has been handling the stuff off and on for more than fifty years. Mr. Mencher is absolutely wrong; it is not poisonous at all. For proof let him refer to the *National Dispensatory*, 1879 edition, page 1127 and he will find this: ". . . and that it may be administered for *weeks* in the daily dose of several grains, without deranging the health or altering the composition of the urine".

Yours for facts,

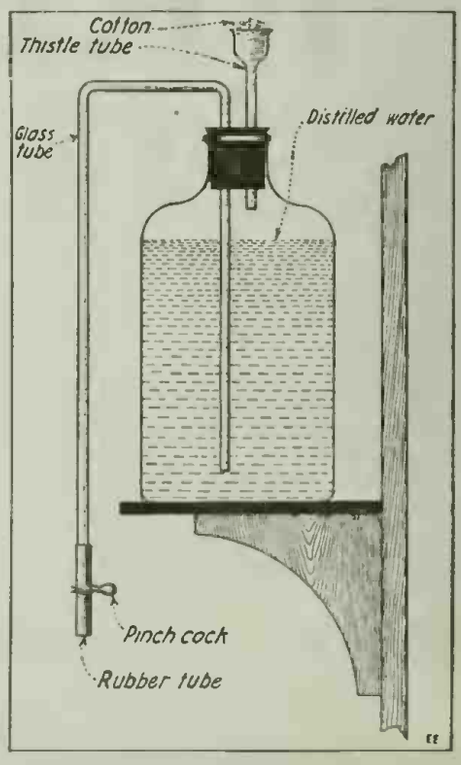
A. GALPIN.

The length of the smallest screw ever made is .028 of an inch, its diameter .026 of an inch, weight .012 of a grain. There are 360 threads to the inch and it takes 582,333 of these screws to make a pound.

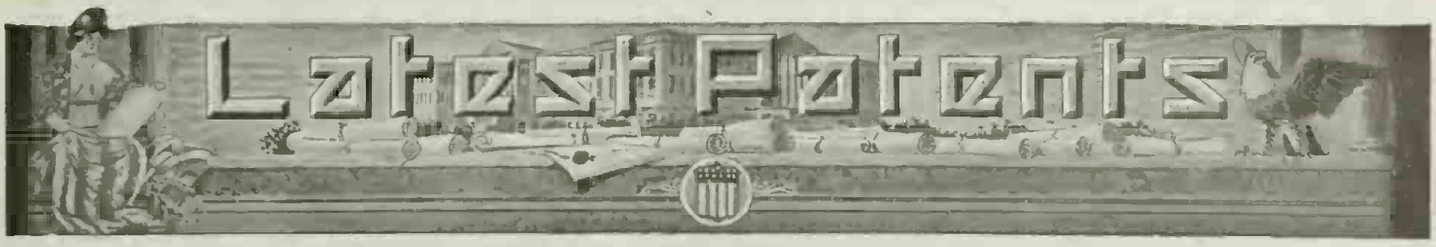
HANDY DISTILLED WATER SUPPLY.

The accompanying drawing shows a convenient method for having a handy supply of distilled water. When it is once started siphoning through the bent tube, it will always be ready. Any amount can be drawn at will. The thistle tube permits the air to enter the container, while the cotton in it keeps the dust, etc., from getting into the water. The drawing explains fully the construction.

Contributed by HAROLD GREINER.

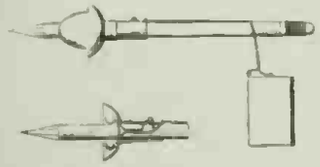


Here Is a Very Handy Distilled Water Supply Acting on the Siphon Principle.



Electric Light for Pencils
(No. 1,274,022, issued to Cristian Edmundson.)

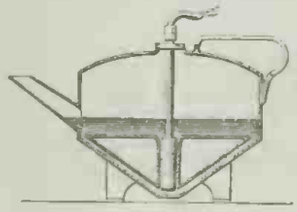
This electric light attachment for pens or pencils is intended for use in conjunction with a small flash-light battery carried in the pocket.



The attachment as here designed is detachable from the pen or pencil, and is also provided with a switch for closing the lamp circuit. The switch is controlled by the movement of the fore-finger while writing and thus the position while writing is a natural one. The attachment may be adjusted at any position along the pencil to compensate for resharpening, etc. Two or more pea lamps can be used in the reflector.

Electric Cooking Vessel
(No. 1,273,821, issued to Howard C. Causton.)

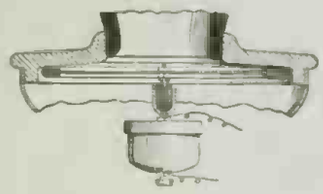
This invention relates to a domestic kettle or cooking vessel adapted for use with an electric heating unit, the improvement being directed to the provision of a receptacle within which the heating unit proper may be removably placed. This receptacle is below the bottom of the general volume of the vessel so as to insure entire



immersion of the heating unit, with an amount of liquid which is relatively small in proportion to the volume of the vessel. By the special design of the vessel as shown, the liquid is delivered to the heating unit from a position in the vessel remote from the location of that heating unit, and an effective circulation by convection is insured.

Wave Impulse Translator
(No 1,274,661, issued to Edward H. Amet.)

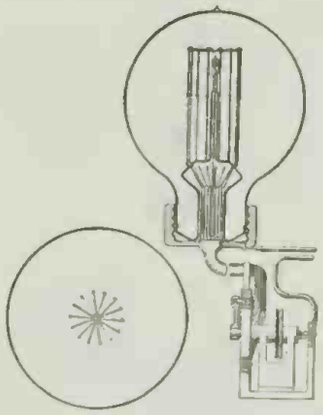
An improved wave impulse translator particularly designed for use in the transmission of sound waves, especially as applied to talking machines and telephones. One of the objects is to translate wave currents without shock or jar, thus giving better articulation of reproduced impulses. There are two members in this translator that may



he oscillated in a common direction, these members being actuated by a resilient and non-resonant means, as by means of a friction coupling, in which soft India rubber is used. The inventor claims that the device is efficacious for the purpose of making talking machine records, and reproducing them by means of this invention.

"Cold" Light
(No. 1,273,130, issued to William L. Barnard.)

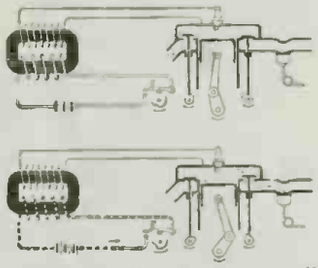
On the order of the cold light of Dussaud, the Frenchman, this inventor provides an incandescent electric lamp having a multiplicity of filaments which are connected to a rotary switch in such a manner that when the switch is rotated by a motor, a continuous and uniform luminosity will be produced by the lamp. Each filament produces but



an intermittent luminosity. In this way each filament is switched off before it produces any great heat, and thus the total heat radiation from such a lamp is greatly reduced.

Art of Illustrating Phenomena
(No. 1,270,369, issued to Charles F. Bisbop.)

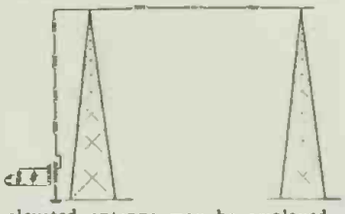
Ordinarily the flow of electrical current along a conductor is an invisible phenomena of course, but the inventor represents action in electrical circuits by using parallel lines to form each conductor, and then partly fills in the space between these lines with short black sections to represent the presence of



a current. He also uses parallel lines of varying density to indicate different degrees of magnetization. When a large number of successive diagrams are constructed in this manner, it is evident that a very realistic effect will be produced upon the spectator, as he can veritably see the current flow around the circuit, the core becoming magnetized and the secondary coil discharge across the spark plug, etc.

Radio Signaling Scheme
(No. 1,273,431, issued to Roy Alexander Weagant.)

An improved method of radio signaling employing a receiving antenna designed to exclude interfering electro-magnetic waves having a frequency considerably higher than the frequency of the incoming waves. The usual arrangement of



elevated antenna may be employed, but included therein at regular intervals, there is inserted a series of fixt inductances, which may be of equal value and in the form of closely wound coils. This antenna is connected in the usual manner to a tunable receiving set. Apparently a species of electrical inertia is thus imparted to the antenna system, which resists the wide oscillations produced by shock.

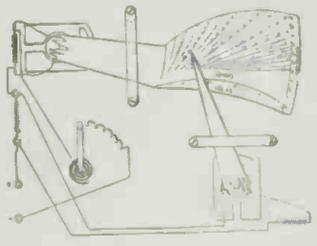
Talking Motion Pictures
(No. 1,275,227, issued to Clyde J. Coleman.)

In this patent an arrangement is provided for establishing synchronism between a motion picture projector and a phonograph, such that this synchronism is attained by providing an escapement for one mechanism, controlled by the driving element of another, each mechanism having a separate source of power. The phonograph is placed behind the screen, and the sound passes thru openings in the same. A commutating disk controls the

electrical impulses sent thru an electromagnet attached to the escapment mechanism or wheel attached to the picture projecting machine, so as to thus control the "speed" and "register" of the film.

Direct Reading Ohm-Meter
(No. 1,275,786, issued to Harry Gould Stuart.)

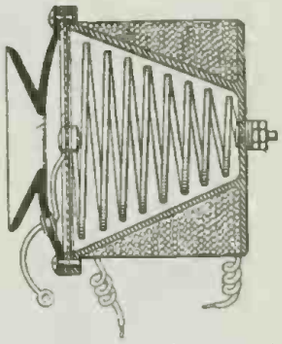
The inventor provides a direct reading ohm-meter comprising two distinct elements, viz: an ammeter and a volt-meter. It operates on the principle of Ohm's law, familiar to all electricians. The movable element of the ammeter carries a calibrated scale or dial; the movable element of the volt-meter carries an indicator which extends in a direction approximately at right angles to the scale attached to the ammeter. Thus the scale and indicator overlap, and by noting the position of the



indicator with respect to the scale, the ohmic value of the conductor can be immediately deduced.

Telephone Transmitter or Receiver
(No. 1,270,920, issued to Konrad Botz.)

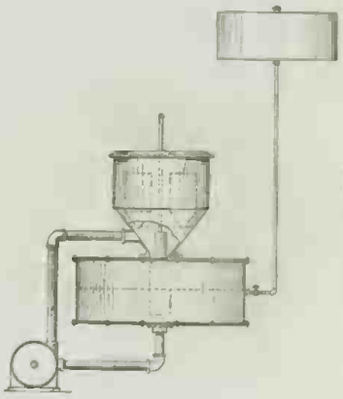
A telephonic device suitable for use in converting sound waves into electrical impulses, or electrical impulses into sound waves. The inventor provides a clever and simple arrangement of telephone transmitter or receiver of the diafram type, and which has operatively connected with the diafram, an oscillator element, made in the form of a helical cone of "magnetic" and "current-conducting" material such as iron. This so influences the magnetic field when the diafram is actuated that current impulses will flow thru the circuit in which the oscillator is connected. Further-



more, the passage of electric impulses thru the magnetic oscillator so influences the magnetic field that the diafram will be oscillated so as to emit the original sounds which set up the electrical impulses thru the magnetic oscillator in the telephone circuit. The diafram used is of mica. The conical helix may be made of iron or steel.

A Liquid Rheostat
(No. 1,275,908, issued to Arthur J. Hall.)

In this improved form of liquid rheostat, means are provided for automatically replacing the losses due to the evaporation of the elec-



trolyte within the rheostat and maintaining a substantially constant amount of electrolyte, which may be continuously circulated thru the liquid rheostat for the purpose of dissipating the heat developed therein. Another provision is an automatic means for maintaining the density of the electrolyte at a constant value. To accomplish this an auxiliary tank of fresh water is connected to the main electrolyte reservoir, so as to automatically supply water to the electrolyte whenever the volume has decreased to a predetermined amount. A pump is provided for circulating the electrolyte continuously as shown.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10C EACH

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay $3.00 prize each month for the best photo. Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

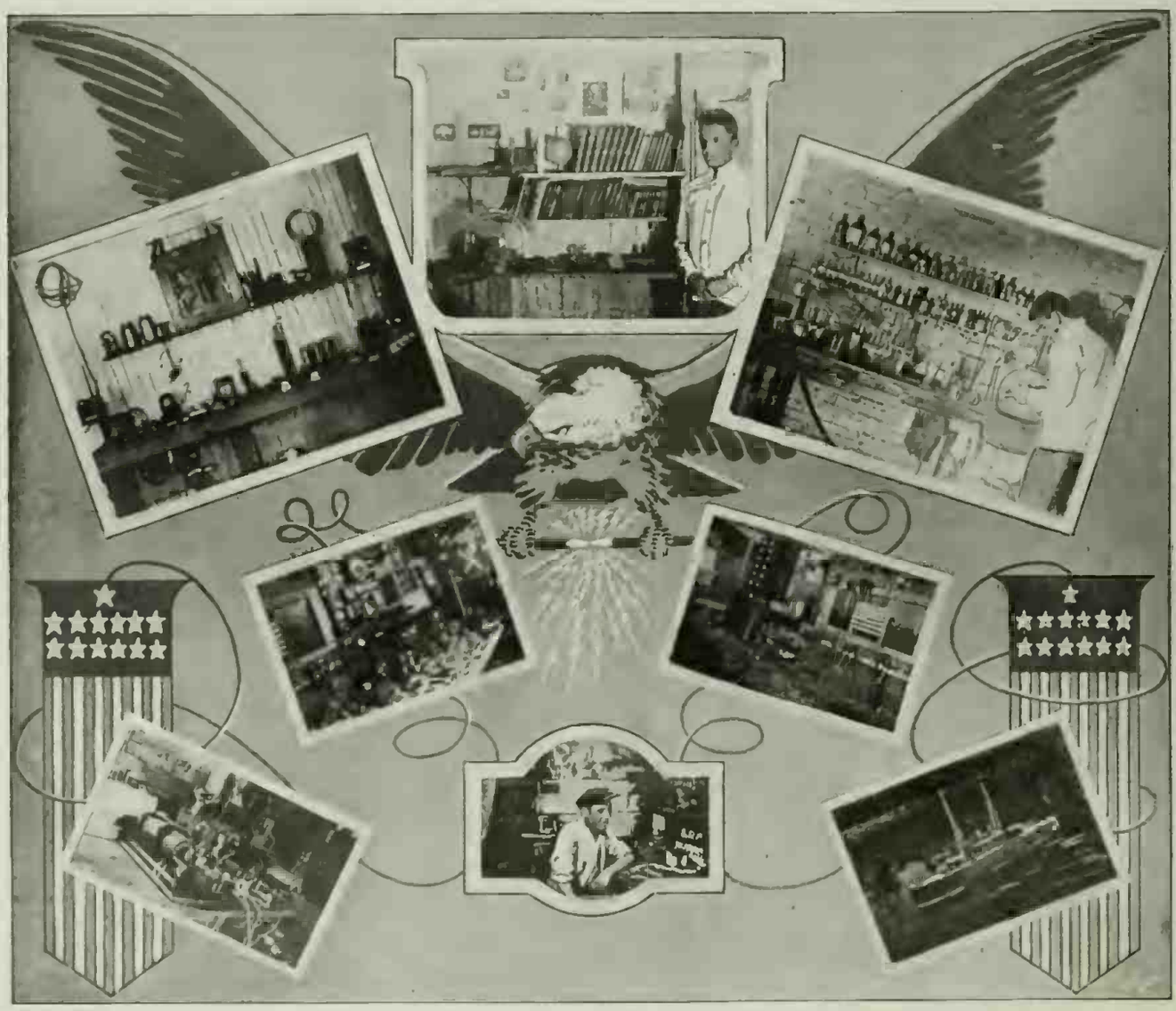
THIS MONTH'S $3.00 PRIZE WINNER—HOWARD BUCKWALTER

HEREWITH I present three photos of my Electro-chemical "Lab." All together my Electrical "Lab" consists of about 45 pieces of apparatus, such as static machine, Leyden Jars, induction coils, switches, spark coil, a lamp bank, a magneto, a small dynamo, several motors, all the parts of a radio outfit, several parts of a telephone, a variable and a couple of fixt condensers, A. C. bells, a resistance, German Silver and copper wire, etc. The static machine is of the Toepler-Holtz type, from which I can coax a six inch spark. With the above mentioned apparatus I have performed a considerable number of experiments, especially with the static machine. The Chemical "Lab" consists of over one hundred and fifty reagents and about 50 pieces of apparatus, among which are ring stands and clamps, test tubes, Erlenmeyer and Florence flasks ranging from 50cc. to 500cc.; graduates, delivery tubes, U-tubes, Hydrometer, lactometers, 2 balances, wash bottles, a nest of beakers, a retort, a mortar and pestle, etc. The apparatus set up in the right foreground is for the electrolytic production of lead carbonat. With the apparatus I have performed a number of experiments in inorganic chemistry. The other photo shows my library, which consists of 52 purely scientific books. Also a 200 diameter microscope, a skull, and several supplement photos from the "E. E." I have all of the "E. E" issues since November, 1915. HOWARD BUCKWALTER, Lancaster, Pa.

HONORABLE MENTION (1 year's subscription to the "ELECTRICAL EXPERIMENTER")—E. BERGQUIST

ONE of the photos (lower group) shows my wireless controlled boat that I made; it goes out and shoots four small cannons off, and has two speeds ahead and two speeds reverse. It is directed by a small spark coil on shore. My shop is located away from the house, so I can make all the noise I want to without disturbing the folks. Two small storage batteries can be seen under the shelf and a transformer is below the switchboard, from which I can get any potential from 1 volt up to 220, and up to 50 amperes. At the right of the large ammeter is a magnetic rectifier of my own design, which is connected to an oil-immersed step-down transformer beneath the table and from which I can draw 20 amperes D. C. current for charging batteries, and I take in quite a few for charging. In front on the shelf is an electric soldering iron, which I find very handy. On the end of the shelf is a 60,000 volt, ¼ K. W. transformer. When I connect this to my Tesla coil, I can get sparks about eight inches long. On the switchboard are various instruments for measuring resistance, volts and amperes. I can obtain from 2 to 12 volts A. C. or D. C. by simply turning a few switches on the switchboard. At the extreme right can be seen my telephone, which goes to 6 other electric "Bugs," one of whom resides a mile away. I also have "Experimenters" dating back to 1913 and a complete set of electrical books.

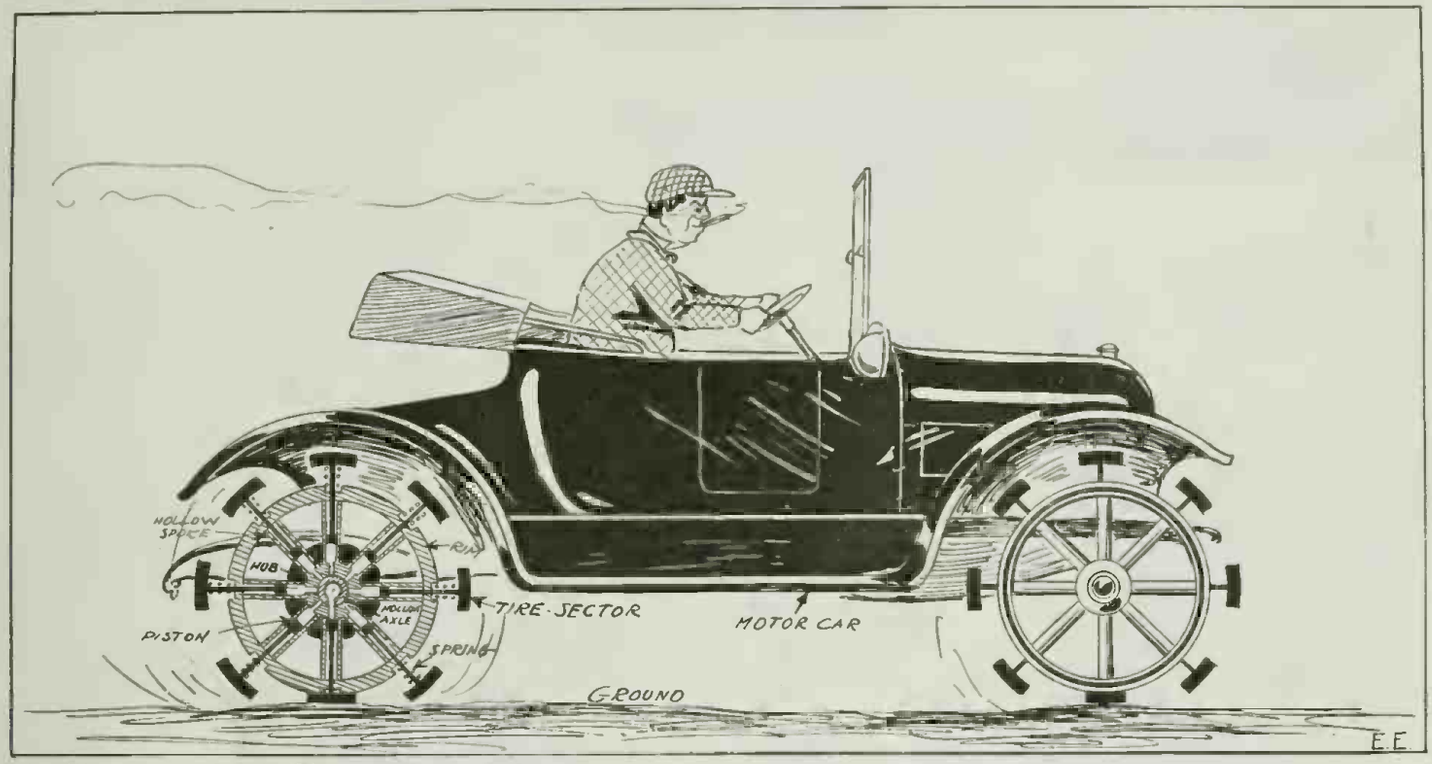
E. BERGQUIST, Spokane, Wash.



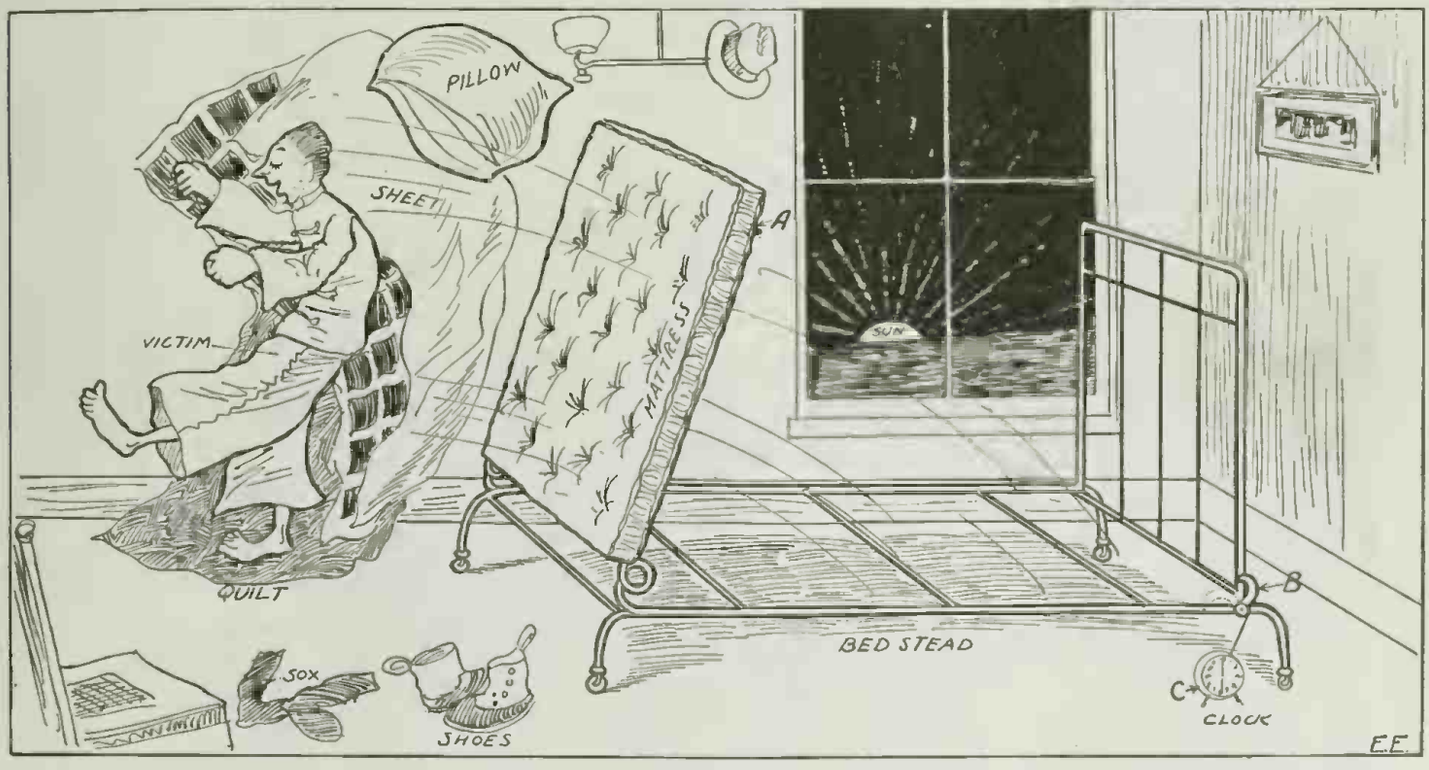
Phoney Patents

Under this heading are publisht electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all sufferiog daffy inventors in this country as well as for the entire universe.

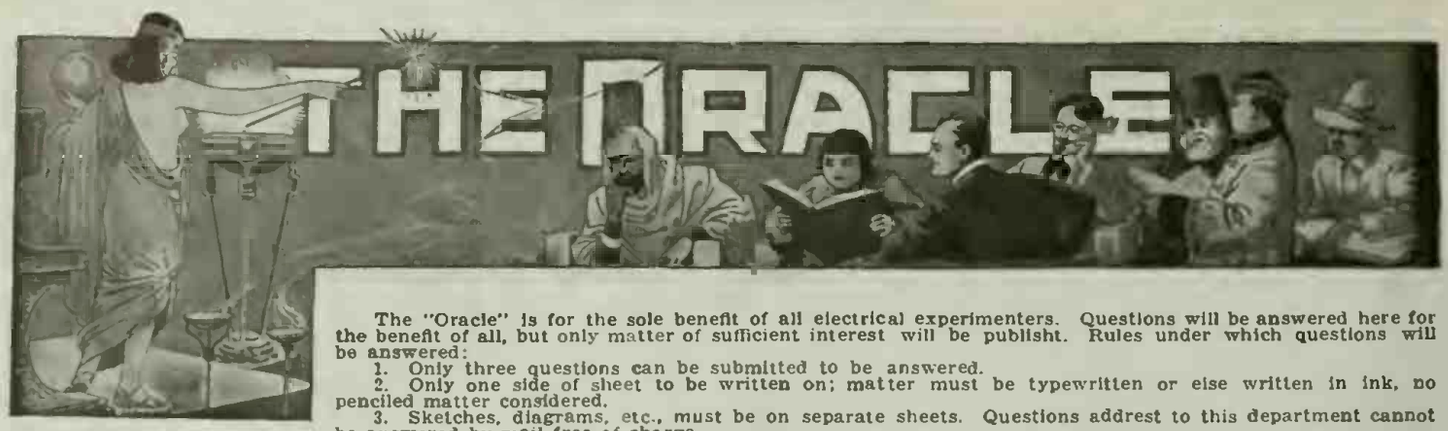
We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of a Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00! We PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00!! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick hat. The daffier, the better. Simple sketches and short descriptions will help our staff of Phoney Patent Examiners to issue a Phoney Patent on your invention in a jiffy.



Prize Winner: AUTO WHEEL AIR COMPRESSOR. The source of the free fuel is all in the wheels, a sectional view of which is here shown. The rim of wheel is divided into sectors and each sector is connected with a piston moving up and down in each of the hollow spokes. As each sector comes against the ground the weight of the car forces the piston inward, compressing the air in the spoke. Near the end of the piston stroke the spoke registers with an aperture in the hollow axle, thus forming a rotary valve. The hollow axle is flexibly connected to a suitable storage tank equipt with pressure gages, etc., mounted at any convenient point on the chassis.. From this storage tank the comprest air is led to an "Air Motor" connected to the propeller shaft thru gears engagable by means f foot pedal. With this system you only need to run your gas motor until the air pressure in tank is high enough to start the air motor, and thereafter you travel on air with enough surplus to run such attachments as a signal siren, air brakes, self-commencer and all the other confounded contraptions so dear to the hearts of all "motor-bugs." Inventor, J. A. Wever, Baltimore, Md.



GETUPQUICKBED. The failure of the ordinary garden-variety alarm clock to arouse the heavy sleeper is well known, even when the expedient of placing the clock on the family dish-pan is resorted to. Again, some of us are so absent-minded that we shut the clock off in our sleep, or else go off into slumberland again after the clock has sounded its 6 A. M. warning. So, be it known to the patriotic alarm-clock public that I, D. M. Haig, have this day invented an alarm clock "getupquickbed," and it sure lives up to its word. To use it, proceed thusly: The mattress is attached to the bedstead by means of two powerful springs at the foot of the bed, which when free hold the mattress in a vertical position. At night the mattress is deprest, and the pin A is engaged by the catch B, which retains it in a horizontal or sleeping position. The alarm hammer of the clock C, instead of beating viciously at a murderous gong, as heretofore, releases the catch at 6, 7 or 8 A. M., and you will rise punctually, never fear! Inventor, D. M. Haig, New York, N. Y.

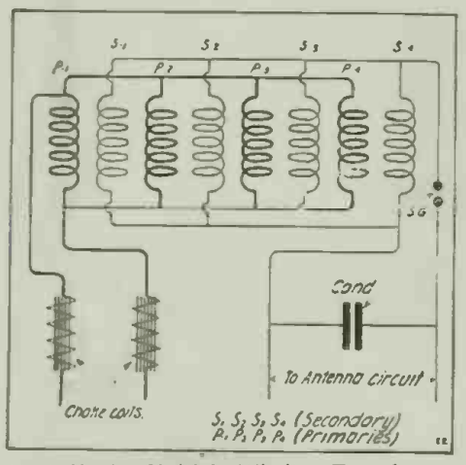


The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions address to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

TRANSFORMER CONNECTION AND POWER FACTOR.

(964) W. B. Cain, Montreal, Quebec, Can., asks us:



Hook-Up for Multiple Winding Transformer. The Primary Divisions Are All Connected nn Parallel, as Well as the Secondary Units.

Q. 1. Why will the transformer connection I show not work?

A. 1. You have shown the transformer windings connected in series which is wrong. The transformer windings both primary and secondary should all be connected in parallel, as shown in the accompanying diagram. The transformer ought to operate with about the same efficiency as a 2 K. W. transformer.

The effect of connecting these in parallel will be that of using energy to the amount of 2 K. W. or using the normal lighting current (110 volts, 60 cycles), a current of about 18.2 amperes will be used, at 100% power factor. Such a transformer would only have a power factor of about 80%. Hence the apparent watts (volts × amperes) = 2400 watts; current then equals 22.7 amperes as indicated on an ammeter. Thus you will see that a special circuit will be necessary because the ordinary house circuit is only heavy enough to carry 6 amperes. By placing proper choke coils in the primary side, the effect of dimming the lights can be minimized.

DECREASE OF INDUCTANCE WITH INCREASE OF FREQUENCY.

(965) W. O. Powers, New York, writes "The Oracle":

Q. 1. Re: the article on "Investigation of Inductance Coils" in the July issue of the ELECTRICAL EXPERIMENTER, page 179:

You will note that as stated, the inductance of a coil is decreased with increasing frequency of current. According to my understanding of what takes place in the windings of such a coil this statement is not quite clear to me.

A. 1. The reason for the inductance increasing when high frequency is used, is that the high frequency current merely traverses the outside layer of the wire and produces only an outside magnetic effect; while if low frequency were used the current would traverse the whole cross-section of the wire, and all of the wire would produce magnetic effects. As the inductance is caused as a direct result of this magnetism, it consequently follows that a greater inductance value is therefore obtained with low frequency current. You are no doubt aware of the fact that a current is induced every time the magnetic lines of force vary in density, and thus you will see clearly the solution of the problem.

TELEGRAPHING OVER TELEPHONE LINES.

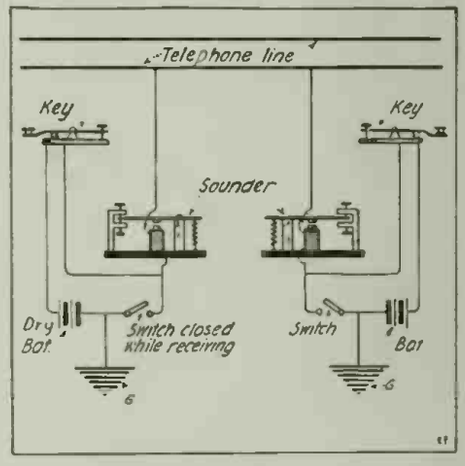
(966) Everett Ziemer, Waltham, Minn., writes "The Oracle":

Q. 1. How can I telegraph over a telephone line without interfering with the talking currents?

A. 1. Regarding the connections of a telephone line to be used for the operation of telegraph instruments, see diagram. It is not a very good practise to use telephone lines for this purpose, as it is against local statutes to use any Public Service utilities for personal use. If the telephone line is a privately-owned affair it does not matter.

With reference to the ground connection, this can be made by using a metal plate about one foot square, and burying it about eighteen inches in a moist spot of ground. Should the ground prove to be dry, it would be advantageous to place some charcoal about the plate, and at periodic intervals to pour water over it.

Another way is to connect a percussion



Telegraphing Over One Side of a Telephone Circuit, Using the Ground as a Return Circuit.

type telegraph key to the metal stand of the telephone. By manipulating the key of such an instrument the clicks of the code can be transmitted over any length of telephone line, without any batteries or other paraphernalia beyond that making up the telephone instruments. We will supply address of company supplying such a key on receipt of stamped envelope.

(*Continued on page* 568)

THE ORACLE.

(*Continued from page* 566)

HOW TO PRODUCE "INFRA-RED" RAYS.

(967) James F. Glancy, Keosququa, Ia., writes:

Q. 1. Asking several questions regarding fluorescent mineral effects, infra-red rays, their production, etc.

A. 1. Replying to your first query, the fluorescent pad you speak of is probably nothing more than some granulated carnotite and zinc sulfid or willemite, all of which can be procured from one of the companies advertising in these columns.

Relative to infra-red rays: these rays are developed by means of powerful searchlights, which consume as high as 20 K. W. or more. They are focust by means of parabolic reflectors, the reflective surface of which is usually highly polished zinc or silver. The electrodes are of carbon and some barium chlorid is usually added to increase the production of the infra-red rays. The visible rays can be screened off by the interposition of a suitable diathermanous screen which consists of black fluorit, smoky quartz or a strong solution of iodin in carbon disulfid. The rays may be detected by the aid of a thermo-pile or a bolometer, the expansion of liquids, etc. We do not see anything in the way of developing them for use on powerful war machines. For most interesting information on the use of powerful, invisible infra-red rays, for radio control we refer you to the book "Radiodynamics," supplied thru our Book Department at $2.15, postpaid.

MAKING STEAM DIRECT FROM ELECTRICITY.

(968) Karl A. Loeven, Bismarck, N. D., writes us:

Q. 1. Can I produce steam from electrolytic action in water directly at a reasonable efficiency.

A. 1. Your particular idea of using electricity for the production of steam is indeed very good, because efficiencies of 98% have been reached by some investigators along these lines. By referring to the March, 1918, issue, page 748, of this Journal, and to U. S. Patent No. 1,251,116, we believe you will obtain the desired information.

PHOTO-ELECTRICITY.

(969) Albert S. Osgood, Ames, Ia., writes "The Oracle":

Q. 1. Refers to several queries concerning photo-electricity.

A. 1. Photo-electricity is the development of electricity by certain cells when exposed to light. They bear no relation to wireless in the common sense. There are no examples at present of P.E.C. being used in wireless work. Extensive articles pertaining to electricity developed direct from sunlight, which deal with P.E.C., are given in the September, 1916, issue of the ELECTRICAL EXPERIMENTER, page 316, and March, 1918, issue, page 798.

SIGHT OF WOUNDED TO BE RESTORED BY NEW INVENTION.

An invention is being perfected in France which, it is claimed, will restore sight to men blinded by the most serious wounds and accidents. The experiments are being conducted by a Polish foreign legionary named Kann. Work upon the apparatus is being watched with the keenest interest by Allied officials.

The perfection of the apparatus would be unusually timely, following up the reports from German sources that the Huns are planning to use two new kinds of gases which blind their victims.

BURGESS BLUE BOOK. A book of electrical formulæ and electrical drawings, problems and calculations. Compiled by Yorke Burgess. Flexible covers, 108 pages, profusely illustrated, size 6½ x 4 inches. Price $1.00. Publisht by the Burgess Engineering Company, Chicago, Ill, 1918. Pocket style.

This useful and out-of-the-ordinary hand-book is moderately priced and highly suited to the needs of the practising electrician. It is, frankly stated, the book electrical men have been expecting. There is no padding of the usual old "rehash" about theoretical circuits and design figures. If a student or electrician wants these he knows where to find dozens of excellent treatises on these subjects. What Mr. Burgess has done is to give the practical electrical man, artisan and engineer alike a real, boiled-down and meaty pocket-size volume, which he can always have with him and find therein just what he wants.

The treatise opens with clear blue-line drawings of practical hook-up for motor starting boxes and speed controllers, including remote control apparatus, as well as drum controllers, printing press controllers, "monitor" automatic starters, reversing controllers, float switches, elevator controllers, series and compound machine hook-ups, variable speed devices, mine locomotives, street car wiring diagrams, induction motor connections and auto transformers.

Then comes a section of wiring diagrams for all the usual lighting circuits, such as 3-way and 4-way control, three-wire systems, and numerous other hook-ups which often puzzle the electrician when he comes to install such circuits.

The author gives explanations of the perplexing problems met with in every-day electrical installation and design, as, for instance, how to solve square root, etc.; the principal electrical units and their meaning and their relation to the electrical circuit; how to figure the resistance, voltage and current of various kinds of circuits; resistances and batteries hooked in series, parallel and series-parallel; the B. & S. wire gauge and how to understand it; Ohms law and miscellaneous practical formulæ; properties of wires; kinds of copper and bronze wire and carrying capacity of wires; wire calculations; how to compute correct size of wire for any lighting or motor circuit; finding the multiplying power of an ammeter shunt; finding unknown resistance by drop of potential method with a voltmeter; proper size of pulleys, etc., etc.

The section on dynamo and motor troubles and how to find them is very clearly written, and presented in a succinct manner, so that one does not have to read through several pages of irrelevant text to find any particular trouble and its remedy. This section contains sound advice on the setting up of electrical machinery, testing out faults, brushes, functions of the field and armature and their characteristics, etc. Following this we find a set of useful Alternating Current formulæ, including the various connections of transformers.

EVERYDAY PHYSICS. A laboratory manual, by John C. Packard, A. M., publisht by Ginn and Company, Boston, Mass. 136 pages. Price, $1.00, cloth bound, size 8 x 10½ inches.

The work is profusely illustrated and bound in green cloth. It starts with the elementary ideas of measurements of different kinds, and therefrom begins with elementary mechanics. The author considers such topics as buoyancy and specific gravity.

He follows up the subject of air and gas measurements and considers therein the measurement of density of air, thermometers, etc., and the study of heat, its measurements and its uses. The author treats the subject of levers and pulleys in an easily understood manner. The subject on mechanism is also well written. He considers the subject of sound, its generation and measurements; under "generation" the siren and vibrating strings are treated upon. He also discusses in a very good way the study of the defects of hearing and the test therefore.

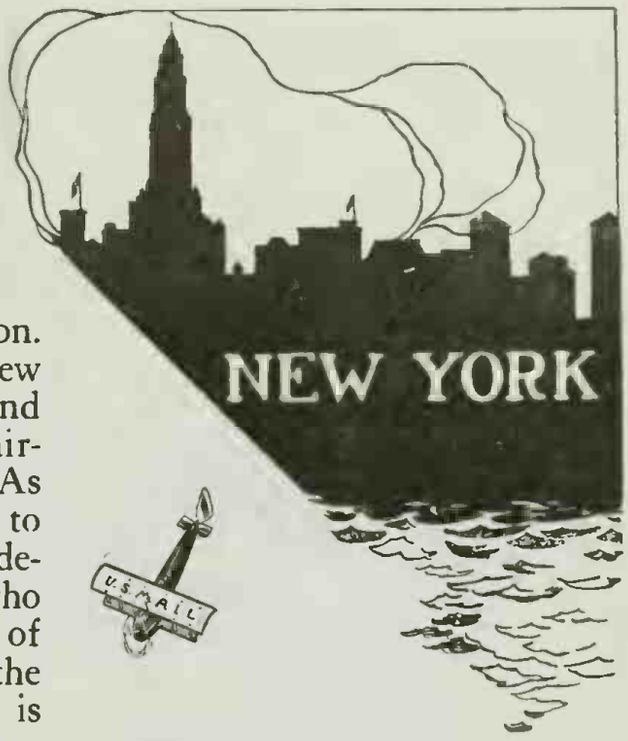
Next we find the subject of photometry and the study of light problems such as reflection and refraction, etc., also defects of vision and the tests therefor. The author concludes the book with a study of electricity and magnetism, and in a short space are given laboratory exercises and illustrative experiments for the beginner, so that he may fully grasp the subject of electricity and magnetism.

The author is to be congratulated on the very clear and concise manner in which he treats the subject, and for the excellent illustrations he has provided. It makes an excellent manual for high schools and similar institutions.

(*Continued on page* 570)

U. S. AIRPLANE Mail Service

Started May 15, 1918



marks the real beginning of commercial aviation. Uncle Sam is carrying mail every day between New York, Washington and Philadelphia and the end of the war will make possible the extension of airplane mail delivery to all parts of the country. As fast as machines can be built they will be put to work carrying freight and passengers. But the demands of commerce must wait. Every man who knows, not merely how to make one small part of an airplane, but who has studied and learned the scientific principles of design and construction is needed RIGHT NOW to help win the war.

Learn by Mail

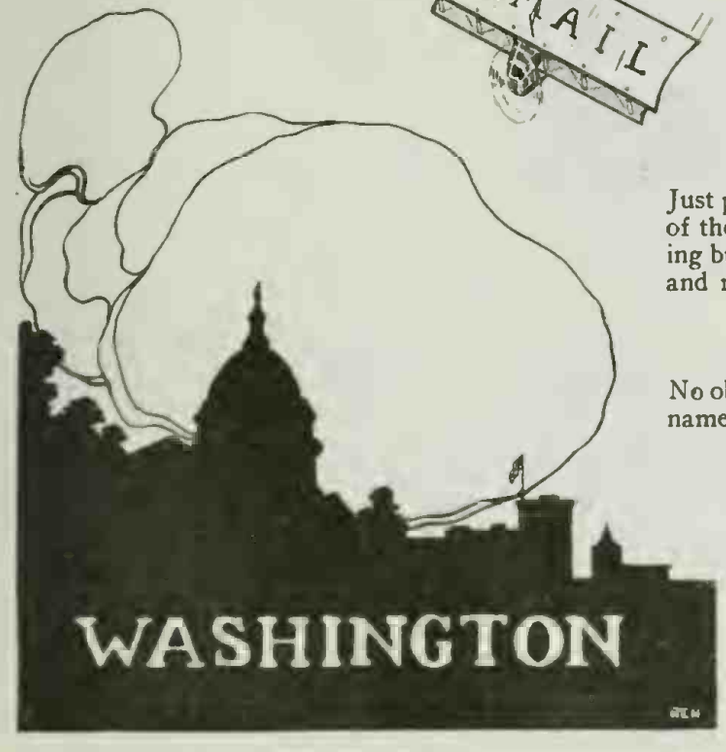
in your spare time at home. Our new, practical course has the endorsement of airplane manufacturers, aeronautical experts, aviators and leading aero clubs. Every Lesson, Lecture, Blue Print and Bulletin is self-explanatory, right down to the minute in every detail. No book study; no schooling required. All lessons written in non-technical, easy-to-understand language. You can't fail to learn quickly under our expert direction. We furnish just the kind of practical, scientific training you need to succeed in this wonderful money-making industry. Write today.

More Men Needed

Men, Young and Old, to Learn the Mechanics of

AVIATION

Wonderful salaries are being paid to trained experts in airplane building, airplane assembling, repairing and adjusting. Here is an easy road to promotion or to a splendid paying position in the private employ of one of the scores of airplane manufacturing companies. We have more calls for men than we can supply. Never has any industry offered so many golden opportunities for ambitious men. Make it your business to investigate first before you decide. But don't wait to send for full information.



FREE

NEW BOOK—"OPPORTUNITIES IN THE AIRPLANE INDUSTRY."

Just published and mailed free on request—the first complete story of the recent remarkable development of the airplane manufacturing business and the wonderful future it holds for you. Get a copy and read it. Let your friends read it.

Mail Coupon--QUICK

No obligation of any kind. But the edition is limited. Send us your name today, before it is too late, and avoid disappointment.

American School of Aviation,
431 S. Dearborn St., Dept. 744 C, Chicago, Ill.

Without any obligations on my part, you may send me full particulars of your course in Practical Aeronautics and your Special LIMITED offer.

Name .....

Address .....

.....

BOOK REVIEW.

(*Continued from page* 568)

INTERIOR WIRING, by Arthur L. Cook, publisht by John Wiley & Sons, New York. 416 pages, 248 illustrations, size, 4½ x 7 3/16 inches. Dark red, flexible binding with numerous folding plates. Price, $2.00.

The author starts the opening chapter with the characteristics of light and with the various types of electric filament lamps. Then follows the applications and construction of each lamp. Then comes the subject of arc lamps, both open and closed, and in the same chapter he considers mercury vapor lamps. Next he takes up the elementary concepts of the principles of illumination, where he considers the quality of light distribution, candle-power, curves, necessary requirements of artificial light, etc. Good reasons are given for the use of various types of reflectors, and the subjects of lighting fixtures are presented in a very complete and thoro manner. The chapter on practical methods of calculating interior illumination is commendable, and the author gives examples of various methods of illumination, including out-door lighting.

In the second part of the book we find the wiring of motors, and connections for direct and alternating current motors. Here, too, are wiring diagrams for interpole motors, squirrel cage induction motors, slipring motors, split phase and single phase induction motors, self-starting synchronous motors and single phase repulsion motors. The chapter on selecting motors for industrial purposes is important, and the author shows how a specific type of motor is necessary to properly operate each style of machine. In this chapter the author also gives a clear description of the different types of motors as used for various industrial purposes.

Section three is devoted to the system of wiring for both D. C. and A. C.; also the subjects of insulation and wiring are taken up in detail. Calculation and uses of different types of wires and cables, switches, circuit-breakers and fuses are well presented. The author takes up in the same chapter the subject of switch-boards, and gives two excellent plates, one showing the layout of the wiring for an office, and the other a simple wiring chart for direct current circuits. By means of this chart, the electrician is able to quickly select the proper size of conductor necessary to carry a particular load. An appendix contains a number of tables which are very good for the general electrician, and which facilitates the calculation of electric circuits and allied problems.

RADIO COMMUNICATION, by John Mills, 5 x 7 5/16 inches. Price, $1.75 net, publisht by McGraw-Hill Book Co. 206 pages and 126 illustrations, including diagrams. Imitation red, flexible leather. This book was written for the purpose of instructing army and navy men, especially officers who are being prepared for the Signal Corps of the United States Army.

The author has treated the subject of radio communication in a very peculiar manner. At the beginning of the book he gives us some elementary concepts of electricity and then suddenly jumps into the subject of alternating currents and therefrom develops certain mathematical relations. It seems rather unusual that at the very beginning he should delve immediately into the subject of imaginary quantities, which very few engineers utilize, as this subject of imaginary quantities is used mostly in the advanced study of alternating currents.

It would certainly be of greater ease to the average student of Radio Communication if the author had treated the subject of alternating currents in a more simple manner than he has done, the reviewer believes. There is no doubt that the subjects which he has handled at the beginning of his work are of great use to the physicists and to radio engineers in general.

In the second part the author treats on a very important subject—the telephone receiver. The author has at least done himself justice in treating the telephone receiver in a really excellent manner. Here he gives a complete theory and explanation of the various receiver parts and their functions. In a lucid manner he describes the various functions of the parts of the telephone receiver, including "motional impedance."

A very good chapter on the vacuum tube is also given. In this chapter the author begins with the elementary consideration of the electron, and from there he takes up the subject of ionization. He then treats on the two electrode-vacuum tube and shows the characteristics of the plate with respect to the filament. The three-element tube is ably discust and a short description and the characteristics of this tube are given, both as a detector of high

(*Continued on page* 574)

HOW SHIPS ARE WELDED BY ELECTRICITY.

(*Continued from page* 529)

in this case being two steel plates. The joint is usually prepared by beveling the edges of the pieces to be welded together. The other side of the electric circuit is connected to the hand electrode which is provided with a guard, and this welding tool connects with a heavy flexible cable leading to the current supply circuit. By touching the electrode to the shank material a heavy arc is drawn, and to reduce the blinding glare from the arc the operator wears a head shield fitted with special glasses. The skilled arc welder draws an arc at several points along the seam to be welded, and then establishes several distinct *tack* welds, which serve to hold the plates firmly in line. He then proceeds to start welding the entire seam, moving the electrode from side to side of the groove and giving it a semi-circular motion, while at the same time he slowly moves the electrode along the groove.

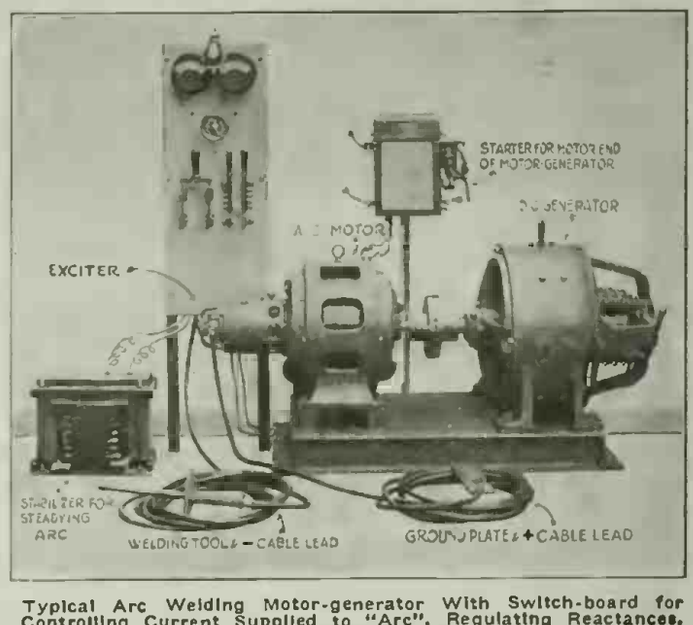
The accompanying illustration shows an excellent sample of arc welding between two plates, and it is of course understood that such a weld is formed of the basic metal composing the plates; thus the weld is invariably as strong as the plates themselves.

It is important that the arc shall "bite" into the shank metal, creating a perfect fusion along the edges, while the movement of the electrode is necessary for the removal of any mechanical impurities that may have deposited. In the coated electrode it is further necessary that the slag which forms for the protection of the pure metal be worked up to the surface, and it is extremely important in the event of a second or third layer that the slag or impurities be carefully scraped away before the virgin metal is again laid on.

The operator in arc welding is protected with a screen covering his face with special glass thru which to observe his work. The electric arc emits dangerous invisible rays in both the upper and lower spectrum scale and it is quite evident that both the infra-red and ultra-violet are dangerous in their effect; the former is pathological, the latter actinic. The operator further uses gloves for his hands and for the very difficult work of *overhead welding*, it is necessary for him to use a helmet which covers his breast.

Without entering into an elaborate analysis of the relative costs of electric welding, it may be broadly stated that there is hardly any question that the electric process is cheaper than any other. The same may be said as regards speed and also reduction of man power. In a recent discussion of this subject by an authority it was stated that at one of the Eastern shipyards the total number of parts on the welding program of the standard riveted ships now building at that yard amounted to 225,000. The labor cost for riveting these pieces is about $245,000, and for welding about $99,000, thus making *a saving of $146,000.* But this is only a mere drop in the bucket when compared to what might be profitably done in this line. The expert stated further that in certain particular instances the saving is as great as 90 per cent.

The electric arc requires a reduced voltage and this is difficult to attain with direct current without relatively expensive machines for a useless expenditure of energy. The practise in this country in manufacturing establishments of any size has been toward an increase in the supply voltage so that very few large manufacturing plants use less than 220 volts direct current. With this voltage the only economical method of transformation is in the use of a motor-generator set. The efficiency in this case is in the neighborhood of fifty to sixty per cent. It is possible to use a supply voltage of 110 volts with a variable resistance which cuts down the voltage to the arc volts. This gives a very poor efficiency. In the case of alternating current the supply voltage can be reduced by a transformer which will supply, as in the case of direct current, a sufficient voltage for striking the arc and a satisfactory reduction when the arc has been struck. On the other hand, if a low voltage alternating current is provided, a simple reactance may be introduced which has a few of the same wasteful characteristics of the resistance used with the direct current. The average apparatus will permit of electric arc welding consuming about six to eight kilowatts per welder, but if low voltage is provided, there are certain outfits which will reduce the consumption to as low as three and one-half kilowatts per welder, or even less.



Typical Arc Welding Motor-generator With Switch-board for Controlling Current Supplied to "Arc", Regulating Reactances, Welding Tool, Grounding Plate, Etc.

Regarding the spot welding of fabricated steel ships, it may be said that experiments were conducted by the Electric Welding Committee, which showed that no difficulty was encountered in welding one-half and three-quarter inch steel plates as well as one-inch steel plates; and in fact experiments were successful in welding three thicknesses of one inch steel plate. Lately, large sized spot welders, having jaws five to six feet long have been designed, and these will be used in building a spot welded steel vessel at a large shipbuilding yard located at Kearny, N. J., which represents the largest portable spot welder ever completed. Getting down to brass tacks, and considering the five foot jaw spot welder with multiple contacts spaced at a distance corresponding to the oldtime rivet, one is actually astonisht when stopping to con-

(*Continued on page* 574)

HOW SHIPS ARE WELDED BY ELECTRICITY.

(*Continued from page* 572)

sider how much time and loss of efficiency is occasioned by the old method of riveting steel plates and girders, where but one rivet can be handled at a time. Think of a six foot gap electric spot welder which can thoroly weld a seam six feet long at forty-eight points simultaneously and corresponding to the usual number of rivets placed in position one by one by the oldtime method.

BOOK REVIEW.

(*Continued from page* 570)

frequency currents, and as an amplifier. In the next chapter we find various types of detectors of high frequency currents. A chapter on the production of undamped high frequency oscillations is also commendable. A short discussion forms the chapter on Radio-telephony. In the eighth chapter the author gives several practical ideas on the construction of radio apparatus. Here are found the necessary information to each problem, and in each case the author works out an example for the student, so that he can familiarize himself with the method of working each typical problem.

PRACTICAL ELECTRICITY, by Terrel Croft. Cloth bound, 646 pages, numerous figures and illustrations, size 5½ x 8½ inches. Publisht by McGraw-Hill Book Co., New York, 1917. Price $2.50.

Another excellent work from the author of many practical books on electricity, that have met with great favor with all interested in the electrical field.

The latest effort surpasses anything in this line before and fills a long felt want for a book that would give and cover every phase of the subject. It has been arranged in 53 elaborately illustrated chapters, with all the matter arranged in proper sequence.

The author states that the object of the book is to present the fundamental facts and theories relating to electricity and its present day applications in a straightforward, easily understood way, for study by any man, especially those having but little mathematical training and enabling him to acquire a clear working knowledge of the subject. The author's hopes may be truly said to have been realized, for everything is so clearly defined and illustrated that a minimum of effort only is required to grasp the subject.

No higher mathematics have been indulged in, with no loss to the value of the work; the numerous and readily visualized analogies, which the author is an adept in supplying, are a great help.

A work that will find a ready demand from all, whether teacher, student, practical worker or layman. Also invaluable to the university trained man for brushing the cobwebs from the mind and to refresh and reconstruct his ideas in line with modern electrical theory and practise.

DIRECT CURRENT MACHINERY, by Cyril M. Jansky. Cloth bound, illustrated, 285 pages, size 6¼ x 9¼ inches. McGraw-Hill Book Co., publishers New York, 1917. Price $2.50.

The author has endeavored to put forth in a clear and concise way the theory and operation of Direct Current Machinery, without the aid of higher mathematics, altho some mathematics of elementary nature has been used here and there. Magnetism and electro-magnetic induction, and the units of measurement are very carefully dealt with in order that the student should obtain a clear understanding of the underlying principles of dynamos and motors. The book further shows that whenever energy is transformed from mechanical to electrical or vice versa, that a loss takes place and a detailed explanation is given regarding the efficiency of a motor or a generator. The various types of motors and dynamos, including the "interpole" machines, with numerous calculations, which aid considerably in the design of such apparatus, are also given. Armatures of the drum, disc, lap, wave, and other types are fully explained, including the various capabilities of each, accompanied by numerous red and black line cuts, which serve to show very clearly the various methods of winding armatures. The uses of electrical energy, the advantages of the three-wire system, types of dynamos and motors—including their operating characteristics and their care, together with a chapter on the "Selection and Installation of Dynamos," are additional features of this book. In general, the book will be of distinct use to electricians, students and engineers, and all those who have occasion to deal with Continuous Current Machinery and its allied problems.

CONTINUOUS CURRENT MOTORS AND CONTROL APPARATUS, by W. Perren Maycock. Cloth bound, 151 illustrations, 332 pages, size 5¼ x 7½ inches. Whittaker & Co., London; MacMillan & Co., publishers, New York, 1917. Price $2.25.

An excellent treatise on the subject of direct current motors and the practical applications thereof, with numerous illustrations of up-to-date machinery.

This book is intended for the student, the owner of D. C. machines, the consulting engineer, the contractor and supervising engineer, for the man who will subsequently have charge of the machines and for the civil or mechanical engineer who desires to have some knowledge of the subject.

There are several chapters in this book which divide the subject into many parts, particularly—the elementary theory underlying the action of motors; the starting of motors that have only to be started and stopped; the variation of the speed and the reversal of the direction of the motor, etc. Still further on the book treats to more of an extent with the theory of D. C. motors, especially as regards torque, speed and power, and several types of central station apparatus, including automatic and semi-automatic appliances. The efficiency of motors and the various methods of determining this quantity, and the classification of the various kinds of motors and central station apparatus, are also fully described. At the end of each chapter there is given a set of examples and answers which should prove of immense interest to all. The appendix shows how to calculate the resistance steps for use in starting a motor, how to use Logarithms, and how to connect a motor on higher or lower voltage than that for which it is rated. In short, the book is a complete treatise on D. C. motors, the various appliances used therewith, the practical application thereof and a text-book for the library of those who have occasion to use or install Continuous Current Motors.

THE ELEMENTARY PRINCIPLES OF WIRELESS TELEGRAPHY, Part 2, by R. D. Bangay. Cloth bound, 242 pages, size 5¼ x 7½ inches, 152 illustrations. Wireless Press, publishers, New York, 1918. Price, $0.75.

Part 2 of this work proves to be a useful handbook and one that will be popular as a ready reference for students, amateurs and the uninitiated generally in this special branch of electrical science. The fundamental principles of the transmitting apparatus are explained in the simplest possible manner, so that most anyone with a little thought can easily master the theory and practise of Wireless Telegraphy.

The following list of contents should prove of interest: Curve diagrams and their meaning—the logarithmic, parabolic and hyperbolic curves, the sine curve, etc.; the theory of direct and alternating current dynamos; the direct current dynamo—the brush gear and its adjustment and methods of field excitation; eddy curreots and their effects—how they are overcome; the A. C. transformer and its action—ratio of windings, mechanical analog of the transformer, inductance of transformers; phase relation between the current and voltage in tuned circuits, with mechanical analogs of various A. C. circuit relations, such as effect of capacity on phase relation; the effect of inductance on phase relation; effect of resonance, etc. The chapter on the excitation of spark transmitters is well written and of great benefit to all radio students. Spark discharges are treated on in detail. A very thoro chapter is devoted to "oscillation valves"—covering "beat" reception of undamped wave signals, reception of weak signals, etc. This section on valves is quite complete and treats on the theory of the Fleming two- and three-member valves. De Forest, Armstrong and Langmuir are unknown quantities to this author apparently.

A valuable book to all interested in the art, and dealing with the subject of Radio in a simple and clear manner without going into the more highly technical problems involved. It treats the problems in a refreshingly new way uncommon in most books dealing with the subject.

DO MAGNETS MAKE PHOTOGRAPHS?

The 1917 Year Book of the Carnegie Institution of Washington, D. C., has the following to say regarding "magnet-photography" experiments conducted by L. A. Bauer and W. F. G. Swann:

A large number of experiments have been performed, and it is impracticable to give more than a general survey of the work. In all of the experiments in which articles were exposed to the influence of a *magnetic* field, a subsidiary plate was set up

with a similar set of articles, but beyond the influence of the magnetic field. In the earlier experiments, this subsidiary plate was placed in an ordinary plate-box at atmospheric pressure, the box being bound around with dark cloth; but in the later experiments it was placed in the same vacuum as the main plate, and shielded from the magnet by an iron disk. All experiments except the first two or three performed were carried out in total darkness, the photographic red light only being turned on after the articles had been mounted under the bell-jar, and the latter had been bound around with black cloth.*

In order to test whether the effects observed could be attributed to radio-active material, two experiments were set up with permanent magnets, but in the case of one of them the bell-jar was washed out with a weak solution of uranium nitrat and allowed to dry. After an exposure of 21 days, the articles showed up *equally strongly* on both plates.

A plate was exposed for 6 days over an *electromagnet*, the articles being pieces of wood, iron, copper, amber, and cork; also, in addition, a piece of wood resting on a piece of lead which was in contact with the plate, and a piece of lead resting on a piece of wood which was in contact with the plate. Both pieces of wood in contact with the plate showed up dark on a lighter ground, the grain of the wood being very clear, and the cork showed up slightly darker than the ground. The metals in contact with the plate all came out lighter than the ground. In the case of the subsidiary plate which was set up at atmospheric pressure, only the amber showed up, and this appeared dark on a light ground.

Several experiments made with the articles slightly separated from the plate showed that their influence fell off rapidly within a distance of 1 or 2 mm.

The *effect of resin* in acting upon a photographic plate, especially when the resin has been *previously stimulated by light*, is well known, and at once suggests the assumption that the resin wood, cork, etc., produce a radiation of some kind, or a gaseous emanation, the latter being produced either directly or as a result of the radiation, and that this gas diffuses over the body of the plate and darkens it. In this case the metal articles would simply act as shields to the plate. Experiments made with stimulated resin and metallic articles showed that distinct impressions of the articles could really be produced in this way *without* a magnetic field or a vacuum. At atmospheric pressure the darkening of the plate falls off rapidly with the distance from the resin, but on evacuating the space around the resin the "range" of the action is increased and the impressions are much more uniform.

A large number of experiments were made with stimulated resin, and it appeared that the action was propagated roughly in a linear manner for a distance of as much as a centimeter or more, and after traversing this distance was still capable of passing thru aluminum leaf.

The apparent action of the magnetic field in the experiment with wood and metal articles suggests that a similar action should be produced in the case of the resin. If the action of the resin is ultimately attributable to the ejection of charged particles, the possibility of producing deviation by a magnetic field at once suggests itself. No marked influence of this kind was, however, found in the case of the pure resin.

* Those interested in magnet photography should refer to the original articles on this work written by Mr. Mace, and which appeared in the May, October and November, 1917 issues of the ELECTRICAL EXPERIMENTER.

One of the most remarkable features of the photographic action produced in the case of wood and metal articles is that it is approximately uniform over the plate, altho the magnetic field varies both in magnitude and direction. If the action of the magnetic field were one of controlling the direction of propagation of a radiation or gaseous effusion emitted by the substances, one would expect it to vary over the surface of the plate. The absence of such variation practically limits the nature of the effect to one in which there is direct or indirect stimulation of the activity of emission or production of active gas, diffusion being subsequently relied upon for the uniform distribution of the effect over the plate.

The *effect of very slight temperature changes* in modifying the action of metallic articles upon a photographic plate is well known, and one has to remember that an *electromagnet becomes appreciably warmed* during its excitation.

The presence of resinous articles does not seem wholly necessary for the production of the apparent magnetic effect. Thus, for example, a number of metal articles, namely, lead, iron, nickel, copper, and brass, were set up over an electromagnet in a vacuum for 14 days, and a similar group was set up in the same vacuum, but in a region shielded from the magnetic field. The first set produced strong impressions, light on a dark ground, while the second set produced no appreciable effect. The experiment was repeated with a *permanent* magnet and an exposure of 21 days, with similar but less pronounced results.

At the stage of the work recorded in the paper here abstracted, the preliminary conclusion was reached that while a magnetic field or vacuum was not essential to the production of effects of the kind recorded by Mace, the magnetic field appeared to have an effect in intensifying the action in certain cases. *The experiments are being continued with the object of ascertaining whether the primary agency producing the effect, in the case of the electromagnets, for example, is really the magnetic field itself or some other influence accompanying the production of the magnetic field.*

EXPERIMENTAL CHEMISTRY.

(*Continued from page* 558)

Properties of Sulfur (Physical).

1. It is a yellow solid, without odor or taste.
2. It has three allotropic forms, two crystalline, and one amorphous.
3. Its color is usually lemon-yellow when solid, when finely divided it is white. It gradually becomes dark red and viscid on gradually raising the temperature from 200 to 250 degrees, when it is too thick to pour, and becomes almost black in color.
4. It is non-poisonous, and may be taken internally, as is frequently the case in the spring, when the so-called Sulfur and Molasses makes its appearance as a blood purifier.
5. The so-called "sulfur odors" do not come from the element, but rather from the compounds, as Sulfur Dioxid, Hydrogen Sulfid, Carbon Disulfid.
5. It is insoluble in water, the best solvent being one of its compounds, Carbon Disulfid, in which it dissolves unchanged, tho the amorphous variety does not dissolve and flowers of sulfur only slightly.
7. It is negatively electrified by friction.
8. Sulfur melts at 115 degrees to a thin, amber-colored liquid. At 200 degrees it becomes thick and dark colored and can hardly be poured, while at 300 degrees it again liquifies. If poured into water at the amber stage, it crystallizes, but if at the latter stage, it is amorphous and elastic.

(*Continued on page* 579)

EXPERIMENTAL CHEMISTRY.

(*Continued from page* 577)

9. Sulfur boils at approximately 450 degrees and emits a light yellow vapor, which sublimes as flowers of sulfur.

(Chemical).

1. It burns in air with a pale bluish flame, forming Sulfur Dioxid.

2. When finely divided and moist it may slowly oxidize to Sulfur Dioxid or on sufficient exposure may even form Sulfuric Acid.

3. Nearly all metals unite with it to form sulfides, while copper and iron burn readily in sulfur vapor.

4. Sulfur combines directly with many other non-metals, as Hydrogen, Chlorin, Bromin, Iodin, and Phosphorous.

5. When heated with oxidizing agents, sulfur is converted into sulfuric acid.

6. Caustic alkalies dissolve it to form a mixture of sulfid and thiosulfate.

Uses.

Sulfuric acid manufacture consumes a great deal of sulfur, but much of the acid is now manufactured from pyrite.

Rubber goods and vulcanite contain a small percentage of sulfur.

Some of the element is used in forming sulfur dioxid, to bleach straw and woolen goods and as an antiseptic to destroy infectious disease. Some is used in medicine, some in the laboratory, some for making compounds like Iron Sulfid and Carbon Disulfid, and a great deal for the manufacture of matches and as an ingredient in gunpowder.

COMPOUNDS OF SULFUR

Hydrogen Sulfid

History.

This gas was known to the ancients, but Scheels, in 1777, was the first to investigate it, heating sulfur with hydrogen. This gas is also known as sulfuretted hydrogen, Sulfurous Oxid, and sulfurous anhydrid.

Occurrence.

It occurs in Nature when organic bodies containing sulfur putrefy. Volcanic gases and certain mineral springs contain the gas. and it is a product of decomposition of organic matter existing in sewer gas, decayed eggs, etc., to which it imparts its characteristic odor.

Preparation.

1. When a stream of hydrogen is past over sulfur heated to the boiling point.

2. For all practical purposes, sulfuric acid is added to ferrous sulfid.

$$FeS + H_2SO_4 = FeSO_4 + H_2S$$

The gas is readily evolved without the application of heat, and may be used either directly or past thru a little water contained in a wash bottle. When it is desired to prepare the solution of the gas, it is past into water in the receiving flask.

Iron (Ferrous) Sulfid frequently contains metallic Iron, in which case the gas will contain some free Hydrogen. This is rarely an objection, but if it should be, then the pure gas may be obtained by heating Antimonous Sulfid with Hydrochloric acid.

$$Sb_2S_3 + 6HCl = 2SbCl_3 + 3H_2S$$

Properties.

Physical: 1. It is a colorless, transparent gas.

2. It possesses a very offensive odor, resembling that of sewer gas or decayed eggs.

3. It is very soluble in water, but the solution slowly breaks up and cannot be kept, as it slowly oxidizes. The solution reddens litmus, and, as stated before, undergoes change on exposure to air, water, and sulfur being the result, the latter separating out.

4. The gas begins to dissociate at 400 degrees.

5. It can be liquefied at —74 degrees, and boils at —64 degrees. It also can be solidified.

Chemical. It is a very inflammable gas, burning with a pale blue flame.

2. The products of its combustion are water and sulfur dioxid. or, if the combustion be rapid, sulfur.

3. A cold object held in the flame causes sulfur to deposit.

4. The gas is decomposed by many oxidizing agents. Chlorin, for example, changes it immediately,

$$H_2S + Cl_2 = 2HCl + S$$

5. Owing to the readiness with which it parts with its sulfur, Hydrogen Sulfid forms an active reducing agent.

$$2FeCl_3 + H_2S = 2FeCl_2 + 2HCl + S$$

6. Hydrogen Sulfid combines with many metals, decomposing their oxides, hydroxides, or carbonates.

7. Paper moistened with lead acetat solution is blackened by the gas, lead sulfid being formed, thus this reagent is usually employed to detect its presence.

Separation.

The separation of the insoluble from the soluble sulfides makes hydrogen sulfid of great service in the qualitative analysis of metals. If, for instance, a mixture of solutions of salts of Barium, Calcium, Copper and Cadmium were made and hydrogen sulfid past into the mixture, sulfides of the last two metals, being insoluble, would precipitat and by filtration would be separated from the first two.

Uses.

Hydrogen sulfid is employed chiefly as a reagent in the chemical laboratory, to separate soluble from. insoluble sulfides, also to make the latter, and as a reducing agent.

SULFUR DIOXID

History.

Sulfur dioxid, or sulfurous oxid, has been known from very early times, being produced by burning sulfur. It was used as a disinfectant by the Romans.

Occurrence.

The dioxid is one of the most abundant gases thrown out in volcanic eruptions and often from fumeroles. It is found in small quantity in the air of large cities, on account of the existence of sulfur in coal.

Preparation.

1. By burning sulfur in air or oxygen, direct union of the elements takes place.

$$S_2 + 2O_2 = 2SO_2$$

This process of burning is used in nearly all cases where the gas is made on a large scale.

2. By the decomposition of sulfuric acid (1 part) by heating with copper (½ part), Mercury, Silver, Zinc, Sulfur, or Carbon.

3. By heating sulfur with various metallic oxides, as Lead, Mercury, Manganese, Zinc, etc.

$$S_2 + MnO_2 = MnS + SO_2$$

4. By decomposing sulfites with dilute acids.

$$Na_2SO_3 + H_2SO_4 = Na_2SO_4 + H_2O + SO_2$$

5. Thru the roasting of Pyrit or other native sulfides, preliminary to the extraction of metals. In this manner sulfur dioxid is prepared for the manufacture of sulfuric acid.

$$Cu_2S + 2O_2 = SO_2 + 2CuO$$
$$4FeS_2 + 11O_2 = 8SO_2 + 2Fe_2O_3$$

Properties.

Physical: 1. When pure it is a colorless gas. As usually prepared it is gray, owing to finely divided sulfur being intermingled. It possesses a suffocating odor.

2. It is very poisonous, rapidly destroying the membranes when inhaled.

3. It is quite soluble in water, with which it forms a weak acid (Sulfurous).

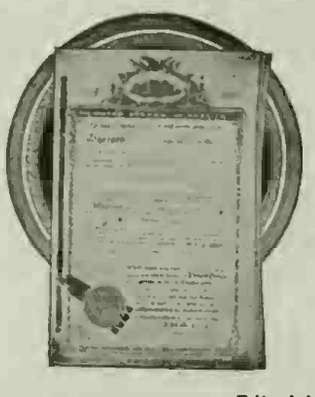
4. The gas liquefies at about —8 degrees and boils at —10 degrees, solidifying at about 72.7 degrees.

Chemical: 1. Non-combustible and non-supporter of combustion.

2. Both gaseous and liquid sulfur dioxid, in the presence of water, possess active bleaching properties. The action in this case being a reducing one, the opposite to that hy which chlorine accomplishes the same purpose.

(*Continued on page* 582)

PATENT ADVICE



Edited by H. GERNSBACK

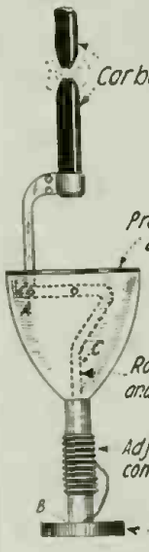
In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Readers' attention is called to the fact that due to the great amount of letters to this department it is quite impossible to answer them all thru these columns. The inquiries answered in this issue date as far back as June, and if readers wish speedy service they should carefully note the announcement appearing in the preceding paragraph.

Arc Lamp.

(279) William Woodward, Wilmette, Ill., submits an idea of a self-regulating arc for moving pictures, on which he would like to have our opinion. He says "let us presume that the operators strikes the arc and adjusts it. In a few minutes the carbons would be too far apart, but for the feeder which pushes the carbon up as follows: When the current diminisbes, that is, the carbons draw apart, the brassrod C becomes cool and contracts, which by a lever of the first class pushes the carbon up. When there is an excess of current, the action is vice-versa. Of course, about every half hour it would be necessary for the operator to screw the carbons up closer. (Note — The horizontal adjustments would be adjusted as on a modern machine.)"



A Novel Arc Lamp.

A. An extremely clever as well as capital idea. It is no doubt one of the most ingenious arc light regulating scheeme that it was cur good fortune to come across.

If tbis works out in practise as well as it looks on paper, we think that our correspondent has a very valuable patent. Our advice is to get busy at once and build a model and apply for patents in the meanwhile.

Swinging Screen Door.

(280) T. C. L., Emporium, Pa., has submitted a very clever device on a screen door which will swing open when pushed in either direction or on either edge. A number of metal strips are used in order to effect this and our advice is asked.

A. This is indeed a remarkably clever idea, and the only fault we have to find with it is that the hinges would sag because the special metal binges used seem to be too long, and sooner or later would cause trouble. However, there might be found ways to overcome this objection, and we are certain that a patent can be obtained on tbe invention.

Another idea by the same writer relates to making distilled water, or drinking water from salt water. The apparatus contains a water chamber to which heat is applied and a coiled metal tube, cooled in water thru which the distilled water is discharged.

A. There is nothing fundamentally new contained in this idea, and a patent could not be obtained on it.

Power Jack.

(281) Cleo Maddy, Utica, Ka., sends an idea of a oower jack for an automobile to be permanently installed thereon, one jack under each axle. The jack is operated by the starter by means of two clutches, one for each jack. Our correspondent wishes to know if the idea has been patented, and if it is practical.

A. We are afraid that while the idea is not impossible, of course, it would be impractical for a number of technical reasons, unless simplifying improvements were made on the device. We think a patent can be obtained on the idea—of how much value it will be, we do not pretend to know.

Changing D. C. to A. C.

(282) Edward Heubner, New York City, encloses a diagram of a device for changing 110 D. C. current to 110 A. C. to any number of cycles desired. The idea is to have a metal spider wound with wire operated from an 110 D. C. motor, the ends of the spider cutting thru an electromagnetic field. A. C. current thus could be taken from slip rings from the wire ends of the spider.

A. This is quite a clever idea, and we believe it is feasible, but we doubt if a patent can be obtained on it as very similar types are in use.

The main objection, however, is that such a device is far too expensive and there are very much cheaper commutating devices on the market now which accomplish the same object.

Rifle Improvement.

(283) Tilford Dozier, San Francisco, Cal., sends in a device whereby it becomes possible to equip guns or rifles with an auxiliary device, so that the gun or rifle can fire any size cartridge desired. As is obvious, present guns can only fire one size cartridge.

A. This is a clever idea as well as ingenious, and and we think a patent may be obtained upon it. We doubt, however, that it has any practical value, as too many special inserts would be necessary in order to equip rifles that way. This is one of the inventions that seem very good, but have practical objections which are often unsurmountable.

Re: Our Patent Advice.

(284) We publish in full an interesting letter by one of our readers, Jacob K. Marcus, Rochester, N. Y.:

"I notice in the July issue of the ELECTRICAL EXPERIMENTER that you have inaugurated a new feature in one of your most valuable Departments, the 'Patent Advice' Department, whereby you will disclose the invention freely to the public, sent to you for your able advice by the originator. Now, Mr. Editor, you have yourself taken one of the most valuable departments of the ELECTRICAL EXPERIMENTER and turned it into a practically worthless department with one stroke of the pen. You have done this, you claim, because it has been found in the past that this department was rather dry and uninteresting to your readers. I wonder, Mr. Editor, who told you that. This department, which I have always found highly interesting, was one, if not the principle reason why I subscribed to your fine publication a short while ago. Does that prove that it was dry and uninteresting to your readers? I wish to make a most vigorous protest against this change. The few reasons which you give for disclosing the ideas of somebody else in your publication before patenting it, is sound on paper but does not work out so well in practise. Your plan whereby you are mailing the answers to your correspondents two or three weeks before publishing it,—and

so giving them a chance of communicating with a patent attorney and file application for patent,—is all right. But, Mr. Editor, have you ever thought of the fact that at least one inventor or originator of an idea in about a thousand is financially able to apply for patents as soon as his idea is perfected? The rest, like myself, have to wait months and sometimes longer for various reasons before they have the necessary moneys for applying for patents. In disclosing the idea, as you unfortunately have decided to do, and hope you will change your mind about it and go back to the former practise, you not only invite unscrupulous persons to apply for patents and claim the idea as his in this country, but also in foreign countries where the first applicant gets the patent before the originator may financially or otherwise be able. Should a patent be granted to an 'infringer,' as you say, tho the originator may have nothing to prove it, but who may have thought of the invention earlier or at the same time, you suggest that an opposition be filed. Look at the trouble and expense it would cost him. Why? Just because you want the public to know and see what his idea is and looks like. Please for the sake of those who frequent this department, go back to the former practise."

A. Before the step was taken to publish in full the various ideas of our correspondents in this department, all the phases were carefully considered by us as well as an unbiased patent attorney whose final opinion was asked on the departure.

While many of the things which our correspondent mentions are true, he has lost sight of the more obvious ones.

It does not make a particle of difference whether an inventor is financially able to apply for a patent or not as soon as an idea is perfected or publisht in this department. He can apply for patent within two years after the publishing of his idea, and still get his patent, and in the meanwhile he has a better protection than if he had not had the idea publisht at all. The reason is, of course, obvious. Should anyone attempt to patent the device outside of the original inventor, he would very likely find himself unable to do so, for the simple reason that the United States patent office is a subscriber to the ELECTRICAL EXPERIMENTER and we have good reasons for believing that ideas of this kind are all carefully classified by the Patent Office for reference purposes. If our correspondent has had many business transactions with the U. S. Patent Office, he will have found that very often the Patent Office refuses to grant a patent on certain inventions *because such an idea had been publisht in this or that journal by such and such an individual.* It is the Patent Office's business to know what has been accomplisht in every art. In other words, instead of not giving protection, the Patent Advice Department gives the best possible protection to any inventor that he could have and *it does not cost him one cent* until he gets ready to actually apply for a patent within two years after the description was publisht in the ELECTRICAL EXPERIMENTER.

The same thing holds good for foreign patents. Even if you apply for an American patent and do obtain it, this does not at all prevent any foreigner from patenting the invention unless you apply for the patents yourself and pay for the fees in the various countries.

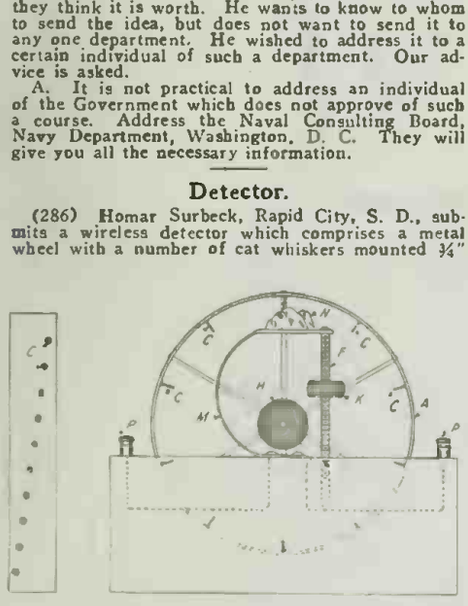
Naval Consulting Board.

(285) Percy F. Walsh, Keyser, W. Va., claims to have an excellent idea for big guns but does not care to have it patented; he would rather give it to the Government and let them pay for it whatever they think it is worth. He wants to know to whom to send the idea, but does not want to send it to any one department. He wished to address it to a certain individual of such a department. Our advice is asked.

A. It is not practical to address an individual of the Government which does not approve of such a course. Address the Naval Consulting Board, Navy Department, Washington, D. C. They will give you all the necessary information.

Detector.

(286) Homar Surbeck, Rapid City, S. D., submits a wireless detector which comprises a metal wheel with a number of cat whiskers mounted ¾" apart on the inside and rotated by a central knob. The separate sketch shows the arrangement how the cat-whiskers are staggered. When the wheel is revolved each cat-whisker travels over the surface of the crystal, but each cat-whisker touching a different spot. Final adjustment can be obtained by regulating the tension of spring *M* by turning the knob *K*. Our advice is asked on this arrangement.



A Multiple Cat-Whisker Detector.

A. This strikes us as an excellent idea and certainly quite original. There does not seem to be anything on the market of this kind, and we are certain a patent can be obtained on the idea. We suggest that our correspondent get in touch with patent attorney at once.

This correspondent also submits a diagram on an electric horn for cars operating on the vibrating diafram principle. Our advice is asked.

A. There is nothing new about this device, there being on the market several automobile horns working on this principle.

Phonograph Motor.

(287) Floyd Hoskins, Pine Bluff, Ark., submits an idea on an electric motor concealed in the inside of a phonograph, driven by dry cells, thus driving the phonograph disc. Our advice is asked on the arrangement.

A. This is quite an old idea and nothing of this sort can be patented, many motors being used accomplishing exactly what our correspondent describes.

Sound Electric Shutter.

(288) Emison Furrell, Higginsville, Mo., wishes to have our advice as to patentability of a sound electric shutter operating device for a camera. When the person standing in front of this camera says "Hello," the sound waves strike a microphone which in turn allows a current to pass thru a highly sensitive relay. An armature is then pulled over, making contact, while the current from the battery passes thru an electromagnet and the magnetism induced therein pulls over an armature which in turn snaps a shutter by a certain arrangement. The entire device would, of course, have to be made as compact as possible when placed in a camera. Not alone could this be accomplished, but the camera could be utilized for taking close pictures of explosions, for secret service work, and for novelty use of taking unexpected pictures of friends.

A. This is a really capital idea, and while the idea itself is not fundamentally new, we are certain that a patent can be obtained on it in the combination with a photographic camera. While, of course, such a sound operated device is not new, there being on the market at present a toy dog who comes out of his house when one whistles, still the combination of the device with the camera shutter presents great possibilities. We would advise our correspondent to obtain a patent on this invention.

ELECTRICAL GOODS FOREIGNERS NEED.

There is on display at the Bureau of Foreign and Domestic Commerce, at the New York Custom House, Battery Place, a large technical collection of samples of electrical goods used in foreign countries. It includes wiring devices, heating appliances, electrical porcelains, dry cells, flashlights, electric bells, conduit and conduit fittings, insulated wire, etc.

These samples have been forwarded mainly in connection with the special investigations undertaken in South America by P. S. Smith, and in Australia, New Zealand, China, Japan and eastern Siberia by R. A. Lundquist, special agents of the Bureau. Complete data accompany each article on exhibit, giving country of origin, where obtained, how used, selling price, etc. There are several hundred items in the exhibit.

There is a wide field abroad for standard American electrical goods, as well as for adaptions of American designs to foreign requirements, and when our electrical manufacturers study the types of goods now in use in such markets, they can obtain a grasp of the standards and of the conditions existing that can be secured in no other way except by a personal visit to the field, and this knowledge will enable them to push the sale of their goods with the best possible efficiency.

EXPERIMENTAL CHEMISTRY.

(*Continued from page 579*)

Uses.

It is used mainly in making sulfuric acid. Bleachers of silks, woolens, and straw goods employ it, but it is not used on cotton goods.

It is sometimes used as a disinfectant, Sulfur being burned in a room occupied by persons having an infectious disease, the room being tightly closed, and the sulfur dioxid from the burning sulfur would kill all disease germs. Formaldehyd (Formalin) is, however, becoming quite generally used in place of the sulfur dioxid for this purpose.

Experiment No. 140

Forms of Sulfur.

Fill a test tube one-third full of pieces of brimstone and heat it slowly. Note the fluidity of the liquid at first. Continue the heating until it becomes almost solid, then note any further change on more heating. Notice color changes at each stage. Finally pour some of the contents of the tube into a dish of cold water. Pull that portion and observe its elasticity and amorphous nature. Let the part in the tube cool and see whether it resumes its original state. Be on the alert for crystallization.

Experiment No. 141

Compounds of Sulfur. Hydrogen Sulfid.

Prepare a generator of about 125 or 250 cc. capacity and fit with a two-hole stopper. Into this put about 5 grams of Ferrous Sulfid (FeS), about 20 cc. of water, and at first 5 cc. of Hydrochloric acid, which amount may be increased from time to time as necessary.

First collect some of this gas by downward displacement in a wide-mouthed bottle (See Fig. 149). Note the color, and apply the splint test for combustion. Test the solubility of the gas by passing some into about 10 cc. of water (See Fig. 150). Test this water with (a) Litmus paper. (b) By putting a drop on a silver coin, say a dime, by means of a pipette. (c) By pouring a little into a solution of Lead Nitrat. (d) By holding over the mouth of the tube a paper wet with a drop of lead acetat solution, and warming the tube while making

the test (see Fig. 151). Do these tests show its solubility in water? What does the litmus test show? Try and account for the effect upon the silver coin.

Experiment No. 142

The use of the gas in the laboratory may be illustrated by the following method of separating one metal from another. Take about 10 cc. of copper chlorid solution in one tube and in another an equal amount of calcium chlorid solution. Pass some of the gas from the generator into each, and note the different effects. In which is there a precipitat? What is it? Is it soluble? Why was there no precipitat in the other case? Could you separate the two metals, copper and calcium, from a mixture of the two solutions? Try it.

Experiment No. 143

Make a mixture of 5 cc. of copper chlorid and an equal quantity of calcium chlorid, making in all 10 cc. Pour into a tube and pass the gas into the solution for some time. What will precipitat and what will not? Presently filter the substance. What is on the filter paper? What is the filtrat? Is the filtrat colored? If so, what does it indicate? Put this filtrat again under the hydrogen sulfid gas and see if any further result is obtained. If so, continue the process awhile and filter again. All color must be taken out. Why? When that is done, add to the filtrat a little sodium carbonat solution. Note the result of this last addition and name the precipitat.

Carbon Disulfid

Carbon disulfid is so volatile and so dan-

(Continued on next page)

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, of Electrical Experimenter, published monthly at New York, N. Y., for October 1, 1918.

State of New York, County of New York—ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of the Electrical Experimenter, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, The Experimenter Publishing Co., 233 Fulton Street, New York City; Editor, Hugo Gernsback, 233 Fulton Street, New York City; Managing Editor, Harry Winfield Secor, 233 Fulton Street, New York City; Business Manager, Hugo Gernsback, 233 Fulton Street, New York City.

2. That the owners are: Experimenter Publishing Co., 233 Fulton Street, New York City; Hugo Gernsback, 233 Fulton Street, New York City; Sidney Gernsback, 233 Fulton Street, New York City; Mrs. K. Hymes, 233 Fulton Street, New York City; Harry Winfield Secor, 233 Fulton Street, New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but, also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is —(Required only of daily publications.)

(SEAL) H. GERNSBACK.

Sworn to and subscribed before me this 15th day of October, 1918.

BEATRICE K. OWEN.

(My commision expires March 30, 1919.)

gerously explosive that it must be kept out of the range of any possible combustion, except as described. Hot tubes must not be brought into contact with any amount of it. To see whether a hot glass tube will set it on fire, use *not over 3 or 4 DROPS* in an evaporating dish, and stir with a hot tube.

Experiment No. 144

Pour *3 cc.* of carbon disulfid into a dish and note (1) its odor, (2) to volatility, by putting a drop on the finger with a rod and noting the sensation as it disappears. (3) Test its miscibility in water, pouring 2 or 3 drops into 10 cc. of water in a small tube, shaking well and watching it settle. (4) Test its action on tincture of iodin by putting one drop of the latter in the mixture of carbon disulfid and water just made, and shaking it vigorously for half a minute, then letting it settle and watching the result. Describe its odor, the sensation on the hand and what it shows, its miscibility in water, its action on iodin solution. Name the color of the latter. Which is the best solvent of iodin, water or carbon disulfid?

Experiment No. 145

Have a short old glass tube with a right angle bend (one end about 3 cm. long), and with it dip up from the dish containing it a few drops of carbon disulfid. Bring the tube to a flame, holding it so that the liquid will flame up, then remove it and watch the combustion, testing (a) the odor (b) the effect on a tube held across its flame (c) the product of combustion for Carbon dioxid and sulfur dioxid.

Experiment No. 146

Try to dissolve a little sulfur in a dish (use half a gram of brimstone to 3 or 4 cc. of Carbon disulfid). Watch the result, and if the sulfur dissolves, either set the dish in a draft of air or blow across the liquid, and look for the formation of crystals. This is an interesting observation and should be carefully described. What evaporates, the carbon disulfid or the sulfur, or both? Is it then apparently a physical or chemical solution? As the sulfur is thrown out, does it occur in the crystalline or the amorphous state? Of what other element have you found carbon disulfid a solvent? What is the natural state of the two elements of which this compound is composed?

(To be continued)

3,000,000 FISH AN HOUR WITHOUT A HOOK.

(Continued from page 528)

sacred angling grounds. That was the time that you were angry, if you ever were in your life. The same principle seems to apply in this instance and, according to Captain Lydeck, he has overcome any possibility of alarming the fish. In fact, with the ten powerful searchlights that he will have at his command, five of which are shown in action in our illustration, he will lull the fish into a sense of security and their natural curiosity will cause them to follow the beams of light to the apex and there the light ceases suddenly and they are whirled into the scoop, which, by the way, measures one hundred and fifty feet in width by 100 feet in height.

In the figure there is given a detailed drawing of the conveyor and the net portion of the collecting scoop, wherein N is the newly patented herring-bone netting, which will allow the seaweed and other debris to pass thru its meshes, but will retain the fish, literally speaking, within its grasp. There are eight rows of knives situated inside of the scoop as a precaution against the entrance of very large size fish. Should a shark enter, he will be forced against these knives with sufficient impact to slice himself to pieces, thereby committing *suicide*.

At a speed of ten miles an hour, using searchlights enough to cover a strip of water two miles wide at a distance of 10 miles ahead of the oncoming Giant Fisherman,—the beams of the searchlights being spread in a fan shape focus as shown in the photograph,—it naturally follows that the range covered by the scoop is 100 x 150 feet; the amount of water actually strained thru its walls therefore amounts to a little over 12,000,000 cubic feet of water each minute. By making ten miles per hour, a distance of 880 feet each minute is covered and if the light can he seen from a depth of 100 feet, why then the straining capacity of the Giant Fisherman will be 929,000,000 cubic feet of water per minute! Under these superior working conditions it is claimed by Captain Lybeck that he will catch practically all of the fish that are lined up before him, up to the full capacity of the conveyors. With the assumption that there are only six pounds of fish inhabiting every 1,000,000 cubic feet of water and if only half of these (or 3 lbs.) were caught, even then at the close of a ten-hour run the weight of the fish theoretically caught would average 1,672,200 pounds. The agreement by scientists and men that ought to know is to the effect that every one million cubic feet of the ocean contains 100 pounds of fish stock and at that conservative figure at the end of a ten-hour run the Giant Fisherman should catch and have conveyed to her decks the stupendous total of 27,870,000 pounds of fish, allowing for the catching of only one-half of that amount, or 50 pounds of edible fish per million cubic feet of water.

Besides supplying the public with fresh fish at a small cost, the canning, preserving and fertilizing that would be by-products manufactured from the waste portions of the fish, would go to make up three distinct industries that will be found on board this newest fishing smack *de luxe*.

The writer recently witnest a demonstration given by Captain Lybeck of a large model of his Giant Fisherman and it was extremely interesting to note that the light rays had a noticeable effect on the fish and that when they followed this beam they were caught by the scoop and conveyed by the traveling belt arrangement into a container placed at the rear of the model for demonstration purposes.

NEW YANKEE WAR INVENTIONS.

(Continued from page 530)

interval, so as to scatter the bombs over a wide area. The torpedo is propelled by comprest air or other form of engine, and its equilibrium is maintained by means of a swinging pendulum hung within the shell, and which is connected by suitable cables to the rudder and elevating planes.

The inventor claims that the machine is capable of traveling at a high rate of speed over a considerable distance—much farther than is possible to fire ordinary projectiles—and it is also intended that a very large number of the torpedoes be launched simultaneously, in order that the way can be cleared on a broad front and to a considerable depth for infantry charges, etc. By electrical or other means the mechanism inside the aërial bombing torpedo can be set when it is fired or liberated, so as to cause the machine to travel in a certain direction and at a predetermined altitude and distance, at which time the doors in the bottom of the shell are released, and the bombs dropt on the unhappy Hun. The bombs ordinarily weigh down the rear end of the machine to maintain the balance, and as soon as they are dropt the equilibrium of the machine is destroyed, the nose or front end becomes heavier, thereby turning the machine downward. The shell contains an explosive charge so that when it strikes the ground the charge, in being detonated, will blow the machine to atoms, preventing it from being used by the enemy—destroy-

ing its secrets of operation—and invariably increasing the general destruction and havoc created.

The final patent here illustrated is that awarded to John B. Felicetti, a Philadelphian, and an inventor with true Italian ingenuity and originality. We have had one-man tanks and one-man submarines, but this one-man self-propelled tank is about the best device in this branch of military inventions that we have come across for some time. As the illustration indicates, the operator lies prone inside the tank, and the whole body is protected by the steel armor. When desired he can also sit up in the tank. The inventor claims that his tank is sufficiently light so that it may be carried when necessary over short distances by the operator. The Signal Corps should find a device of this kind very useful, for an observer could safely advance quite a distance beyond the front line observation points, with a well camouflaged steel tank of this description. It is propelled by the operator pulling on the two handles shown, which actuate two steel spades on the rear of the machine and which dig into the ground alternately. The steering is accomplisht by means of the feet. The inventor ambitiously points out that his tank can travel over *land, sea, snow and sand,—or thru water and mud.* In order to be able to negotiate ponds, brooks, and the like, the vehicle is provided with broad flanged wheels, and the axles are not brought out on a line with the wheel hubs, but extend upward behind the wheels before they enter the tank housing. The reciprocating levers actuating the two spades which propel the vehicle slide in water-tight stuffing boxes. When operated thru water, the steel spades at the rear act as oars or paddles. Imagine what a flock of these one-man tanks, all decked out in their camouflage war-paint would look like as they swept up over a hill on a charge.

THE CODE-NUMERALS GET THEIRS.

(*Continued from page* 549)

. . . – = "3" " "V"
– = "5" " "T"
– . . = "8" " "D"
– . = "9" " "N"

Imagine writing: "Would not consider offering you 925; may go to 813 Illinois if not satisfied," and having it delivered "Would not consider offering, you nut; may go to Dav-Ill. if not satisfied!" Some business has to be declined, of course; but a declination in a form like that would be considered abrupt, if not actually rude. Well, then, if the "abbreviated" numerals can avoid such pitfalls, why need our little dots shake in their little shoes?

Finally, brethren (as you reach for your hats under the pews), behold the number 128,035, exprest in the four different ways we have considered:

(1) with the digits spelled out:

––– –. . . ..– –. –.. .–. .
–.. – .–– . –. – –.–– . .
––. ..... – – .... ––– ..– ...
.– –. –.. .– –. –.. – ....
.. .–. – –.–– ..–. .. ...– .

(2) In the official numerals:

.–––– ..––– –––.. ––––– ...––
.....

(3) In the abbreviated numerals:

.– ..– –.. — ...– –

(4) In plain dots:

. .. . — ... .

Try it on your "buzzerola." And now, Human Nature, let the blow fall!

HOW TO MAKE A SEVEN-INCH REFLECTING TELESCOPE.

(*Continued from page* 553)

There are numerous formulae for silvering the concave surface. The so-called sugar-loaf method has been satisfactorily used by the writer at all times. Solution (A) Silver Nitrat crystals 100 grs.; Water (distilled) 4 oz. (B) Set aside one-tenth of "A" for future use. (C) Caustic Stick Potash (pure, by alcohol) 100 grs.; distilled water 4 oz. (D) Aqua Ammonia strong. (E) Reducing Solution: Loaf sugar 840 grs.; nitric acid, 39 grs.; alcohol pure, 25 drs.; distilled water, 300 grs. After mixing make up to 25 oz. distilled water and bottle. This works better as it matures in time.

Clean the speculum with nitric acid until a film of distilled water will adhere unbroken to it. Immerse face down in an enamel dish of distilled water. Drop (D) ammonia into (A) Silver Nitrat until the solution darkens and clears. Add (C) the caustic potash and drop in enough ammonia again to clear. Then add enough of the solution (B) to bring to a warm saffron color without becoming muddy. Add then 8 drs. of the reducing solution (E) and pour the mixture into a porcelain or enamel dish large enough just to accommodate the mirror and to allow the fluid to extend about one-half an inch over the concave surface. Agitate gently and note the change of color in the fluid. When it becomes a muddy pink pour off quickly and wash the silvered film of the speculum in running water. When dry the film can be gently polished with a cotton and buckskin pad dipt into fine dry rouge. The polished surface will reflect about 90 per cent of the light and when mounted as shown in the diagram wil serve both as an *astronomical* and as a *terrestrial telescope*. The flat mirror necessary to bring the cone of light into the eyepiece tube can be a piece of selected plate one-quarter of an inch thick. It can be silvered at the same time with the concave mirror.

It may be interesting to know about how much time will be required for the grinding, polishing and figuring the speculum. Of course this will vary with the particular kind of glass and the degree of one's energy, but the processes should require approximately the following: 5 hours for the rough grinding, 10 hours for the fine grinding, and about 35 hours for the polishing and figuring. During the latter stage of figuring the work becomes tedious, because only a few moments of polishing can be done before the speculum is tested

The mounting can be that of an *altazimuth* as shown in the photograph, or a simple *equatorial* as shown in the diagram The eyepieces can be of one-inch, one-half inch and one-quarter inch equivalent focus and are cheaper purchased than to attempt to make them. The ordinary microscope eyepiece (Huyghenian or negative) is recommended.

Having used both the altazimuth and the equatorial form of mounting, the writer can recommend the latter as the simpler to construct and the more generally serviceable. As the tube can be pointed at the celestial object and then clamped only the motion around the polar axis need be considered in following the diurnal movement of the planet or the stars.

From a plank one-inch thick cut two circular discs, eight inches in diameter and seven inches respectively. Center them and screw them together with four screws. The mirror will be held flat with its back supported by a circular piece of Brussels car-

pet as a cushion resting upon the seven-inch disc. Around the edge to hold the mirror firmly without pressure a strip of thin brass can be bent and screwed to the wooden disc. To keep the mirror from falling out of the support the brass strip can be bent over the edge of the glass a distance of about 1/32 of an inch. A strip of surgeons tape has been found serviceable to be fastened around the edge of the wooden disc and the glass before putting on the metal strip. This prevents the metal from coming into contact with the glass and also holds the mirror more firmly.

The telescope tube may be either of wood or of galvanized iron covered with heavy manilla paper to counteract thermal effects and dew. A wooden tube is entirely satisfactory and can be made by screwing a few strips of light wood such as lattice strips to four wooden rings whose inside diameter is eight inches. These rings are painted black and the inside of the tube, whether metal or wood should be lined with black blotting paper. If the tube is of wood an opening should be left at the lower end to allow a metal top to be placed over the mirror when not in use. If the tube is of metal and is made air tight the metal cap can be fitted over the upper end of the tube. Another cap will close the lower end when the mirror has been properly adjusted.

Four iron strips about four inches long are bent at right angles. Three holes are drilled into the strips, two for the screws that hold the angle-irons to the inner side of the tube and one for the bolt that will work against the under part of the eight-inch wooden block. A simple way to adjust the mirror with this arrangement will be to have the metal strip threaded to accommodate this bolt-screw and to have the nuts at the end of the bolts embedded in the bottom of the wooden disc and held there by means of a thin strip of brass screwed at the corners. This permits the bolt to be adjusted to hold the mirror firmly at whatever position may be found necessary. At four equal distances around the disc these bolts are fastened.

The matter of adjusting the mirrors is a delicate operation. First get the flat mirror mounted at an angle of 45 degrees in the exact center of the tube at a distance of about fifty inches from the surface of the concave mirror, or speculum. This will bring the eye-piece outside the tube at about five or six inches. Shift the set-screws of the mirror mounting until the image of the eye as seen in the center of the eye-piece tube will be exactly in the center of the dark opening as seen in the flat mirror reflection. The whole of the large mirror will be reflected into the flat mirror so that the slightest change of adjustment will bring into view one or other portions of the upper end of the tube. A concentric adjustment shows only the whole of the speculum and in its center the circular image of the flat mirror and in its center the circular image of the eye-piece tube.

A paper mailing tube with a crosswire at each end can be used for the telescope finder unless one wishes to purchase a cheap lens for the objective. Adjusted with the telescope pointed at a distant object the finder merely makes easy the rapid pointing of the telescope. But with a meniscus lens of two inches aperture and an eyepiece a fairly powerful finder may be constructed as indicated by the proportions shown in the diagram. An easy method of fixing the cross wires in the eyepiece, if the latter is one of positive type will be to remove the front lens and stretch two very fine threads obtained from a drop of mucilage across the diaphragm. This can be accomplisht with the aid of a needle. The glue-threads should be at right angles. When hard, replace the front lens and the cross wires will be seen in the field of view. A lens of twenty-inches focus and an eyepiece of one-inch equivalent focus will make a powerful finder capable of disclosing many objects not visible to the naked eye. A non-achromatic lens will, of course have to be stopt down if definition is desired.

If one is able to obtain the best material and has the aid of a machine shop there is scarcely any limit to the fine workmanship that can be bestowed upon the delicate mounting of a telescope. But from just such materials as one may have at hand and without elaborate tools one's ingenuity is called upon. Experience has shown that a post of seasoned pine twelve inches in diameter and about three feet long will make a solid support for the telescope if four two-inch pieces are nailed to the base to brace the post. The upper end of the post must be cut approximately at an angle corresponding to the latitude of the observer. The axis mounted upon this slope must point to the northern pole.

WHY USE TUNGSTEN LAMPS?—ASK UNCLE SAM.

(*Continued from page* 545)

are *less robust* than those in the *larger* sizes and their life is consequently shorter.

Attention is furthermore called to the fact that the efficiency of the smaller sizes of tungsten lamps is considerably less than the efficiency of the larges types.

There are many locations and conditions particularly in the household where the larger sizes of lamps are now being used and where smaller lamps would no doubt give adequate illumination, the substitution affording a large reduction in the total consumption of current thru which a large aggregate saving of fuel would be effected.

It is desirable to secure the complete elimination of the metallized filament (GEM) type of lamps even tho the substitution for them of carbon filament lamps in the few exceptional cases where it becomes absolutely necessary to use particularly rugged filaments may result in an apparently increased energy consumption. This increase in a few isolated cases should not defeat the important advantages to be attained by the complete elimination of the GEM lamps, an intermediate type between the carbon and tungsten lamps now become unnecessary.

In order to secure the most complete elimination possible of the inefficient carbon and GEM lamps of all sizes it is recommended that where consumers specifically request lamps of these types from central stations or lamp dealers, their attention be called in each case to the recommendations of the Fuel Administration as outlined in this program and every effort be made to discourage the use of inefficient lamps by the public.

The following data on carbon and tungsten lamps will make clear the reason why such a big saving is effected by the use of the so-called Mazda or tungsten filament lamp; as will be seen the larger the unit the more efficient the consumption of electric energy per candle-power. The relative saving gained is in proportion to the watts per candle-power in each case. To find the cost of operating any number of lamps for a given length of time in hours proceed as follows: Multiply the number of hours per month *each lamp burns* by the number of lamps, and this product by the watts consumed by each lamp. This gives the watt-hours per month; divide by 1,000 and the answer is the required *kilowatt-hours.* Multiply this by the rate you pay per K.W.H. (average rate 10 cents per K.W.H.)

when the amount of your bill will be had. For example, if six 40-watt lamps (carbon or tungsten) burn say 60 hours per month, then: $60 \times 6 \times 40 = 14{,}400$ watt-hours, or divided by 1,000 = 14.4 K.W.H. At 10 cents per K.W.H. the bill would be $14.4 \times .10 = \$1.44$.

Data on Carbon and Tungsten Lamps

	Carbon	GEM (Metallized filament)	Tungsten
Watts consumed (rating)	50	50	50
Candle-power (mean horizontal)	16.8	20.8	48.8
Watts per candle-power	2.97	2.5	1.04
Corresponding lumens	174.0	207.0	476.0
Lumens per watt	3.48	4.14	9.52

The larger sizes of tungsten lamps are much more efficient than the smaller units, and this applies particularly to the gas-filled types, as the following table shows.

Data on Mazda Lamps

Schedule T-1

105-125 Volt Mazda B Lamps—Straight Side Bulbs. (Vacuum only.)

Watts. (Rating.)	Efficiency. Watts per Spherical C. P.	Type of Bulb.	Diameter in Inches.	Max. Overall Length in Inches.	Position of Burning.
10	1.67	S-17	2⅛	4⅝	Any
15	1.47	S-17	2⅛	4⅝	Any
20	1.41	S-17	2⅛	4⅝	Any
25	1.35	S-19	2⅜	5¼	Any
40	1.32	S-19	2⅜	5¼	Any
50	1.31	S-19	2⅜	5¼	Any
60	1.28	S-21	2⅝	5½	Any
100	1.22	S-30	3¾	7⅞	Any

105-125 Volt Mazda C Lamps—Pear-shape Bulbs. (Gas filled.)

75	1.09	PS-22	2¾	6⅛	Any
100	1.00	PS-25	3⅛	7⅛	Any
200	0.90	PS-30	3¾	8⅜	Tip down
300	0.82	PS-35	4⅜	9¾	Tip down
400	0.82	PS-40	5	10	Tip down
500	0.78	PS-40	5	10	Tip down
750	0.74	PS-52	6½	13⅜	Tip down
1,000	0.70	PS-52	6½	13⅜	Tip down

RADIO AROUND THE WORLD.

(*Continued from page* 547)

that trans-Atlantic communication has been successfully carried on for some time without any such elevated antenna, *the aerial being placed in the ground.* Details of the exact arrangement of such ground antenna cannot be given, of course, at the present time, but the fact can be vouched for that messages from England and other countries have been and are regularly received on this form of aerial, and also some of the high towers erected some years ago have been taken down. Another interesting point connected with long distance radio transmission and reception is the fact that an American radio engineer succeeded in picking up messages from England and other European stations in a laboratory situated on the southeast coast of the United States without any elevated aerial wires, ground antenna or anything excepting a coil of wire placed in the laboratory, the coil measuring about eight feet long and eight feet in diameter. This coil comprised about five thousand feet of insulated bell wire; by tilting the coil in various directions, many interesting and valuable scientific measurements were taken. As might be suspected, the tuning was not quite as sharp with this arrangement as when elongated antenna were used, but the very fact that messages were received by such a small coil inside a laboratory, in comparison to the gigantic antenna erected for the purpose in every case a few years ago, speaks for itself.

Some very interesting work has been done in the direction of high speed wireless transmission and reception. Speeds up to four hundreds words per minute have been experimented with, and up to one hundred words per minute, the radio messages have been transmitted and received very successfully, the received signals being amplified by means of two-stage vacuum valve amplifiers, and recorded on a talking machine of the cylindrical wax record type. In connection with the experiments with the ground aerials, it can be stated that no appreciable success has been had in experiments for transmitting with such aerials, it having been found in this case that in order to radiate the energy without too much loss, that an elevation of at least one hundred feet above the ground is usually desirable and necessary.

Long distance wireless has developed tremendously since the outbreak of the war. The great German station at Nauen, which at the outbreak of the war, included a single tower 300 feet high, now consists of ten towers, ranging in height from 360 to 890 feet and messages have been transmitted 6,200 miles. It is from these towers that South America has received messages in the past.

Japan is fast developing communication with the United States and altho Japanese high power stations have communicated with Hawaii, it is planned to build stations in Japan and on the Pacific coast, a distance of over 4,000 miles, that will be of commercial use.

The development of wireless between Scandinavia and the United States is making vast strides and the great station at Stavanger, Norway, has communicated with the Marconi station at Belmar, N. J., with good results.

Japan is to have one of the greatest wireless stations in the world. It will be built in Fukushima prefecture, says the Department of Communications, and will cost 860,000 yen ($430,000). The dispatch station will be at Hibarigahara, near Hariamachi, and the receiving station will be at Hosoya-cho. Survey work has been started by engineers of the department.

EXPERIMENTAL PHYSICS.

(*Continued from page* 544)

stand S so that the blackened surface gets the direct rays of the sun. With this crude apparatus we are in a position to measure the amount of energy received from the sun on each square inch in a certain definite period of time, such as second, minute, hour, etc. The soot is used because of the almost perfect absorption qualities it possesses, and consequently its poor radiating or reflecting qualities. The heat striking the black surface is absorbed, and then conducted by the metal can to the water. The weight of the water multiplied by its change in temperature gives the heat absorbed (in *calories*, if weight is measured in grams and temperature in degrees Centigrade). Dividing this result by the time elapsed from the initial and final readings of the thermometer, gives us the heat received per unit of time. Dividing this result by the area of the surface B, gives us the heat units received per second, on each square inch of surface. By careful determination and necessary corrections according to Newton's law, stated in Experiment No. 99, we find that each square inch of surface on the earth receives about 10 calories of heat per minute from the sun,

while in the path of the vertical rays. From this may be calculated the total heat energy received from the sun by the whole earth. This is calculated to be equivalent to about 350,000,000,000.000 horse-power or about 250,000 *horsepower for each inhabitant!*

Experiment 102.

If we continue our observations (by the aid of proper instruments) of waves still longer than the *heat* waves we come to the *electrical* waves, the short—of which are about ¼ *of an inch*, running over a wide range into *wireless* waves of hundreds and even thousands of feet in length.

The following analogy between sound and electricity will serve to strengthen the wave nature of electricity. With the so-called loud pedal of the piano "on" strike *middle C*. Placing a finger gently on the string *middle C* (the front panel of the piano being removed) the vibrations are felt. Since middle C is the only note that has been struck one would expect that only that string would be vibrating. Placing the finger gently on C, *above* or *below* middle C, we find those strings also vibrating. The explanation is simple: The string middle C on being struck, begins to vibrate at a certain rate, setting up waves of a certain frequency the sound of which we interpret as *middle C*. These waves on striking the other C's of the piano,—since their rate of vibration is similar to middle C, in fact a *multiple* of middle C's rate,—start them vibrating rather faintly but sufficiently to be felt.

Let the inner and outer coats of a Leyden jar be connected to a loop of heavy wire composed of two segments D and E and a movable cross-piece F, so that the length of the loop can be altered to suit. Let jar B be connected with a loop C of fixt length. A space of about ¼ of an inch should exist between the loops and the knobs of each of the jars respectively. On charging and discharging the jar B, a spark will pass thru the gap at knob of jar A provided the loop of jar A is adjusted so as to have the same area as the loop of jar B. On moving wire F to any other position, no spark is observed at jar A. This electrical case is similar to the sound example given above. When the electrical system of A and B are such that they have the *same vibration rate*, just as the C's of the piano having the same vibration rate, then vibrations of the one cause the second to vibrate. *We therefore conclude that electrical discharges are vibratory.* Moving the sliding wire F is called *tuning*, and when the two systems are tuned they are said to be *in resonance*. Just as heat can be transmitted by radiation, so electrical energy can be transmitted. Electricity differing from light only insofar as its waves have a tremendously greater length and the speed of transmission being independent of the wave length we should note that the speed of electrical transmission equals that of light or 186,000 miles per second.

Electro-Magnetic Theory.

An intensive study of electrical radiations shows us that they not only have the speed of light but that they are reflected and refracted, etc., just as light is. Hence in modern Physics, light is considered an electro-magnetic phenomenon. Light waves are considered to be generated by the vibrations of electrically charged parts of the atoms. James Clerk Maxwell, as far back as 1864 showed that it ought to be possible to create waves in the ether by the use of electrical disturbances. Hertz's experiments in 1888 confirmed Maxwell's theory, these two events and dates really marking the beginning of *Radiotelegraphy*.

(To be continued)

ELECTRICAL TESTING ENGINEERS MADE TO ORDER.

(*Continued from page* 538)

tested supply most of the electricity required for testing them, only the losses being supplied from the power station.

The test men operate the machinery being tested, and also operate the machinery used for testing the apparatus which has been manufactured for shipment. With this operating experience, the graduate of the "Test Course" can enter almost any main station, sub-station or switch house and take charge of its electrical operation. This feature was probably one of the main reasons so many of the test men were appointed for officers in the Army and Navy.

The fact is not as generally understood as it should be, that the student engineers are continually shifted from one kind of work to another, and are consulted regarding the sort of work they desire to specialize in and also what class of testing they desire to take up month after month.

For example, if a student engineer has exprest a preference for turbine work, he can spend 50 per cent or more of his time testing large and small turbo-generator sets. Turbines are tested non-condensing and also with vacua up to 29 inches. The student becomes familiar with the properties of steam, ranging from 200° superheat down to 20 per cent moisture. One of the surprises in store for the student engineer who enters the Test Course, is the vast amount of information which he secures in regard to steam.

An indication of the scale on which this mechanical electrical phase of the Company's testing has been developed, is shown by the fact that recently a condenser equipment was installed at an expense of $300,000 and a steam equipment is being installed at a further expense of $200,000—both solely for "testing purposes." Such is practical turbine testing today on a great scale. In comparison with this work the little jet and barometric condensers in the old power plants, 15 years ago, were but cunning little toys.

This wide variety of apparatus for steam and electric railways, transformers, motors, both mill, mine and crane, motor generator sets, etcetera, illustrates the breadth and scope of the "test man's" work. It embraces the latest, and hence the most interesting electrical mechanical devices that are manufactured. When the Engineer of the Chicago, Milwaukee and St. Paul electrical locomotive throws his controller handle one notch ahead, he but duplcates what an electrical test man has previously done. When an operator of the great electric locks of the Panama Canal throws the switches which permit a 32,000 ton battleship to pass thru, he also merely operates what the student engineer has previously tested and adjusted.

The theoretical phase of the training of a student engineer is taken care of by an extensive series of lectures, which are given to the students by prominent designing, research and production engineers, together with the commercial managers of the Company. Not only are these lectures free but the students are paid full time while attending them. Attendance is not compulsory and a student may attend one or two each week as desired. These lectures are given between four thirty and five thirty P. M.—after the close of the working day.

The purpose of these lectures is to round out the student's knowledge of the Company's products as well as develop his versatility. The young men are encouraged in their desire to become specialists, but are prevented from becoming narrow-minded by the broad fields of knowledge that are opened up to them by these various lectures. Altogether there are 50 lectures given every year.

After six months or more have elapsed since the student enered the "Test Course," another opportunity presents itself to those who have made a good record. The Superintendent of the Testing Department selects men for a three months' assignment to the various offices in the Engineering and Commercial Departments, at the end of which training they then return to the Testing Department.

POPULAR ASTRONOMY.

(*Continued from page* 543)

and more unsymmetrical in appearance. The streamers are greatly elongated in the equatorial regions of the sun while above the poles the rays are extremely short with pronounced dark rifts between them. The equatorial streamers *sometimes extend to eight or nine million miles from the sun.* This type of corona is called the sun-spot minimum corona. In June the solar activity was just past the maximum for this sun spot cycle which had been reached the year before. The decline toward minimum activity several years distant was setting in gradually. Sun spots had been observed frequently for several weeks preceding the day of the eclipse and a brilliant sunspot maximum type of corona was expected. The corona of June 8th was indeed extremely brilliant and its light was described as an intense bluish-white. The form was characteristic of the gradual decline of activity, that is, it was a mixt-type corona roughly triangular in shape. The evenly developed portions to the west of the sun of the sun spot maximum type forming the base of the triangle and the long equatorial streamers to the east of the sun spot minimum type forming the apex of the triangle. Their greatest extent was three solar diameters or two and one-half million miles. The corona was also a petal-formed corona, a most beautiful type observed in certain eclipses of the past. The rays curved and interlaced to form enormous petals and Gothic arch formations above the brilliant blood-red prominences of incandescent gases that were plainly visible to the naked eye and formed a most impressive feature of the total phase. The arching of the coronal streamers above the prominences, to a height of several hundred thousand miles from the surface of the sun implies that the same force that causes the eruptive prominences is accountable for the arched coronal rays above them. The prominences, which are chiefly incandescent vapors of hydrogen, helium and calcium often rise to heights of one hundred thousand miles or more and then rapidly fade away. The accompanying photograph taken at Green River, Wyoming, by the Yerkes eclipse expedition. shows a number of conspicuous prominences visible on June 8th, and also the inner corona. Unfortunately it is never possible to reproduce in prints the complex coronal rays, tho the negatives show a wealth of fine detail and delicate tracery. Drawings from the original negatives are necessary to show this complex structure.

Since it is possible to observe the prominences on any clear day with the spectroheliograph they possess little scientific interest during totality, tho they are a most impressive and beautiful feature of the eclipse, owing to the great height they attain and their conspicuous scarlet hue and variety of form. The chromosphere, the richly colored lower solar atmosphere, tinged with pink and orange colored vapors of many elements, that appears as a narrow rim above the eclipsed solar surface is also extremely beautiful and indeed the color

(*Continued on page* 593)

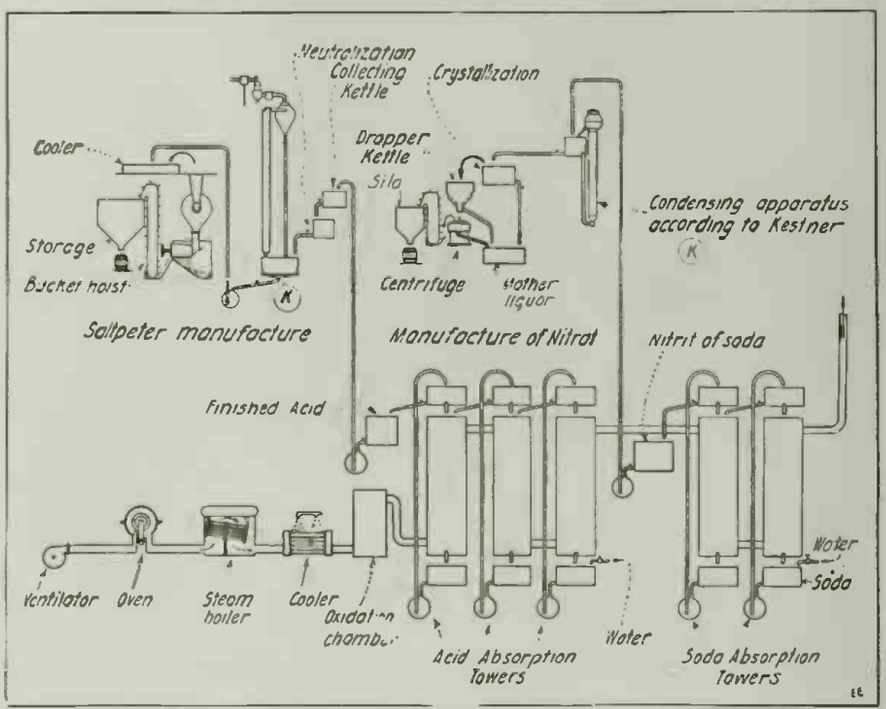
TURNING AIR INTO BREAD—NITRATES FROM THE AIR.

(*Continued from page 541*)

Thus we see that the electrical engineers abroad have actually succeeded in transforming "air into bread," as we might say. At the present time, there is no plant such as here described in use in the United States, or in fact, in the two Americas so far as we know, but it is safe to say that with the gradually changing conditions resulting from the present war, and also in view of the fact that the engineers of today are continuously striving to reduce the cost of all commodities, we of the present generation and our children will live to see gigantic electric-nitrogen power plants, such as here illustrated, sprinkled across the country. It may be of interest to some of our more technical readers to trace the steps followed in the manufacture of nitrat, etc. The schematic diagram herewith shows the various steps that are used in the disassociation of the nitrogen from the atmosphere in a procedure closely following the appended outline, viz.: After the sodium nitrat has been taken from the air by the electric arcs it is admitted into the soda absorption towers, which precipitate the soda and allow the nitrat to pass on into the acid absorption towers and simultaneously the free nitrat is conveyed by means of piping to the apparatus used for the manufacture of the nitrit in powder form; at this stage of the operations the nitrit is condensed in the condensation tower, according to specifications by Kestner, the renowned chemist and is then run into the crystallization chamber where the mixture is crystallized. There is an outlet whereby the *mother liquor* is drawn off and collected in a vat especially constructed to retain the strong acid. Outlets from the filtering apparata also lead into this container, and likewise a third outlet for the overflow of the liquor after the mixture has been separated from the paste by centrifugal action of the Centrifuge. The Nitrit is then carried to the Silo in powder form and stored there until it is to be placed into barrels.

The second line leading from the absorption towers that are shown at the center and at the bottom of the illustration, carries the acid after it has been valenciated with an *additional atom* of oxygen brought from the ventilator, past thru an oven to eliminate the moisture, superheated in the steam boiler and chilled in the condensers. This oxygen then associates itself with the nitric acid as the first step of the manufacture of saltpeter (these apparata are shown at the upper left hand portion of the drawing).

The acidulated paste is neutralized and condensed; then it is stirred until it is evenly mixed and all the lumps are broken. The ball mill comes into action at this period and grinds the paste to a powder, after which it is run thru a sieve and conveyed by a bucket hoist to the Silo, where it is dried and stored for future consumption as the regenerator of the soil and to produce better, bigger and more wholesome crops for our consumption.



Schematic Diagram Showing the Various and Successive Steps Followed in the Disassociation of the Nitrogen from the Atmosphere by the Electrical Furnace Process. The Nitrat of Soda from the Electric Arcs, Mixed with Water, Enters the Refining Apparatus at the Lower Right Corner, as Marked.

A 55,000 KW. TURBO-ALTERNATOR.

The first turbo-alternator of 60,000 kv. a. capacity has recently been completed in the A. E. G. (German) works, and the following description is abstracted from *Elektrotechnische Zeitschrift*. The output of the machine is 55,000 kw., at a speed of 1,000 revs. per min. It gives 7,000 volts, three-phase, with excitation at 220 volts. The turbines work at a super-heat of 326°C., and with cooling water at 27°. The weight of the turbine is 250 tons, of which the turbine rotor is responsible for 49 tons; the total weight of the alternator is 225 tons and of its rotor 106 tons. The entire weight of the machine, turbine and alternator, is thus 475 tons.

This machine, together with a second one of similar size and output, designed by B. Goldenburg, will be installed in the Rheinisch-Westfälische Elektricitätswerke power station, located on the site of the coal fields at the foot of the hills near Cologne. The total installation at this station (named after the designer, the "Goldenburg-works") will consist ultimately of six turbo-alternators from 15,000 kw. each up to about 200,000 kw.

POPULAR ASTRONOMY.

(*Continued from page* 590)

effect of the entire solar surroundings during the total phase is gorgeous beyond description.

The Sun's Prominences—Photographed by Yerkes Obaervatory. This is a particularly Fine View of One of the Larger Prominences.

To astronomers the all important problem in conection with a total eclipse of the sun is—the corona, its composition, the nature and cause of its radiant energy. It contains an element so far unknown elsewhere and named "coronium." An important result that has followed from observations of the June eclipse is definite knowledge of the wave length of the characteristic green line of this unknown element. The existence of one or two additional distinct coronal elements is also suspected, inasmuch as a number of lines of unknown origin appeared in the spectrum of the corona photographed on June 8th, as well as in the coronas of several past eclipses. Determinations of the positions of these lines have also been made. Tho several of them may belong to coroniums it is likely that some of them are lines of other unknown elements. It has also been found that the inner corona shines chiefly by its own inherent light instead of by reflected sun light. The outer corona on the other hand shines largely by reflected light from the sun. It is believed that the corona is composed partly of scattered particles of matter that reflect the rays of the sun, but electrical forces are probably the cause of its peculiar ethereal radiance and magnetic lines of force may cause the complex and periodically changing form of the coronal rays and streamers. It is possible that the clue to the secret of the radiant energy of the sun may lie in the yet unsolved mystery of the solar corona. Every successful observation of a total eclipse of the sun brings us nearer to the solution of this important problem. By correlating a series of observations made by different eclipse expeditions at various total eclipses of the sun or by different observers of the same

This Shows Another View of the Sun's Prominences. Some Idea of the Size May Be Gained by Noting That the Height is Almost Sixty Thousand Miles, While the Width of This Particular Prominence is Almost 100,000 Miles.

eclipse the handicap of being granted only a few brief moments at long intervals for the solution of a perplexing problem is largely overcome.

(*Watch for next Installment.*)

A TRANS-ATLANTIC 10,000 HORSE-POWER AERIAL LINER.

(*Continued from page* 537)

each motor, or a total of twenty-four blades to the machine. The general contour will be similar to the illustration of the "Etheric" shown herewith. The exhaust from the engines will be used for heating "muffler" stoves, upon which all of the food can be cooked, water will be heated, and a general warmth provided in cold weather and while flying at unusual heights.

Quite an appreciable amount of reserve lifting power is utilized for the comfort of the passengers in the way of cushions, hammocks, fans and periodicals.

The "Etheric" is equipt with a *wireless outfit* having a range of two thousand miles, and each passenger is taken care of in the event of accident by an individual combination *parachute and life-belt*, for should he drop from any altitude over one hundred feet his body would be crusht beyond a trace of recognition. These parachutes are situated in a small compartment over the door of each state-room, all of the state-rooms facing the exterior of the ship.†. It is then a very simple matter in the event of an unforeseen occurrence, for the passenger to jump out of bed, open the door, slip on the life-belt and parachute hanging before him, and forgetting all fear, make a leap over the side. The parachute will open, and he will float gently to the surface of the water, in which element he will again be taken care of by the life-belt.

Use will, of course, be made of the *Radio Direction Finders*, which will be in a synchronous tune with New Foundland and Ireland, and any interference from radio messages of other stations will be immediately recognized, as this is due to the close tuning between the liner's station and the shore.

We had all better buy Liberty Bonds, so that by the time they will mature, we will have money laid away in order to buy a ticket for this wonderful voyage ten thousand feet in the air, across the Atlantic, and at a speed of one hundred and ten miles an hour with all the comforts of home.

Note—The motors necessary to propel this gigantic machine would necessarily have to be of approximately 1.9 or 2 pounds weight per brake horsepower developed. At present we have motors that will develop a horsepower at a weight of 2.5 pounds per brake horsepower.

†It is of interest to note that at the large aviation fields maintained by the government, the airplanes are called "ships."

EXPERIMENTAL MECHANICS.

(*Continued from page* 557)

The main point of accuracy of split-chucks lies principally in the fact that the mandrel, made especially large and strong in the first place, is not only very accurately fitted to ground-in bearings of glass-hard steel, but is in itself, the chuck body for the reception of the different sets of jaws, of which one split-chuck may be regarded as a set. To bring this about, the mandrel is bored true thruout to as large a diameter as possible, and is further coned out at the front end to an included angle of 45 degrees. It can be clearly seen that with such a contrivance nothing short of a sledge hammer blow will put the running of this internally coned surface out of truth with the lathe axis. All the principal gripping chucks for such a lathe are made of one size externally, to fit exactly into the mandrel bore. They are then bored exactly to the size they are intended to grip, screwed at the back end, split and hardened to form what is called a split-chuck. By placing within their grip around work of the size they are intended to hold, and drawing them in tightly to the mandrel end by means of a hollow draw-in spindle screwed to their back end, and working thru the bore of the mandrel, absolute truth of running is obtained within limits where .001 (one one-thousandth) of an inch would be regarded as a serious error.

Thus in order to procure accuracy of the finished material or product, it is essential that the means of chucking the work plays a very important rôle. For small work and where precision is desired, no other than the spit-face chuck should or can logically be used.

(*To be continued*)

WORK OF BELGIAN COMMISSION OF AMERICAN RED CROSS.

The American Red Cross, thru its Belgian Commission, has authorized the installation of an electric storage battery plant at the colony of 400 Belgian children which it is supporting at Recques. These children are refugees from the towns in which the fighting is going on today on the Belgian front.

SPECTROSCOPIC METHODS AND SPECTRA.

(*Continued from page* 555)

be slipt. This clip is made of sheet brass, altho tin or copper may be used. The arc is struck by moving this carbon forward till they both touch, and then moving them back about ¼" to ½". The current connections are made to the carbons by the holders or clips and should be connected to binding posts on the base.

A sheet of white cardboard tacked to the back will serve to reflect the color. The current used is the 110-volt lighting current. A rheostat must be used in the circuit. This was made by filling a ½ gallon jar full of water and adding ½ to 1 oz. hydrochloric acid and then immersing the strips in it. The amount of current can be varied by lowering or raising one of these strips. The wiring connections are shown in the figure.

It is advisable, if this apparatus is used for any length of time, to see that the house fuse plugs have not less than 25 amperes capacity, as the usual house fuse is of 15 amperes rating, which will burn out in a short time, especially if too much acid has been used in the water.

It will not be out of place here to refer to the disadvantages mentioned in several places in the article. These are mainly connected with the fact that the means to produce the spectra sometimes give a continuous spectrum of their own, which completely blots out the band spectrum. This can only be overcome by using very narrow slits, but if a very narrow slit is used, the illumination must be increased. It is really advisable to make about six slits, in which they vary in size from one large one, about ⅛" diameter, and five small ones, in which the smallest should be about as wide as the thickness of a sheet of writing paper. A set of these will greatly facilitate good work.

This covers briefly all the general fields of spectroscopic work, but several miscellaneous items still remain.

If the slit of the instrument is pointed at the sun, a *continuous spectrum* will be seen, which, however, is crost by a considerable number of black lines. These were found on investigation to correspond to the colored lines in ordinary spectra. They are called *Frauenhofer's lines* after their discoverer. They are explained by the theory that the sun is a white hot mass of *solid* matter, surrounded by a mantle of gaseous vapors. These vapors under ordinary circumstances would emit *band* spectra, but with the background of incandescent matter they are *reversed*, and appear as black lines on a colored background.

It is obvious that by comparing these lines with ordinary spectra, we can tell what elements exist in the sun. This has been done, and the sun has been found to contain chiefly iron, sodium, magnesium, calcium, chromium, nickel, barium, copper, zinc and hydrogen. Hydrogen especially has been observed in enormous quantities. Four hundred and fifty of the lines of the iron spectrum (which contains an enormous number of lines) have also been identified. It is also a fact that *the sun contains countless numbers of lines that are* NOT KNOWN ON EARTH. One substance has since been discovered, namely, *Helium*, and it is a startling fact to consider that this element was discovered in an incandescent body millions of miles away in space before it was known on our own little globe.

An experiment to illustrate the reversal of the spectrum can be made by placing a sodium flame in front of the spectroscope, and behind it a small arc. The yellow band will disappear, and the *continuous spectrum* of the arc will be crost by a black line where the yellow should be. The experiment can also be made with other elements, but the result is in every case the same.

A little consideration should now be given to the best materials, etc., used to obtain the spectra. As a general rule, it can be said that the halogen salts, that is the chlorides, bromides or iodides, are the best to use. The chlorides being the cheapest and most easily procurable, are generally used.

The reason these salts are the best is because of their instability at the high temperatures used. They are decomposed (disassociated is the more correct term) into the free metal and radical. Care must be taken, however, with some salts, for example calcium chlorid, which yields a spectrum of its own which lasts until it is decomposed into calcium oxid; and, in fact, if possible, it is best to use the oxid instead of the chlorid.

The foregoing remarks apply equally alike to flame, spark and arc spectra, but in the case of the flame methods being used, in which it is evident that the temperature is not nearly so high as the arc and spark methods, materials can be used that will materially aid in increasing the spectrum. The salts referred to are the chlorates, which practically amount to a chlorid with three atoms of oxygen attached. When, for instance, potassium chlorat is introduced into a flame, the heat begins to drive off some of the oxygen, which increases the temperature of the flame. in which the residual chlorid is being volatilized. It will, therefore, be seen that the use of the chlorates where available, for flame spectra, is a decided improvement.

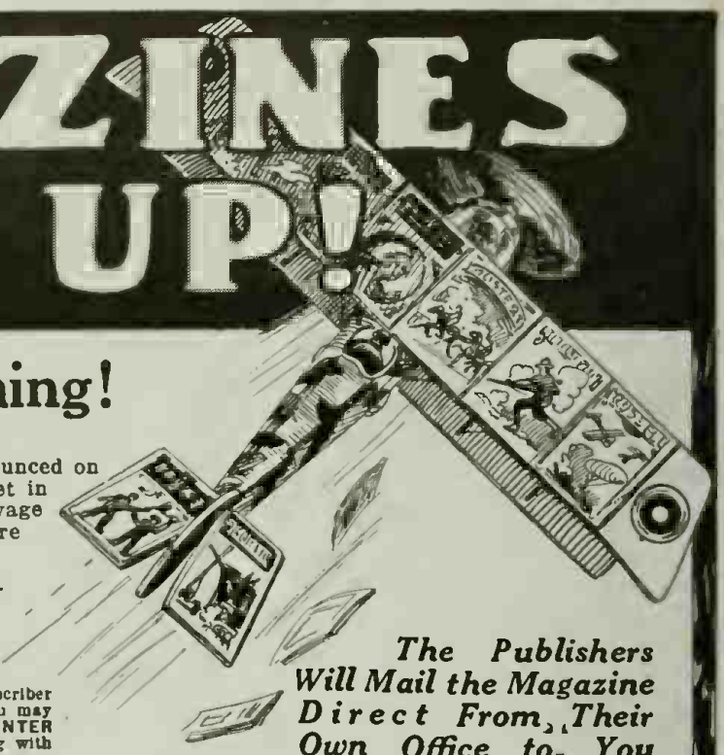
The nitrates can also be used in a similar capacity, but are not so efficient as the chlorates.

It will be well to again repeat the warning that nitrates or chlorates must never under any circumstances be used for arc spectra, as the combination between them and the carbon of the electrode, making practically gunpowder, at the temperature of the arc, may result in a dangerous explosion.

It is to be hoped that enough has been said in the preceding articles to give to the careful and earnest Experimenter some small glimpse of the wonders that can be revealed with a very little expense, a normal amount of ability and patience, opening up, as this subject does, such a fascinating and enormous field for experimental work, and yet it is a strange but true anomaly that the more we learn and the farther we extend our knowledge, the stronger becomes the conviction that we know less and less of it than ever before.

(*Conclusion*)

MAGAZINES GOING UP!



Further Increases Coming!

NOW IS YOUR CHANCE!

With this issue, the price of the EXPERIMENTER, as announced on another page, goes to $2.00 a year. With the paper market in chaos and soaring prices, printers demanding another large wage increase, engravings going up 90%, we feel sure that before spring ALL magazines will go much higher than now.

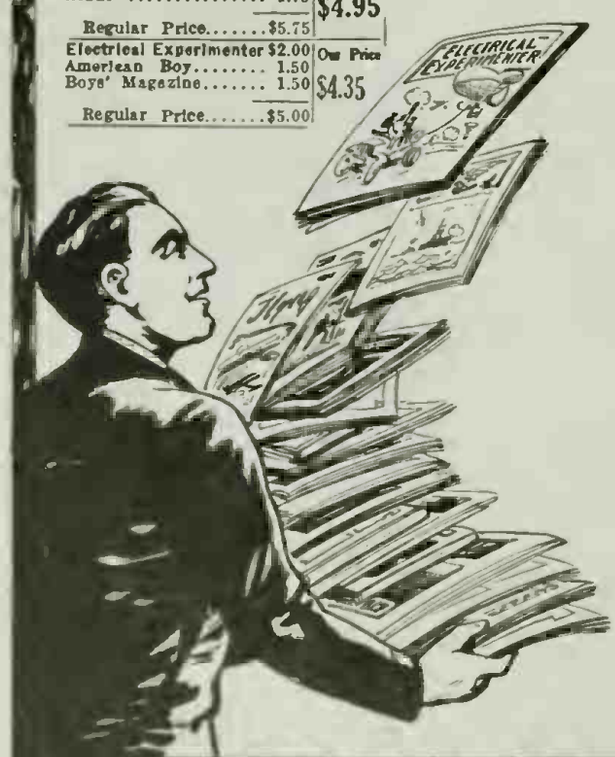
By subscribing now for from one to five years, YOU POSITIVELY WILL SAVE BIG MONEY.

The prices below are unquestionably the lowest for standard magazines that it is possible to obtain anywhere. Only by a special arrangement with the publishers are these prices possible and they are good only until December 15th, after which date all prices as given on this page are withdrawn. Make up your list at once—do not delay. If you are already a subscriber and your subscription to the EXPERIMENTER runs for a long time, you may subscribe for any other magazines by deducting the price of the EXPERIMENTER from the clubs at the rate of $1.85 (the special price allowed in clubbing with other magazines). Thus you can make up any club yourself of as many magazines as you wish from the list below.

The Publishers Will Mail the Magazine Direct From Their Own Office to You

All prices quoted are for subscribers in U. S. only. Canadian and foreign subscriptions require additional postage.

Electrical Experimenter $2.00 Popular Science..... 2.00 Illustrated World, (Technical World).. 2.00	Our Price $5.50	Regular Price.....$6.00
Electrical Experimenter $2.00 Scientific American.... 5.00	Our Price $6.50	Regular Price.....$7.00
Electrical Experimenter $2.00 Popular Astronomy... 3.50	Our Price $5.15	Regular Price.....$5.50
Electrical Experimenter $2.00 Wireless Age..... 2.00 Etude 1.75	Our Price $4.95	Regular Price.....$5.75
Electrical Experimenter $2.00 American Boy..... 1.50 Boys' Magazine..... 1.50	Our Price $4.35	Regular Price.....$5.00
Electrical Experimenter $2.00 American Boy..... 1.50 St. Nicholas..... 3.00 Youth's Companion.... 2.00	Our Price $7.85	Regular Price.....$8.50
Electrical Experimenter $2.00 Today's Housewife.... .75 McCall's Magazine.... .75	Our Price $3.00	Regular Price.....$3.50
Electrical Experimenter $2.00 Collier's Weekly..... 2.50 Literary Digest..... 4.00	Our Price $8.00	Regular Price.....$8.50
Electrical Experimenter $2.00 Etude 1.75	Our Price $3.20	Regular Price.....$3.75
Electrical Experimenter $2.00 Boys' Magazine..... 1.50	Our Price $3.00	Regular Price.....$3.50
Electrical Experimenter $2.00 Everybody's Magazine. 2.00 Delineator (all to one address) 2.00	Our Price $5.35	Regular Price.....$6.00
Electrical Experimenter $2.00 Motion Picture Magazine 2.00	Our Price $3.60	Regular Price.....$4.00
Electrical Experimenter $2.00 Everybody's ..... 2.00 American Magazine... 2.00	Our Price $5.50	Regular Price.....$6.00
Electrical Experimenter $2.00 World's Work..... 4.00	Our Price $4.85	Regular Price.....$6.00
Electrical Experimenter $2.00 Smart Set..... 3.00	Our Price $4.10	Regular Price.....$5.00
Electrical Experimenter $2.00 Parisienne 2.00	Our Price $3.50	Regular Price.....$4.00
Electrical Experimenter $2.00 Youth's Companion... 2.00 Review of Reviews.... 3.00	Our Price $6.10	Regular Price.....$7.00
Electrical Experimenter $2.00 Pictorial Review..... 2.00 McClure's Magazine... 1.50	Our Price $5.00	Regular Price.....$5.50



Special Clubbing Prices of Electrical Experimenter WITH

	Regular Price	Our Rate Per Year
Adventure	$5.00	$4.70
American Boy	3.50	3.00
American Magazine	4.00	3.85
Black Cat	3.50	3.00
Blue Book	4.00	3.75
Boys' World	2.50	2.25
Century	6.00	5.30
Christian Herald	4.00	3.60
Collier's	4.50	4.25
New Country Life	7.00	5.85
Delineator	4.00	3.60
Etude	3.75	3.20
Everybody's	4.00	3.60
Field & Stream	4.00	3.50
Film Fun	3.50	3.25
Grit	4.00	3.60
Illustrated World (Technical World)	4.00	3.50
Judge (Weekly)	7.00	6.75
Leslie's Weekly	7.00	6.75
Literary Digest	$6.00	$5.70
McClure's Magazine	3.50	3.00
Metropolitan	5.00	4.75
Modern Priscilla	3.50	3.25
Nation	6.00	5.35
Outing	5.00	4.75
Outlook	6.00	5.75
Pearson's Magazine	4.00	3.50
Popular Science Monthly	4.00	3.75
Red Book	4.00	3.75
Review of Reviews	5.00	4.00
St. Nicholas	5.00	4.75
Scientific American	7.00	6.50
Scribner's Magazine	6.00	5.35
Smart Set	5.00	4.10
Wireless Age	4.00	3.50
Woman's Home Companion	4.00	3.75
World's Work	6.00	4.85
Youth's Companion	4.00	3.75

Write for Special Prices on ANY Publication not listed here

We will save you money

SEND ALL ORDERS TO "CIRCULATION DEPARTMENT"

EXPERIMENTER PUBLISHING CO., Inc.

233 Fulton Street, New York City, N. Y.

SEND FOR OUR FREE SUBSCRIPTION CATALOG

Scores of Publishers are increasing their prices overnight. Protect yourself by subscribing NOW

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms and dealers from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section six cents a word for each insertion. No advertisement for less than 60c accepted. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted. Advertisements for the January issue must reach us not later than November 22.

The Circulation of the Experimenter is over 100,000 and climbing every month
EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Automobile Accessories

Does your Ford Miss? Apply Elevated Timer Bracket and know your timer. Write for circular. Atlantic, 285 East 16th St., Brooklyn, N. Y.

More Power, Less Fuel, No Carbon. No mystery, plain facts, results guaranteed. Write for booklet. S. O. Automobile Accessories Co., Baltimore, Md.

Fords Start Easy in Cold Weather with our new 1919 carburetors. 34 miles per gallon. Use cheapest gasoline or half kerosene. Increased power. Styles for any motor. Very slow on high. Attach it yourself. Big profits to agents. Money back guarantee. Thirty days' trial. Air-Friction Carburetor Co., 270 Madison, Dayton, Ohio.

Agents Wanted

Insyde Tyres, inner armor for automobile tires, double mileage and prevent punctures and blow-outs. Quickly applied. Costs little. Demand tremendous. Profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, O.

Hel-Met The Kaiser Pin—Latest war novelty. Biggest hit out, every patriotic citizen wants one. Sample 10c. Wedge Mfg. Co., "KM," Binghamton, N. Y.

Easy, pleasant work for mechanics, shop men, clerks, during spare hours, will add many dollars to their salaries. Also want persons who can give full time. Big wages assured. Novelty Cutlery Co., 308 Bar St., Canton, Ohio.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Ave D, Decatur, Ill.

Agents wake up. For 25 cents we will send a secret that will earn you from $20.00 to $40.00 weekly. Gem Supply, 311 West 37th St., New York, N. Y.

Electrical Supplies and Appliances

For Sale Cheap: About 7 lbs. 35 double cotton covered magnet wire. J. L. Lange, 9 Roosevelt Ave., Jersey City.

Make Dry Batteries. Simple, practical instructions with blue print, 25 cents. Dirigo Sales Company, Bath, Maine.

Electrical Tattooing Machines and Supplies. Catalogue free. Prof. Temke, Exp., 517 Central, Cincinnati, Ohio.

Electric Motors for your Hand Power Washing Machines, Small Grinders, Lathe, Drill Presses, Air Compressors, Coffee Grinders, etc., are New with 10 ft. cord and pulley. ¼ H.P., Regular Price $30, My Price $21.00. ½ H.P., Regular Price $70.00, My Price $50.00. S. H. Rhodes, 129 Plum St., Johnstown, Pa.

Wanted—Electrical Device. Canadian manufacturer, having plant and staff available for additional work, wishes small electrical device to manufacture either on contract basis or for both manufacture and sale in Canada on royalty or percentage basis. A device having a large market similar to electric fan, sewing machine motor or automobile electric horn preferred. Address full particulars to S. D., P. O. Box 107, Times Square Station, New York City.

For Sale—3 300 Watt. 110 Volt Step down, transformers good condition. 20 different Variations of Voltage from 1 to 25. $10.00 each. John Kassel, 114 North Kilbourn Ave., Chicago, Ill.

Toy Transformers, $1.60. Just a few left. Write for folders. A. R. Darling, 56 N. Bradley Ave., Indianapolis, Ind.

A Few Electric Stoves for Sale, size 4 by 6 inches. Price complete, $2.25. Address Alfred Gaillard, 1719 Pendleton St., Columbia, S. C.

Stamps and Coins

Stamps—61 all different free. Postage, 3c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

California Gold, Quarter size, 27c; Half-dollar size, 53c; Dollar size, $1.10; Large cent, 1820, and catalogue, 10c. Norman Shultz, Kings City, Mo.

500 Finely Mixed United States or Foreign Stamps, 12c. Philatelic Star, Madison, N. Y.

32 Different Foreign—Cuba, etc., to applicants for approvals. Merlyn Kennedy, Oshawa, Ontario, Canada.

225 Different Stamps 25c. Fred Onken, 546 Carlton Avenue, Brooklyn, New York.

We Buy and Sell Old Money. $2 to $500 each paid for hundreds of coins dated before 1895. Keep all Old Money. Send 10 cents for new illustrated Coin Value Book, 4x7. You may have valuable Coins, get posted. Clarke Coin Company. Box 110, Le Roy, N. Y.

Pay Good for Coins. Send 15c Book showing prices paid. Roessler, East Orange, New Jersey.

Aviation

Learn Aviation Motor Mechanics or Aeroplane Building. Prepare for Government call or civilian work. Big money after few weeks. Write. Moler Aviation School, 105 S. Wells St., Chicago.

Auctions

Auctioneers make from $10 to $50 a day. Free catalog. Missouri Auction School, Kansas City.

Business Opportunities

I made $20,000 here past four years making burial vaults. Will start you in same permanent business without capital. Absolutely no selling. Stamp brings details. Charles Murphy, Dept. 3, Bloomington, Ind.

Enter a New Business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks, at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

I Teach Profitable Home Work. Honest proposition. Particulars for stamp. De Lany Walton, Prairie City, Ill.

Office Device Wanted—A National Sales Organization will develop two new inventions or improved attachments and manufacture, and sell same on a large scale. Preference given to the Office Specialty devices. State briefly in first letter post what you have and interview will be arranged. Address Box E. E. 12, Room 904, 171 Madison Ave., New York City.

I Made $30 a Week, easy money, evenings home. Free Booklet explains. Mail Order Business. Send stamp. Alec. Scott, Cohoes, New York.

Make Die-Castings. Sketch, Sample, Booklet, and Proposition, 12c. R. Byrd, Box 227, Erie, Pa.

"Quick-Action Advertising—How it is Building Business for the Progressive Advertisers of America"; A little story of RESULTS, told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet, which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates today. Douglas Wakefield Coutlee, 225 West 39th Street, New York.

Build up an Income in Oil—Others are doing it—Why not you? Today is the opportunity. Join our easy monthly payment plan NOW—it may mean hundreds in profits. Write for information. National Oil Drilling Co., Dept. K, Houston, Texas.

WANTED—for one year, $500 to help market my new patent, double twin turbine. A fuel saver, easy to make, operate and repair, simple in construction, efficient working. I will repay the $500 at $10.00 or more a week until fully repaid. Will pay $30 the year interest, and will give a year's dividends of $50.00 upon the receipt of the above loan. E. W. Barton, 8 Judd St., Binghamton, N. Y.

WANTED—Specialities for mail order house. What have you to offer? Stone Specialty Co., 11 Broadway, N. Y.

Wanted Electrical Device. Canadian manufacturer, having plant and staff available for additional work, wishes small electrical device to manufacture either on contract basis or for both manufacture and sale in Canada on royalty or percentage basis. A device having a large market similar to electric fan, sewing machine motor or automobile electric horn preferred. Address full particulars to S. D., P. O. Box 107, Times Square Station, N. Y. City.

Motors, Engines, and Dynamos

Small Motors and Generators: 1000 New Motors and Generators from Bankruptcy Stock, ¼ H. P. A. C., $18.50 each; ½ H. P., $30.00. Battery Charging Sets—Robbins & Myers new outfits, all sizes, $30.00 each and up. Charging Lighting and Moving Picture Arc Generators, $10.00 each and up. Motors for all phases of current. Immediate delivery. Less than ½ regular prices. Write for late bulletin. Johnston, West End., Pittsburgh, Penna.

Motorcycles

Motorcycles from $25 up—New and second-hand. Easy terms, large list to choose from, all makes. Send 4c stamps for Bulletin "A." Peerless Motorcycle Co., Watertown, Mass.

Watches

Expert Watch Repairing. Reduced Prices. References. Leo Hirsh, Elkhart, Ind.

Books

Free—$5,000 worth of valuable books as premiums. Write for more information and catalogue; it's free. I have many books on Natural healing, personal magnetism, Clairvoyance, seership, Hypnotism, Mesmerism, concentration, character reading, mind power, etc. Tell me your wants. A. W. Martens, JX8, Burlington, Iowa.

Rare and Secret Books at Lowest Prices Ever Advertised—History Elks (800 pages), $3.50; Secrets Freemasonry Exposed, 93c; Art and Science Personal Magnetism, $3.00; Philosophies and Religions of India, $3; Secrets Odd Fellows, $1.30; Private Sex Lessons of Physician, $1.50; Social Evil In Chicago, $3; Occultism, $1.50; Memory Training, $3; Secrets of Scotch Rite Freemasonry Exposed, 2 volumes, 1026 pages, $2.60; Chapter Freemasonry, $1.30; Red Men, 57c; Knights Pythias, 57c; Maccabees, 48c; Knights Columbus, $1.50; Mah-hah-Bone, $3; Life After Death, $1.50; Salesmanship, $2. Order several of these books direct from this advertisement. Catalog 10c. Jay McCarthy, 1236 Arthur Ave., Chicago, Ill.

To Get Better Pictures: Read the Amateur Photographer's Weekly; illustrated; weekly prize competitions; print criticisms; many unique features; $1.50 per year; three months' trial subscription 25c. Abel Publishing Company, 401 Caxton Bldg., Cleveland, Ohio.

Old E. E. Back Numbers: We have some valuable old E. E. back numbers on hand as follows: 1915—Jan., March, April, June, July, Aug., Sept., Oct., Nov., Dec., price each 35c. 1916—Jan., Feb., March, May, June, August Sept., Oct., Nov., Dec., price each 35c. 1917—Jan., Feb., March, Apr., May, June, July, Aug., Sept., Oct., Nov., each 35c; Dec., 20c. 1918—Jan., Feb., Mar., Apr., May, June, July, Aug., each 20c; Sept., Oct., Nov., each 15c. We can fill orders at once upon receipt of your remittance, and if you have not these numbers already, now is your chance to get them, as they probably will be snapped up very quickly. Experimenter Publishing Co., 233 Fulton St., New York City.

100,000 Large Second Hand and New Books for sale cheap; costly bindings, 25c each; some cost $25.00 when brand new; Technical, Mechanical, Scientific, Sex, Religious, History, Medicine, Surgery, Chemistry, Encyclopedias, Philosophy, Mathematics, Law, Fiction, International Correspondence School, Text. Improve your mind and self educate yourself. I urge you to send me 10c for big catalogue and make immediate selections. McCarthy, 1236 Arthur Ave., Chicago, Ill.

What Every Draughtsman Should Know: Very useful booklet. Price only ten cents. Wack Booklet Co., 1943 Patten St., Philadelphia, Pa.

Experimenters—Subscribe to **The Amateur's Friend,** a non-technical, semi-monthly, pocket size magazine. 3 months—30c. Sample copy—5c. Advertising rates 1c word. Maurice Goldberg, 711 Dayton Ave., St. Paul, Minn.

I Offer the world's finest Scientific and Technical Books on Electricity at Less Than Regular Prices—Remember, these treatises are by world's renowned experts and are unquestionably the finest works you can obtain on this subject—They are profusely illustrated with magnificent engravings. Electrical Tables and Engineering Data (331 pages), $1.25; Alternating Current, Theory, Practise and Diagrams (296 pages), $1.40; Wiring Diagrams and Descriptions (296 pages), $1.30; Armature and Magnet Winding (270 pages), $1.35; Modern Electrical Illumination (275 pages), $1.40; Motion Picture Operation (393 pages), $1.30; Modern Electrical Construction (440 pages), $1.40; Electricians Operating and Testing Manual (361 pages), $1.30; Electrical Dictionary (320 pages), $1.40; Telephone Handbook (286 pages), $1.30; Electrical Measurements and Meter Testing (328 pages), $1.60; Electric Motors, Direct and Alternating (250 pages), $1.35; Elementary Electricity up to Date (500 pages), $1.55; Electricity Made Simple (233 pages), $1.30; Easy Electrical Experiments and How To Make Them (220 pages), $1.60; Dynamo Electric Machines (380 pages), $1.90; Telegraphy Self Taught (170 pages), $1.25; Storage Batteries (100 pages), 70c; Operators Wireless Telegraph and Telephone Book (210 pages), $1.40; Electro-plating (192 pages), $1.30; Oxy-Acetylene Welding and Cutting (215 pages), $1.30; Practical Mechanical Drawing and Machine Design Self Taught (160 pages), $2.50; Pattern Making, $2.00; Alternating Current Machinery (486 pages, 409 illustrations), $3.60; Electrical Railways (300 pages), $1.75; Electric Wiring and Lighting (195 pages), $1.40 Elements of Electricity (250 pages), $2; Electrochemistry and Welding (233 pages), $2; Standard Electrical Dictionary (682 pages, 393 illustrations), $3.50; Storage Batteries Simplified (320 pages), $1.75. Order these books at once before advance in price. Catalogue of Book Bargains, 10c. McCarthy Book House, 1236 Arthur Ave., Chicago, Ill.

Cameras, Supplies, Photo Developing

"Camera Kinks and Photo Fads" tells how to make Transparent photos on watch caps, chinaware, etc.,—Chemical oil photos,—Photos on silk,—Direct positives,—Red firelight photos,—Perfectly titled negatives,—Instantaneous developer, and many other new processes. Price 25c. E. Greenhalgh, The Lexington, Indianapolis.

Clean Neat Finishing—Postage paid both ways. Free Mailing boxes. Write for samples and prices. Myers Studio, Department Four, Summit, New Jersey.

Mail us 15c with any size Film for development and 6 velvet prints. Or send 6 negatives any size and 15c for 6 prints. 8 x 10" mounted enlargements 35c. Prompt, perfect service. Roanoke Photo Finishing Co., 255 Bell Ave., Roanoke, Va.

Miscellaneous

Tobacco or Snuff Habit Cured or no pay. $1.00 if cured. Remedy sent on trial. Superba Co., SA, Baltimore, Md.

Catch Fish. Descriptive folder containing valuable information mailed for stamp. George Julian, Albany Building, Boston.

Boys! Build Aviation Type Speedster. Easy to make at small cost. Speed 35 miles per hour. Send Quarter for plans. Aerocar Company, Racine, Wisconsin.

Patent for Sale—Polyhedral Shaped Silo. Pateot No. 1,154,511. John O'Conner, Box 432, Helper, Utah.

Don't Throw It Away. If a pot leaks send for a box of Mendets. Save money. Simply tighten Mendet and leak is mended. Fits any surface. Only 10c. Agents wanted. The Crystal Agency, 35 Crystal St., Brooklyn, N. Y.

Ohio Ford Owners Guaranteed 1918 List. $2.00 per 1000 names. Milton Matthews, Chagrin Falls, Ohio.

Patented Articles, Models, Brass Work, Machine Construction; Dies Made. Baum's Metal Specialties, 1311 Baltimore Ave., Kansas City, Mo.

Wanted—Small Gasoline and Steam Engines. Cash paid for 1 to 4 cylinder light weight Motors. ¼ to 10 H.P. Johnston, West End, Pittsburgh, Pa.

Catch Sparrows Wholesale. Self-acting cage trap. (Other birds can be liberated uninjured) Easily made at trifling cost. Blue prints with instructions, one dollar. George Julian, Albany Building, Boston, Mass.

Pyorrhea—H. E. Kelty, D. D. S., M. D., pyorrhea specialist for 15 years, has developed a successful home treatment for pyorrhea. Purifying, healing, preventative. Full month's treatment and booklet, $1. Circular free. Dr. H. E. Kelty, 106 Gladwin Ave., Leonia, N. J.

Novelties

Genuine Indian Baskets—Wholesale and Retail. Catalogue. Gilham, Highland Springs, California.

Printing

100 Bond Noteheads, 4 lines and 100 envelopes, prepaid, $1.00. Southwestern, 1413-H Berendo, Los Angeles.

Beautiful Lithographed Stationery at Printer's Prices; Small quantities. Raq-Dee Lithographing Co., 768 E. Tentonia, Milwaukee.

For Advertisers

20 Word Ad. in 100 Pulling magazines, $1.00, About 75,000 readers. Send copy now. Lindhorst Magic Shop, St. Louis.

"Quick-Action Advertising—How it is Building Business for the Progressive Advertisers of America"; A little story of RESULTS told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates today. Douglas Wakefield Coutlee, 225 West 39th St., New York.

For Inventors

Inventors—Market and secure your inventions through National Institute of Inventors, World Bldg., New York City. Membership co-operative organization.

Help Wanted

Thousands Government Jobs open to men, women, girls. $95.00 month. Quick increase. Short hours. Common education sufficient. Write immediately for free list of positions open. Franklin Institute, Dept. Y 26, Rochester, N. Y.

Men Wanted to join American Toy Manufacturers, to make Toy Soldiers, Army, Navy and other toys. Homeworkers on small scale. Manufacturers on large scale. Greatest chance for industrious people for independent business. Enormous demand in American Made Toys. War stopped all importation. We buy these goods all year, whole output or surplus over sales, paying fixed prices. Anyone can turn out perfect work without experience or additional tools. Hundreds and more made per hour. Casting form outfits, $3.00 up. Booklet and information free. Toy Soldier Manufacturing Co., 32 Union Square, N. Y.

Letter Specialties

Letters, Booklets, Folders, well worth mailing. Pontifex, 62 Frank St., Ottawa, Ont., Canada.

Motion Pictures

Motion Picture Machines bought and sold; bargain lists free. National Equipment Company, Duluth, Minnesota.

Write Photoplays, $50 Each. Experience unnecessary. Details free to beginners. Producers League, 358, St. Louis.

Phonographs

Build Your Own Phonographs and manufacture them for profit. Drawing instructions, Parts, Price List, Blue Prints, etc., complete, sent free upon request. Write today. Associated Phonograph Co., Dept. E-1, Cincinnati, Ohio.

Build Your Phonograph. "Perfection" high-quality spring and electric Motors, Tone Arms, Reproducers. Wonderful results. Big saving. New catalog and building instructions mailed for ten cents. Indiana Phonograph Supply Co., Indianapolis, Indiana.

Scenery for Hire

Collapsible Scenery for all Plays. Amelia Grain, Philadelphia, Pennsylvania.

News Correspondents

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Patent Attorneys

Patents—Without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D. C.

Inventions Wanted! Manufacturers constantly writing us for patents. List of inventions actually requested and book "How to Obtain a Patent" sent free. Send rough sketch for free report regarding patentability. Special assistance given our clients in selling patents. Write for details of interest to every inventor. Chandlee & Chandlee, Patent Attorneys, Est. 21 years. 551 7th St., Washington, D. C.

Patent Your Own Inventions. Save attorney's fees; we prepare applications; furnish full instructions and give satisfaction. Free information. Carl Larsen Co., Park Row Building, New York City.

Millions Spent Annually for Ideas! Hundreds now wanted! Patent yours and profit. Write today for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. 212 Patent Dept., American Industries, Inc., Washington, D. C.

M. F. Miller, Ouray Building, Washington, D. C., **Patent Attorney,** Mechanical and Electrical Expert. Best quality of work and results. Moderate charges. Advice free.

Your Idea Wanted. Patent Your Invention. I'll help you market it. Send for 4 free books, list of patent buyers, hundreds of ideas wanted, etc. Advice free. Patents advertised free. Richard B. Owen, Patent Lawyer, 130 Owen Bldg., Washington, D. C., or 2278T Woolworth Bldg., New York.

Post Cards

Everything in Postcards. Live wire list free. Worth-while samples 25c. Mention subjects preferred. Mutual Supply Co., Bradford, Pa.

Song Poems Wanted

Write the Words for a Song. We write music and guarantee publisher's acceptance. Submit poems on war, love, or any subject. Chester Music Co., 538 S. Dearborn St., Suite 265, Chicago.

Stammering

St-stu-t-t-tering and Stammering cured at home. Instructive booklet free. Walter McDonnell, 105 Potomac Bank Building, Washington, D. C.

Tricks, Puzzles and Games

1000 stage tricks with 500 illustrations. Catalogue 10c, small catalogue FREE. Hornmann Magic Co., Sta. 6, 470 Eighth Avenue, New York.

New and Mystifying Hindo Magic Tricks. Tokio Trick 10c, Chinese Link O Link Mystery 25c, Magic Jacks 15c, Flying Half Dollar 35c, Rising Card 15c. How to make Fireworks, Roman Candles, etc., 25c. All the above for limited time 60c, including free trick and catalogue. You can earn $15.50 in cash by reading the "Magic Advertiser" and recommending it to your friends. Full particulars on request. Lindhorst Magic Shop. Dept. EE, St. Louis, Mo

Scientific Exchange Columns

LIVE readers with something to "swap" or sell have found that the surest and quickest way to make the desired trade is thru an ad in these columns.

The rates are: *Five cents per word* (name and address to be counted.) *Remittance must accompany all orders.* No advertisement for less than 50c accepted. We reserve the right to refuse any advertisement which we consider misleading or objectionable. Dealers' advertising accepted in Opportunity Ad-let columns only. Advertisements for the January issue must reach us not later than November 22.

OVER 100,000 CIRCULATION

For Sale—Erector Electrical Set, Erector Set No. 1 and Meccano Motor. Will sell cheap. Apply to Harold Tornquist, Caribou, Me.

Bargains—All kinds of telephone parts. Want D. C. Charging dynamo. Clarence Kositzky, 911 South Ninth Street, Lincoln, Nebraska.

For Sale or Exchange—Bausch and Lomb microscope, magnifies 285 times. Physics Laboratory equipment—Weston D. C. Voltmeter 1-15, Wheatstone bridge, etc. Want Tesla and spark coil, etc. Edw. Nickerson, Warrenton, Mo.

Will Exchange—New $21 Meccano for Chemical Laboratory Outfit. Charles Blake, Fayette Street, Wollaston, Mass.

Wanted—A Luger pistol in good condition, state price. J. O. Grisinger, Vanetta, Fayette Co., W. Virginia.

Sell—Small stamp collection cheap. Write. Granville Whittlesey, Jr., 130 E. 67th St., New York City.

For Sale or Trade—Weston D. C. 300 Amp. Ammeter with 300 Amp. shunt I. C. S. tangent galvanometer, slide wire bridge for cash or chemical supplies. John Cauffiel, 1911 Summit St., Toledo, Ohio.

Wanted—Bound Volume No. 4 Electrical Experimenter. Good condition. State price. George Hawley, Hutchinson, Kansas.

Sell or Exchange—Shaw equipped motor bike used two months. Good as new. Make offer. W. C. Cagle, Hearne, Texas.

For Sale—Complete course 100 lessons for violin $10.00. Easy to learn. Mathew Johnson, 305 So. 5th St., La Crosse, Wis.

Wanted—Sensitive Polarized Relay. Walter D. Smith, Delaware College, Newark, Delaware.

Wanted—DeForest round audion bulb also 1 K.W. Mareoni or Blitzen transformer. Harry Weber, 1113 Walnut St., Dover, Ohio.

For Sale—Smith Motor Wheel, $28.50, Goodell-Pratt Grinder-Lathe, $6.00. Both in good condition. Joseph Backert, 1015 South Sixth St., Terre Haute, Ind.

Bargain—6,000 M. Navy coupler, $10.00; 15 Omnigraph Dials (continental) $1.85; Cabinet Receiving Set, $4.00. Harold Davie, Bolivar, New York.

For Sale—Complete Chemical laboratory, switchboard, etc. Cheap. Send 3c stamp for list. Chas. A. Purdy, 1115 Monroe St., Evanston, Ill.

For Sale—Indian Motorcycle Engine, fifteen dollars. Harold Lambert, Haverstraw, N. Y.

Sell—110 volt motor $4, cost $7. ¼ inch spark coil $1. Crystaloi Detector never used $2.50, 75 ohm receiver 50c, one Brandes Headband, double, $1. Donald Pratt, 2326 Farragut Ave., Chicago, Ill.

Complete Chemical Laboratory for sale or exchange for wireless goods. Rakosy, 331 East 80th St., New York City.

Strongfort Strength Course, $10.00. Clay Hewes, 102 S. Lake Ave., Albany, N. Y.

$100.00 Chemical Laboratory, $60.00. Value steadily advancing. Contains practically unobtainable equipment. Pray, 102 Heath, Somerville, Mass.

Wanted—Screw cutting bench lathe or High frequency apparatus. Have 29 Vol. Encyclopedia Britannica, latest. Handy volume edition in brown leather, good as new. Address Nestor J. Saffron, Box 306, E. Akron, Ohio.

Electrical Laboratory For Sale—Send for list of apparatus and parts. Ray Wengel, 29 W. Doty St., Madison, Wis.

Exchange—$30 worth electrical apparatus for gas engine. Sell $35 bicycle, good tires, $16. Violin $5. Goodwin, 23 Wilmore St., Mattapan, Mass.

For Sale or Exchange—One 30-40 Winchester Rifle with 1,000 loaded shells, would like Victrola. E. C. Moorman, 809 North King St., Xenia, Ohio.

For Sale—15 Horse Curtis Motorcycle. Trade for twin engine. Harry Nelson, Haverstraw, N. Y.

Sell—Everyman Encyclopaedia, Hawkins Electrical Guides, Boy Mechanic, Boy Electrician, Boy Craftsman. Others send for list. Excellent condition. Will sell very cheap. T. H. Blacknall, Box 107, Raeigh, N. C.

FIGHT *or* Join the Industrial Aircraft Service

YOU may not be free to get into the actual fighting, but you can still give valuable service to your country. Join the Industrial Aircraft Service and you'll not only be serving where you're most needed but you'll be laying the foundation for your future success.

Here is both Duty and Opportunity.

Here is your chance to get into essential war work, serve your country and make a good connection in the industry that's fast becoming one of the foremost in the world.

The Aircraft Industry is more than a wartime emergency. The Aerial Mail Service has established the definite commercial value of the Aeroplane. After the war there will be opportunities aplenty for men who make good in the Industrial Aircraft Service *now*.

An Opening for You in One of America's Foremost Aircraft Plants

At present our plants in New Brunswick (N. J.) and Long Island City are engaged solely in the manufacture of Aeroplane Motors for the Government. To meet our ever increasing schedule of production we must have the man power to operate the machines in our various departments.

We want your help. *We want skilled mechanics, machine operators, inspectors, draftsmen, etc.*

We will pay good wages for the right men.

Our Offer to Men Not Technically Trained

You do not have to be a skilled mechanic to get started with us.

If you have the right spirit and the determination to learn, we will take you on and train you at our expense in our School of Instruction.

Not only will we give you, free of charge, a full course of practical instruction under the supervision of competent instructors, but we will pay you while you are learning.

When you have completed the course which takes about ten days, we will pay you full wages prevailing in the factory.

Living Conditions Good

Living conditions in New Brunswick and vicinity are being bettered every day. Every Wright-Martin man will be able to count on a comfortable and congenial place to live. Moreover, the Government is now building 200 houses especially for war workers at Wright-Martin and other factories.

The company provides for social and recreational activities for everyone. With baseball, football and track athletics, picnics, concerts and dances, there need be no dull times for you or your family in New Brunswick.

One Hour from New York City

New Brunswick is just about one hour out of New York on the Pennsylvania. It is within short commuting distance of Newark, Elizabeth, Trenton and Philadelphia.

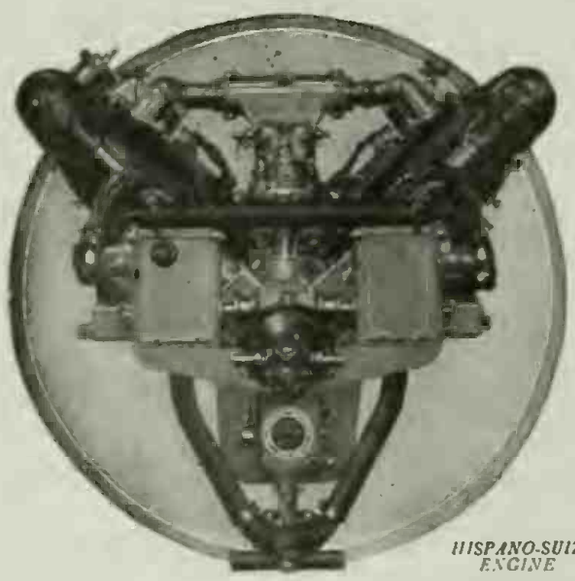
Your Duty Is Here

In fairness to yourself you can't afford to pass up this opportunity to advance yourself and serve your country, too.

Write, phone or apply in person to Employment and Welfare Department, Wright-Martin Aircraft Corporation, New Brunswick, N. J., and Long Island City, Starr and Borden Avenues.

Earn While You Learn

To men without any previous technical training we give a thorough and intensive course in our School of Instruction. We pay you during your period of instruction a rate higher than that of many actual shop rates until you are fully trained to hold down a regular job at full factory pay. Period of instruction takes from four to ten days



HISPANO-SUIZA ENGINE

Wright-Martin Aircraft Corporation

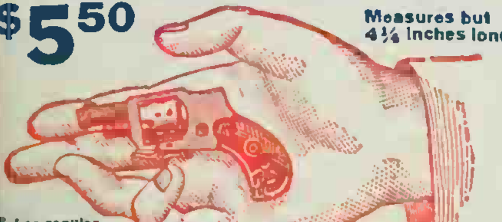
New Brunswick, N. J., U. S. A.

"The Baby" Double Action Hammerless Revolver

A HANDSOME AND MOST EFFECTIVE WEAPON

$5.50

Measures but 4¼ inches long



Takes regular .22 calibre cartridges

The new Baby Double Action Hammerless Revolver has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of Efficiency and Practicability. It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Every lady should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciated. The ammunition used is the standard .22-calibre (short) cartridge obtainable anywhere, or you may obtain the cartridges from us (cartridges can be shipped only by express). The revolver fires six shots in one loading. The operation of the charging mechanism is extremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 4½ ounces. The Price of the Baby Revolver is only $5.50, sent by mail postpaid to any address. JOHNSON SMITH & CO.

The CONJURER'S CASKET

Apparatus and Directions for a Number of Mysterious Tricks Enough for an Entire Evening's Entertainment

ANYONE CAN DO THEM. PRICE 50c POSTPAID

Get this Conjurer's Cabinet. It contains the apparatus for seven first-rate tricks, including The Disappearing Rose, that, when placed on the lapel of your coat, vanishes from sight at will; the Magic Vase and Ball Trick (a Wooden Ball is placed inside, and upon replacing the lid has disappeared and is found in someone else's pocket); The Magic Nail with which you can apparently cut your finger almost in two; the Wonderful Card Trick (a card is placed in an envelope, and when opened an entirely different card altogether is found); The Disappearing Coin Box (a coin is placed in the little wooden barrel, and, when opened again, is found to have vanished entirely, or can be made to change into a coin of another denomination); The Famous Mesmerized Penny that defies the law of gravitation (suspends from the palm of the hand, nose, cheek, wall, clothing, etc.); The Glass Goblet and Vanishing Coin Trick (a coin is dropped into a glass of water, and when the water is poured out the coin has vanished). Full printed instructions for performing each trick. Besides the tricks contained in the Cabinet, there are twenty-five other feats and illusions fully explained with full printed instructions, for which you can easily make or procure the necessary apparatus. We also send the secret of performing three wonderful stage tricks.

JOHNSON SMITH & CO., Dept. E 54 W. Lake St., CHICAGO

ELECTRIC INSOLES

Comforting to the Feet and Healthful

You will never suffer from Cold Feet while you wear these Electric Insoles. Any size. Comfortable even in a tight shoe. Alternate plates of copper and zinc generate a mild and pleasant form of electric energy that promotes the circulation of the blood and thus tones up the entire system. Positively Prevent Cramp, avert Nerve Troubles, save you from Colds and Chills and dispel Rheumatic Pains. Having obtained a large stock we are able to reduce the price to 25c per pair or better quality, 50c postpaid.

JOHNSON, SMITH & CO., Dept. E, 54 W. Lake Street, CHICAGO

INVISIBLE INK

The most confidential messages can be written with this Ink, for the writing MAKES NO MARK. Cannot be seen unless you know the secret. Invaluable for many reasons. Keep your postals and other private memorandums away from prying eyes. Great fun for playing practical jokes. Only 15c Bottle

LUMINOUS INK

writing can be READ ONLY IN A DARK ROOM; writing shines like fire. Quite invisible at daytime. Very remarkable. 15c bottle; 3 for 40c postpaid.

JOHNSON SMITH & CO., Dept. E, 54 W. Lake St., CHICAGO

New Vamping Card

No Teacher Needed
Surprisingly Simple System

Persons having neglected their Musical Education need not despair, for with the aid of our new VAMPING CARD (placing the card upright over the piano keys), you can at once Vamp away to thousands of Songs, Ballads, Waltzes, Rag Time, etc., etc., equal to a Professional Musician. No knowledge of music is required. After using it a few times, you will be able to dispense with the aid of the Vamping Card entirely. Only 15 cts. p.pd. Johnson Smith & Co., Dept. E. 54 W. Lake St., Chicago

Serpent's Eggs

Each box contains 12 eggs, which are no larger than a grain of oats. When lit with a match, however, each one gradually hatches itself into a Snake several feet long, which curls and twists about in a most lifelike manner. Per box, 10c ppd.

Mystic Skeleton

10c ppd.

A jointed figure of a skeleton 14 in. in height, will dance to music and perform various gyrations and movements while the operator may be some distance from it. Simply placed on a chair or table it will seemingly become endowed with life and begin to move. At command of operator will lie down, stand up, dance, etc. J. S. & CO.

A Great Curiosity
Midget Illustrated Bible

The Smallest Bible in the World

The Midget Bible is a perfect gem, and a work of art. It is about the size of a postage stamp and contains TWO HUNDRED AND FIFTY PAGES of the NEW TESTAMENT, profusely illustrated. This little Bible is a wonder. It is said to bring good luck to the owner. Must be seen to be appreciated. Price, only 12 cents, three Bibles for 30 cents; one dozen Bibles for $1.00 or 100 for $6.00. Good money can be made selling these Midget Bibles amongst friends, church acquaintances, Sunday schools, bazaars, etc. Send for a few and try it.

JOHNSON SMITH & CO., Dept. E, 54 W. Lake St., CHICAGO

Thumb Brander

NEW & NOVEL JOKE to play on your friends. Fits on your thumb, and "brands" your victims as you shake hands. Great fun. Won't wash off very easily, either. Any of these choice epithets: Owl, fool, liar, grouch, baby, chicken, hot air, bull, Safety First. Complete with pad and ink, 15c (post 2c). Any other brand made to order 25c.

INKLESS PEN

WRITES with WATER 600 words every time you dip. Makes its own ink. Writes fashionable violet color. Better and cheaper than fountain pens. Writes a long letter with one dip in plain water. No trouble—no bother—no muss. A pleasure to use. With Nickel Plated Reversible Holder 10 CENTS, 3 for 25c postpaid. Extra Points 6c, 6 for 25c.

The Border Bandit Books

Thrilling Adventures and Daring Deeds of Notorious Outlaws

PRICE ONLY 25 CENTS EACH; OR THE FULL SERIES OF 19 BOOKS FOR $4.00 POST PAID

This series of books contains thrilling accounts of the adventures and daring deeds of notorious outlaws. Each book has full page illustrations. The influence of these books cannot be anything but beneficial upon the characters of the most youthful readers. They do not glorify the sensational exploits of thieves, rascals and detectives; on the contrary, there is an obvious moral to be drawn from every story that cannot fail to have a wholesome effect. Price of these books is 25 cents each copy, by mail, postpaid.

- B 1. Tracy the Outlaw, King of the Bandits, by Harry Hawkeye.
- B 2. The Dalton Boys and Their Gang of Desperadoes, by Harry Hawkeye.
- B 3. Buffalo Bill, King of the Scouts, by Harry Hawkeye.
- B 4. Rube Burrow, the Outlaw, by Harry Hawkeye.
- B 6. James Brothers (Life of the James Boys), by J. W. Buel.
- B 6. Younger Brothers (The Border Outlaws and Companions of Frank and Jesse James), by J. W. Buel.
- B 7. Cowboys of the Wild West. Life on the Texas Plains, by Harry Hawkeye.
- B 8. Lives and Exploits of Frank and Jesse James, by Thaddeus Thorndike.
- B 9. Jesse James (new) The Story of His Adventures.
- B10. James Boys and Their Daring Deeds, James Edgar.
- B11. The Allen Outlaws. Their Career and Crime of the Blue Ridge Mountains Moonshiners, by James Edgar.
- B12. The Auto-Bandits of Paris. Most Amazing True Story of Crime.
- B13. Buffalo Bill and His Thrilling Adventures in the Wild West, by Nebraska Ned.
- B14. Northfield Bank Robbery, by Cole Younger and Convict Life in Minnesota State Prison.
- B15. James Boys, The Missouri Bandits, by Edgar James.
- B16. Daring Exploits of Jesse James and His Band of Border Train and Bank Robbers, by Lige Mitchell.
- B17. Frank James and His Brother Jesse, The Daring Leaders of the Fearsome Border Bandits, by Harry Hawkeye.
- B18. Auto Bandits of Chicago — A Correct Account of the Greatest Detective Work in the History of Chicago Police Force, by James Aloysius Durkin.
- B19. The Great Beattie Murder Case. A Thrilling Story of a Man's Double Life of Henry Clay Beattie, Jr. The Sensational Story of Beulah Binford, the Woman in the Case.

JOHNSON SMITH & CO., Dept. E., 54 W. Lake St., CHICAGO

THE EXPO WATCH CAMERA

The most wonderful and ingenious Camera made

It is but little larger than a watch, which it closely resembles. You can carry the Expo about in your pocket and take pictures without any one being the wiser.

One Cent a Picture

The Expo loads in daylight with 25 Exposure Films, costing 25c, thus the picture taking part of a whole day's outing may be had for the nominal sum of 25c—One cent a picture. 10 Exposure Films also obtainable. It is simplicity itself to operate. Takes pictures through the stem, where the Rapid Fire Lens is located. The photos (5/8 x 7/8) may be enlarged to any size.

Price **$2.50**

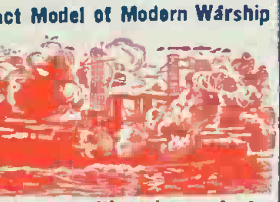
QUICK AS A FLASH Time and instantaneous shutters; weighs but 3 ounces; nickel plated. Endorsed by amateurs and professionals the world over. Thoroughly practical—printing and developing of films just the same as ordinary cameras—in daily use by the police, newspaper reporters, detectives, and the general public. Important beats have been secured with the Watch Camera by enterprising reporters. Produces clear, sharp negatives indoors or outdoors equal to any camera on the market, size or price notwithstanding.

Expo Watch Camera **$2.50** Postage 10c Anywhere. FILMS, 10 Exposures 15c, 25 Exposures, 25c. Leather Pocket Carrying Case, 35c

JOHNSON SMITH & CO., Dept. E., 54 W. Lake St., CHICAGO

THE FIGHTING DREADNAUGHT

Sensationally Realistic! Exact Model of Modern Warship

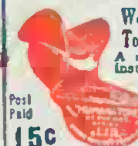


The greatest toy sensation of the day. The Fighting Dreadnaught is an exact model of Uncle Sam's latest fighting monster. It carries eight big guns, each of which flashes, at correct intervals, from twelve to twenty times. Extra ammunition always obtainable. Absolutely harmless. Can be operated indoors or out. Now, boys! Here's your chance to see a battleship in action, and the best of it is you can OWN the ship and command the firing yourself! By having two or more Battleships, you can arrange EXCITING NAVAL BATTLES in your own home. Price of Warship and Ammunition, 15c, three for 40c, or a fleet of 12 ships for $1.50 postpaid. Extra Ammunition, 5 cents per pkg.

MUSICAL KAZOO

With the Musical Kazoo you can, without previous practice whatsoever, play any tune right off, imitate any bird or animal, bagpipe, snare drum, Punch and Judy, etc. No holes to finger. It is simplicity itself. Produces excellent music. You do not blow into it, but sing, speak, laugh or make any desired imitation. Used with astonishing results at society meetings, home, club or church entertainments, dances, serenades, picnics, outings, excursions. Just the thing for choruses and shows, bicycle and marching clubs, etc. Excellent for vocal or instrumental accompaniments, either with or without other musical instruments. Price 15c p. pd.

MAGIC FLUTE



Wonderfully Sweet Toned and Musical

Post Paid **15c**

A marvelous musical instrument. No other instrument produces sweeter music, whether it be the joyous notes of a quick-step or the solemn strains of a church hymn—in fact, any class of music can be played upon the Humanatone without practice, as it is almost a self-playing instrument. When played with a piano accompaniment, or any other musical instrument, the effect is charming. Full printed instructions for playing sent with each instrument.

CIGARETTE ROLLER

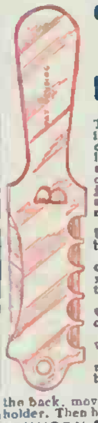
Very neat and handy. Weighs less than a quarter of an ounce. It makes better cigarettes than you can buy and makes them easily and quickly. You can use just the tobacco you prefer and thus have nicer "smokes" than ready-made, and more of them, besides saving about half of your money. Just try one and make your cigarettes just to your own liking. Price only 10c or 3 for 25c postpaid, with full instructions for use.

JOHNSON SMITH & CO., Dept. E, 54 W. Lake St., CHICAGO

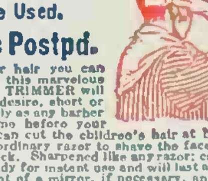
Latest Novelty: Aerial Balloon

Flies gracefully in or outdoors. VERY LATEST SENSATION IN BALLOONS. A brightly colored balloon that measures sixteen inches long is blown up in the usual way, and, when released, the air pressure sends the balloon SOARING UPWARD, the 3½-inch propeller SPINNING AROUND AT A LIVELY RATE. The effect is startling. It is a graceful flier that makes the youngsters WILD WITH JOY. May be used repeatedly indoors or outdoors. An immensely interesting toy. Price 10c each, 3 for 25c ppd. Johnson Smith & Co., Dept. E. 54 W. Lake St., Chicago

Trim Your Own Hair With the Utility Safety Hair Cutter



Cuts the Hair Any Length, Short or Long—Saves Its Cost First Time Used.



Price Only 35c Postpd.

If you can COMB your hair you can TRIM your own hair with this marvelous invention. The UTILITY TRIMMER will cut hair any length you desire, short or long, finish the job as nicely as any barber and in one-fourth the time before your own mirror. The ladies can cut the children's hair at home in a jiffy; can be used as an ordinary razor to shave the face or finish around the temples and neck. Sharpened like any razor; can be carried in the vest pocket ready for instant use and will last a lifetime.

To use it, stand in front of a mirror, if necessary, and use the UTILITY TRIMMER like you would a comb. Push it through the hair, downward, in the direction the hair lies, but Never Upward.

To cut long hair, first moisten the hair and comb it, so it will lie close to the head, then start cutting with downward cuts as high as you desire, evenly all around the head. Finish around the neck and temples with a square cut, like a barber.

It is impossible to leave any "nicks" or "cat steps" in your hair with this device, as the handle guard guides the cutter blade evenly over the scalp.

To cut very close, push the blade until the cutting edge is even with the guard teeth.

To shave the face or neck it can be used as an ordinary razor by reversing the blade in the holder, the cutting edge being to the back of the holder, exposing the entire blade, except each corner.

To hone, place the blade in the holder, with the cutting edge to the back, moving the blade out until the cutting edge is clear of the back of the holder. Then hone in the usual manner; finish on a strop as with an ordinary razor.

JOHNSON SMITH & CO., Dept. E. 54 W. Lake St., CHICAGO

7-in-1 Combination Bill Book 50c

23 KARAT GOLD NAME

With Name Stamped In 23-Karat Gold Letters

With a view of getting our name still more widely known, as well as to secure new customers, we make this REMARKABLE OFFER of a handsome Leather Combination Bill Fold, as illustrated, with the owner's name stamped in 23 Karat Gold Lettering, for ONLY 50 cents, postpaid. Here is an all 'round useful combination that serves NO LESS THAN SEVEN DISTINCT PURPOSES. There is, (1) a large pocket for storing bills in, (2) another pocket for cards or tickets, (3) still another for checks, (4) a fourth for miscellaneous papers and memorandums, there is (5) a short center panel pocket with clasp for postage stamps, (6) an identification card with room for your own or dear one's photograph, and (7) removable Calendar by months. The Identification Card and Calendar are protected by a transparent covering, the whole folding up into a compact space of 3x4¾ inches. Price 50c with name in 1 line (add 15c for each additional line). Also obtainable in very superior quality, $1.00 p. pd.

Johnson Smith & Co., Dept. E 54 W. Lake St., Chicago

NEW BOOK ON ROPE SPLICING

USEFUL KNOTS, HITCHES, SPLICES, ETC.

PRICE **20c**

How Different Knots Are Made and What They Are Used For. Knots to Use and Knots to Avoid.

A most practical handbook giving complete and simple direction for making all the most useful knots, hitches, rigging, splices, etc. Over 100 illustrations. All about wire rope attachments, lashing, blocks, tackles, etc. 37 Heraldic Knots illustrated. Of great value to mechanics, riggers, campers, boatmen. Price 20c p. pd.

Johnson Smith & Co., Dept. E. 54 W. Lake St., Chicago

THE MINSTREL SHOW

Only 10c Postpaid

The Best Collection of Minstrel Wit and Humor, comic songs, endmen's jokes, gags and repartees, yarns, conundrums, darkey dialogues, stump speeches, monologues, plantation sketches, interludes and farces. The very book for amateurs; 64 double-column pages of genuine burnt-cork comicalities that will be highly appreciated by all who enjoy a good laugh. PRICE, including catalog of all kinds of wigs, masks, make-up goods, grease paints, etc., for amateurs, Only 10 cents postpaid. JOHNSON SMITH & CO., Dept. E. 54 W. Lake St., CHICAGO

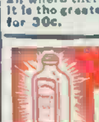
Sneezing Powder

Place a very small amount of this powder on the back of your hand and blow it into the air, and everyone in the room or car will begin to sneeze without knowing the reason why. It is most amusing to hear their remarks, as they never suspect the real source, but think they have caught it one from the other. Between the laughing and sneezing you yourself will be having the time of your life. For parties, political meetings, car rides, or any place at all where there is a gathering of people. It is the greatest joke out. Price 12c or 3 for 30c. JOHNSON SMITH & CO.

STAGE MONEY

With a bunch of these bills, it is easy for each person of limited means to appear prosperous. By flashing a roll of these bills at the proper time and peeling off a genuine bill or two from the outside of the roll, the effect created will be found to be all that can be desired. Prices, postpaid: 15 Bills 10c, 50 Bills 25c, 125 for 50c, or $3.50 thousand.

LUMINOUS PAINT



Make Your Watches, Clocks, Etc., Visible by Night

The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, emits rays of white light, rendering it perfectly visible in the dark. THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES. Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match boxes, and innumerable other articles; make your own Luminous Crucifixes, Luminous Rosaries, etc. Bottle containing sufficient to coat several small articles, Price 25c. Larger sizes 50c and $1 postpaid. Johnson Smith & Co., Dept. E 54 W. Lake St., Chicago

All the Latest Surprising and Joke Novelties

Pharo's Serpents Eggs, box	10c
Miniature Water Pistol	10c
Cleopatra's Snake (very lifelike)	15c
False Mustache (fool your friends)	6c
Ford Auto Puzzle (Latest)	15c
Mysterious Ghost, shines at night	10c
Rubber Razor (very formidable)	20c
Rubber Dagger (sensational)	20c
Window Smashers (great joke)	25c
Lookbackroscope (see behind you)	15c
Great Mind Reading Mystery Cds.	10c
Thurston's Mysterious Trick Cds.	10c
Fighting Roosters, pair	10c
Cover the Spot Trick, a scien. nov.	10c
X Ray Novelty	10c
Trick Pencil	10c
Rubber Tacks (a good joke)	10c
Mesmerized Penny (defies the law of gravitation)	30c
Mysterious Tumbler and Vanishing Coin Trick	25c
Magic Mirror (take one peep)	10c
Magic Plate Lifter	20c
Imitation Gold Teeth	3 for 10c
Great Burglar Puzzle	10c
Wire Puzzles, 10c. 22 different,	$1.96
"Elec-Trick" Push Button	10c
Inkless Pen (writes with water)	10c
Imitation Bed Bugs	10c
Squirt Ring	20c
Trick Bill Book	10c
Acquaintance Cards (witty and amusing)	10c
Glass Watch	25c
Multiplying Billiard Ball Trick	25c

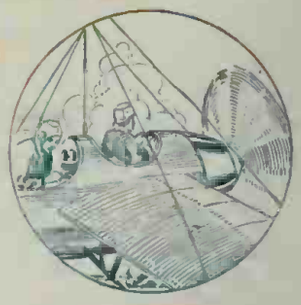
JOHNSON SMITH & CO., Dept. E 54 W. Lake St., CHICAGO

A Grand, New Opportunity for Young Men in America

MERCHANT MARINE

Thousands of Wireless Operators Wanted—at Big Salaries

A few short years ago wireless telegraphy was only the dream of dreamers. Today it is one of the most important of modern industries. Its usages are widening with terrific rapidity, until it is now considered an essential to the progress of man. So great has been the growth of wireless that there are now over 30,000 unfilled openings for Radio Operators.



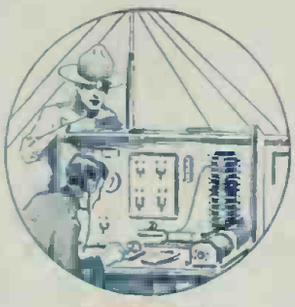
AVIATION

Master Wireless in Ten Weeks

The National Radio Institute, headed by authorities who are now closely allied with governmental training of students, has perfected an easily mastered course in wireless telegraphy whereby students are taught completely in ten weeks. Many of our students are ready to take up actual wireless work in much less time. The course is founded on actual practice, hence the rapidity of the progress of the student.

THE PRICE IS REASONABLE—EASY TERMS

Our unusual facilities enable us to teach thousands of students by mail, affording them the same efficient service as if they attended our big school here in Washington. Herein lies our ability to offer this course at a figure which everyone can afford. To those unable to pay the full amount on entering, we offer easy terms of payment.



ARMY

America Takes Her Place on the Seas

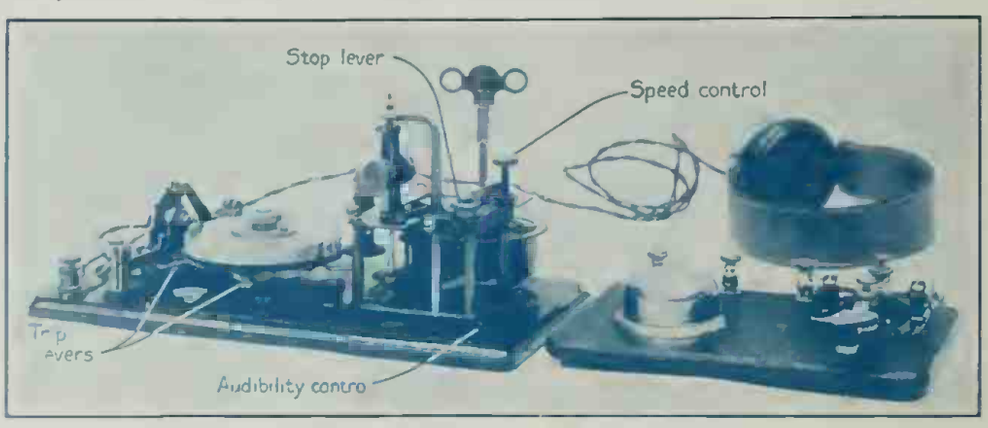
America is spending billions of dollars on the mightiest navy and merchant marine in the world. Practically all vessels are being equipped with wireless apparatus of the most up to date type. Thousands of operators are needed now. Salaries are high, and constantly rising. The field affords a wonderful opportunity for the man who starts now to master wireless. He can enter the navy, the army, the aviation field, the merchant marine, or a land station. Operators are needed badly in all of these branches of governmental and private industries.

NAVY

Be a Trained Man in 10 Weeks

In the short period of ten weeks we can make of you a wireless operator, a man with a profession, independent, and not subject to the rise and fall of wages in the labor market. Salaries are as high as **$150 per month and expenses.** The man who acts now is the lucky one. Such glowing opportunities do not present themselves often in a life time.

These are the instruments you work with—they are given FREE with your course.



Get this coupon in the mails today. It is a step you will never regret. This coupon brings to you full particulars as to the unusual possibilities in the wireless field, the high salaries paid, and other interesting facts.

FREE COUPON

NATIONAL RADIO INSTITUTE,
Dept. 65 Washington, D. C.

Send me, free of charge, your booklet "Wireless, the Opportunity of the Age" with full particulars regarding your famous 10 Week Home Study Course, and your Special Free Instruments Offer.

Name .....
Address .....
Town ..... State .....

YOU ARE NEEDED NOW—GET YOUR INSTRUCTION FROM THE NATION'S CAPITAL

National Radio Institute

Dept. 65

14th and U Streets, N. W., Washington, D. C.

THE CAREY PRINTING CO. INC.
NEW YORK