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Vol. VII. Whole No. 76 **Contents for AUGUST, 1919** **No. 4**

EDITORIAL

Speeds

IF you had read twenty years ago that it was considered probable and very possible that in 1919 some one would fly across the Atlantic Ocean on canvas wings, propelled by a gas engine, at a speed of 100 miles an hour, you naturally would have turned away impatiently at such childish nonsense. Moreover, you probably would have doubted the sanity of the writer; but even Jules Verne with his most prolific and prophetic mind never prophesied the 1919 trans-Atlantic flight in a heavier-than-air machine.

This naturally brings us face to face with the future. Tho prophesying, as a rule, is bad business, there are certain scientific subjects that can be predicted safely, basing the prediction on mathematical as well as purely scientific grounds.

The question before us is: How fast is it possible for man to travel thru the air? Theoretically at least, there is no limit to the speed at which a human being can travel.

Airplanes already have covered over 200 miles an hour without discomfort to the aviator. At this point we venture to say that should the speed be increased over 300 miles per hour, the aviator will probably be very uncomfortable, due to the terrific rush of air. Even at 100 miles per hour the air lashes the face of an aviator badly. Therefore, flying above 300 miles per hour, he will have to sit in a cabin surrounded by glass, where the rush of the air cannot be felt. Suppose we increase the speed to 500 miles. What happens? Nothing. This speed is so probable that it will no doubt be reached before 1925; possibly much sooner. But we think such speeds will not be reached near the surface of the earth where the density of the air, and consequently the greater resistance to an airplane, is too high. In order to travel at 500 miles per hour, the future airplane must offer as little surface to the air as possible. It should have no struts, wires, or stays. It probably will fly at a height of 5,000 feet or more, decreasing its speed as it approaches the earth. 1,000 miles an hour? Yes, man will do it. It is not only possible, but very probable. It will be accomplished in a machine which bears but little resemblance to our present-day airplane. Moreover, it will be absolutely necessary to rise at least to 25,000 feet above the earth, as otherwise the dense air will tear the machine apart, unless it were constructed entirely of metal. But because very much less power is required at the level of 25,000 feet, future express airplanes will prefer the high altitudes.

We might mention, *en passant,* that if you were in a machine flying at a steady speed of 1,039 miles per hour, also supposing you had enough fuel to stay up 24 hours, the following historical event would take place. Starting at noon and flying due West along the equator, with the sun above your head, the sun will not set for you on that memorable day. It will be directly overhead, as long as you keep on going, *for you will now be flying at the rotational speed of the earth,* which is 1,039 miles an hour. Looking down you will see the earth make one complete revolution; you will have seen every point and every continent along the equator. But 1,000 miles per hour is very tame. The earth in its orbital motion around the sun rushes thru space at the terrific rate of 65,533 miles an hour; Venus at 77,054 and Mercury at 105,325 miles per hour. So let us be hopeful!

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.**

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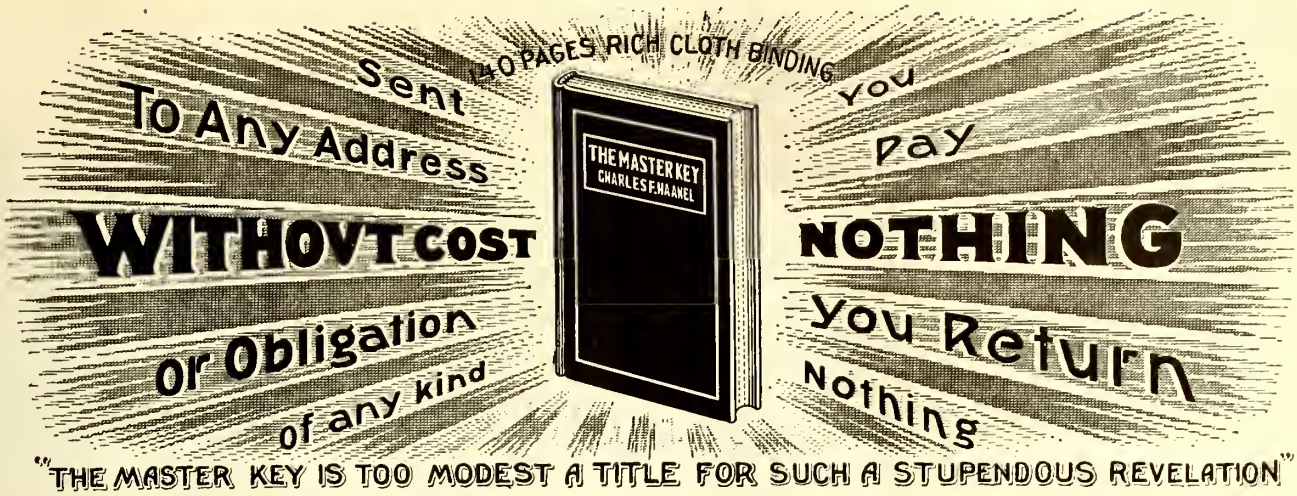

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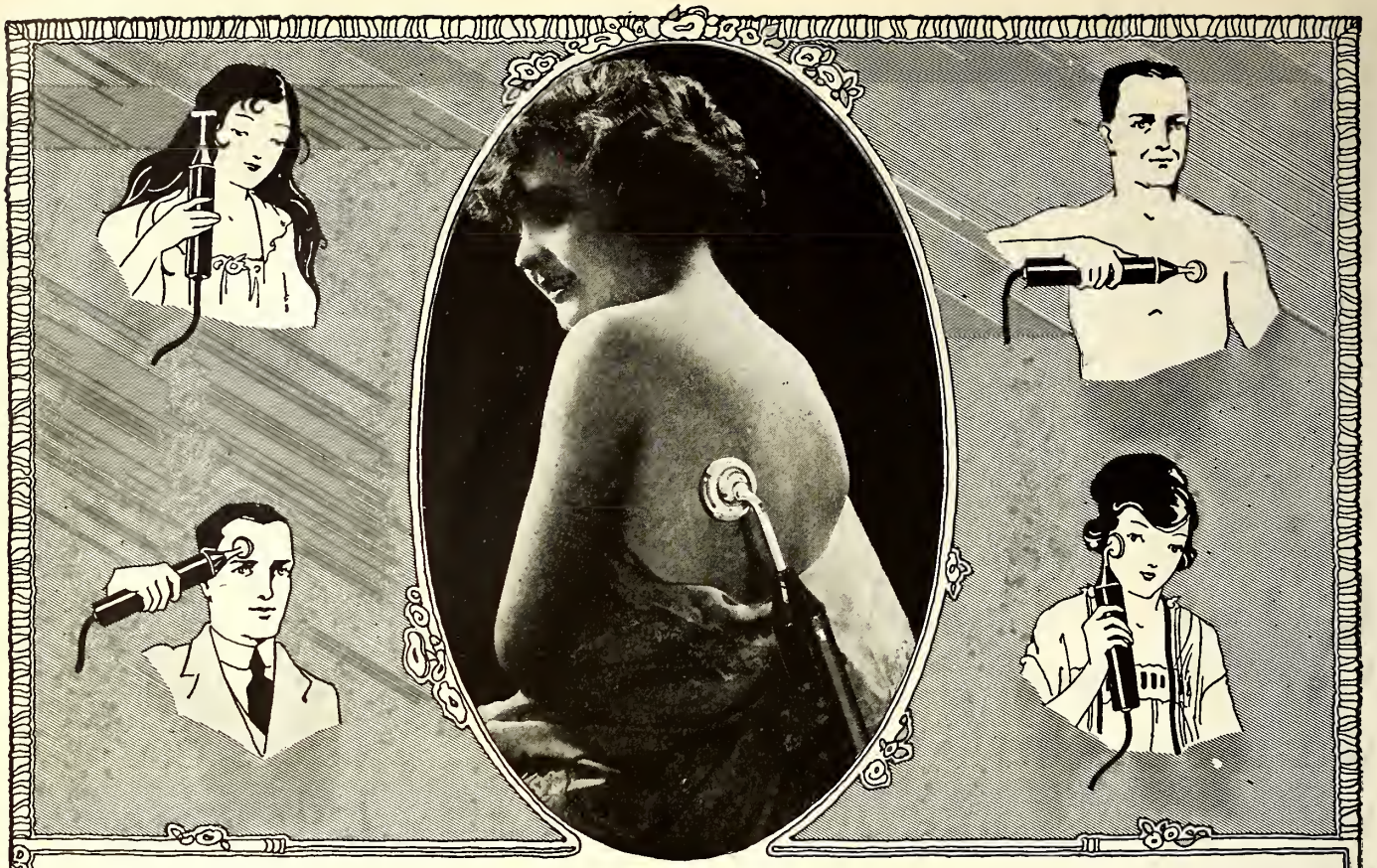

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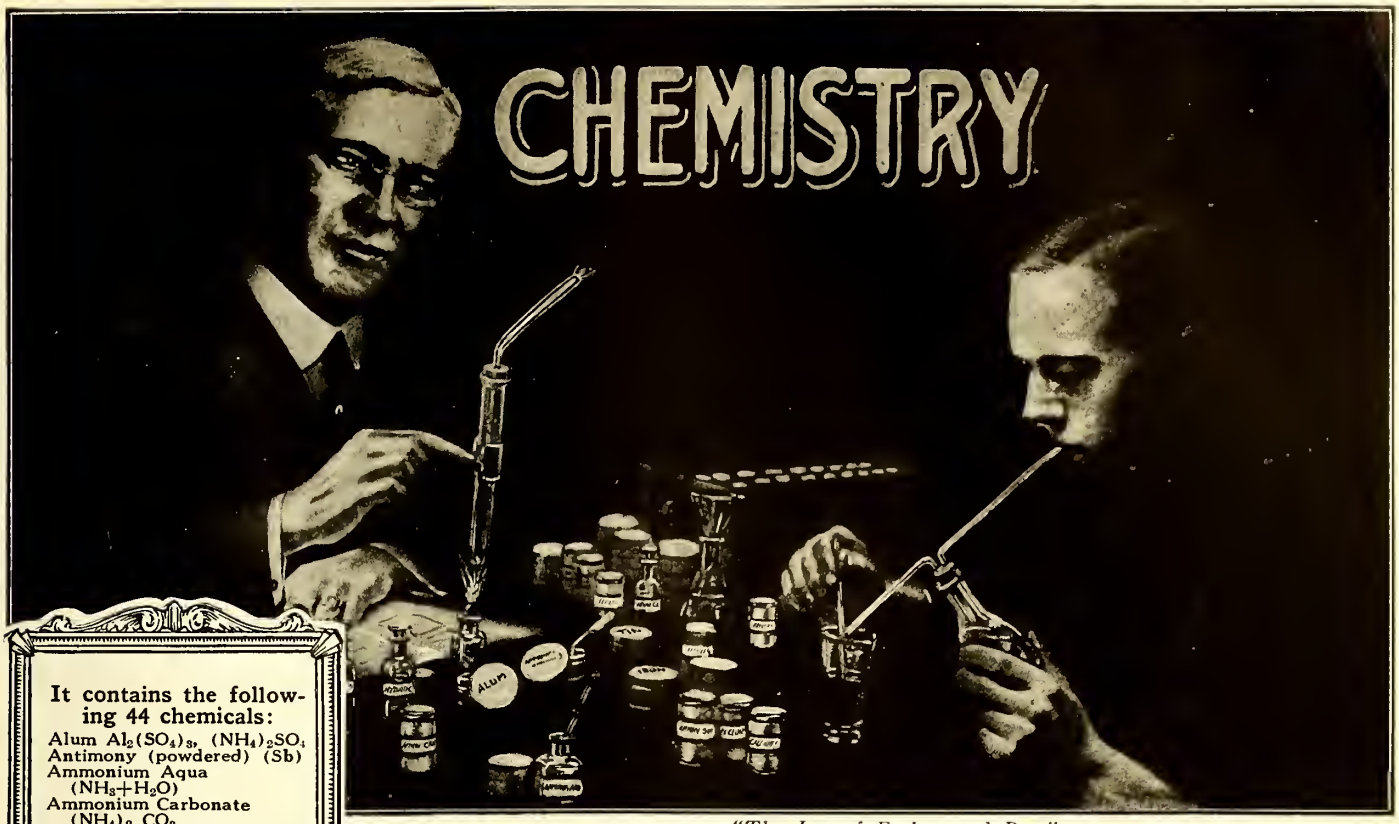

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Ammonium Carbonate $(NH_4)_2\ CO_3$
Ammonium Chloride (NH_4Cl)
Ammonium Sulphate $(NH_4)_2\ SO_4$
Barium Chloride ($BaCl_2$)
Boric Acid (H_3BO_3)
Brimstone (Sulphur) (S)
Calcium Chloride ($CaCl_2$)
Calcium Oxide (CaO)
Calcium Sulphate ($CaSO_4 2H_2O$)
Charcoal (Carbon) (C)
Chloride of Zinc ($ZnCl_2$)
Copper Sulphate ($CuSO_4$)
Ferrous Sulphate ($FeSO_4$)
Ferrous Sulphide (FeS)
Glycerol (Glycerine) $C_3H_5(OH)_3$
Hydrochloric Acid (HCl)
Iodine (I)
Iron Chloride ($FeCl_2$)
Iron Oxide (Fe_2O_3)
Lead Acetate Pb $(C_2H_3O_2)_2$
Litmus Paper
Magnesium Carbonate ($MgCO_3$)
Manganese Dioxide (MnO_2)
Mercury (Quicksilver) (Hg)
Nickel Chloride ($NiCl_2$)
Oxalic Acid ($H_2C_2O_4$)
Sodium Bicarbonate ($NaHCO_3$)
Sodium Borate ($NaBO_2$)
Sodium Carbonate (Na_2CO_3)
Sodium Chloride (NaCl)
Sodium Nitrate ($NaNO_3$)
Sodium Phosphate (Na_2HPO_4)
Sodium Sulphate (Na_2SO_4)
Sodium Sulphite (Na_2SO_3)
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Sulphate of Nickel ($NiSO_4$)
Sulphate of Zinc ($ZnSO_4$)
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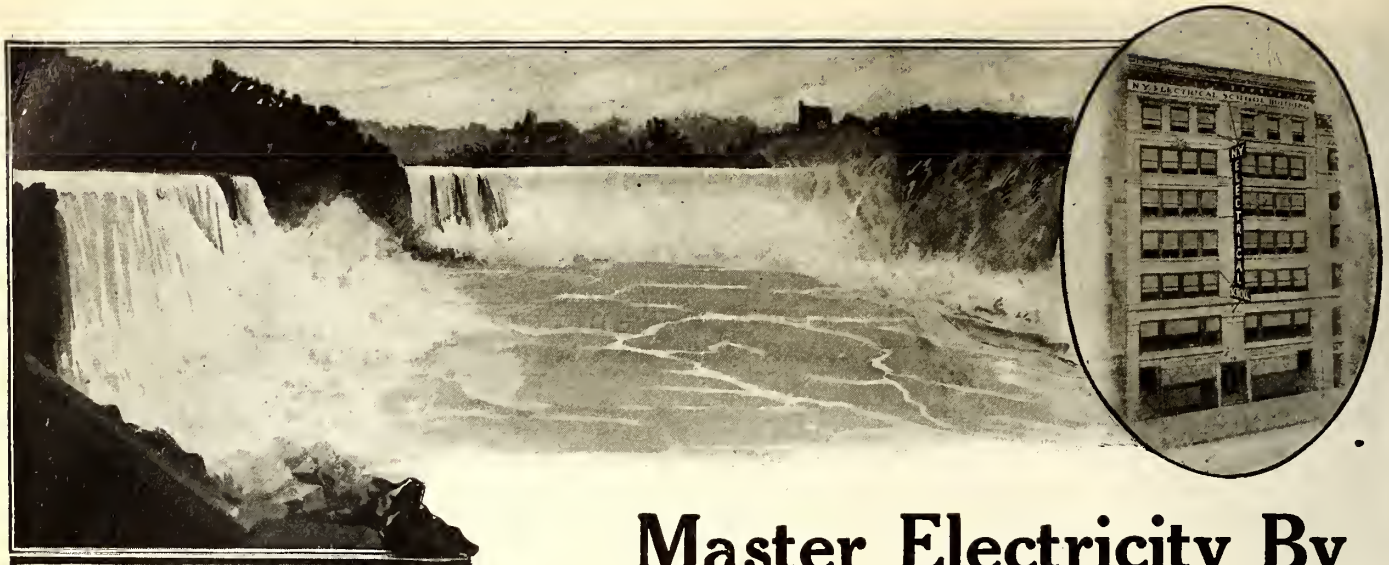

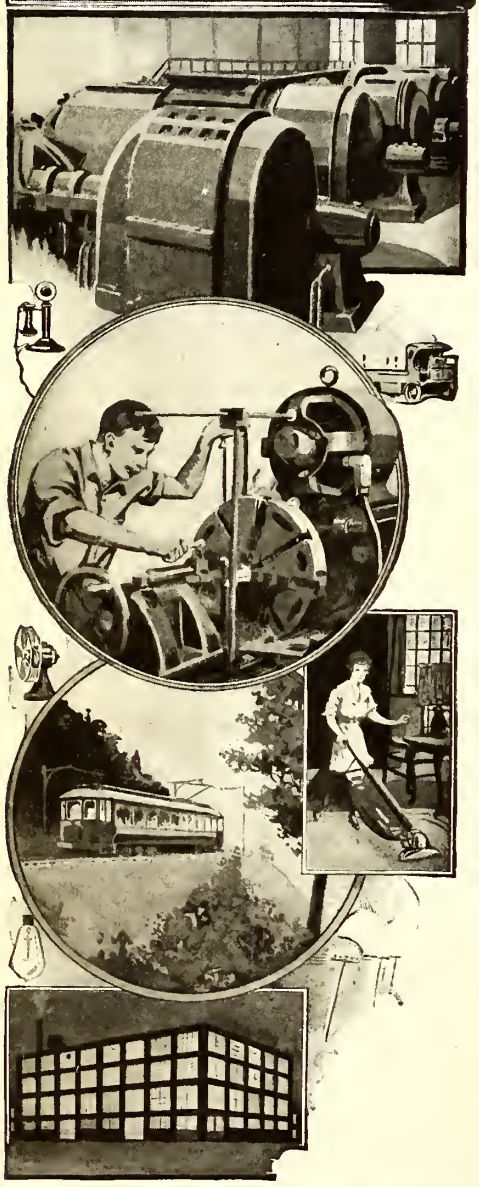

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ELECTRICAL EXPERIMENTER

H. GERNSBACK – EDITOR
H. W. SECOR – ASSOCIATE EDITOR

Vol. VII. Whole No. 76 AUGUST, 1919 No. 4

Radio-Planes Watch Forests and Ranches

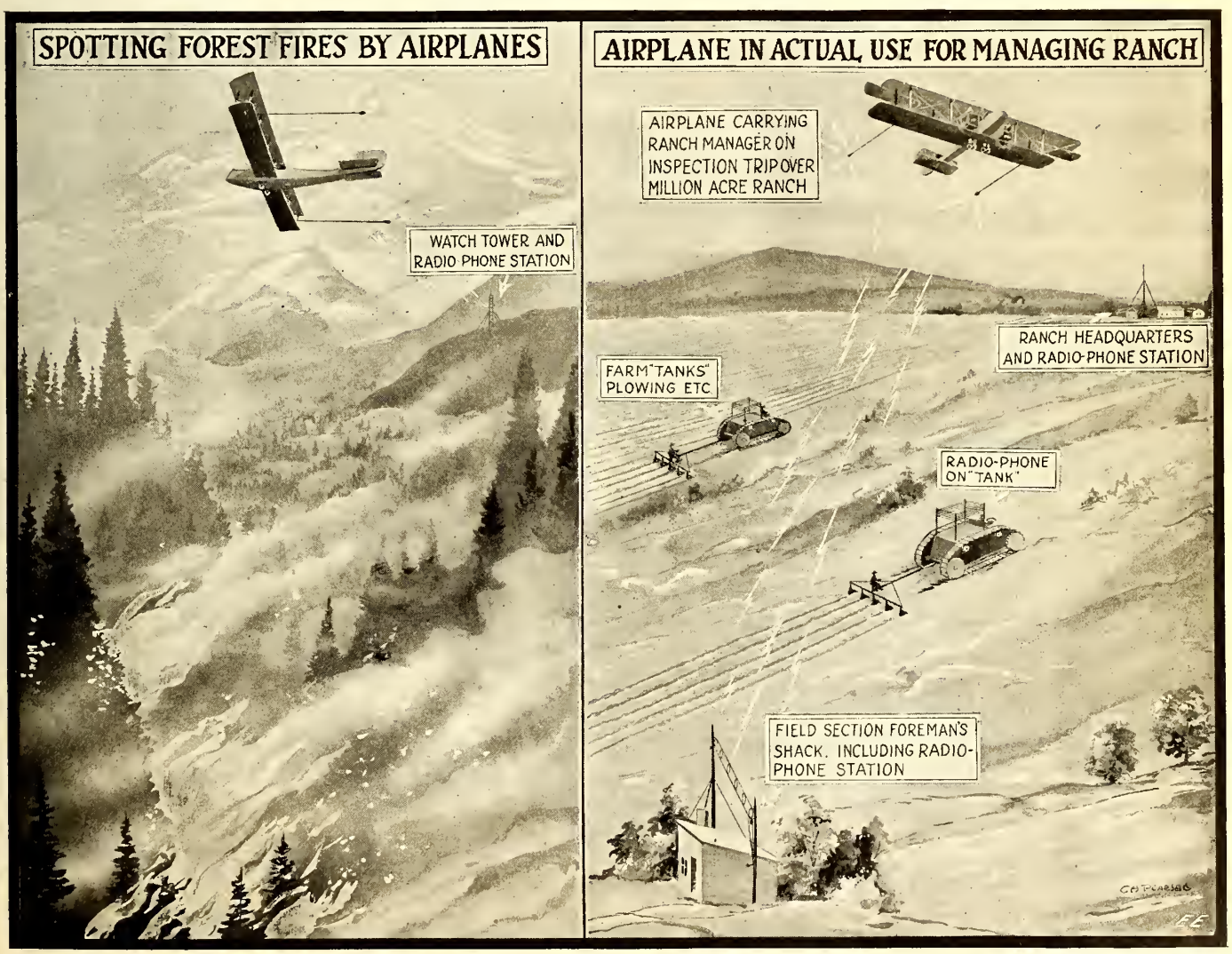
AIRPLANES, plus radio-telephone equipment, have found a brand-new peace-time utility—watching for forest fires in the vast government timber preserves, and also for supervising the operation of large ranches, such as those embracing thousands of acres and found frequently in the great Western farming regions. Some of these farms and ranches are so large that it takes a superintendent all day to make an inspection trip across the ranch, even with a high-powered automobile.

How the Airplane Plus Radio Is Used to Watch Great Forests and Ranches

The airplane as part of a farm equipment is now a reality. It makes its appearance at Hardin, Mont., on the wheat ranch owned and controlled by John Pierpont Morgan and other New York capitalists. Erhardt Schmitt, former American army aviator, has been employed to operate the machine. His duties are to carry the ranch manager from one part of the 250-mile, 100,000-acre wheat ranch to other fields. A wireless telephone in the airplane enables the manager to keep in constant communication with the ranch headquarters.

Not only can the manager or superintendent immediately report back to the ranch headquarters, by radio-telephone, but he can give local orders to gang or section foremen by means of small radio receiving

(*Continued on page* 364)

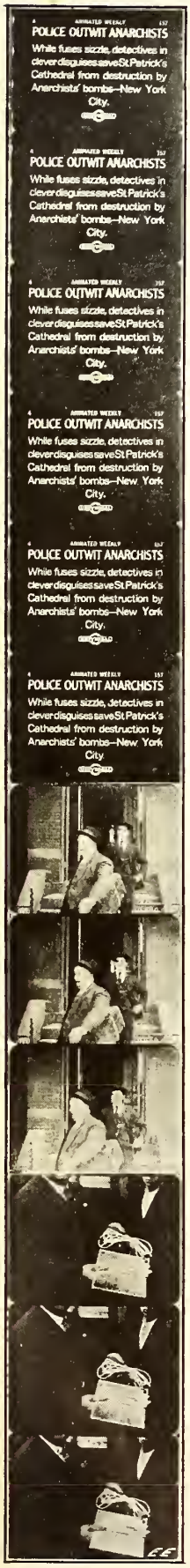


Two New and Important Peace-time Uses for Radio-equipt Airplanes—Watching for Forest Fires and Inspecting Large Farms and Ranches.

Bomb Expert Eagan

SPECIAL INTERVIEW TO THE ELECTRICAL EXPERIMENTER

Types of Bombs and How to Handle Them



Section of a Film Story of Mr. Owen Eagan's Exploits in "Bombland." For Years Inspector Eagan Has Inspected Infernal Machines by the Hundred and Still Lives to Tell the Tale.

"OWEN EAGAN"! At the mention of his name, the thought of bombs, anarchistic plots and explosives flood the mind. Seated at his desk, I found a man of sixty years, of medium height and massive proportions; head covered with curly gray locks. His eyes are of piercing steel gray and he has an ever-ready smiling countenance. A firm hand clasp told of a man of power, youthful in spirit, a believer in the great out-doors, a staunch American who cherishes a long and lasting friendship with that Great American, Theodore Roosevelt.

Mr. Eagan Classifies the Bombs.

We will now let Mr. Eagan tell of his bombs. Among other things. Mr. Eagan said:—

Bombs may be classified into four types, according to the explosives used: Nitro-cellulose, Nitro-glycerin, Nitro-benzol, Alkalin metallic nitrat mixtures.

These explosives permit of many combinations and varied means of igniting them. Bombs may be further classified according to the method of ignition used: Manual, Mechanical Electrical, Chemical.

The container or envelope of a bomb may be anything from a newspaper wrapt around the explosives to iron pipes, ice cream freezers, violin cases, cigar boxes, bottles filled with concrete and all imaginable kinds of wrappers.

RULES FOR HANDLING BOMBS

By INSPECTOR OWEN EAGAN,
Bureau of Combustibles,
NEW YORK FIRE DEPARTMENT.

If you should receive what you believe to be a bomb or infernal machine thru the mails or by messenger

1. **LEAVE IT ALONE,**
2. **DO NOT PLACE IT IN WATER,**
3. **CALL THE FIRE DEPARTMENT, OR IF IT IS NOT CONVENIENT, CALL THE NEAREST POLICE OFFICER, WHO WILL AT ONCE NOTIFY THE FIRE DEPARTMENT, AND HAVE THE EXPERT COME TO INSPECT THE SUSPICIOUS PACKAGE IMMEDIATELY.**

It is a common but fallacious rule among the general public, that in order to be safe with a bomb or infernal machine, it should at once be placed in a pail of water. If the bomb or infernal machine has a fuse attached to it, and the fuse may be seen burning or sputtering, then drop the bomb in water, which method usually is efficacious in making it harmless, as the lighted fuse is at once extinguished, but the best advice is to leave the house.

However, when this lighted fuse is NOT PLAINLY EVIDENT on the bomb or infernal machine, IT SHOULD NOT BE PLACED IN WATER, as many of these hellish devices are chemically or electrically operated. Another possibility likely to occur, if the suspected bomb or package is placed in water, is that some of them are made up in part of certain chemicals which will explode as soon as the water reaches them. There is an added probability that if the package or bomb is immersed in water, the reaction between the water and the chemical may give rise to a violent and persistent combustion, the flames of which will set fire to the house. In some of these contrivances there is a second compartment containing a high explosive, which can be ignited by heat, and where such a condition as outlined may occur, it is at once apparent that the heat due to the combustion of the initial chemical may generate sufficient heat to detonate the explosive, with possibly fatal results.

Every bomb presents a new problem as regards its envelope, contents and construction, and the best means of opening it without causing it to explode and send me "West." Everything is filled with uncertainty at this stage. The task requires ingenuity, nerve, precision and firmness of hand, which is essential to a surgeon in performing a very delicate operation. In both cases, a life is in the balance. These qualities cannot be gained by study, but must be secured by experience covering many years.

We now enter the second phase of the work. It is now necessary for me to classify and analyze the layout, materials, methods and plan of the bomb maker. What's in the vial? Why the wire? Where is it attached? What's this powder? Is it a mixture of several chemical substances? Why this and why that? Two, four, seven compartments, everything interlocking! Can't see the battery, detonating cap! Can't pull its "teeth"!

The scene is set in someone's home or office, sometimes it is my laboratory; every one has gone; the windows have been raised, doors opened to relieve the compression in the event of an explosion. There are two opponents, a bomb and Eagan, but Dame Experience is always with me.

The hellish combination has been broken down and then the "guests" are called and there on the table before them in various groups are explosives, timing devices, detonators, ignition mixtures, acids, vials, batteries, wires, fuses and the "bomb-maker's camouflage". Now the wheels of Justice are set in motion and the search for the bomb-maker begins.

Since the discovery and use of gunpowder, bombs of various types have been used.

The First New York Bomb Outrages.

The first series of bomb outrages in New York, from 1902 to 1910, known as the "Blackhand Bombs," occurred in the Italian section, and these were chiefly of the nitro-glycerin group, manually ignited. Dynamite was placed in olive oil cans and ignited by a time fuse which the "dynamiter" lighted and walked away to await developments.

A large number of bombs of the alkalin metallic nitrat group were made during this period. These consisted of various nitrats and chlorats and were exploded by time fuses manually ignited. Some were of the grenade type and were hurled at the victims.

Most of the bombs of this period were of a crude design and were made from articles of every day

(*Cont. on page* 341)

Another view of the "Animated Weekly" Film Story of Inspector Eagan's Great Work—that of Official Bomb Opener to the City of New York. His is the Only Job that Has no "Waiting List" of Future Aspirants.

A Few "Samples" of Eagan's Bombs

(Exclusive Story of Mr. Eagan's Bomb Exploits on Opposite Page.)

Peacetime Uses for War Inventions

By H. Winfield Secor

"SCIENCE moves in mysterious ways, her wonders to perform"—to paraphrase the well-known biblical passage, and never was this demonstrated more pertinently than at the present time, when we find many of the great World War's deadly inventions being converted to peacetime uses. Everybody is being benefited by the industrial application of some of the greatest inventions yet perfected by man, and many thousands more will live to reap the benefits accruing from the as yet undreamt-of applications for both business and pleasure, of airplanes, tanks, wireless devices, submarines, and a thousand and one other attainments of the world's master scientific minds.

A semi-humorous application of the Meissner *airfone*, described elsewhere in this number, is shown in Fig. 1. This device, which is very simple in construction, resembles a speaking tube in form, but incorporates several novel and distinct improvements, among others, an acoustic amplifier, making the device very efficacious for carrying on conversation between the pilot and observer in an airplane, where it is extremely difficult to hear under ordinary conditions, due to the great noise of the engine. A new application of this device is here suggested, namely, to muffle the ever-present and detestable "movie pest." Not only do we find these miserable atoms of humanity in the dark quiet of the movie theater, but also in all of the regular theaters. These brilliant insects must have seen some of the shows which we happened to frequent, about 999 times,—so replete is their knowledge of the "star" and "staress" and all the lesser satellites appearing in the play. They will tell you loudly the climax half an hour before it comes off and so on. So, thanks to the Meissner *airfone*, it should not be so very long before "us ordinary mortals" shall be able to go to the theater and enjoy a performance without having one of these human dramatic compendiums racing along two knots ahead of us, all the way thru the play and telling his sweetheart every move just before it happens. Some of you may like your entertainments served up that way—as for us, we object!

A very good use for the Boche's far-famed *Poison Gas* is shown in Fig. 2. What better application than to annihilate the rats by asphyxiation—"sauce for the goose is sauce for the gander." The Germans thought they had something brand new in strictly war inventions when they tried poison gas on the Allies, but among other recent applications of this invention to peacetime utilities and requirements was that of killing rats. Of course it goes without saying that before injecting a few dozen cubic feet of mustard or chlorin gas into a rat hole, that you had best provide yourself with a guaranteed gas mask and also buy a few dozen corks with which to plug up the other openings in the walls or floor boards. Give it a trial, ladies and gents—it's the "kaiser" of all rat killers.

Embryonic *Tanks* were already in use for agricultural and other purposes long before the World War, and in fact the first tanks used by the British Army on the battlefields of France were reconstructed agricultural tractors, built in the United States. These tractors were armed with steel plates and fitted with rapid-firing guns. The illustration, Fig. 3, shows another application besides that of the usual plowing and cultivating operations—that of hauling large logs in the lumbering districts of the great West. In these localities it is difficult to build even small railroads, and it doesn't pay to build any extensive trackage for such log railroads, as they are not apt to be used for any great length of time. Therefore, the tank tractors should prove very useful, as they can travel over practically any kind of ground, including ditches and even over logs. It will be remembered that during operations in the World War the tanks could crawl over great shell holes, trenches and brooks. This application should provide some fine chances for those of our Tanks Corps soldiers who are aching for army life and the ups and downs met with in the everyday career of a "tank rider." These tanks can haul tremendously heavy loads and resemble in their operating characteristics the work of the famous elephants of India, who pick up with their trunks giant timbers 30 to 40 feet long and measuring 8 to 10 inches square.

Airplanes—oodles of them—will soon be flying over our heads every day all over America. Many people have an idea that the airplane is a peacetime luxury, not to mention a wartime necessity. But such is not the case. If for no other reason the airplane has come to stay in its everyday application to the transportation of mail and the lighter classes of merchandise as by multiplying its everyday utilities, the practical development of aircraft is bound to result. This country, as well as every other power, is keen, of course, to develop aircraft to the highest pinnacle of practicability. The U. S. Army, as well as the Navy Department, has only recently put up a stiff fight for many millions of dollars with which to carry on much-needed airplane developments. One of the best ways to train fliers, especially in this country, where a large standing army or navy personnel is never maintained, will be without a doubt to encourage in every way possible the commercial application of flying machines of all types. Already in England a piano has been transported across the English Channel by airplane, and airplanes are at present available which can lift very heavy loads, and, morever, they are daily becoming more reliable and less liable to accident, should any part of the machinery fail while in the air. Hundreds of people of course take one look at an airplane, especially when it is ascending or descending in flight, and are satisfied to keep both feet on old *terra firma*. However, some of the latest types of airplanes are guaranteed to right themselves and land safely, even if the engine stops in mid air and the control cables become tied or ruptured. See Fig. 4.

Liquid Fire, as shown in Fig. 5, should prove efficacious for several industrial uses, such as burning off paint from iron and steel structures, vessels, etc., and, according to H. Gernsback, also for blazing a path or hole thru ice jams, which frequently prove extremely dangerous during the American winters, when they clog rivers and streams, as well as dams. Under certain conditions it might also be used to blaze paths thru jungle brush.

The *Geophone* is a remarkable physical instrument greatly improved and perfected during the war by the engineers connected with the Allied technical staffs, and used with great success for the purpose of locating enemy artillery and other military operations. Now it has found a distinct peacetime use. See Fig. 6. The saving of many miners' lives has been made possible, thanks to the Geophone, which can detect sound vibrations thru the earth at surprisingly long distances. It has been used successfully in some Government mine tests to pick up the sound of a pick-axe at a distance of about one-quarter mile. There is nothing electrical about the Geophone. It is purely mechanical and acoustic in its function. It operates on the principle that the inertia of a small lead weight within the instrument, and which is secured to a set of diaframs, will tend to hold its initial position whenever an earth-borne sound vibration, for instance, happens to affect it. The other part of the instrument moves and the lead weight tends to remain stationary in the same manner as your body sways forward due to its inertia when a car suddenly stops. The relative movement of the diafram to which the weight is attached with respect to the movement of the casing sets up an air wave, and this is transmitted to the ears thru a rubber tube, in the same way as a physician's stethoscope works. By means of this wonderful instrument, therefore, it is now possible to actually locate entombed miners at considerable distances. Communication with them is also possible by this means. Knowing the location of the entrapt men, it becomes much more expeditious to carry on rescuing and excavating operations in order to save them.

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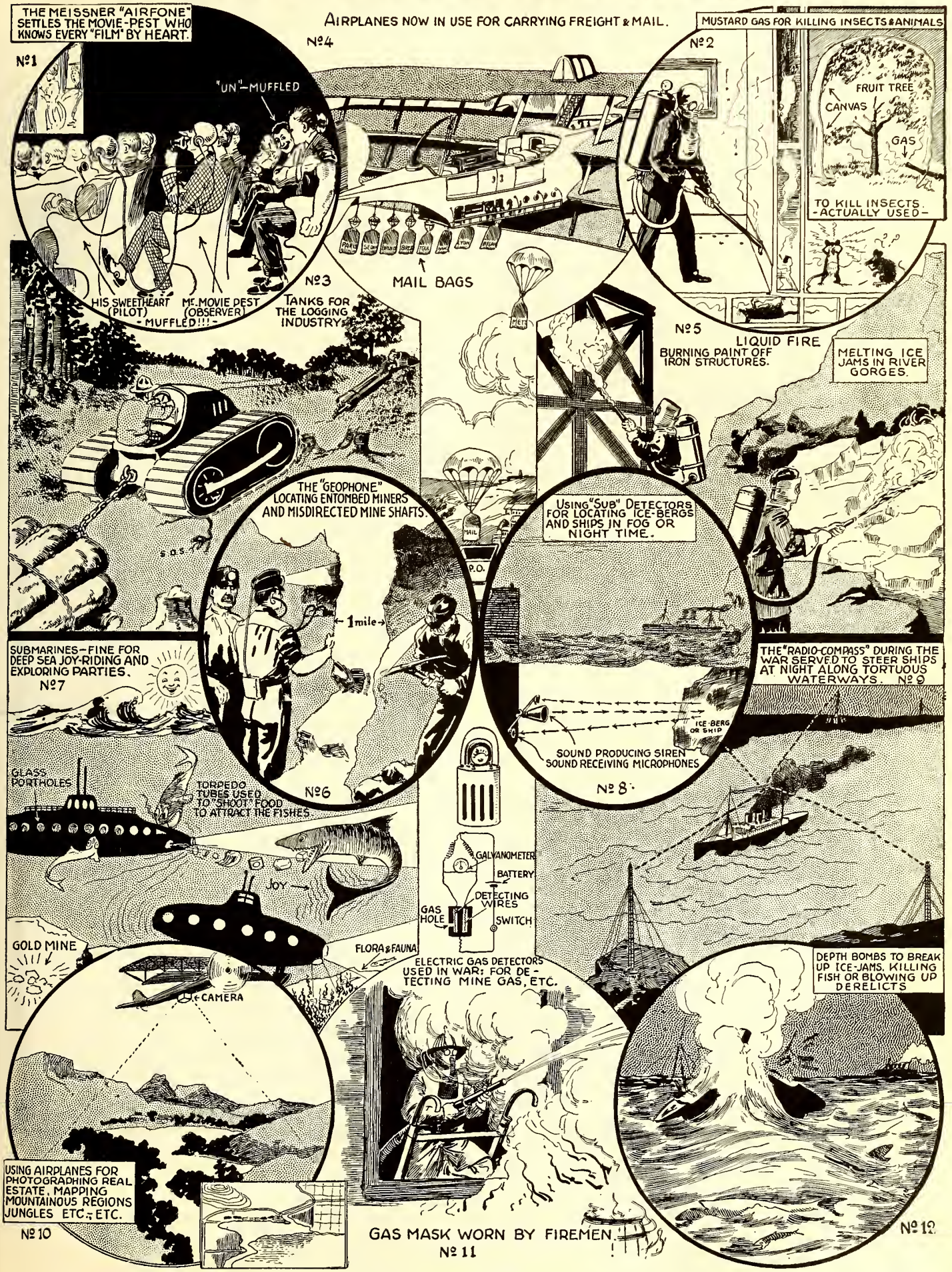
Peacetime Uses for War Inventions



Full description on opposite page.

Changing Nature's Face

How Electricity Plus Dynamite Makes Brooks, Removes Stumps and Breaks Up Rock

THE World War has, if nothing else, brought to light the great flexibility and usefulness of explosives such as *dynamite,* not for the purpose of annihilating men and cities, but for the more human, utilitarian purpose of leveling uneven and rocky ground, blasting out stumps from previously wooded ground, and breaking up rock. Again, brooks and irrigating streams are rapidly "dug" in a single day by the use of *dynamite plus electricity,* under the highly developed methods now available for applying explosives, and even the course of a river has been changed in the twinkling of an eye.

What we are interested in, in the present discussion, is the practical application of explosives to the everyday requirements of the tiller of the soil and those who are interested in improving wooded or rock strewn property.

The Electrical Detonator.

In "blasting by electricity," use is made of a slight electric current usually generated by a hand-operated dynamo of the magneto type. The dynamo is placed in a substantial cabinet to stand hard usage such as is encountered in blasting work, with a handle protruding from the top of the box containing it. This handle is attached to a gear rack and pinion, the pinion being secured to the shaft of the dynamo, so that when the handle is drawn up and then quickly deprest, the armature of the dynamo will be spun rapidly, thus generating a current of fairly high potential.

The *electric detonator* used in blasting, comprises a small copper shell, in which an explosive charge is placed. Two insulated

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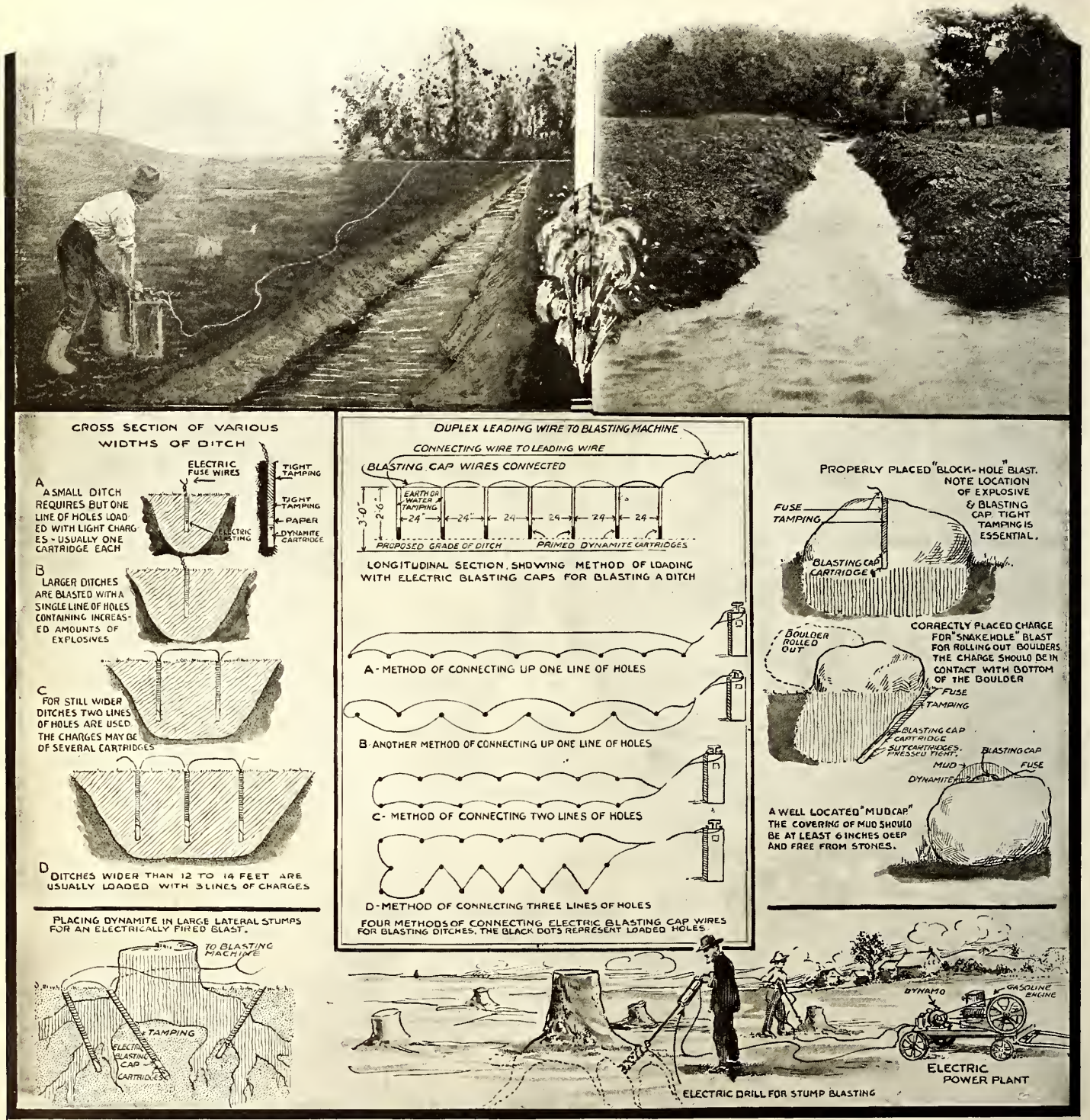


Illustrating a Few of the Wonders Which Dynamite Plus Electricity Accomplish Every Day All Over America. Stumps Are Cleared Out—Boulders Shattered—Ditches Constructed and Even the Courses of Rivers and Streams Altered. Verily the Face of Nature is Changed By Man.

Man's Greatest Curse--Infected Teeth

The Work of HENRY A. COTTON, M. D.

MEDICAL DIRECTOR NEW JERSEY STATE HOSPITAL, TRENTON, N. J.

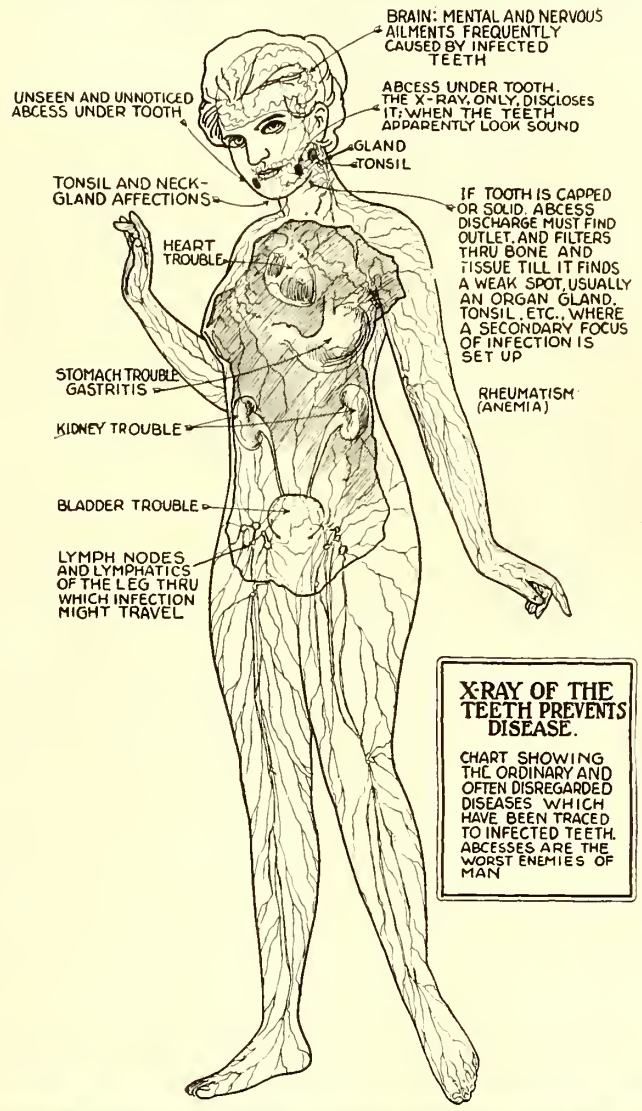
How X-Rays of Teeth May Prevent Disease and Insanity

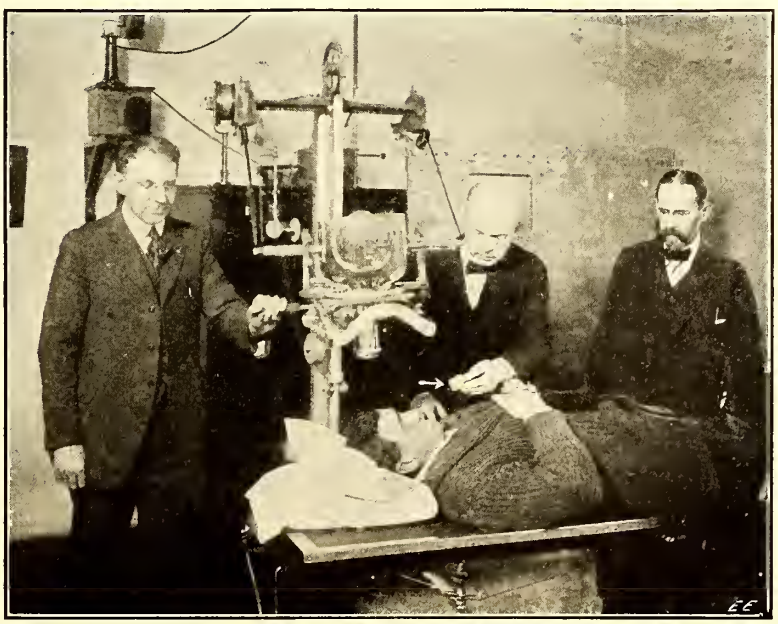
INVESTIGATIONS in the last few years, by both dentists and physicians, have shown conclusively that the greatest menace to the health of the human race today is to be found in the bad condition of the teeth of a large majority of the populace. The instinct of the individual is directed toward saving the teeth, and, unfortunately, a large proportion of the dentists foster this instinct, and in consequence, teeth are capt and otherwise repaired by expensive *bridgework* in order to save the teeth, when from the standpoint of the patient's subsequent ill-health, these teeth should be extracted. Happily,

MAN'S greatest danger, the biggest curse of humanity today, are infected teeth. Millions of people are dying of all sorts of diseases, caused directly by infected teeth. Inflammatory rheumatism, insanity, chronic stomach diseases, Bright's disease, nervous diseases, all these are now attributed to infected teeth. The work of Henry A. Cotton, Medical Director of the State Hospital of Trenton, N. J., is of such epoch-making and tremendous importance that every human being ought to know of it.

the best dentists have realized for some years that serious results frequently follow such procedures and have warned the profession against this danger. This subject has received special attention by Dr. Henry A. Cotton, Medical Director New Jersey State Hospital, Trenton, N. J., who in a recent statement on the importance of X-raying the teeth, has the following to say:

"Unfortunately for the patient, infected teeth may not and often do not cause any symptoms which would lead one to believe that anything is wrong with his teeth. This type of infection is what is known as *chronic* in contradistinction to an *acute* infection, and does not cause pain, pus or swelling, and frequently no rise in temperature. Hence, there are no symptoms which direct the patient's attention to this condition, and often they are amazed when they are told that they have infected teeth and that they must have a certain number extracted if they wish to recover from their particular illness. The question is often asked, 'How are we to know that teeth which give no evidence to the patient of serious and often dangerous infection, and externally give no evidence to the dentist of such condition, are infected'? The answer to this is the *X-ray*, and a more general use of this very simple and harmless procedure will reveal to the dentist as well as to the patient the existence of infected roots, *when to casual inspection the teeth may seem to be healthy and worthy of saving!* Naturally, these should immediately be extracted.





Taking X-Ray Photos of the Teeth at New Jersey State Hospital Laboratory. Arrow Indicates the Small Plate Holder About to Be Placed in the Mouth.

"Each individual should know whether or not he is harboring dangerous infection, which may not only undermine his general health but may endanger his life if it be not eradicated. With this knowledge of the danger of infected teeth, all persons should insist upon a thoro examination of their teeth by means of the X-ray and not take the word of a dentist who merely inspects the teeth and pronounces them all right. The failure of the dentist to recognize the existence of root infection and the practise of putting in pivots, gold crowns and bridge work, without first taking *radiographs* of these teeth to be sure that there are no infected roots, has sounded the death knell of many people, for when the infection has invaded other organs it is often too late for extraction of the teeth to be of any benefit. No matter if the teeth give no trouble or if one feels perfectly healthy at the present time, if he has had any dental work done at any time, *he should insist upon his dentist radiographing his teeth* so that he will not be the victim of a false security and finally succumb to a fatal disease, which might have been prevented if he had taken the precaution mentioned.

Dr. Cotton proves to us that it is wrong to cap or crown devitalized teeth as they will positively make serious trouble sooner or later. Such teeth should all be extracted immediately; they are the seat of nine-tenths of all our modern diseases.

This article is one of the most important we have publisht for a very long time, and we urge every reader not only to carefully read it, but to spread its gospel among friends. It will save thousands upon thousands of lives.

—EDITOR.

The Cause of Infected Teeth

"The public naturally inquires: 'Why do we have such bad teeth today when our parents and grandparents did not have these conditions, or, at least, did not have these fatal diseases?' There are several reasons for this. In the first place, our forefathers did not bother with dentists except to have an offending tooth extracted. In the second place, modern dentistry had not developed to the point of expensive repair and preservation of the teeth as we know it today. It has been estimated that 80 per cent. of the people who have had repair work done, even in the most expensive and latest manner, *have infected teeth which may become a menace to their health at any time.*

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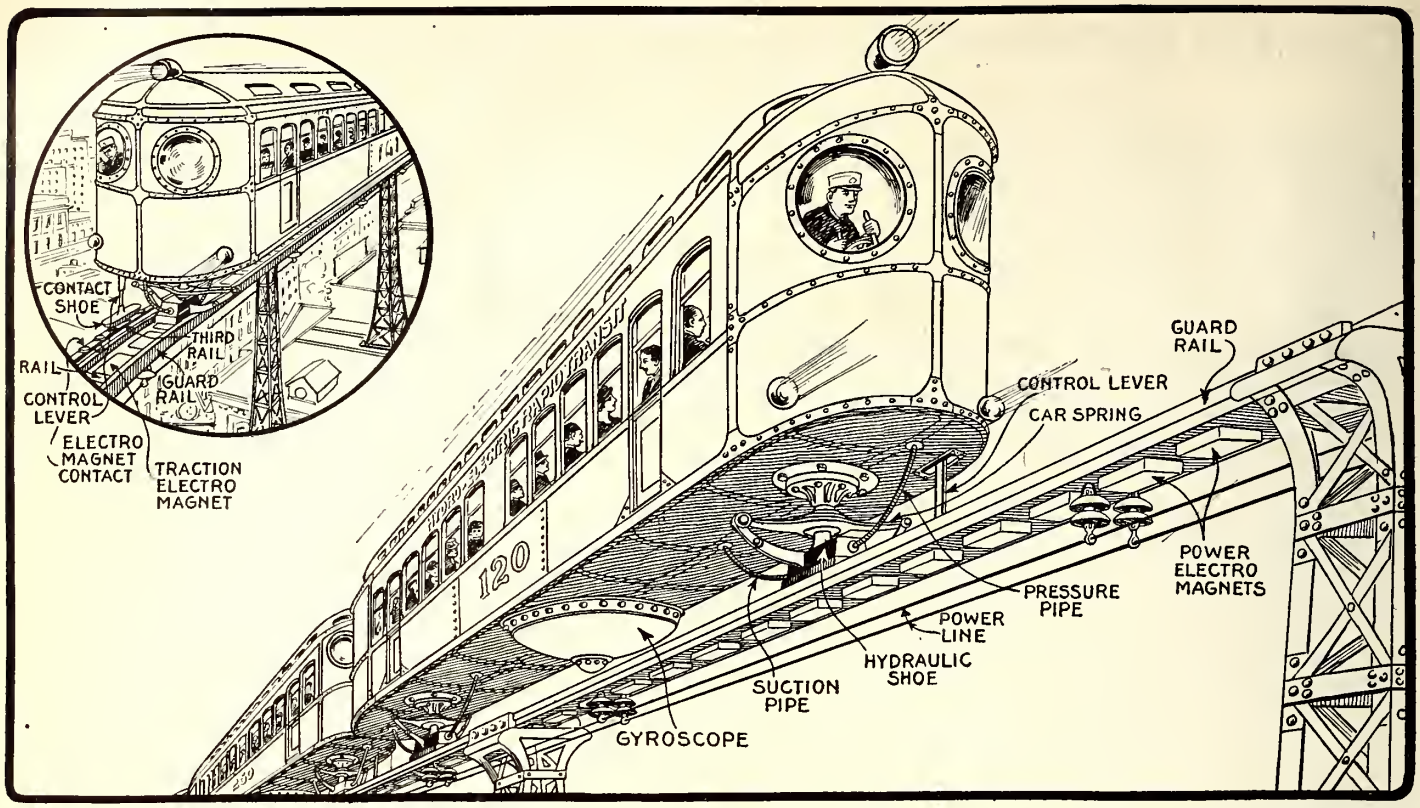


Fig. 5. This Illustrates the Propulsion of the Wheelless Gliding Train. The Two Hydraulic Shoes Glide On a Film of Comprest Water Squirting from Underneath the Shoes. The water Is Recovered by Suction from the Same Shoe So None is Lost. (See Fig. 3.) The Train Itself is Kept Upright On a Single Track by Means of a Gyroscope, While the Cars Are Propelled by Powerful Electro-magnets, the Contacts of Which Are Closed Automatically by the Train as It Moves Along. These Gliding Railroads, Having No Friction, Work So Easily that a Child Can Push Along a Car With Its Passengers.

Solving the Transportation Problem

By H. GERNSBACK

A Railway Which Actually Existed In France

THIS is the story of a most extraordinary railway which at one time existed in France. Its inventor was killed by the invading Germans in 1870. A railroad that is practical and which has demonstrated its successful operation. It is practically frictionless and can move SAFELY with a speed of one hundred miles an hour. It will be in use thruout the world.

SINCE the advent of the steam locomotive in the early 50's of the last Century, no progress whatsoever has been made as far as speed of our railways is concerned. We are today not riding faster either in our electric or steam railways than our grandfathers did 60 years ago. It is true that we have greatly improved everything else as far as comfort, safety, etc. is concerned, but the speed has not been increased whatsoever. Sixty miles an hour was an everyday occurrence sixty years ago, and was attained by many trains. Today, the average speed of the steam or electrical railways does not approach more than 50 miles.

Present Disgraceful Conditions.

What are we to do? In our big cities we are running street-cars on the surface, trains on elevated railroads and down in the subways. The more roads we build, the more acute becomes the shortage of transportation as far as passengers are concerned, and in any big city transportation facilities are always woefully behind the actual demand. In the morning everyone goes to business about the same time and in the evening everyone must ride home—our so-called rush-hours. The density of travel thus become enormous, particularly in cities like New York or Chicago, where conditions, as is well known, are intolerable, and in many cities, disgraceful. If it were possible to operate our railroads with safety only two or three times as fast as they are running now, it stands to reason that everybody would have a seat, an impossible condition now.

We cannot run our trains faster than they run now without encouraging accidents such as collisions, derailments, etc. As far as the present day railroad is concerned, it is not possible to increase its speed at all. There is, however, one solution, an invention which dates back to 1852. we refer to the *Gliding Railroad* which actually had been tried in France, and had been perfected in a small way. At that time, however, many technical obstacles made the project impossible, but all of these objections have now been overcome by new inventions and methods which we will discuss more fully.

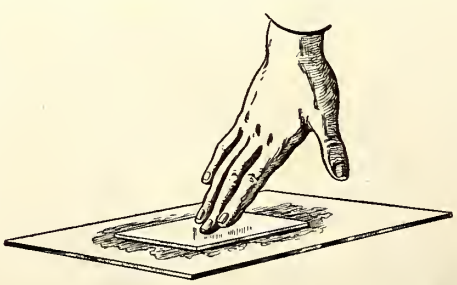


Fig. 1. The Principle of the Gliding Railway. Two Glass Plates Are Dipt Into Water. The Upper Plate Will Glide With Astonishing Ease. The Two Plates Do Not Touch. A Thin Water Film Separates Them.

Principle of Gliding Railroads.

Let us turn to Fig. 1 which gives us the principle of the gliding railroad. Take two smooth pieces of glass, such as are used for photographic plates. Boil them in water, until the gelatin comes off and clean thoroly. Use one large plate and one small plate as shown in illustration. Dip the two plates into water, and place the small plate on top of the larger. It will be seen that the small plate will *glide* with remarkable ease over the large plate. The important thing to note is that *the two plates do not touch.* They are supported by a thin film of water, *hence the top plate glides on an exceedingly thin water film.* As we move the plates back and forth we squeeze out the water little by little, and as soon as the plates touch, the free movement will stop. Were we to drill a hole in the top plate and attach a small tube to it containing water under pressure, we could then for a long time move the plate back and forward with very considerable ease; we would then always maintain a good water film on which our top plate could glide.

Exactly this is the principle of the gliding railroads, first invented by L. D. Girard, a great French engineer. Already in 1852 M. Girard proposed to replace the ordinary railways by means of hydraulic propulsion. He was quite successful with

his first models and in 1854 he conceived the idea to replace the wheels by means of *hydraulic skates* gliding over flat rails. By means of this method, he did away entirely with all friction for the reason that *he interposed between the skate and the track a film of water under pressure.* At first M. Girard was using comprest air, but he found that it was necessary to use water under pressure because air did not give satisfactory results.

Railroad was Actually in Use.

He actually constructed on his property de la Jonchère, near Paris, such a wheelless railroad which had no locomotive, the cars of the train gliding on a film of water. The propulsion of the train itself was affected by a sort of turbine arrangement whereby a stationary water jet was hurled against stationary vanes mounted under the cars. In other words, the train acted as the stationary part of a turbine, while water jets placed alongside the road, and operating automatically, pushed the train along. This railroad worked very well and actually transported passengers in a limited degree. In 1869 M. Girard obtained a concession from the French Government to run a wheelless railroad line from Paris to Argenteuil. Unfortunately, the Franco-Prussian War in 1870 then broke out and his experimental railroad at de la Jonchère was ruined by the Germans and Girard himself was killed. Nevertheless, the principle had been proven sound by actual practise. There is no reason why with modern methods and improvements it cannot be made a huge success.

In our Fig. 2 is shown one of Girard's hydraulic skates or shoes and its operation. M. Girard's train had two *flat* rails, and each car had four hydraulic skates or shoes which replaced the usual wheels. Fig. 2 shows three views of the shoe. It will be noted that water pressure is supplied to the shoe which fills the interior fully. As soon as the pressure becomes high enough, it is obvious that the water must escape by raising the shoe clear from the rail, providing enough pressure is used. While the water escapes, it will be readily understood that the shoe itself can nowhere touch the rail proper. In other words, *the shoe floats on a thin film of water.* If no other means were provided, it can be seen that an enormous quantity of water would be needed to supply the hydraulic shoes, while the train was moving, or even standing still. The water would squirt out incessantly.

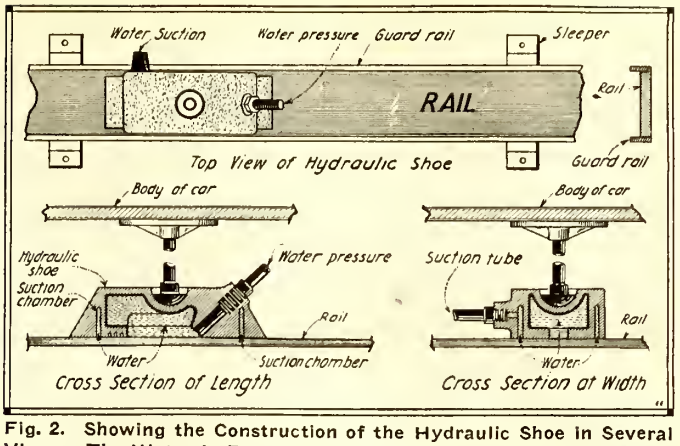


Fig. 2. Showing the Construction of the Hydraulic Shoe in Several Views. The Water Is Pumped Into the Shoe Under High Pressure. As the Water Leaves the Shoe, It Is Sucked Back Thru the Suction Chambers. The Hydraulic Shoe Cannot Leave the Track On Account of the Guard Rails. (See Upper Right Hand Detail Sketch.)

No Water Is Lost.

However, another French engineer, M. Barre had the happy idea to recover nearly all the water, and this arrangement is also shown in Fig. 2. Running near the edge of the hydraulic shoe will be found an annular suction chamber which is connected to a suction tube. It will be realized that as quickly as the water is prest out from under the shoe, it must pass the suction chamber, *and here it is sucked back to the water reservoir* of the train to be used all over again. With this ingenious arrangement, it will be readily seen that practically no water is lost except a minute quantity used in wetting the rail, and this loss per train amounts to only a gallon or two per mile, even for a heavy train.

A very important, and as a matter of fact, the most important part of this railway is, that as the cars glide on water they *can be made to run with marvelous ease.*

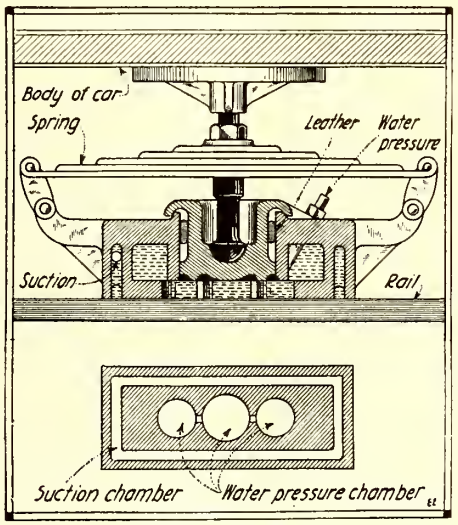


Fig. 3. A Modified Form of the Hydraulic Shoe. It Works Similarly to the One In Fig. 2. Note the Piston Arrangement Which Gives the Train a Feathering, Cushion Effect.

Child Can Pull Train.

M. Girard already demonstrated that *a six year old child could move a standard railway car* rapidly over a track, so easily does such a railway operate. The reason is of course that no metal of the train touches the track, therefore nearly all friction is suppressed. By actual experiments it has been shown that M. Girard's cars could be moved with a weight *one half of one thousandth of the weight of the car.* In other words, a railroad car weighing several tons can be pushed along rapidly with an expenditure of a few pounds of energy. The water film itself is of course exceedingly thin, measuring only from one-half to three-quarters of a millimeter. In other words, not much thicker than six sheets of paper on which this story is printed. Nor was the water pressure as high as one might think at first:—10 lbs. per square centimeter.

M. Girard found his greatest trouble in two points. First, he had trouble with his rails at the point where the latter connected. It is of course necessary that a railway of this kind should have an exceedingly smooth metal rail which must not have any uneveness whatsoever. Also where the rails join, it was found necessary to interpose pieces of leather or soft rubber, otherwise the water would squirt out between the rails. Of course, we would not have this difficulty today because we would simply weld the rails together, making them a uniform piece of metal. This source of trouble, and it was M. Girard's greatest one, would be unknown today. The other great difficulty was to propel the train.

How to Propel Wheelless Trains.

There was used in Paris at one time an arrangement as shown in Fig. 4. Inasmuch as no wheels are used, and because the hydraulic shoes have no tractive effect themselves, entirely new means must be provided to move the train. The old French idea is shown in this illustration where a rail rack was run all along between the (*Cont. on page* 336)

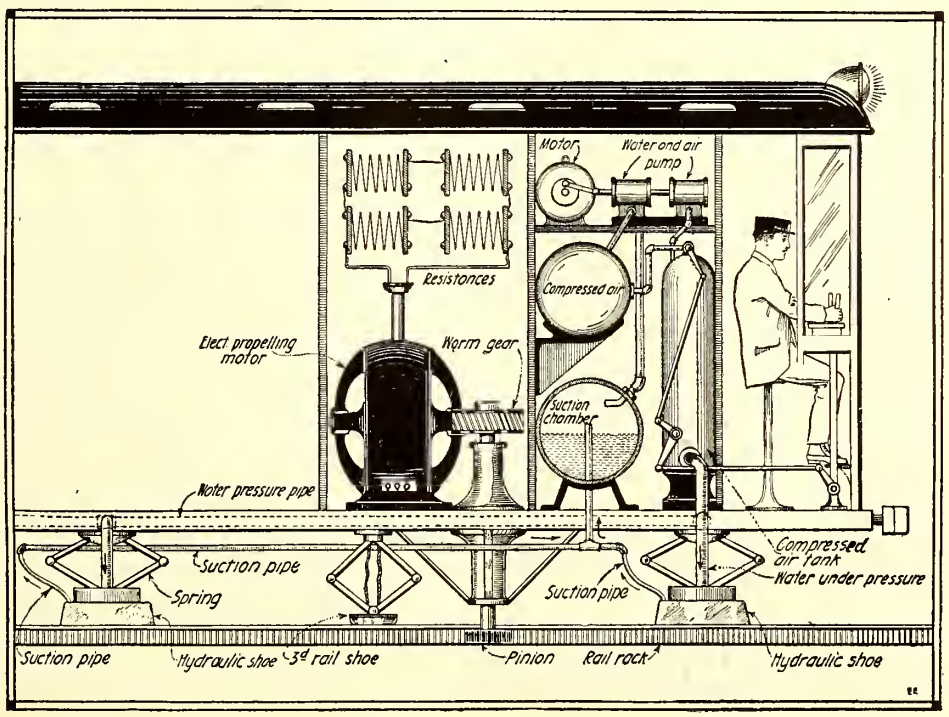
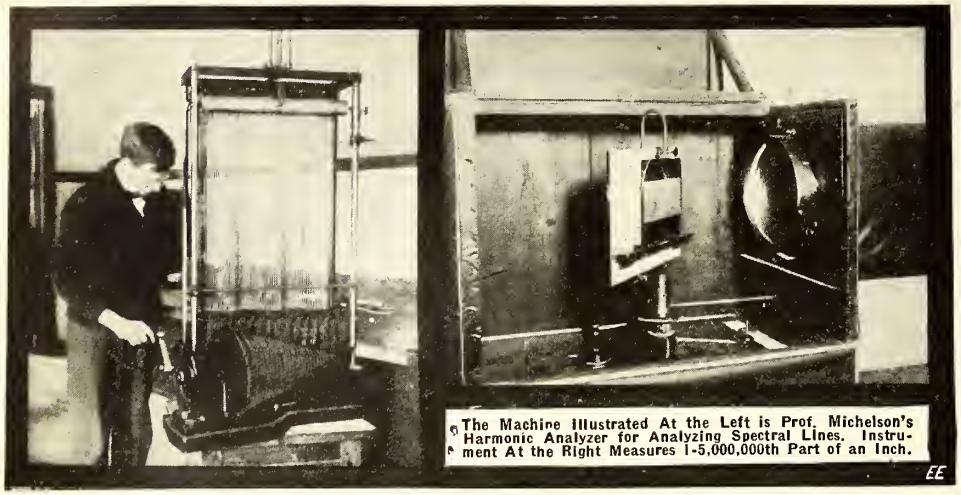


Fig. 4. Showing the Propulsion Used in the early French Gliding Wheelless Trains. A revolving Pinion Engages with a Rail Rack, Thus Pushing the Train Along. Illustration Also Shows the Method of Hydraulic Shoe with Comprest Water, and How the Lost Water Is Sucked Back.

Measuring 1-5,000,000 of An Inch



The Machine Illustrated At the Left is Prof. Michelson's Harmonic Analyzer for Analyzing Spectral Lines. Instrument At the Right Measures 1-5,000,000th Part of an Inch.

The wonderfully precise measuring machine here illustrated measures down to 1-5,000,000 of an inch. It was invented by Prof. G. Michelson. Prof. Michelson's grating (on the stand to the left) contains 50,000 parallel, equally spaced lines to the inch.

Precision to the 1/1,000,000th part of an inch has until recently seemed only to be within the realm of ultra-science, as we might say. However, during the war, mechanical precision instruments were improved so markedly that it was quite common, especially in Government ordnance specifications and requirements which called for an accuracy of 1/1,000,000th of an inch.

The photo at left shows Prof. Michelson's Harmonic Analyzer, for analyzing spectral lines into their constituent parts. By means of this device an assistant can do in a few minutes what would require many weeks for a skilled computer.

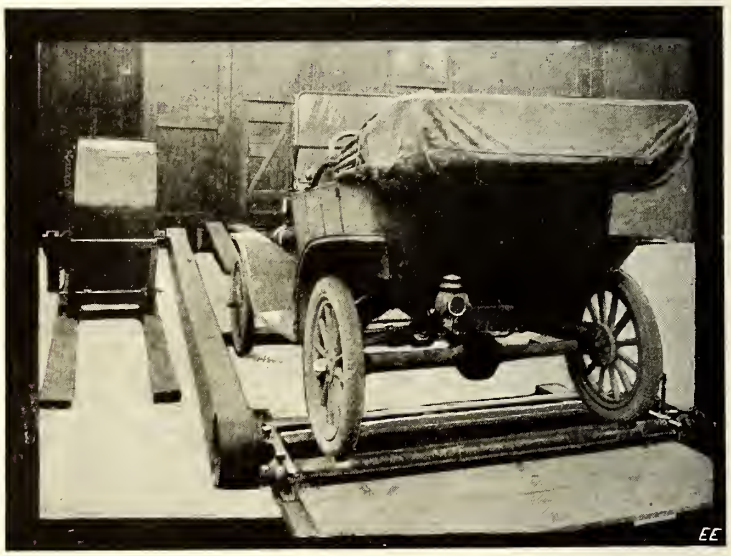
Farmers Drive Machinery from Automobile

Herewith is illustrated the latest in automobile power transmitters for driving farm or other machinery. A recent invention of the proprietor of a Colorado machine shop promises to become very popular with farmers who own autos. The invention is an apparatus for transmitting power from an automobile to run the machinery of the farm, but unlike most contrivances of its kind, nothing is removed from the auto, and the auto can be driven off within a minute of the time it is used on this new invention.

The device consists of two four-inch rollers set parallel to each other in a frame and long enough to run the automobile onto them. These rollers are connected by a chain belt, and on one of them is a pulley to run a belt to the machinery. The rollers are locked against turning while placing the auto on the machine, by putting an iron pin thru the links of the drive chain. When the rear wheels of the auto are resting squarely on the rollers, pin is removed and the engine started. This turns the rollers as the wheels revolve, and the belt runs the machinery, the same as any other power would do.

The inventor claims to develop half the rated horsepower of any automobile engine on the belt of the machine, which is very good indeed, considering that the power is transmitted by friction only, with a consequent loss by slippage. The device should find wide favor among farmers everywhere.

Here's How to Put Your Henry Ford to Work and Make It Drive Farm or Other Machinery—even Down to Cutting Up Fire Wood. The Inventor of the Automobile Power Transmission Scheme Here Illustrated, Claims to Develop Half the Rated Horsepower of an Automobile Engine on the Belt of the Machine, Which is a Very Good Efficiency Indeed, Considering That the Power is Transmitted by Friction With a Consequent Considerable Loss, Due to Slippage. The Device Comprises Two Four-Inch Diameter Rollers, Set Parallel to Each Other, in a Frame Long Enough to Permit the Rear Wheels of the Automobile to Rotate In Contact With Them.



"Movie" Sign Works by Colored Lights

This Picture is not Quite so "Infantile" as it Might Seem At First Glance, Altho the Subject Illustrated Happens to Be. By Painting Two Objects Such as a Hobby-Horse as Here Shown, in Two Different Colors, Say Red and Green, a San Antonio, Texas, Inventor, Richard M. Craig, Has Found That When a Set of Red Lights Are Flashed on the Sign by a Special Electric Flasher Switch, the Red Image Stands Out Plainly; and When the Green Lights Are Lighted and the Red Extinguished, the Green Image Stands Out. By Rapidly Switching the Lights On and Off a "Movie" Effect is Obtained.

One of the lastest and cleverest advertising devices is that covered in a patent recently granted to Richard M. Craig of San Antonio, Texas. The inventor arranges two figure positions on the sign, one position of the figure for illumination by red lights and the other by green lights. Next he arranges red and green lights for illuminating the display with a device for alternately switching the current from one set of lamps to the other, the switching device being motor-driven. In the present illustration, we at once perceive that the subject is painted twice in two extreme positions, each position being painted in a different color, such as *red* for the extreme position and *green* for the second extreme position. These two positions in red and green under ordinary daylight conditions show plainly, but when they are lighted alternately with red and green lights, then the sign becomes alive and animated, giving a very near approach to a moving object.

Two Views in Paris, Showing the Famous "Camelots" or Street Fakirs, Who Have Here Elected to Tell the Good French People Their "Past, Present and Future" by Wireless. Only it Isn't Wireless!

Paris Letter

By JACQUES BOYER

THE Parisian "camelot" is more than a street peddler, he is a business man and an actor, sometimes even an acrobat, but always he is a marvelous talker and a humorous entertainer.

A good "camelot" will sell anything on the asphalt of the good town of Paris, be it an old sponge, a pocket-book, a collar button, or ice-cream. We have no intention to give in the following, a history of this so interesting specimen of human being, but we will show, with the help of the photographs herewith, that the renown of the "camelots" is by no means exaggerated and that they keep abreast with the developments of science and are not at all indifferent to the particular trend of public attractions. These peculiar peddlers, instead of meddling with ordinary merchandise have put the fairy Electricity at work to attract their clients.

Here for instance, one of them detects your thoughts by means of the *"Teleradio"*; the other one uses the *"Radiograph"* to discover the past, present and future.

Of course we don't need to tell you that the instruments which they exhibit have only a very vague resemblance to the ones attributed to Tesla, Marconi or Branly.

Most of the time these apparatus consist solely of a bell connected to a few dry batteries and other formidable appearing scientific apparatus. The answer to the question concerning the past, etc., of the victim, is printed in advance, of course, and glides out of a box by means of a clockwork.

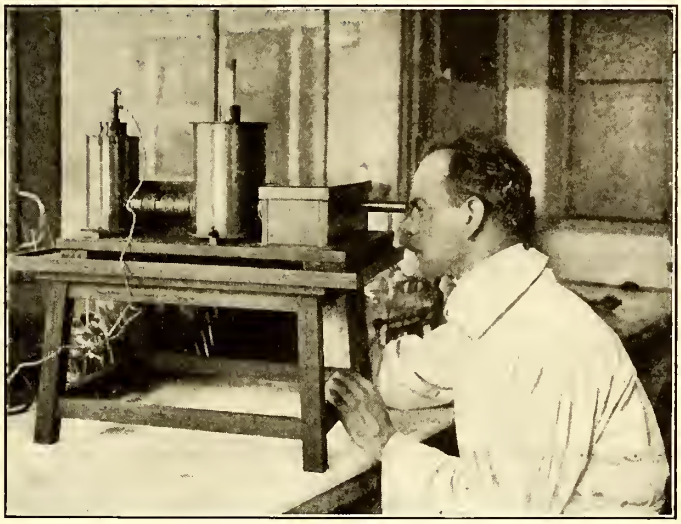
The rest is *camouflage. Scientific camouflage.* But some one always falls for the fakes. P. T. Barnum was right. The public wants to be fooled—and gladly pays for it.

New Electrical Apparatus to Count the Microbes.

The Opacimeter.

This new instrument invented by Messrs. Lambert, Vles, and de Watteville, who have given it the name of *Opacimeter*, makes it easy to count rapidly the microbes in an emulsion prepared for vaccination purposes.

It is composed principally of a photometer made up of two parallel light circuits, coming from one source, the one traversing the phial containing the emulsion, the other subject to a system of dimmers, capable of modifying the intensity of light, after a determined law. The two circuits produce, in the field of an eye piece, two light-spots opposite each other and the other realizes their equal value by adjusting the dimmer system.



New French Instrument for Rapidly Counting the Microbes in an Emulsion. It is Called an "Opacimeter."

A very ingenious system of gauges, lenses and microscopes, the detailed description of which it is not possible to give in this limited space permits the observer to establish with the aid of Spectrophoto-Metric Measures the actual number of microbes contained in the emulsion. The laboratories of the French Army are using the Opacimeter to determinate rapidly and accurately the dose of bacteria to be contained in a vaccinating emulsion.

SHELL LOCATER FOR FRENCH FARMERS.

The shell locating apparatus here illustrated was invented by M. Gutton, Professor of Physics at Nancy, and is akin to one used by surgeons for locating bullets in the body. It consists of two wooden rings each fitted with a pair of electric coils, one traversed by a variable current and the other connected with a telephone. If there is a metal object under the soil in fairly close proximity to the apparatus, the telephone signals the fact; if not, it remains silent. Unexploded hand-grenades are more dangerous than shells, as they are nearer the surface, and liable to burst at the least touch. This apparatus operates on the principle of the Hughes Induction Balance.

The Hughes induction balance is composed of four coils, two in the primary and two in the secondary circuit. When the relative positions of the coils are adjusted correctly, the inductances neutralize each other and no current flows in the secondary circuit. If, however, the slightest change is made in any of the coils, such as by the insertion of any metal object, the mutual induction is unbalanced and a sound is made in the telephone receiver. A detailed description of this device appeared in the February, 1918, issue of this Journal, where a diagram is given of the coil connections. The secondary coils may be connected in series with a galvanometer or 'phones. An experimenter who has no galvanometer can purchase an inexpensive Weston ammeter. When the shunt has been removed, this will serve as an excellent galvanometer. Some form of interrupted primary circuit is necessary to induce currents in the secondary. An interrupter, mounted on the armature of a buzzer, serves the purpose.

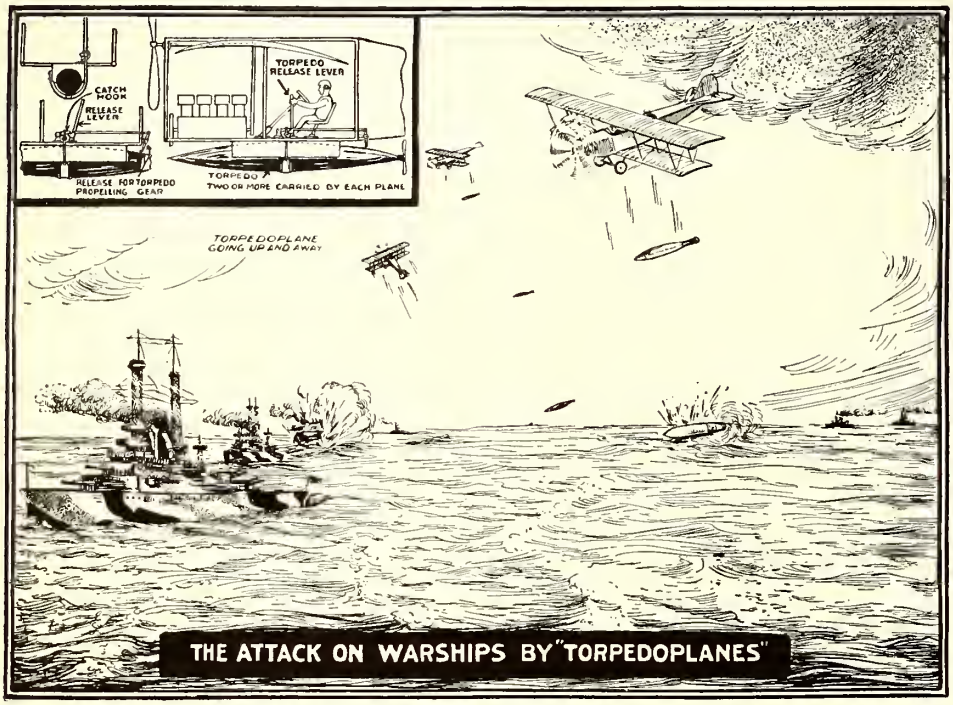
The Fields of France Are Strewn with "Dud" Shells. To locate them Before Plowing, the Electrical Instrument Here Illustrated Has Been Perfected to Detect Their Presence, Even When Buried Several Feet.

The "Torpedoplane" and "Sub" Spotter

By GEORGE HOLMES

TWO important and novel war inventions are here illustrated and described—the torpedo-carrying seaplane or dirigible, and the microphonic submarine locater, both of these naval warfare improvements being the inventions of an American naval officer, Rear Admiral Bradley A. Fiske.

Two Revolutionizing Naval Inventions of Rear Admiral Fiske



The Naval Engagement of the Future as Rear Admiral Fiske, U. S. N., Sees It. His Powerful "Torpedoplanes" Will Provide New Ways to Repulse Landing Parties and Attack Warships That Are Worrying Naval Experts of Foreign Powers.

The torpedo-airplane or "torpedoplane" as it is called, is a development of the torpedo-carriers, which were first successfully employed in action by the R. N. A. S. at the Dardanelles in 1915, and were subsequently used against us by the Germans in 1917, when they were thus enabled to sink three of our merchant ships off the Southeast Coast. The torpedo carried by the torpedoplanes is of a small size as modern torpedoes go, and weighs about half a ton.

The Mystery Plane or "Torpedoplane"

The "mystery airplane" was designed to perform from the air more effectively and more swiftly the work formerly allotted to our torpedo-boats. The enemy had devised such successful protection of harbors and ships against our torpedo-boats and submarines that it was only with the gravest risk that we could approach within 30 miles of Kiel and other German fortified ports. But for the newest peril, the torpedoplane, the enemy had no reply.

The news of our discovery of a means of attack that was immune from mine dangers and too swift in its operation to be held off by gunfire reached the ears of the enemy, and is believed, in one quarter at least, to have hastened the Germans in their decision to accept the surrender terms.

Had not hostilities ceased so suddenly these machines would have operated effectively against Kiel harbor and the German warships in their very lair. The efficacy of the weapons will be realized when their operation is explained. One of these mystery airplanes, espying its target, makes a sudden dive from the clouds, at a speed of 150 to 200 miles an hour, levels out at 50 feet above the surface, discharges a torpedo directly at the enemy ship at the right moment, after which the pilot pulls back his control stick and disappears into the clouds as suddenly as he appeared. The operation is so swift that the enemy has little if any chance of training a gun on the assailant. The "smoke cloud" produced by modern war planes is excellent for this purpose. In one of these attacks a British airman torpedoed and sank a Turkish troopship containing 3,000 troops.

When the idea was first conceived of having an airplane to carry an ordinary torpedo such as is used on the submarine, technical difficulties almost defeated the project, until an American designing firm got hard at work in conjunction with the Air Ministry. The difficulty was not so much of lifting a torpedo as of ensuring that the action of discharging the torpedo be carried out with accuracy of aim and with safety to the pilot. Experiments were carried out in the face of great difficulties and perils.

On the occasion when the initial experiment of discharging a torpedo from an airplane was made, the lightening of the airplane had such a serious effect on the latter that the wings collapsed and the pilot was hurled to sudden death. In another case when the torpedo had been discharged, it hit the water at an awkward angle, and ricocheting over the surface, rose and demolished the airplane, which had not risen out of the way. This discharging of a torpedo was no light risk when the torpedo was of full size, weighing anything up to a ton—three times the weight of the machine in which Blériot first crost the English Channel.

These wonderful planes can ascend from land or from the deck of a ship, and can descend on the sea and float until help is brought by wireless. When the German fleet surrendered, a seaplane "mothership" with 20 of these machines in its bosom met the Germans 50 miles out at sea, and had any tricks been tried, it would have been simple work for a score of "mystery airplanes" to have leapt into the air and torpedoed the major part of the enemy fleet. This mystery or "cuckoo" airplane—so

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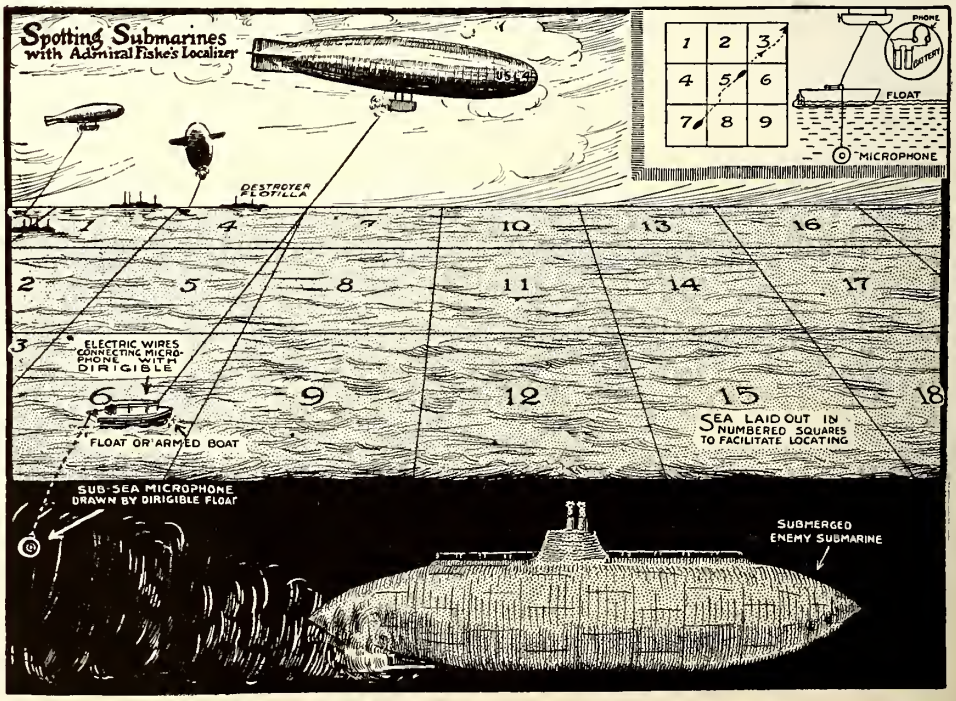

The "Fiske" Submarine Spotter. The "Sub," Once It Is Picked Up by Sound Waves Impinging on a Microphone, Is Trailed Along From Square to Square. The Aircraft Can Attack It With Depth Charges or Signal Instructions to Destroyers.

Thunderstorm Electricity

By ROGERS D. RUSK, M. A.

Late of the Meteorological Section, U. S. Army Signal Corps.

ONE hundred and fifty years ago the famous Voltaire said: "There are some great lords whom we should always approach with extreme precaution, and lightning is one of them." This is perhaps one reason why we know so little about lightning at the present time, for it certainly is not a very safe subject for close laboratory investigation. For a long time after the electrical nature of lightning was demonstrated by Benjamin Franklin, very little more of any scientific importance was discovered about it, and only today are we learning how the great charges of atmospheric electricity are generated in a thunder-storm. It is a significant fact when we think that a thunder-cloud is the most stupendous and powerful generator of electricity of which we know. A single lightning flash may carry *twenty thousand or more amperes at a pressure of millions of volts.* Moreover it is Nature's own method, the simplicity of which makes it the more wonderful, for it involves no intricate and complicated machinery. It is not too much to think that the future will sometime see Man harnessing and making use of this tremendous source of energy and bidding it do his will instead of holding it in awe, as he so long has done in the past.

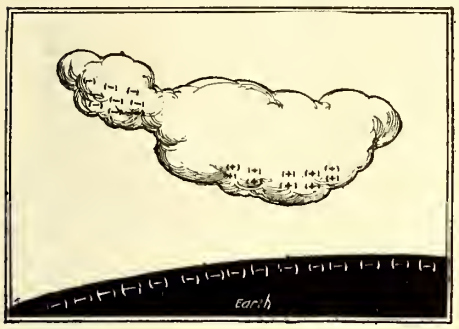

Fig. 1. Showing How a Cloud Is Charged by Electro-Static Induction. The Negative Charge on the Earth Induces an Opposite Charge in the Cloud.

During the war lightning and thunder-storms proved a serious menace to balloonists and aviators, and on this account they were made the subject of special study by the *Meteorological Section of the Signal Corps.* Their results, in connection with the latest discoveries of scientists in general, are now beginning to throw light on the long hidden mysteries of thunder-storm electricity.

In recent years many theories have been advanced to explain the cause and nature of lightning, but all of them have been more or less vague and indefinite and for the most part they have been unsatisfactory one way or another. Electricity is now recognized as being one of the important factors in the determination of weather conditions, and conversely, weather conditions are very definitely known to determine the electrical state of the atmosphere at any particular time. *Sometimes rain produces electricity, and sometimes electrical phenomena cause rain.* The place where the two, rain and electricity, are most closely related is in the thunder-storm. Here the rain drops condense primarily about small electrically charged particles called *ions,* and then again the motions of these particles cause the growth of the lightning charges in a manner to be explained more in detail.

The Physics of Thunder and Lightning Simply Explained

How Thunder-Clouds Form.

In a thunder-cloud the almost inconceivably large charges of electricity are often generated in a very short space of time, and sometimes a complete reversal of sign from *positive* to *negative,* or vice versa, may occur in a *thousandth of a second or less.* It is usually thought that lightning discharges occur from one cloud to another or from a cloud to the earth, but this is not necessarily the case. Quite frequently discharges *as long as a mile in length* will take place in the interior of a single cloud itself. For these reasons it must be explained just what a thunder-cloud is, and how it differs from other clouds which seldom carry charges of electricity of any great magnitude, or act in the capacity of electric generators.

WHAT TO DO IN A THUNDER-STORM

If you are out of doors in a very severe electrical storm, it is well to observe the following rules for your own protection:

1. Keep away from wire fences. They may carry a dangerous electrical charge long distances. Cattle in pastures are frequently killed thru the neglect of farmers to ground the wire of the fence.

2. Keep away from hedges, ponds and streams.

3. Keep away from isolated trees. Oak trees are frequently struck; beech are seldom struck. It is safe in a dense forest.

4. Keep away from herds of cattle and crowds of people.

5. Do not hold an umbrella over you.

6. It is safer to sit or lie down in an open field than to stand.

7. Drivers should dismount and not stay close to their horses.

8. Do not work with any large metal tool or implement.

If you are indoors:—

1. Keep away from the stove and chimney. The hot gases from the chimney may conduct the lightning to and down the chimney.

2. Do not take a position between two bodies of metal, as the stove and waterpipe, for example. An exception to being near metals is the case of an iron bed. One of the safest places is on a mattress in an iron bed, provided you do NOT touch the metal. The metal surrounding you makes a safe cage, which will prevent the lightning from reaching a person inside.

3. Do not stand on a wet floor nor draw water from the well or faucet.

4. Do not stand directly under a chandelier, near a radiator, nor on a register.

5. Do not use the telephone in suburban districts. In cities there is practically no danger, as the wires are placed underground.

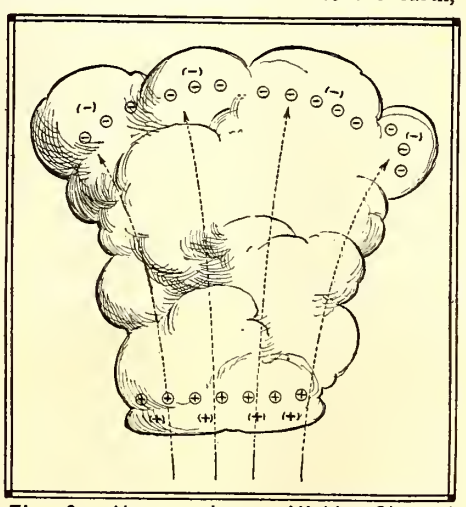

Fig. 3. How a Large Highly Charged Thunder-Cloud Forms by a Continual Shifting of the Oppositely Charged Particles Composing It. The Negative Charges Tend to Move Toward the Top, and the Positive Charges Toward the Bottom of the Cloud.

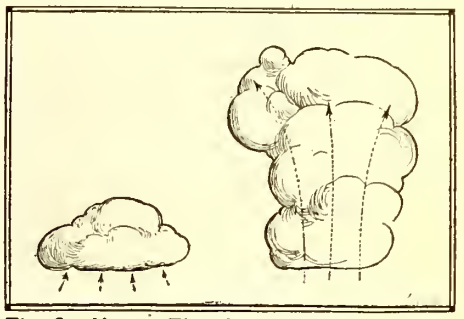

Fig. 2. How a Thunder-Cloud Grows. The Larger Cloud Is the Result of Intense Local Heating and a Strong Up-Rushing Current of Air. Its Height May Be a Mile or More from Base to Top. The Smaller Cloud May Measure Only a Few Hundred Feet in Height.

Everyone is familiar with the huge rolling, billowy clouds (cumulis) so common on a warm day, but not everyone knows how they are formed. In reality each cloud represents a column of heated air which has risen by convection from the earth's surface, due to the heating effect of the sun, and has carried moisture up with it. When the top of this column has risen to such a height that it begins to cool, and the moisture to condense, the cloud is formed. This may seem unimportant but in reality it is the beginning from which a thunder-storm may develop, if conditions are just right. As moisture in the air does not condense in the form of drops unless there are dust particles or electrically charged particles (ions) in the air to act as centers of condensation, the cloud may already have received a charge from these ions, providing there was a majority of ions of one sign present.

How Clouds Receive Charge.

A cloud may also become charged by *induction.* If a cloud which has approached the earth as shown in Fig. 1, is of a form which may divide into two parts, the charge of the opposite sign which has been attracted to that portion nearest the earth may be carried away by it at the time of division, and the other portion of the cloud may carry away a charge of the same sign as the earth. Neither of these two ways in which a cloud may become charged, explains however the production of the enormous charges which are present in a thunder-cloud. These are produced in another way, due to the forces at work when a thunder-cloud is formed.

If the heating is intense and there is much moisture present, when the billowy clouds mentioned above are formed, the result is a thunder-cloud. The process is shown in Fig. 2, where the smaller cloud is the common type visible on most any warm summer day. The larger cloud is the result of intense local heating and a strong up-rushing current of air, and its height may be a *mile or more from base to top,* while the smaller type may be *only a few hundred feet in height.* The bulging tops of the larger clouds are the common-

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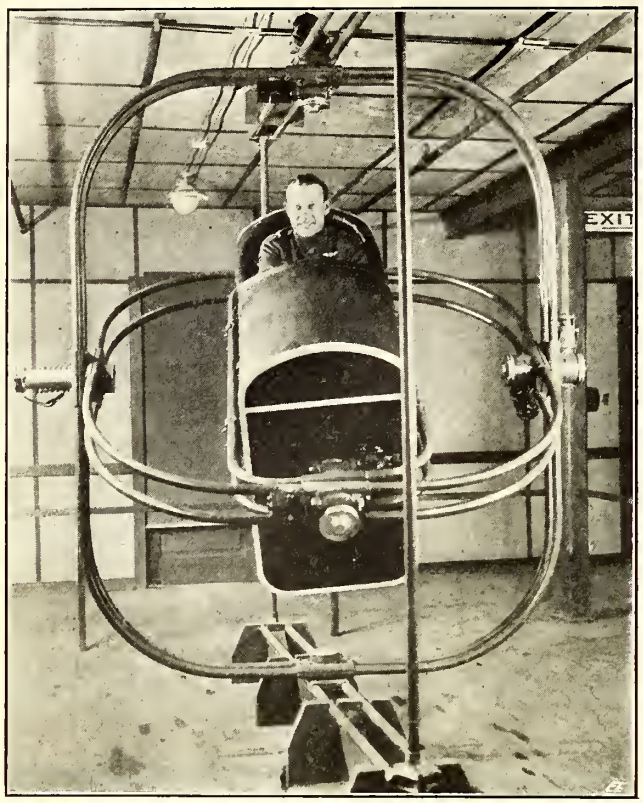

Above:—The Meissner "Airfone" for Talking Between Pilot and Observer. It Amplifies as Well as Localizes the Speech Waves. At Left:—The Ruggles "Orientator". It Is Electrically Operated and Gives All the Thrills of Real Flying.

"Ground Flying" for Aviators

This machine is used to familiarize the student aviator with the various loops, turns, cuts and dives that every flier must know. One can loop the loop, take a nose dive, make a tail spin and execute the "falling leaf" by simply operating the various electric controls. The invention is now being used with greatest success by the young army officers learning the elements of the flying art at the Army's flying school at Washington, D. C. The Orientator may be controlled by a switch-board at the side but on the floor, so that when desired the instructor may put the student thru various flying maneuvers at unexpected moments.

How Pilot and Observer Talk

The airfone is a form of speaking tube designed especially for service as inter-communication device between pilot and observer, instructor and student, or any airplane occupants, during full power flight. It consists essentially of a flexible speaking tube provided with a mouthpiece and a neck band, and of a helmet to which two earpieces are attached, suitable connections between the speaking tube and the earpieces being provided. For two-way conversation, two such head gears and tubes are used. Its present design is based on a very close and detailed study of aircraft noise conditions and in the application of acoustics.

Electric Brush Contains Dynamo

We are all more or less familiar with the various faradic electric appliances such as massage rollers, brushes, et cetera, which can be used in connection with medical coils and the like, but one of the most interesting and withal extremely efficient electric devices recently brought out is the Electro-dynamo Brush shown in the accompanying illustrations. It is claimed for this brush that it will rejuvenate the hair, and the makers cite the testimony of experts that it will in many instances help the scalp and also aid in the treatment of a great many ailments. In treating other parts of the body than the scalp, use is made of a flexible conductor and various electrodes which can be quickly attached to the brush. No batteries are required and a powerful current is generated as soon as the projecting finger lever is gently prest. This brush was tested by one of the leading New York electrical testing laboratories, and their report states that it develops an average potential of about 50 volts, and a peak value of from 100 to 200 volts. It is therefore impossible to receive an injurious shock from this unique device.

Young Lady Using the Newest Electric Hair Brush. On the Back of This Brush Is Mounted a Tiny Dynamo Operated by Pushing the Trigger.

A New York physician, Dr. H. J. Lowbringer, expresses his opinion on the electric brush as follows: "This little dynamo is therefore more than a scientific curiosity, because it generates currents of very high voltage with an amperage of infinitesimally low strength; consequently the results of application are similar to one of high frequency current, and thoroly superior to the ordinary faradic battery or the galvanic current, in instances where either diathermic or catalytic results are intended." With this electric brush and the attachments furnished with it, it is possible to give an excellent face massage, the current passing thru the hand of the massager. Also electric foot baths may be taken, or the current, in fact, past thru any part of the body, such as in the treatment of rheumatism, nerve disorders, etc. There is nothing in the device to wear out. The strength of the current may be varied by a regulator on the back of the brush, and it is also controlled by the rapidity with which the finger lever is prest and released. The device is well built.

Application to the Scalp With This Electric Hair Brush Is Said to Revitalize the Hair Roots and Tone up the System.

Inside of a U-Boat

Details of Machinery Found in the Surrendered U-Boats

OWING to the extent and the manner in which it was used by the Germans to attack commerce, the submarine emerged from the war a rather discredited weapon. This is not to say that it was discounted as a legitimate fighting instrument, and the question is being discust in Allied naval circles as to whether, and to what degree, the type will be included in the plans of naval constructors for the fleets of the future.

An answer to the question has its importance because of the possibility of the peace conference being asked to consider the desirability of abolishing submarines altogether. Even if the conference did not touch the matter, it was expected to be one of the first plans for the general reduction of armaments which, in accordance with schedule 111 of the League of Nations covenant, the council would suggest to the member states concerned.

Professional opinion, in all the nations engaged in the war on the side of the Allies, so far as it is confined to the men concerned in the actual fighting, inclines to the view that the submarine was beaten. There have been clear expressions on this point in Britain, America, France, Italy and Japan. Admiral Sims, for instance, declares that 205 U-boats were sunk by the Allies during the war. Altho this was not known until information had been obtained from German sources after the surrender. He also says that the grand fleet, when cruising in the North Sea, was surrounded by a screen of destroyers so intimately placed that it would have been suicidal for any submarine to attempt to penetrate it.

When such a screen was out, a submarine had to go down and stay down on penalty of being "depth-charged."

Altho the German high command to the end profest faith in the submarine war on merchantmen, Captain Persius has declared since the armistice that this faith was built up on "lies" spread about by the naval chiefs, as to the powers of the U-boats.

Submarines Have Advantages, Say Naval Experts.

On the other hand a significant indication of the utility of submarines for scouting duty has been afforded by Lord Jellicoe's recent book. He shows therein that not until June, 1916, was it possible to maintain a regular submarine patrol off the Horn reef (Denmark), by two or three submarines. By that time, the range of wireless equipment in the British submarines had been increased from 50 miles to 300-400 miles. "It was a vital matter," says the commander-in-chief, "to install efficient wireless apparatus in the only class of vessel that could carry out a watching patrol in the vicinity of German bases."

While, therefore, there are many strong reasons for desiring the abandonment of submarines as they were used by the Germans, yet equally strong is the professional opinion that under-water craft have not been rendered entirely useless by the inventions directed against them in the war, and that in any case they form a necessary adjunct to any complete naval organization of the future.

What the inside of a German U-boat looked like was a complete mystery to the layman until quite recently when several of the Ex-Kaiser's *unterseeboote* "visited" this country under the guidance of American crews. These sub-sea craft were piloted 3,000 miles across the Atlantic to aid in putting over the Fifth Liberty Loan. The first captured U-boat to reach these waters, flying the American flag, was the U-111. A few days later the mother ship "Bushnell" arrived at New York with several other

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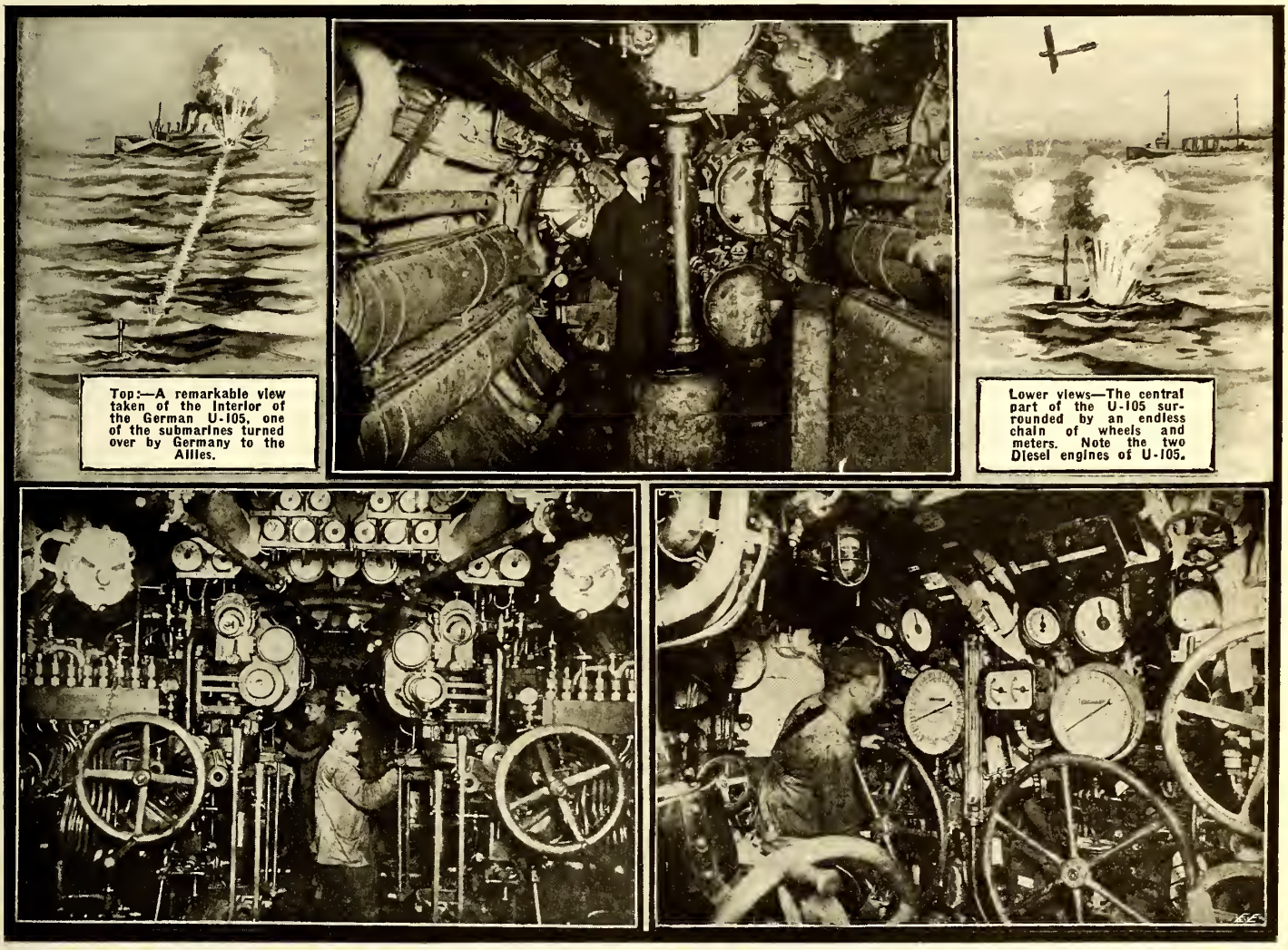


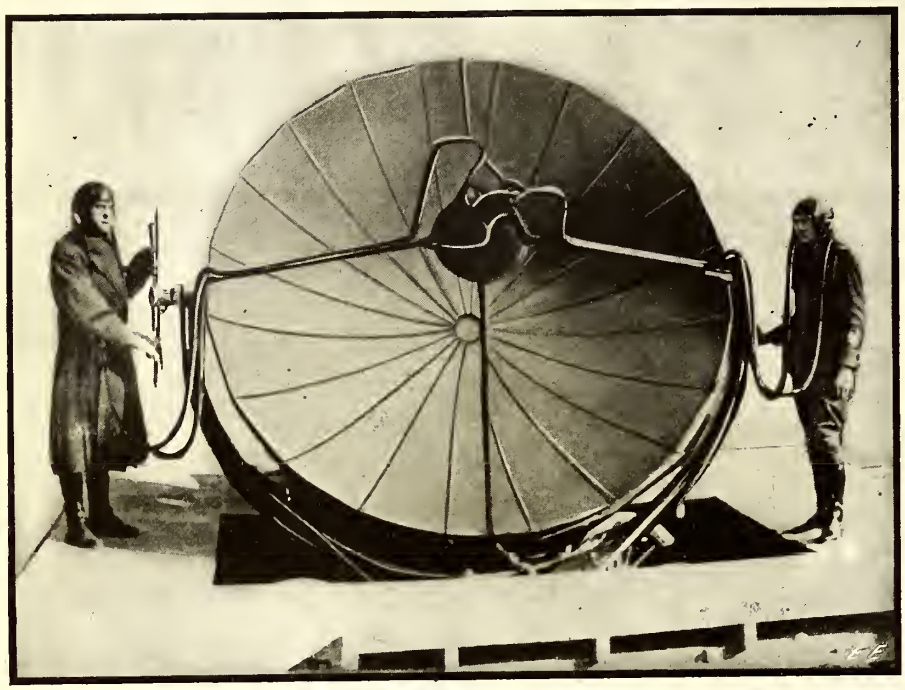
Top:—A remarkable view taken of the interior of the German U-105, one of the submarines turned over by Germany to the Allies.

Lower views—The central part of the U-105 surrounded by an endless chain of wheels and meters. Note the two Diesel engines of U-105.

Photos © by Underwood & Underwood

Locating Airplanes in Night Fighting

THE photograph herewith of the large Paraboloid reflector with two soldiers standing at either side, and equipt with special head phones, which are connected with the sound detecting apparatus mounted in the central focus of the reflector, is employed for locating the direction of approaching hostile aircraft at night. The reflector is balanced and pivoted so that it can be rapidly swung to any angle desired. When the approximate location of the approaching aircraft is determined by means of this sound wave catcher, then powerful searchlights are suddenly flashed on, and their beams pointed in the direction previously indicated by the sound detector. The range of this sound detector, owing to its efficient design, is said to be about 3½ times that of the unaided ear. It is extremely light and portable, and can be rapidly transported to any place desired.



Here Is the "Paraboloid"—the Clever Sound Focusing and Detecting Device Used by the Allied Armies in Locating Enemy Aircraft While They Were Yet Several Miles Away. The Sound of the Airplane Engine Carried Far, and by Carefully Focusing the Collected Sounds and Concentrating Them onto a Sensitive Microphone, the Trick was Done.

Five-Foot Searchlight Added to Terror of Night Fighting.

The accompanying photograph illustrates one of the remarkably light, yet extremely powerful, electric searchlights developed for use in the war. Searchlights of this type were built by the thousand by all of the leading powers, and both sides used them for various purposes, including night battles, the discovery of hostile aircraft, trailing the movements of enemy troops and freight trains, and automobile freight lines.

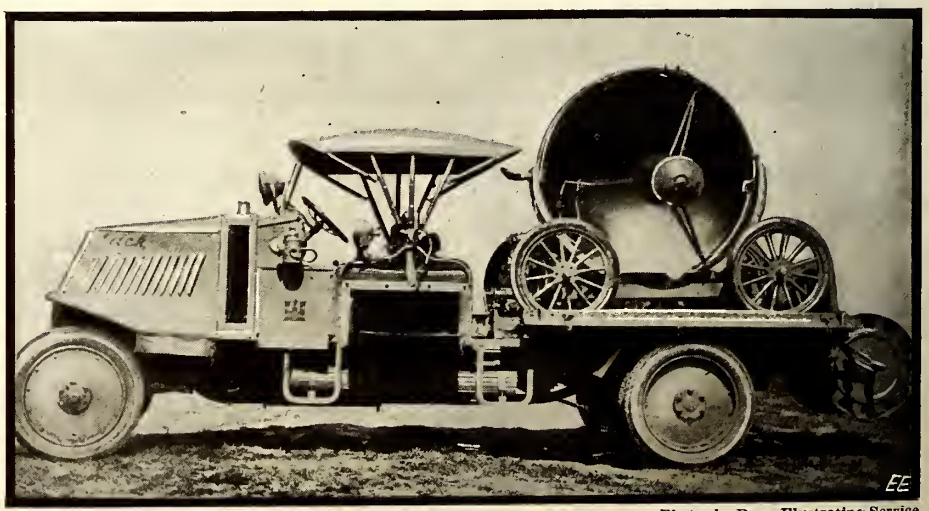
The searchlight here shown requires about 15 K. W. or 20 H. P. to light it to full brilliancy, and its powerful light will carry from 10 to 15 miles easily. The searchlights that we are usually accustomed to seeing on vessels and in the neighborhood of forts are usually cumbersome affairs, but the exigencies of wartime, where such vast amounts of paraphernalia had to be hauled over by train, horse, or auto-truck, called for the very lightest weight in all such apparatus as these, where there was no real necessity for making such an apparatus of great weight, as is the case with many pieces of machinery, such as guns, dynamos, motors, gasoline engines, et cetera. The searchlight is mounted on light wheels, similar to small auto wheels, fitted with rubber tires. It can be hauled to any desired spot in a short time.

During the period of the war, many novel and startling inventions have come to the fore, especially means for locating hostile airplanes and dirigibles. The majority of these operate on the simple sound wave principle, the waves being transmitted thru the medium of the air from the propellers of the hostile aircraft. Some of these devices have been made in the form of large tubes, provided with a simple microphone method of detection, but they were rather unwieldy, and to a certain extent never gave full satisfaction, due to the fact that too great a dependence was placed on the amplifying of the hum of the airplane engine by means of microphones alone. This new form of locater—the Paraboloid—has several novel improvements over previous apparatus of this type, one of the best features being that it can readily detect the hostile aircraft at great distances, especially valuable when the enemy tries to make a surprise attack at night.

Spotting the Enemy.

Imagine a peaceful village, such as are numerous in the sparsely settled sections on the coast of England, seemingly defenseless. Yet there seems to be an air of mystery about some of these places—and there is, for thru underhand means, the enemy "spies" learn that secret research work is being carried on in this unassuming little hamlet. It would be suicide upon the part of these "spies" to personally attempt to carry out any large exploitation or even to think of attempting to blow up the place with any hope of success. The nearest recourse that they could have would be to get in touch with a squadron of enemy planes, and notify them where these operations are taking place. On a dark night, these enemy planes issue forth and swoop down, like a nest of hornets, upon this defenseless little village. But one thing they have overlooked. Altho they have come unheralded, it is true, the watchful *electrical eyes and ears* of the engineer corps are prepared for any such surprise, thanks to the fact that they have this marvelous invention on hand, whereby it is possible, no matter how dark the night, to quickly and positively locate the approach of enemy aircraft. To their sensitive ears comes the hum of the engines. Word is flashed to every little town, fort and hamlet within the vicinity, and especially planned advance action is arranged. Ere the fliers have reached their destination, the heavens are being explored by gigantic searchlights for the enemy marauders. Trained gunners, using the very latest types of anti-aircraft guns, are soon popping away at the enemy, and what was hoped to be a great surprise and success on the part of the enemy, turns out to be one grand fizzle, much to his discomfiture.

These powerful searchlights, besides being available for enemy spotting, are also much used as a means of signaling. This is one branch of the signal corps work which has proven one of the big factors in helping to win the war. Searchlights of this type mounted on warships helped to protect the American sea coasts.



Photos by Press Illustrating Service

Gigantic Electric Searchlights of the Portable Type Were Used to Expose the Enemy Flier as Soon as the "Paraboloid" Had Succeeded in Spotting Him. The Anti-Aircraft Guns Then "Saluted" Him—and the Allied Planes Finished the Rest.

Jeweled Portal Welcomes N. Y. Fighters

NEW YORKERS, who openly boast "there is nothing new under the sun," had an agreeable surprise in the "jeweled portal" of electric lights erected in Fifth Avenue at Sixtieth Street, on the occasion of the grand review of the Twenty-seventh Division returning warriors. It was designed and erected under the direction of Walter D'A. Ryan, lighting expert.

So magnificent was the illuminated arch that it drew forth the unstinted praise and commendation of everyone who saw it. Frank L. Dowling, President of the Borough of Manhattan, when he first saw the beautiful spectacle, exclaimed: "Like the entrance to Heaven!" And no better description could be given of this handsome testimonial to the bravery, sacrifices and triumph of the sons of the Empire state. The details of the "portal" were worked out by Captain J. W. Gosling, under the direction of Mr. Ryan, who was chief of the department of illumination of the Panama-Pacific International Exposition which took place in San Francisco in 1915, and the success of which became one of the wonders of the world.

Mr. Ryan carried the same style of decoration here as was used at the Panama-Pacific Exposition. The same jewels, to the number of 31,000, were used in this jeweled portal as were used at the Panama exposition. This is really the first time the people of New York had an opportunity to see something that was really new, and it was the second time these jewels were used, the same ones that hung on the tower at San Francisco for one year.

The "Jeweled Portal" is really a gigantic curtain of jewels draped between two obelisk forms, and spans the street at a height of twenty-five feet at its lowest point, and fifty feet at its highest.

The architecture is simple, bold Roman, and is the kind of thing which might have been built on a street in Rome on the return of their victorious legions, but instead of painted and embroidered banners the modern jewels have been substituted and the whole portal has been given a most modern touch by bringing out upon it the delicate flashings of thousands of points of true light, not the color of pigment but the pure colors of the spectrum, the colors only seen in the rainbow, a bubble or in the sky at dawn or sunset, by illuminating it with arc projectors.

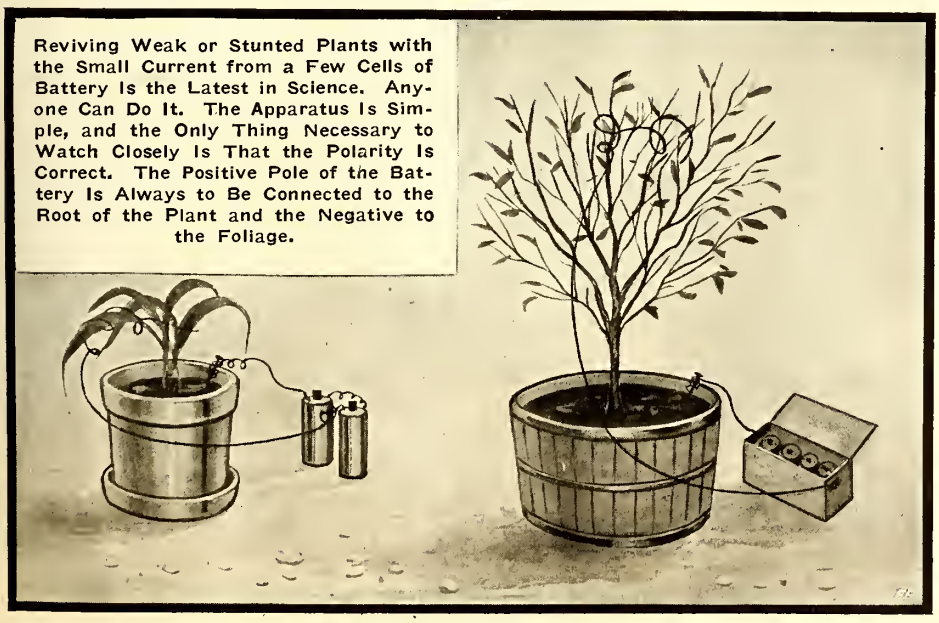
The obelisks stand at either side of the roadway and arc flanked by Roman altars, each of which is twenty-six feet high. The jeweled curtain is draped from altar to obelisk across the avenue and down to the

(*Continued on page* 377)

One of the Most Handsome and Bewitching Electrical Decorations New York Presented to Its Home-Coming Troops. The "Jeweled Portal"—a Mass of Shimmering Cut-Glass Jewels, Illumined by Reflected Spot Lights.

Reviving Plants With Electricity

The accompanying illustration shows a clever scheme devised by a Connecticut flower grower for reviving almost lifeless plants, by the application of low-voltage direct current, such as that supplied from a dry or other battery. One of the experiments was tried on a small cactus plant which had been sent from Mexico, and which seemed to pine away rapidly. The cactus was about dead when the experiment of applying electric current was first tried. Two cells of dry battery were connected up with some fine copper wire, the positive pole being connected to a nail placed in the soil of the flower pot, while the negative pole was secured delicately around the upper branch. The cactus brightened up very sprightly after one week of this treatment, and in two weeks it was plump, green, and growing nicely. Further experiments were tried on a rose bush and a fuchsia with good results, care being taken to see that the positive wire from the battery is applied to the root of the plant and the negative pole to the foliage, so as to promote the flow of sap upward.



Reviving Weak or Stunted Plants with the Small Current from a Few Cells of Battery Is the Latest in Science. Anyone Can Do It. The Apparatus Is Simple, and the Only Thing Necessary to Watch Closely Is That the Polarity Is Correct. The Positive Pole of the Battery Is Always to Be Connected to the Root of the Plant and the Negative to the Foliage.

It may be thought at first that the battery would soon be exhausted, but the resistance of the plant is of considerable value, so that the flow of current is but a small fraction of the ampere, and the cells will thus give quite a lengthy treatment before being entirely exhausted. Those having access to a storage battery will find it very useful for the purpose. The current in this case should be regulated by means of a small rheostat, such as the rotary, porcelain base 10-ohm rheostats available on the market. Several other interesting experiments were tried by the Connecticut florist, notably on a small plum tree, which was electrically treated with 6 cells, with the result that it blossomed out fully, several days ahead of the other adjacent trees. Another experiment was that conducted on an ever-bearing strawberry plant, which was treated with 2 dry cells. This plant was left in the same row with other berry plants, and its increased size and fruit production was very striking.

Popular Astronomy

By ISABEL M. LEWIS
Of the U. S. Naval Observatory

The Nature of Comets

COMETS, along with shooting stars and meteors, are to be clast as part of the debris of the solar system. According to prevailing theories they may have been originally tenuous outer portions of the primitive solar nebula that escaped being swept up by the nuclei of the planets and their moons owing to the fact that they did not share in the general rotation of the system, or they may, possibly, have been the lighter gases ejected from one or the other of two closely approaching suns that furnished, by the disintegration resulting from their close approach, the material wherefrom our present solar system was formed.

The orbits of comets are inclined at all angles to each other and to the orbits of the planets which, on the other hand, lie very nearly in the same plane.

The larger members of the sun's family, the planets and their satelites, revolve from *west* to *east* around the sun. Comets on the contrary frequently *retrograde* or back around the sun in the opposite direction, from east to west.

The paths that these erratic visitors follow in their journeys around the sun bear not the slightest resemblance to the paths of the planets, which are almost perfect circles. The cometary orbits are ellipses of such high eccentricity that it is customary in computing a preliminary orbit of a comet to assume that its eccentricity is unity, *i.e.*, that it is travelling in a parabola. If the eccentricity is less than unity the orbit is a closed curve or ellipse, and if it is greater than unity the orbit is an hyperbola. In the latter case the comet would make one and only one visit to the sun, coming from interstellar space and returning thereto after a brief sojourn within our solar system. Since no cometary orbit has ever been found to be hyperbolic in form it has been assumed that the eccentricity of the orbit is less than unity in all cases and that the comets are all travelling in elliptical orbits and therefore are permanent members of the solar system. The nearer the eccentricity of the orbit of a comet approaches to unity the greater is the path described and the less frequent the comets return to the sun. Since it is very unlikely that the eccentricity of an orbit is exactly unity there are probably no comets that have parabolic orbits tho, for the preliminary computation of the orbit of a newly discovered comet the unknown eccentricity is assumed to be unity. This is generally a safe assumption for the majority of all comets travel in ellipses whose eccentricities approach closely to unity and their periods of revolution around the sun consequently run into the hundreds or thousands or even hundreds of thousands of years. A wonderful study, indeed.

Giacobini's Comet, December 29, 1915, Photographed with 10" Bruce Telescope, Yerkes Observatory, by E. E. Barnard. Note the Unique Sharply Defined Tail With Convex Edges. The White Dashes Are Stars Leaving a White Trail on the Photographic Plate as the Telescope Followed the Comet During Its Exposure of Several Hours.

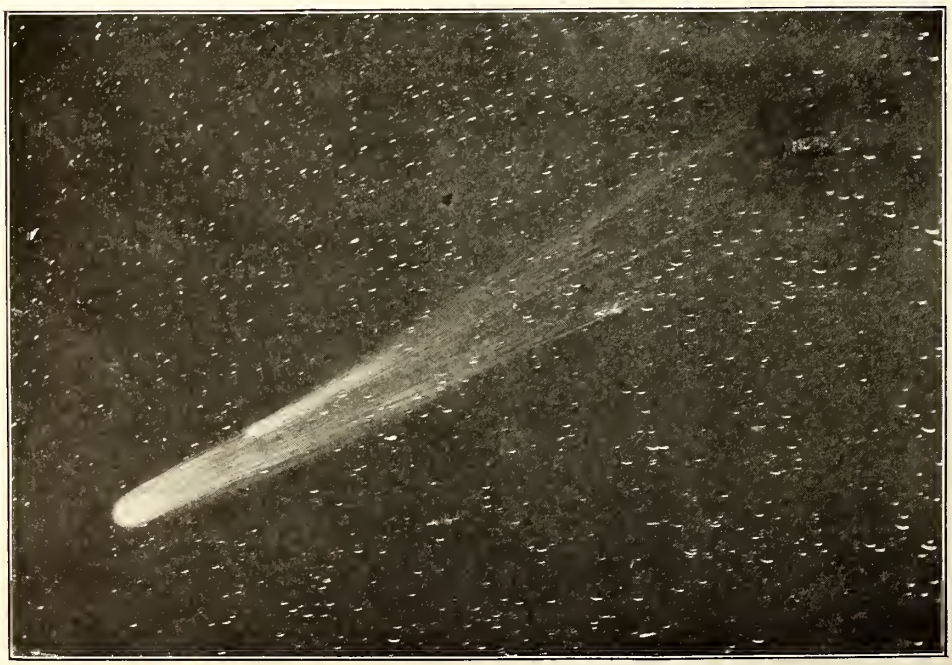
Donati's comet of 1858, one of the greatest comets of the nineteenth century, had a period of more than two thousand years and its aphelion (the point in its orbit farthest away from the sun) was five times more distant than the orbit of Neptune.

There is, however, a class of comets known as *periodic* comets that are characterized by extremely short periods of revolution around the sun. To this class belongs Halley's comet whose period of seventy-five years exceeds that of any other periodic comet. Encke's comet, on the other hand, has a period of three and a third years which is the shortest cometary period known. Most of the periodic comets are inconspicuous and only visible telescopically even when comparatively near to the earth. Halley's comet is the only one of this class that lays any pretensions to remarkable size or brilliancy and it also is showing the effects of disintegration resulting from too frequent visits to the sun.

Comets are bodies of *great bulk* or volume and *small total mass.* Their tails, which only develop in the vicinity of the sun, are formed of the rarest gases and the best vacuum that man can produce would not be in as tenuous a state as the material existing in the tails of comets. There are many proofs of the extreme tenuity of comets. The earth has on a number of occasions past directly thru the tails of comets without experiencing the slightest visible effects. Stars shine undimmed in lustre even thru the heads of comets. If the earth should encounter a comet "head on" it is doubtful if it would experience anything more serious than a shower of meteors which would be consumed by friction with the earth's atmosphere. It is possible, however, that matter in the nucleus, the star-like condensation in the head of a comet, may consist of individual particles weighing in some instances a number of tons surrounded by a gaseous envelope and held together by the loose bonds of their mutual attraction.

Since the total mass of a comet is so small a close approach to one of the planets, especially Jupiter, produces great changes in the form of the comet's orbit tho the motion of the planet is not disturbed in the slightest degree by the encounter.

The majority of all the periodic comets have been "captured" by Jupiter, that is, the original orbits have been so changed by the perturbations produced by close approaches to the giant planet that their aphelia lie in the vicinity of Jupiter's orbit. Several of the other planets have also "captured" comets in this sense, and the fact that the aphelia of a number of comets are grouped at certain definite intervals beyond the orbit of Neptune has been considered by some astronomers to be an indication that there are two or more additional planets in the solar system revolving around the sun at these distances.



Halley's Comet, June 6, 1910, Photographed at the Yerkes Observatory by E. E. Barnard, Taken With 10" Bruce Telescope, Exposure Two Hours. The Most Remarkable Part About This Comet Is That It Disintegrated. Photograph Shows Upper Part Leaving Main Section

The most interesting feature of a comet is its characteristic tail which develops and increases in size and brilliancy as the comet approaches the sun. As the tail is always turned away from the sun it follows the comet as it draws near the sun and precedes as it departs. Its origin is due, it is believed, both to electrical repulsion and *light pressure* acting upon minute particles of matter in the coma or head of the comet.

It is believed that the curvature of the tail depends upon

the nature of the gases of which it is composed.

Long, straight tails consist chiefly of hydrogen, it has been found, curved tails of hydrocarbons and short, bushy tails of mixtures of iron, sodium and other metallic vapors. At times the same comet will have two or more tails of different types.

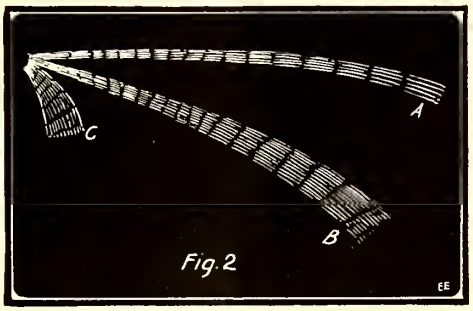
Since the material driven off from the nucleus or head of a comet by electrical repulsion and light pressure is never recovered, it is evident that comets are continually disintegrating. Also, comets that have past close to the sun at perihelion passage have frequently been so disrupted by tidal forces that one nucleus has separated into several parts and the newly formed nuclei have pursued paths parallel to the original orbit, each nucleus developing a tail of its own.

Daniel's Comet, August 6, 1907, Photograph Yerkes Observatory by E. E. Barnard. This Photograph Shows the Full Length of Tail About 12°, Taken With 3" Lens.

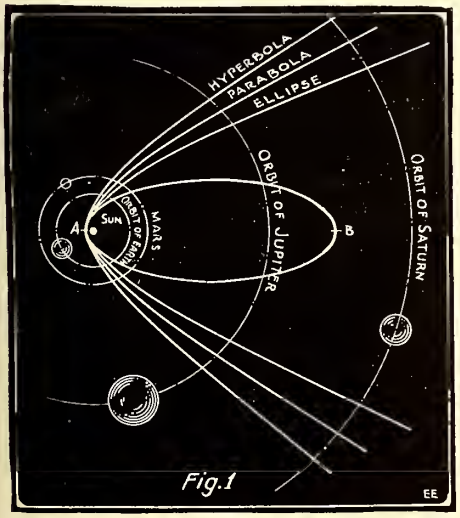
Many periodic comets, it is now known, have gradually been broken up and dissipated into periodic swarms of meteors as a result of the disruptive effect produced by too frequent returns to the vicinity of the sun.

The luminosity of comets is due not only to reflected sunlight, but to certain unknown causes that produce sudden and erratic increases or decreases of brilliancy. The causes of these sudden changes in luminosity are unknown, possibly electrical discharges or chance collisions between fragments of considerable size may account for some of these sudden flashes of brilliancy.

The peculiar behavior of the tails of comets at certain times has frequently been noted and suggests the existence of quantities of finely-divided meteoric or gaseous matter within the solar system that have no appreciable effect upon the huge planetary masses, but offer sensible resistance to the passage of the tenuous gases of which the tails of comets are composed. The fact that the earth daily encounters meteoric dust, meteorites and fire balls also indicates that meteoric matter exists in considerable quantities within our solar system. Tails of comets appear at times to be twisted or brushed aside as if they had encountered some unknown force or some resisting medium.



Different Types of Tails of Comets. A—Hydrogen; B—Hydrocarbon Gas; C—Iron and Other Metallic Vapors. The Majority of the Tails of Comets Belong to Type B and Are Therefore Chiefly Composed of Hydrocarbons.



This Diagram Shows a Typical Cometary Orbit of Short Period. A Marks the Perihellon, or Closest Approach to the Sun, and B the Aphelion, or Point Most Distant From the Sun. The Great Difficulty of Determining Whether a Comet of Long Period Is Moving in an Ellipse, Parabola or Hyperbola Is Evident When One Considers How Closely the Three Curves Coincide in the Vicinity of the Sun.

Up to the present time several hundred comets have been discovered. Nearly three-fourths of this number travel in orbits that are sensibly parabolic with eccentricities approaching closely to unity. Of the remaining number there are about forty that have been "captured" by the major planets, Jupiter, Saturn, Uranus and Neptune, tho Jupiter possesses the lion's share of these captured comets. Scarcely a year passes by that several comets are not discovered. Most of these are telescopic, however, even when they are near the sun and at their greatest brilliancy. Naked-eye comets of great splendor and brilliancy are comparatively rare and there has been a particular dearth of such unusual comets during the past thirty years or so.

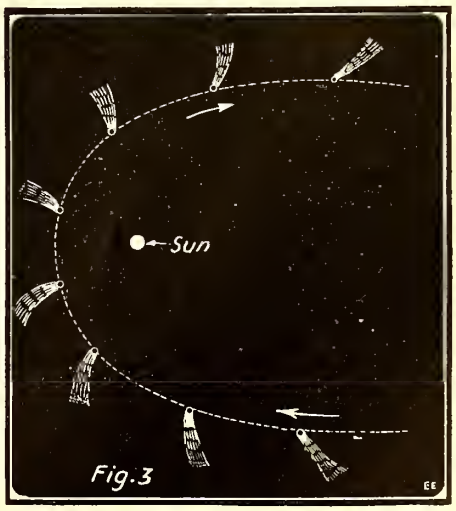
The last spectacular comet, unless we make an exception of Halley's comet, which made its return according to prediction in 1910, was the great comet of 1882 which was visible in broad daylight close to the sun and at its perihelion passage swept thru the solar corona with a velocity that exceeded two hundred and fifty miles a second and carried it thru one hundred and eighty degrees of its orbit in less than three hours.

Some comets approach much closer to the sun than others. The majority of all comets observed have come within the earth's orbit and no known comet has its perihelion distance beyond the orbit of Jupiter. It is, of course, possible that there may be a number of comets that never come within the orbit of Jupiter, but it is very unlikely that any such comet would ever be discovered. The majority of comets are simply small, fuzzy points of light that are only visible telescopically and the greater the perihelion distance of the comet the less likely is it to be seen with the naked eye.

Since comets as well as planets obey Kepler's first law, known as the law of areas, and sweep over equal areas in equal times it is evident that when a comet is at perihelion or nearest to the sun it is moving at maximum speed and when it is at aphelion or farthest from the sun it is moving at minimum speed. Moreover, its speed at these two points in its orbit varies tremendously since the orbits of comets are ellipses of very high eccentricity. The speed with which the planets are travelling is, on the other hand, remarkably uniform since their orbits are nearly circular.

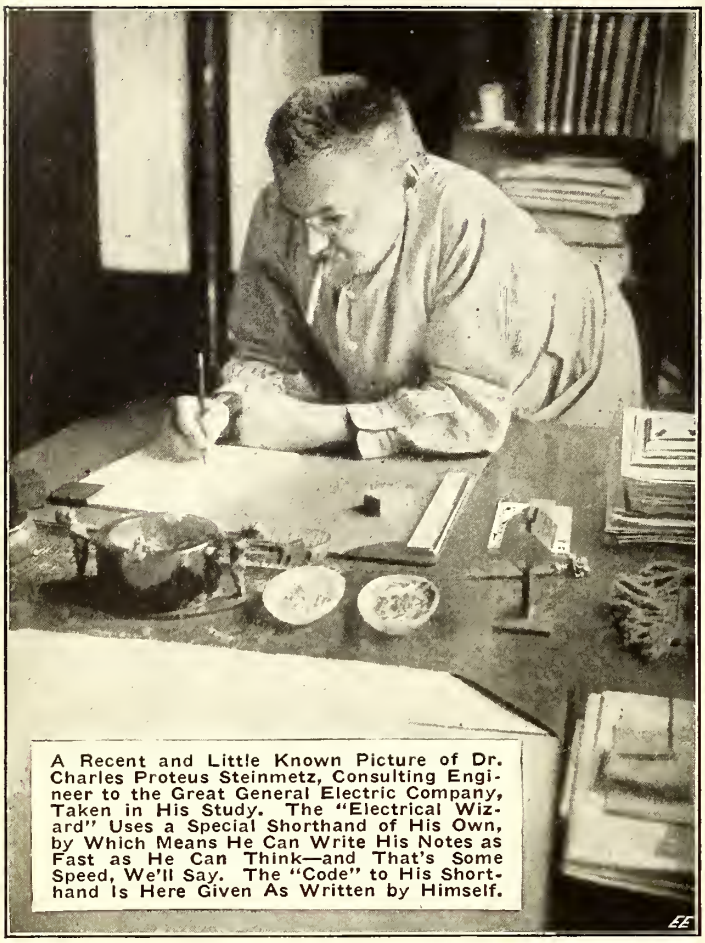
The leisurely speed with which a comet travels thru the frigid outer regions of the solar system is gradually accelerated as the comet draws nearer and nearer to the sun until it has acquired near the time of perihelion passage a velocity that occasionally exceeds two hundred miles a second. Here, also, the great increase in light and heat and the strong magnetic field of the sun produce complex changes in the gaseous and meteoric substances of which the comet is composed until the character-

(*Continued on page* 350)

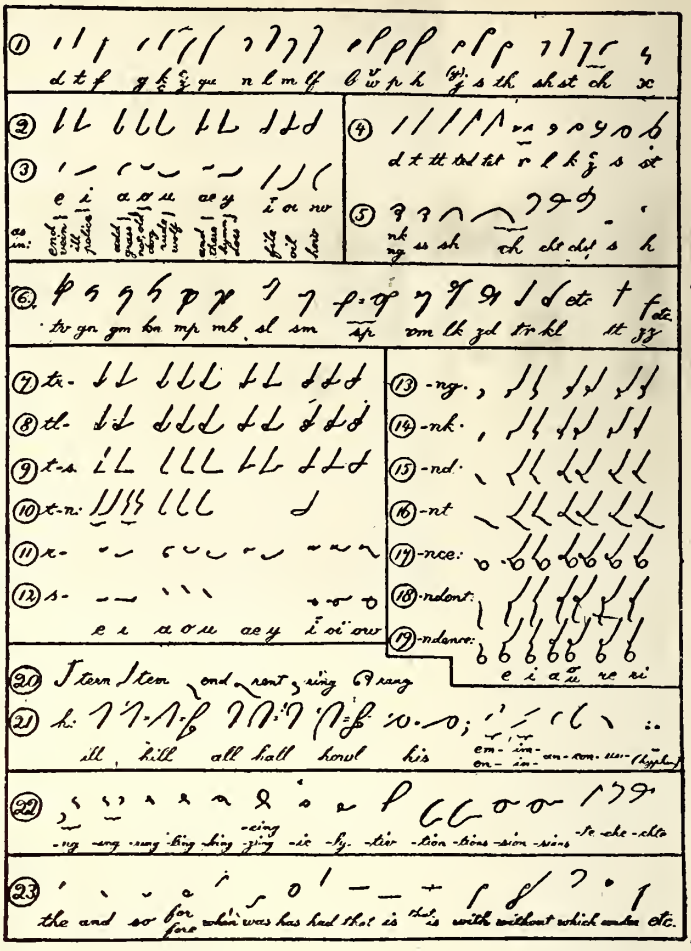


How a Comet Behaves at Perihelion (Closest Approach to Sun). The Tail of a Comet Is Invariably Directed Away From the Sun, No Matter What Its Position in the Heavens.

Steinmetz's Own Shorthand



A Recent and Little Known Picture of Dr. Charles Proteus Steinmetz, Consulting Engineer to the Great General Electric Company, Taken in His Study. The "Electrical Wizard" Uses a Special Shorthand of His Own, by Which Means He Can Write His Notes as Fast as He Can Think—and That's Some Speed, We'll Say. The "Code" to His Shorthand Is Here Given As Written by Himself.



Can you write as fast as you can think? If you cannot, then your efficiency is impaired; and the difficulty of putting down your thoughts at the proper speed constitutes a real stumbling block in your onward march toward your goal.

Dr. Steinmetz, one of the greatest authorities on matters electrical that the world has known, and who is an author of many volumes of useful knowledge which he has given to the scientific world, possesses no "neck in the bottle" when it comes to jotting down the results of his researches in his wonderful laboratory at Schenectady. In a recent interview upon this subject he said:

"With this shorthand I can write as fast as I can think. The only other way in which I could put down my thoughts as fast as I could think would be to dictate to a phonograph, but I have not always a phonograph with me.

"I learned this shorthand while I was in high school in Europe, and took all of my notes while in college in shorthand. All of these notes I have preserved and had bound, and I can read them as well after thirty-five years as I could thirty-five minutes after taking the notes down.

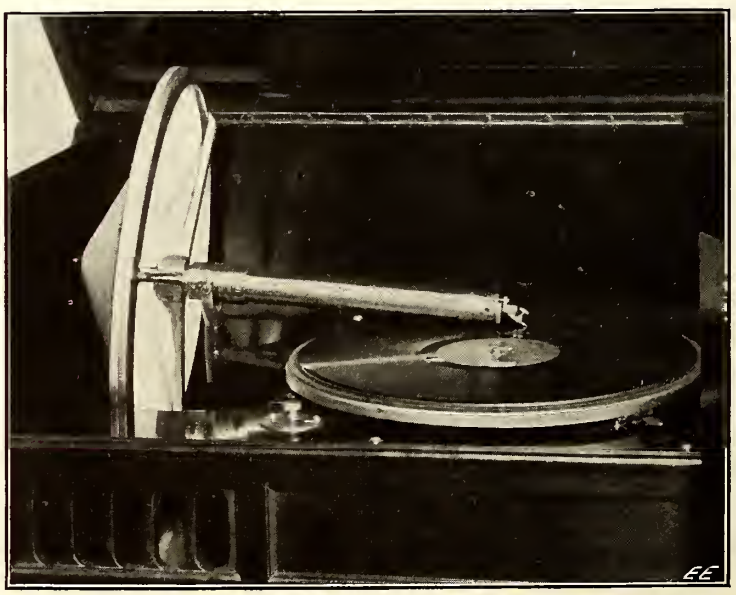
(*Continued on page 373*)

A Hornless Phonograph

This talking machine eliminates the usual tone-arm, sound-box, and horn. Instead of these we have a large cone-shaped diafram of parchment fitted into a large circular aluminum frame. The center of the diafram is connected by a wire, under tension, with the needle holder. The sound as it comes from the record sets up vibration in the wire, and the vibrations are released in the form of recognizable sound directly from the diafram. The volume of sound is controlled by a special attachment on the arm protecting the wire, for those who desire this method, but is more readily controlled by the opening and closing of the doors of the cabinet. There are two doors in front, each of which may be closed separately, and a large door on the side which also gives control to the tonal volume.

The circular frame holding the diafram is constructed of aluminum, heavily gold plated, as is the tube thru which the wire runs from the needle to the diafram as well as the other metal parts of the attachments. The simple twist of the needle holder permits the playing of either hill and dale or lateral cut records on the same machine, and it therefore makes the new reproducer practically universal in its application. It is claimed for the Pathé "Actuell" that, inasmuch as the sound comes in its full volume direct from the reproducer to the ear, it does not suffer from the overtones or conflicting vibrations that sometimes devlop when the sound is carried thru an amplifying chamber and likewise by reducing the number of factors incident to tone reproduction.

Thru the use of this large diafram surface, noise, if not entirely eliminated, is reduced to a point where it is not audible.



The Newest in Talking Machines—No Horn, Just a Large Vibrating Diafram That Radiates the Sound in All Directions Equally.

Experiments in Physics

By JOHN J. FURIA
DEPARTMENT OF PHYSICS, N. Y. UNIVERSITY

1--Perpetual Motion

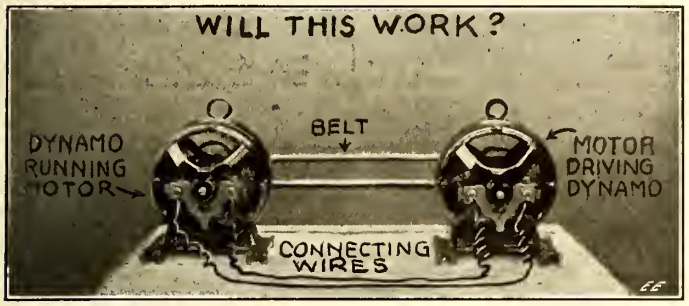


Fig. 5. The Electrical Student's Dream: Belt a Dynamo and a Motor Together. Connect Their Windings Electrically and—Presto! You Have Perpetual Motion! But Do You? Read On, Macbeth, Read On!!

IT is a well known fact that more Time, Energy and Money have been spent and wasted in searches for a machine capable of producing *Perpetual Motion* than for all other scientific pursuits combined. The impossibility of perpetual motion can be demonstrated by the simple elementary laws of Mathematics and Mechanics, and consequently the *truly* scientific mind wastes no time in such a search. Perpetual motion is a direct violation of that fundamental law of Physics, the law of *conservation of energy;* hence in order not to waste time in argument with a perpetual motion inventor, to show him the fallacy in his reasoning (?) one has but to say "it contradicts the law of conservation of energy." The U. S. Patent Office has a sure-fire means of disposing of these would-be inventors—it asks them to produce a working model! That settles it, for if the inventor cannot make the proposed scheme work, who can?

Perpetual motion and perpetual motion machines are defined in many ways, all the definitions conveying the idea of *getting something for nothing, indefinitely.* The getting something for nothing idea, of course, will appeal to the general public ignorant of science, and the natural consequence is "swindling schemes." One definition is—a perpetual motion machine is one which will go on moving without assistance from any external force, except possibly gravity, until the parts of which it is made wear out! The inventor usually adds that his machine will evolve more power than is required to run it. The efficiency of such a machine would therefore be *greater than* 100 *per cent.!* Perpetual motion machines fall naturally into two classes—the *absurd class* and the *frauds.* The second of these classes hold no interest for us scientifically. In general a perpetual motion machine would be invented (the inventor being backed up by publicity specialists). A glowing account of the operation of the machine before a distinguished audience from "Podunk" would appear, together with front page photographs of the machine and of the handsome and distinguished looking inventor—who always spent a life-time and several fortunes in perfecting the ninth wonder. The inventor having spent all his money and all he could borrow would therefore be willing to *sacrifice* a major share in his invention for a few thousand dollars, and some fortunate young heir or widow would perchance acquire an expensive education. Nowadays, if an account of a perpetual motion machine should appear in the papers, some secret service men would keep in touch with the "benefactor to mankind" and in a short time, or as soon as his "gilt edge stock" began to sell, said benefactor would shortly rest behind prison bars.

The first class of machines is of considerable interest. Most of us have at some time or other spent much time in thinking up perpetual motion machines and still more time in trying to fathom the reason why our schemes *would not work.* Which one of us has not at some time or other hooked up a small toy dynamo and motor with the intention of causing the dynamo to supply current to run the motor and some lights, bells, trains, etc.—while the motor in turn, belted to the dynamo, drives the latter machine. See Fig. 5. What a great disappointment it was to find that the scheme wouldn't work. To be sure, on connecting the hand drive to the dynamo, we get enough "juice" from it to run our motor and our lights and other things. Also we can run our motor from some cells and by belting cause the dynamo to run. Why then does our perpetual motion machine fail us? The answer is simple—the *law of conservation of energy.* Let us assume that our motor and dynamo were identically made and practically frictionless. The machines of Fig. 5 are of this type. A current of 1/10 ampere is used by each when acting as a motor, at a potential of 10 volts; therefore, 1 watt of power is consumed. Since the efficiency would have to be less than 100 per cent., due to friction and eddy current losses, etc., then when acting as a dynamo *less* than one watt power is given off. Hence one of the machines *can never be made to run the other, let alone do other work besides!*

Another electrical type of perpetual motion machine familiar to most of us depends for its operation (or rather for its failure to operate) on the action of points.

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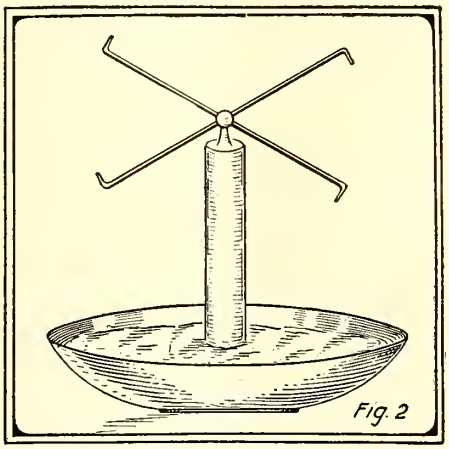
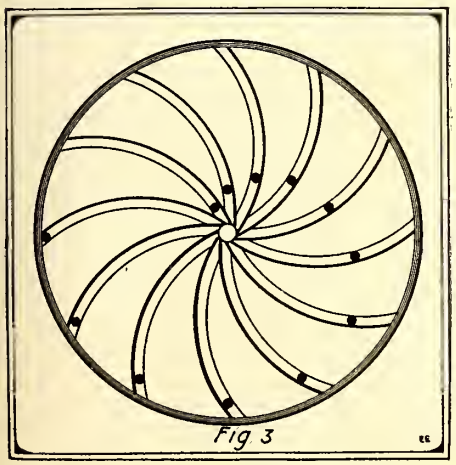
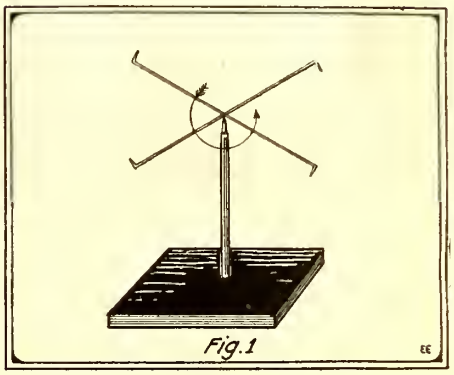


It Should Go on Forever, They Say—This Hydrostatic Marvel. The Atmospheric Pressure of 15 lbs. per sq. Inch on the Water in Bowl Forces It UP Thru the Revolving Arms. The Water Shoots from the Nozzles Back Into the Bowl—Ad Nauseam.



See the Little Balls in the Hollow Spokes of This Wheel? Their Constantly Changing Center of Gravity Was Supposed to Keep the Wheel Revolving—Only It Didn't!



The Static Electric Motor. A Metal Wire Cross with Pointed Ends Pivoted on an Insulated Upright. Connect It to a Static Machine, Fig. 6, and You Have Perpetual Motion—Perhaps?

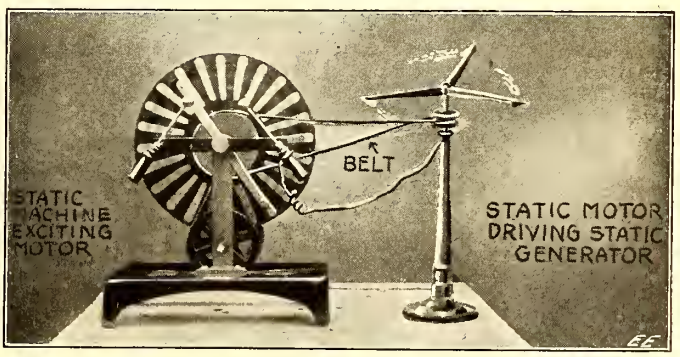


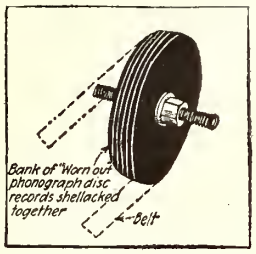
Fig. 6. An Electro-Static Nightmare! The Static Machine Charges the Motor—the Motor, Thru Its Belt, Drives the Generator! Quick, Watson, the Needle.

$50.00 Prize Contest

Uses for Old Phonograph Records

NOT so long ago we ran a "Burnt-out Lamp Contest" giving prizes for the best ideas what to do with the old burnt-out lamp globes. Thousands of suggestions were received from every part of the world, and we all had a lot of fun. We publisht the best ideas and we know that many of them are now actually being used daily.

Your average experimenter is happy only when he can take a lot of antiquated old "junk" and put it to a new use——he'd take an Egyptian mummy and convert it into a rotary spark plug, if it were possible!



Want a Small Belt Pulley? Procure a Few Old Phonograph Records, Shellac Them, Place in a Vise Until Set, and You Have a Fine Pulley.

So the other evening when we stumbled over a lot of old phonograph records that had been played so long that they would "phono" no longer, we said—Ah, what can we do with them? Too good to throw away! So we thunk awhile and ended by making a fine Wimshurst static machine, using two plates to generate the juice. Of course that's old stuff, every "bug" knows that trick.

But we felt we had stumbled into a veritable gold mine. Now we admit that our editorial think-tank becomes clogged up once in a while, so we thought we'd put it up to EXPERIMENTER readers—they have us beat forty different ways as a rule. True, in our younger days ye Editor once made a very serviceable pulley by shellacking eight, old, cracked 7" disks together which made a pulley about one inch thick, and which did gallant work. True, that he also once made a rotary variable condenser from a dozen 10 cent records (tin foil shellacked to one side of the records). True, also, that he once constructed an emergency rotary spark gap using two 7" records shellacked together with zinc plugs screwed to the face of the records——but really all such stunts are commonplace.

Of course you can do much better than this. Somewhere there is a "bug" who will turn in a really good idea. And we're out to find that "bug." Yes it will cost us $25.00 for that prize idea, but we think it will be cheap at that.

Now, then, boys, let's see how much ingenuity there is around. I promise you lots of fun and your fellow-bugs will bless you for generations, because your ideas will be of tremendous value to them.

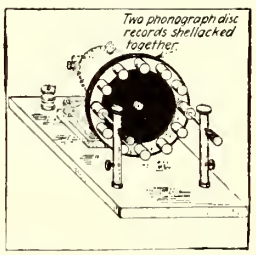
Now listen!

$50.00 IN PRIZES

1st Prize
$25.00 in Gold

2nd Prize
$15.00 in Gold

3rd Prize
$10.00 in Gold



Rotary Spark Gaps Are Quickly Made From Old Phonograph Record Discs.

OLD PHONOGRAPH RECORD CONTEST.

This contest is open to every reader whether subscriber or not.

These prizes will be paid by the publishers of the ELECTRICAL EXPERIMENTER for the best useful ideas what to do with old phonograph records.

The two important conditions are that the idea must be a useful and original one. It is not necessary that the record or records be used with electrical devices, *any* use is satisfactory as long as the resulting device is useful and, of course, therefore practical.

Any amount of records, and any and all sizes can be used. Records can be sand-papered, turned down, bent in hot water, etc., it matters not, as long as they are actually used. The final shape does not matter.

Two Old Phonograph Records Make a Good Static Machine, When Drest Up a Little With Some Tinfoil Sectors, and Then Rotated In Opposite Directions.

We shall try and award the prizes to those *who actually have built or made the device which they describe.* Therefore those contestants sending actual photographs of the ideas stand a better chance to win a prize.

Description is limited to 200 words. Use one side of paper only. Use ink or typewriter. No pencilled matter considered. Sketches must be on separate sheets of paper.

Contest closes in New York, September 15th. Prize winners will be announced in our November issue.

Address all letters, photographs, etc., to: Editor: "Old Phonograph Record Contest."

Airplane Parachute a Success

Lieutenant Jean Ors, of the French Army, demonstrated the usefulness of his "aërial life preserver" recently at Atlantic City. This device is an adaptation of the parachute to airplane use, and toward the end of the war was widely employed by the Allied armies, greatly reducing the mortality when machines were shot or caught fire. The test of the device was before a committee of American and foreign experts, and after Lieutenant Ors had proved the worth of the life preserver, he received a special prize of $500.

The aërial device, contained in an oil-cloth packet, is only fifty inches in diameter and four inches thick. It weighs about fourteen pounds. For the test it was affixt to the underbody of the airplane with a rope running into the cowl, so that the lieutenant could make the release at the proper moment. When it was in place "Eddie" Stinson, America's leading fancy flier, tuned up his craft and he and the Frenchman hopped in.

Stinson and his passenger rose well above 1,000 feet, and swinging in a giant circle made two trips around the airport. Then, dipping down to about 500 feet, Stinson ran his machine southeast, directly into the wind, so that the parachutist could gage his distance. As Stinson shot in a 200-yard spurt at eighty-mile speed, the watchers saw the lieutenant crawl cautiously over the cowl of the machine, poise there a second, and raise an arm as he ript the fastenings of the parachute, and then plunged earthward from the streaking airplane.

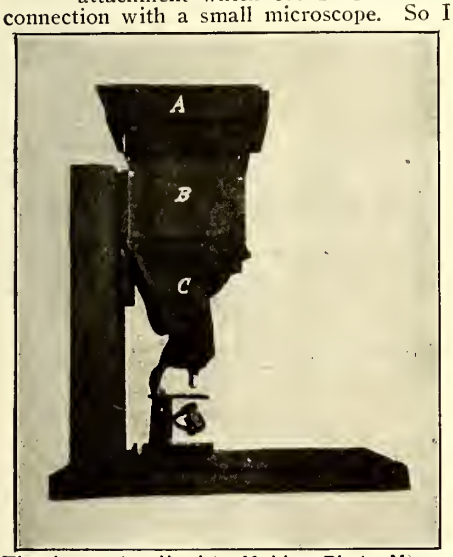
For the fraction of a second he was enveloped in the smoke of the exhaust. Then he came hurtling at the field. Quick as a flash the life preserver opened, the fall of the Frenchman being checked without perceptible shock *within fifty feet after he made the jump.* Slowly the wide-spreading white silk umbrella, with the army officer dangling at the end of the ropes, swung to earth, the landing being as gentle as the arrival of a raindrop. The descent was made in forty-six seconds.

THE CONSTRUCTOR

How to Make Photo-Micrographs

By G. D. LAUDERMILK

BIOLOGY being one of the subjects in which I became interested, and having fitted up a small laboratory, I found that I required a photographic attachment which could be used in connection with a small microscope. So I finally evolved one made in the following manner:



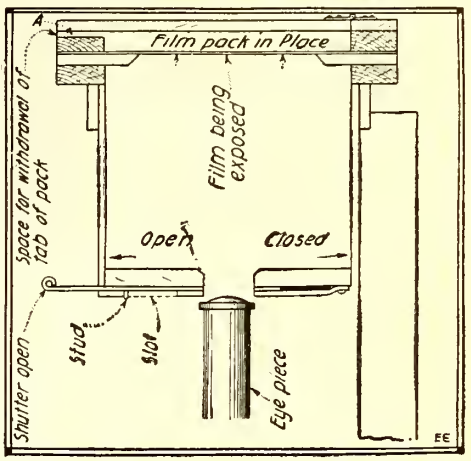
The Apparatus Used in Making Photo-Micrographs, Comprising a Home-made Camera for Holding Plate Holder or Film Pack in Proximity to Microscope Eye-piece

The camera was made in two parts; "A," the plate holder, is a shallow box 6" long, 4" wide and 1" deep. The top of the box is hinged and the interior of the plate holder has a depression of a size to take a No. 320 Premo film-pack. It is modeled after the plate holder of a Premo camera. The camera box is 5" deep, 3" wide and 4⅜" from front to back. The camera has a strip ½" wide around it, ¼" from the top, forming a shoulder upon which the plate holder rests when in place; both the edges of the plate holder opening and the rim above the shoulder are covered with black velvet, forming a light-proof joint.

In the center of the opposite end is an opening ¾" in diameter closed by a simple sliding shutter made of sheet metal. Both the plate holder and the camera box are covered with imitation leather and are constructed of light wood. The hood "C" is of black cloth and serves merely to confine the draw-tube and prevent leakage of light between the eye-piece and the opening in "B." At the base of the upright is a wooden form exactly of the same shape as the foot of the microscope. This form is so placed that it acts as a guide to keep the microscope in position with the eye-piece.

When photographing, the slide is placed on the stage in the usual way and focust so that all details are brought out sharp. The microscope is then placed in position, the hood drawn around the eye-piece and fastened with a hook and eye. The shutter is now opened and the exposure made. The length of exposure will vary with the degree of transparency of the object and the depth of staining. Thin clear objects or objects stained with methyl-violet or blue

(Continued on page 356)



Drawing Showing Sectional View Thru Camera and the Arrangement for Holding the Film Pack or Plate Holder, in Position Over the Microscope Eye-piece

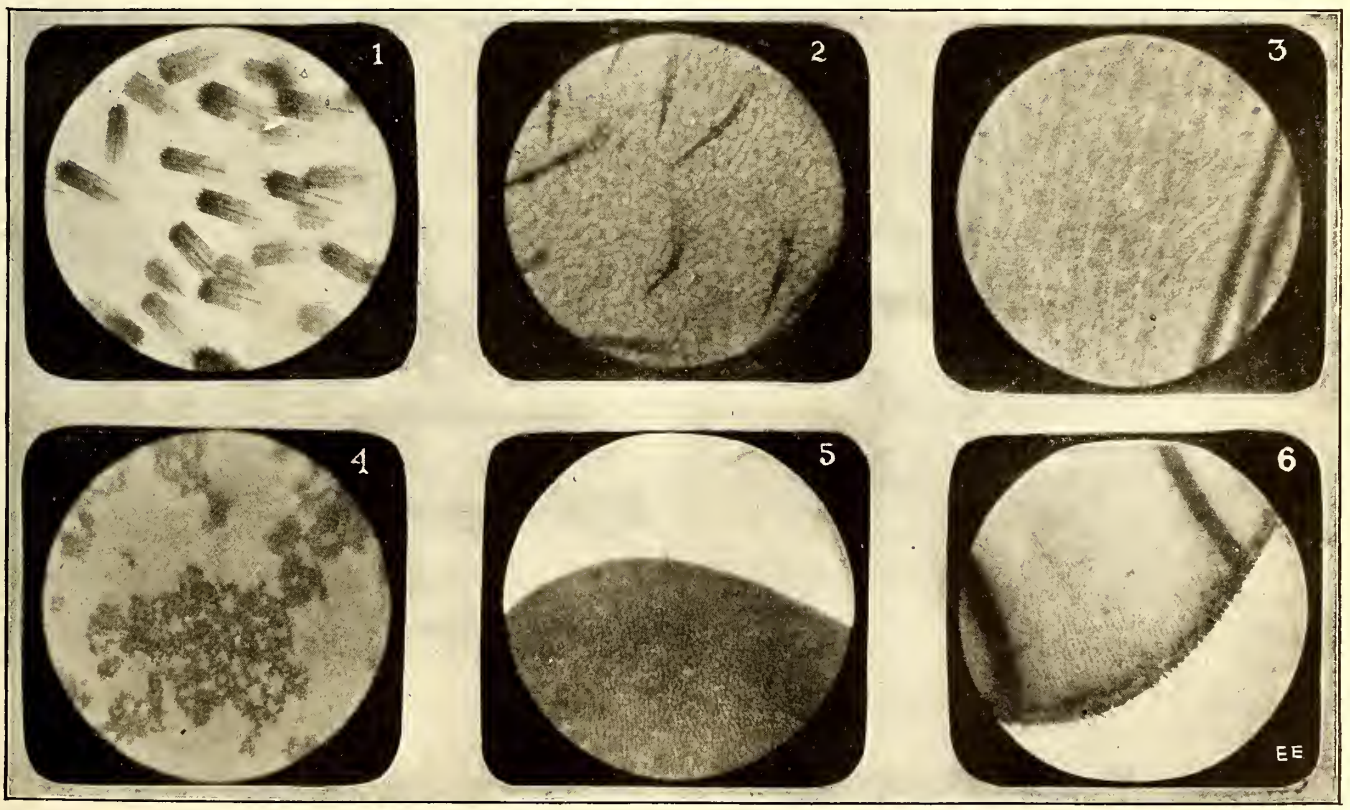


Fig. 1, Microphotograph Showing the Wonderful Wing Structure of the Moth from the Grape-vine Cut-Worm. 2—Parenchyma of Sun Flower Leaf. This Specimen Was Obtained by Stripping a Small Piece of the Epidermis from the Upper Part of the Leaf. The Large Pointed Objects Are Hairs. 3—The Magnified Surface of the Underwing of the Squash Bug; the Dark Line Is Part of the Vein. 4—Nitrogen Fixing Organisms from a Nodule on the Root of a Pea, Which Possesses the Property of Fixing Nitrogen from the Air. 5—Tip of Antenna of a May Beetle. The Short Sharp Bristles Are the Sensory Organs of Smell. 6—Micrograph of a Wing Tip from a Crane Fly, Showing Covering of the Wings.

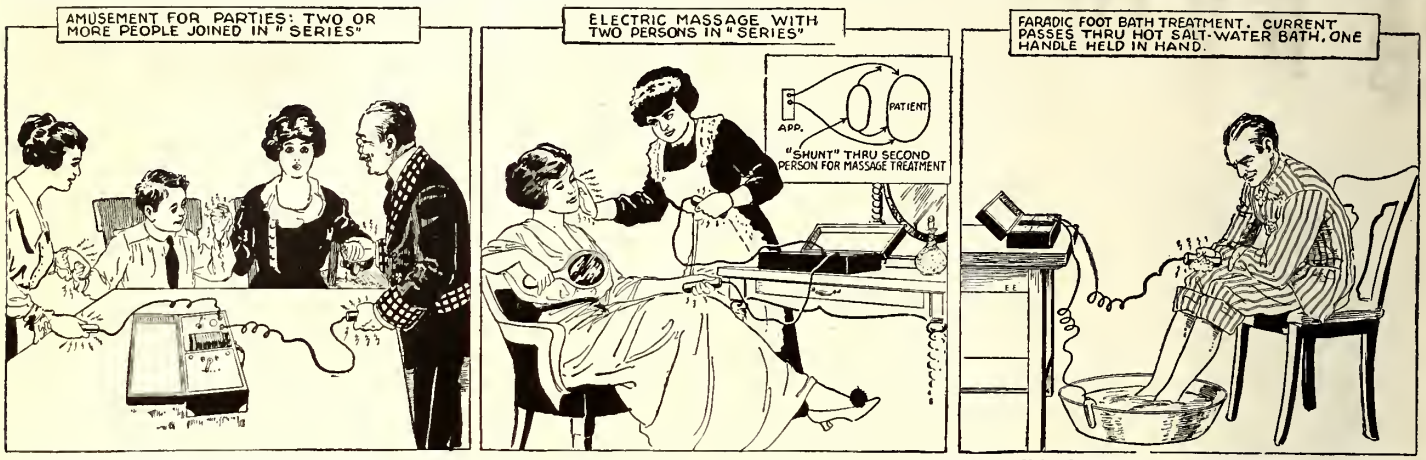
Faradic Currents--How to Apply Them

Sequel to "Building a Medical Coil Set."

AN extensive article accompanied by working drawings and photographs appeared in the June issue of this journal, covering the construction of a high grade electro-medical or faradic coil. Methods were there explained for testing out the polarity of the coil, and thus it becomes easy for even the novice to properly apply the *positive* and *negative* electrodes as required in the following directions for the treatment of various ordinary ills, such as, headache, nervousness, rheumatism, etc.

The accompanying illustrations show how several people may join hands so as to form a *series* connection to the medical or shocking coil, and as many as eight or ten people—or more, may thus join hands in a circle, evolving a great deal of amusement at parties and social gatherings. One of the illustrations shows how a second person may apply the faradic current for facial or other massage with the hand. There are two ways of giving this massage, and one of the accompanying diagrams shows the second method, whereby the person applying the currents forms a *shunt* circuit to the patient. Where a mild current is desired, the shunt method is preferable, while the *series* connection gives a harsher or stronger current. For the purpose of giving massage treatments, there is available on the market special wrist electrodes, which have a binding-post terminal on them, to which one of the secondary wires from the apparatus may be connected. Many other forms of electrodes, including foot-plates, sponge electrodes, hair brushes, massage rollers, et cetera, are shown in one of the accompanying illustrations. The faradic secondary current produced by medical induction coils is, as explained in textbooks, in the form of an unsymmetrical alternating current.*

Where much of this work is being done, it is always best to invest in a sensitive milli-ampere meter which can be connected in series with one of the handle cords, so that the current strength in milli-amperes being administered, can be regulated. The proper current strengths for different ailments is given in any of the works on Electro-therapeutics, which may be consulted at almost every library.



Illustrating Several Interesting Applications of the Faradic Current. The Apparatus for Producing This Current Was Described In Complete Detail in the June Issue of This Journal.

General Considerations.

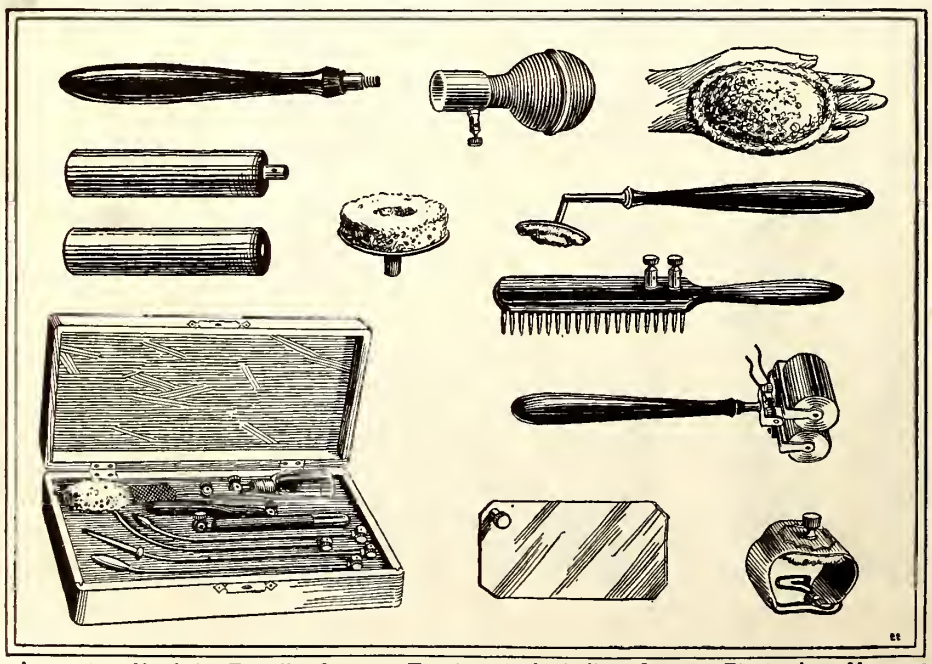
In treating diseases of an inflammatory nature and fevers the *positive* pole is generally utilized. This includes such ailments as swellings, bruises, sprains, extraneous growths and enlarged glands. In this treatment arrange the poles, if possible, *the positive above the negative:* while in debility, numbness, inaction, tendency to decomposition, treatment is given with the *negative* pole. The rule of the positive above the negative cannot always be followed in this treatment.

The primary current starts at the dry cell, passes thru one coil of wire (primary coil) thence thru the circuit-breaker thru the patient. The secondary is the *induced current* in the finer wire of the coil and is of much greater tension (voltage) than the primary, but not of so much volume (amperage). The *primary* current is used particularly in the treatment of scrofula ulcers, cancers, extraneous growths, enlarged tonsils, enlarged joints, granulated eyelids, enlarged glands, strictures, etc.*

The *secondary* current is applied in the cure of nervous and inflammatory diseases and acts as a tonic upon the system. There are two methods of applying electrical currents to the body viz: 1. General Electrization; 2. Localized Electrization.

By the first method the current is past thru the entire body or part of it. By the second method, the object is to influence special nerves, muscles or organs, limiting the action of currents to these parts, or, instead of trying to influence a muscle, we may stimulate the nerve supplying it, thus reaching the same indirectly. When the refreshing effects of the current are desired to relieve fatigue or ward off approaching paralysis some suitable exercise of the muscles should be combined with the galvanic current. Short sittings are better than long ones. In ordinary cases from two to

* For further details on the action of induction coils, including the wave form of the secondary or induced current, as well as the primary current, reference may be made to several works on induction coils including the following: "How To Make Induction Coils and Transformers," by H. W. Secor, and a later revised edition by J. S. Curtis, "Induction Coils in Theory and Practise," by Prof. F. E. Austin, "Induction Coils," by H. S. Norrie, "Induction Coils," by Armagnat, also several other works including those by A. Frederick Collins, Allsop, and Trevert.



Apparatus Used In Faradic Current Treatment, Including Sponge Electrodes, Massage Roller, Wrist Electrode, Foot Plate, Hair-brush, Bust Cupper, Et Cetera.

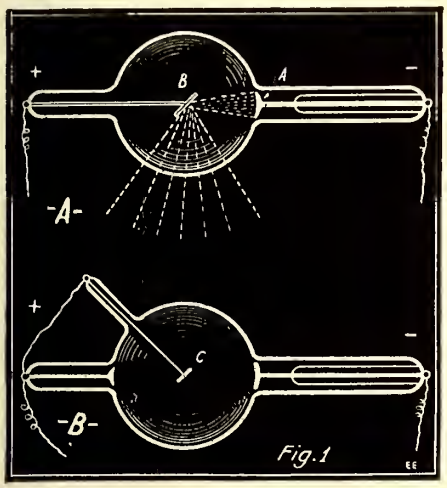
*See Electro-Therapeutics Handbook, by Trevert. Also Handbook of Electrotherapeutics by Dr. Strong.

(*Cont. on page* 366)

X-Ray Experiments

By Ivan Crawford

THE average electrical reader is not ignorant as to the general nature of X-rays, or more properly Röntgen rays, but he usually knows comparatively little about them. Considering the ever broadening field of usefulness of these remarkable rays, it behooves the experimenter who wishes to keep abreast of the times to make himself better acquainted with them and their properties. It is the author's intention in the following article to briefly outline the latest advances in this branch of science and to give some experiments, using apparatus within the reach of every experimenter.



Simple Form of Vacuum Bulb for the Production of X-Rays. When the Cathode Particles Strike the Target, B, They Set Up Etheric Vibrations—X-Rays—Radiating in the Direction Shown by the Dotted Lines.

Röntgen, while experimenting with a vacuum tube, noticed that the sides of the tube exposed to the discharge were brightly phosphorescent, and that if a screen of some phosphorescent substance such as potassium platinocyanid was brought into its vicinity it would become luminous. He also noticed that if a thick piece of metal were interposed a shadow was cast, while a piece of wood or a thin sheet of aluminum cast only a partial shadow, showing that the rays producing the phosphorescence could penetrate more or less easily objects opaque to ordinary light, but that the amount of penetration varied *inversely* as the density. This may be further illustrated by interposing the hand between the tube and the screen. The flesh being less dense than the bones cast only a light shadow while the latter are distinctly outlined. The rays were also found to possess the property of affecting a photographic plate.

Fig. 5. Sklagraph Taken by the Author, Showing Bones of the Hand and Finger-Ring. X-Ray Tube Excited on Two-inch Spark Coil.

Of course, an ordinary vacuum tube such as the one with which Röntgen first remarked the phenomena, does not produce X-rays in any great quantity. Many different forms of bulbs have been evolved but they may be divided into two general classes, namely, those operated on spark coils and those operated on high frequency currents such as those from a Tesla coil. As the spark coil exciter is more within the reach of the average experimenter, it has been selected for description in this article. Those who are interested, however, in the operation of high frequency X-ray tubes are referred to a most complete article on the subject by Dr. Frederick F. Strong, in the September, 1917, issue of this magazine.

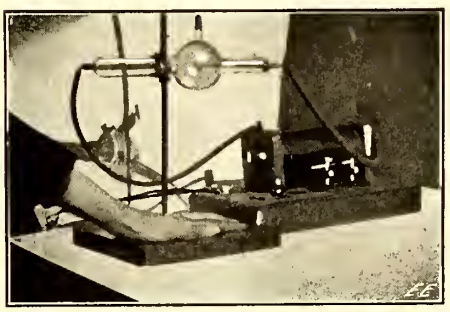


Fig. 4. How the X-Ray Tube, Hand to Be Radiographed, and Covered Photographic Plate Are Arranged.

A simple tube for the production of Röntgen rays is shown in Fig. 1A. The cathode A is generally of aluminum and made in the form of a reflector. The anode B is faced with platinum or tungsten and inclined at an angle of 45 deg. to the cathode. Sometimes a third electrode (C, Fig. 1B) is added. This, however, is not necessary in small tubes. The pressure in the bulb must be extremely low. After extended use this tends to become even lower. This, altho producing more penetrating rays, decreases the supply of electrons, making it difficult for the discharge to pass. To remedy this some bulbs are equipt with a small platinum tube fused into the glass. When this is heated it allows the hydrogen to pass. If the bulb is not provided with any means of increasing the pressure it may be done by gently heating it in an oven. When the vacuum is high the bulb is said to be "hard"; as the pressure increases it is said to become "soft." For general work the bulb should be rather "hard."

The nature and properties of the rays will now be discust. When the cathode particles strike the target they set up etheric vibrations which radiate in the direction of the dotted lines in Fig. 1A. The nature of these vibrations has been the field of considerable discussion but has now been practically settled. It is the general belief that they consist of *extremely short ether waves*, similar in many ways to light. The chief points of difference lie in the facts that the objects which reflect or at least refract ordinary light are transparent to X-rays, neither are they subject to polarization. This evidence is, however, not so conclusive as it might seem at first sight. It has been known for some time that X-rays consist of vibrations about 10^{-9} cm. in length. It is impossible to conceive of a defraction grating of suitable spacing to intercept these waves. On the other hand, they have many similar characteristics. They move in straight lines, cast definite shadows, affect a photographic plate, and Brandes and Dorn have shown that they even produce a slight but sensible effect on the retina. Prof. Marx, by a series of complicated experiments showed that they traveled at the speed of light. His results, however, have not been generally accepted and his methods severely criticized. I have stated above that Röntgen rays are not subject to polari-

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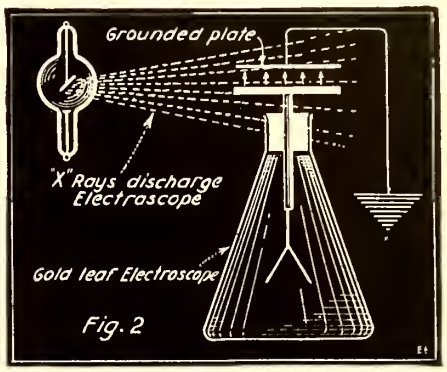
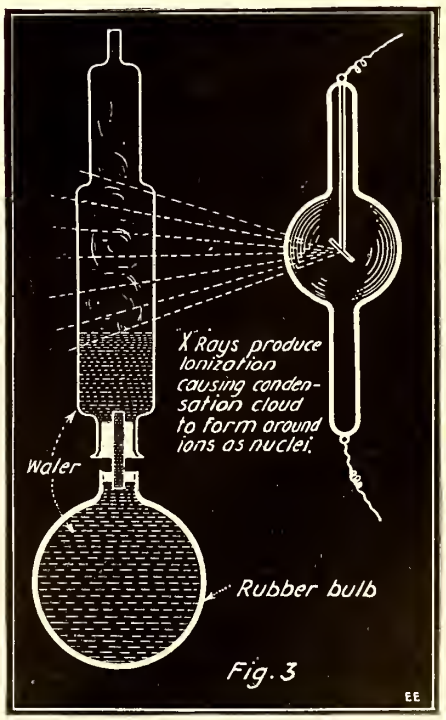


Experiment Demonstrating the Ionizing Property of X-Rays. A Charged Electroscope Is Quickly Discharged When X-Rays are Past Across the Gap Between the Electroscope and a Grounded Metal Plate.



An Intensely Interesting X-Ray Experiment, Showing How Rain (Aqueous Vapor) is Formed by Condensation Set Up on Nuclei Created by X-Ray Ionization.

Heat Engines

By JOHN J. FURIA, M. A.

Dept. of Physics, New York University.

THE question often arises, "why is the *hot air* engine not used?" Air certainly is cheaper than gasoline. It takes less fuel to heat air than to convert water into steam. However, it does not follow that the hot air engine

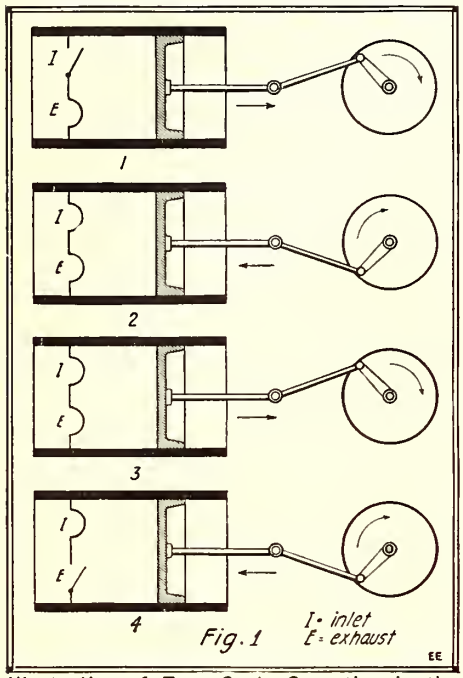


Illustration of Four Cycle Operation in the Gasoline Engine. First the Gas Mixture Is Drawn In. Second, Compression Takes Place. Third Comes the Explosion; and Fourth, the Expulsion of the Burnt Gases Takes Place.

is the cheapest to run and at the same time obtain the necessary power. A little review of the gasoline and steam engines together with the principles of operation of the hot air engine will answer our question, why this type of engine is not used.

The Gasoline Engine.

The gasoline engine (internal combustion) has attained great popularity by its use in the automobile industry. It is flexible, capable of delivering a large amount of power, it develops high speed and power almost instantaneously. It also has an efficiency of about 25 per cent. The engine and the fuel used are light in weight compared with other kinds of engines of similar power. The four cycle engine is typical. Figure 1 is a sketch showing the conditions at each of the four cycles. The first cycle is started by turning over the flywheel (cranking the engine). This causes a *suction* in the cylinder. The inlet valve is either opened automatically or by the suction. The properly mixed fuel (gasoline and air) enters thru the inlet. (During this cycle the exhaust valve remains closed.) After passing dead center, the inertia of

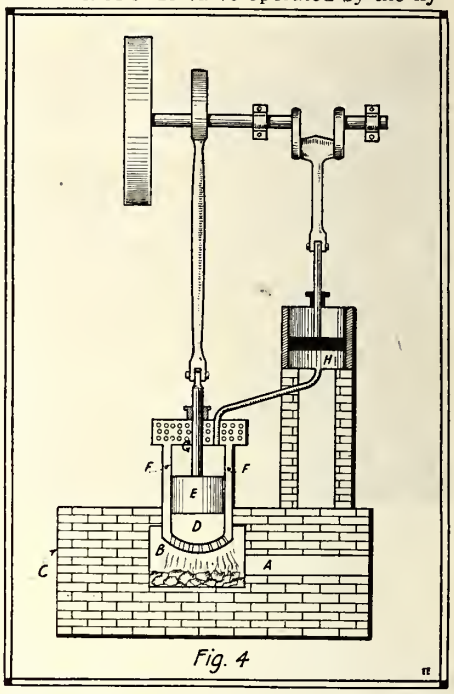
Gasoline—Steam—Hot Air

the moving fly-wheel causes the piston to move inward (cycle 2). The inlet and exhaust valves are both closed during this cycle, and the explosive mixture is comprest, rendering it capable of delivering greater power when it is exploded. As dead center is again reached, and the mixture is comprest to a maximum, the mixture is *ignited* by means of an electric spark properly timed. The mixture disintegrates as a result of combustion and forms a gas of tremendous pressure, this pressure causing the piston to move outward. This is the third cycle or power cycle. (Both valves are closed.) On again reaching dead center, the inertia of the fly-wheel causes the piston to move inward; the exhaust valve is automatically opened and the spent gases are expelled. (The inlet valve is, of course, closed during this cycle.) The four cycles are then repeated over and over again.

It is to be noted that during the whole four cycles, only one power stroke is secured; and that this power stroke is secured as a result of chemical action due to the combustion of the fuel mixture. The *four cycles* occur during *two revolutions* of the fly-wheel. It is therefore necessary to have a fly-wheel with a large moment of inertia in order to cause a steady running of the engine. Smoothness is obtained by using several cylinders instead of one, thus securing *more power strokes per revolution of the fly-wheel.* The high price of gasoline together with the complications arising in the devices for securing the proper mixture and the right kind of spark at the right time are points against the gasoline engine. Because of the high temperatures developed as a result of the chemical action, the cylinders must be cooled by some means, usually water circulation (another complication).

Steam Engines.

The steam engine is still very much used in spite of its low efficiency (usually ranging from 10 to 12 per cent). It possesses the disadvantage of not being capable of immediate starting; perhaps this is the chief reason for its not being used in automobile propulsion except in one or two special instances. Its bulk is, of necessity, very large comparatively as is the bulk of the fuel used. (A one horsepower engine requires about 2½ lbs. of coal per hour.) On the other hand it is simple in operation and control. Once steam is "gotten up," the movement of one throttle is all that is necessary to cause a change in speed and power. No fuel mixing device is used nor any electrical system. Figure 2 shows the main parts of a typical steam engine. Steam is raised by heating water contained in a boiler (any kind of fuel can be used). The steam is led into the cylinder thru the inlet valve. In the type illustrated below there are two inlets to the cylinder, one on each side. A slide valve operated by the fly-



The Stirling "Hot Air" Engine. It Only Consumes 2 lb. Coal per H.P. Hour, Being Therefore More Efficient Than the Steam Engine. These Engines Have Been Built to Develop Several Horsepower.

wheel moves in opposition to the piston, alternately admitting steam to the left and to the right of the piston, thus causing it to move back and forth. It is therefore apparent that there are *two power strokes for each revolution* of the fly-wheel or *four times as many as in the four cycle gasoline engine.* The spent steam is usually exhausted into the atmosphere. In the more modern steam engine the spent steam is condensed and brought back to the boiler, thereby requiring water to be added to the boiler much less frequently besides saving fuel. Because of the high price of gasoline, several automobile concerns have expended a great deal of time and money in research and development on automobile steam engines, and their "selling points" are extremely good ones. Getting up steam is reduced to a matter of only a few min-

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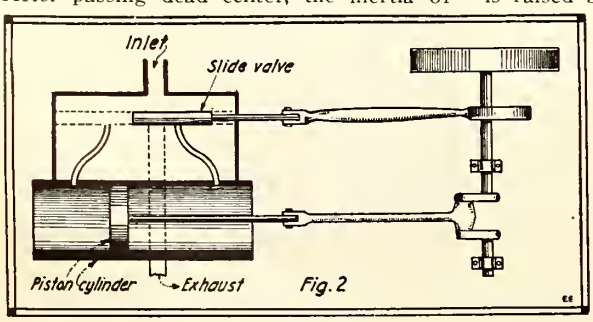
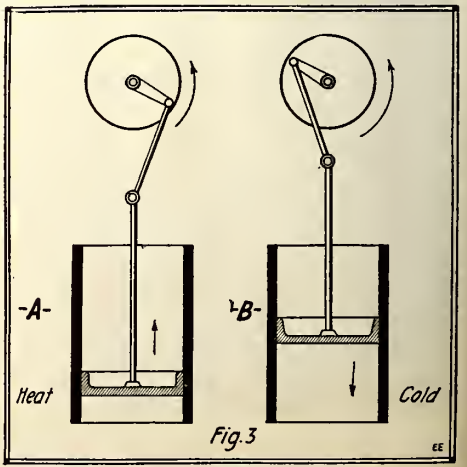


Left:—Principle of Simple Steam Engine, Showing Slide Valve Actuated by Cam Shaft from Flywheel Shaft. The Steam Is Successively Admitted and Exhausted from Alternate Sides of the Piston, Causing Rotation of the Flywheel.



Right:—Ideal "Hot Air" Engine, Comprising a Cylinder, Piston, Connecting Rod and Flywheel. Heat Is Applied to Bottom of Cylinder, Driving Piston Upward.

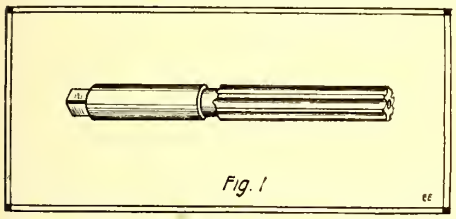
Experimental Mechanics

By SAMUEL D. COHEN

LESSON XIII

REGARDING REAMERS.

IN the last lesson we completed the discussion on the subject of "Twist Drills." The reader is undoubtedly aware by this time that it is quite impossible to drill any size hole he desires with rigid accuracy thru the use of drills in commercial



Standard Form of Hand Reamer. The Reamer Is Used to Accurately Clean Out Drilled or Cast Holes, Especially Journal Boxes and Shaft Bearings of All Types.

practise. For example, it is desired to place a pin into a drilled hole to have a *driving* or a *sliding fit.* The reader will find that nine times out of ten he will be unable to obtain the proper size drill to do the work. In this instance another form of tool is at hand, namely, the *reamer.* This tool is used whenever a hole is to be enlarged just a few thousandths more than the original. Sometimes the reamer is used when a smooth hole is required, in which case the hole being first drilled is made *smaller,* in order to obtain the finally required size after reaming.

As in the case of twist drills, there are a large variety of reamers, varying in size, and each is suited for a definite purpose. Properly speaking, the reamer may be defined as a tool for perfecting holes previously drilled or bored. Fig. 1 shows a standard *hand reamer.* The reamer should never be used to remove any considerable quantity of stock, but merely to eliminate minute imperfections left by other tools. In some cases the hole may be made to within .001 inch before the reamer is applied, but generally the allowance of .002 inch to .010, according to the diameter of the hole, may be left for the standard reamer to cut. If given too much material to remove, the cutting edges of the reamer will wear too fast, and its reliability as a *sizer* will be quickly destroyed.

Reamers may be divided into two general classes: the *side-cutting* or *fluted* and the *end-cutting* or *bits.* Each of these classes are subdivided into *solid* and *adjustable* reamers.

The first well-known reamer is called the *solid fluted* reamer, and is made with slight modifications to suit two different cases, namely, hand and machine use. Fig. 2 illustrates a hand reamer which belongs to the *short set.* Reamers of the same general design are also made longer in regular sets. The cutting edges of fluted reamers taper in diameter for about one-fourth their length, from E to D being about .01 inch smaller at E than at D.

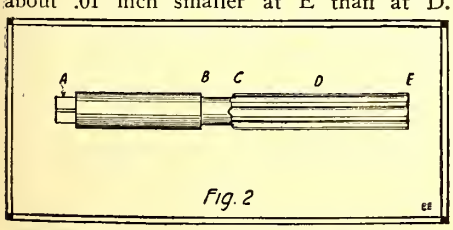


Illustration Showing a Hand Reamer of the Solid Fluted Type for Hand Use. The Letters Refer to Different Tapered Sections Described in the Text.

From D to C the taper is reversed, the diameter decreasing about .0002 inch per inch of length towards C. The part between A and B is usually made about .001 inch smaller than the largest diameter at D. When the cutting edges are worn to such an extent that the blank part, when free from bruises, will not pass thru the reamed hole, the reamer is too small for standard use.

As will be seen, the hand reamer has a square end, upon which a wrench is used to turn it. This is the main distinguishing feature between the above mentioned and the machine reamer of the fluted type. The latter is made with taper and parallel shanks the same as a drill. It may also have a shank of any special shape to fit a certain holder. The machine reamer is generally, tho not always, made straight or parallel, from E to D, Fig. 2.

A reamer having a flute parallel with its axis has a slight tendency to draw in. To overcome this, some mechanics prefer the flutes of both hand and machine reamers, made in the form of a left-hand spiral. The angle of the spiral or helix may be from 4 to 8 degrees.

Another form is the so-called *rose* reamer. Its name is derived from the fact that its cutting end resembles a rose. It is essentially an end-cutting tool and is rarely used for other than machine work. The rose reamer has chip and oil grooves on the sides and is made with any shank required in machine work. This reamer has the larger diameter at its cutting end, and tapers back at about the same rate as the hand-fluted reamer, viz.: .0002 inch per inch of length.

The object of the taper on the fluted reamer is to counteract the tendency of all such reamers to produce a hole larger at the outer end. The rose reamer as well as the twist drill have the taper for the same reason, viz: for clearance.

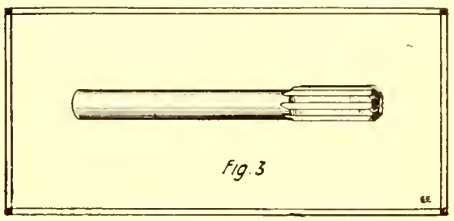
As compared with the fluted reamer, the rose reamer has one advantage, in that when new it will make holes more uniform in size and shape, but has the disadvantage that when the cutting lips are worn, it will bind on the sides and roughen the hole. If the fluted reamer becomes slightly worn at the end, it will still cut on the sides, but because of its cutting on the sides, it is more likely to be deflected by imperfections of the hole, or to cut larger than its fixt size.

As above stated, the standard fluted reamer should be used for *finishing cuts* only. However, the rose reamer can be utilized for roughing or finishing cuts. When the same reamer is used for both purposes, it becomes unreliable as a standard finishing tool. A good illustration of the rose reamer is shown in Fig. 3.

Another type is the *shell* reamer, which is identical in construction to the fluted and rose reamers, with regard to cutting edges, but differs in that the reamer proper is placed upon an arbor, thus saving in cost of material. It will be seen, however, that when the reamer becomes worn to such an extent that its accuracy is destroyed, it should be replaced by a new one, which occupies the same position on the arbor. Fig. 4 illustrates a typical shell reamer. The arbor drives the shell thru the engagement of its key with a rectangular slot cut across the rectangular shell. These reamers are made with either straight or spiral flutes.

The *shells* as ordinarily made are rather short for hand reaming. They are designed mainly for machine work. The taper begins at the cutting end, and the diameter decreases toward the opposite end in about the same ratio as the reamers previously described.

When these reamers wear .0003 inch to .001 inch below standard size, it is necessary to reset or regrind them to a smaller

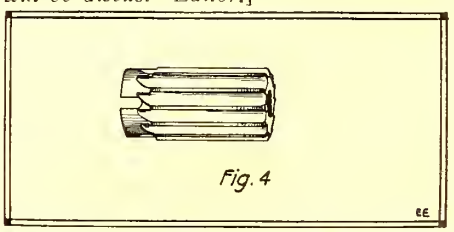


Typical Rose Reamer. This Is Used Considerably for Roughing and Finishing Work, but One Reamer Should Not Be Utilized for Both Purposes, as Inaccuracy Is Bound to Result.

size. Resetting consists in enlarging the diameter of the reamer by hammer blows in connection with a form of *set* or calking tool. The latter, which may be made by grinding a common chisel flat on the end, is held against the front of the cutting edges for this purpose. It is necessary to anneal the reamer for resetting, and each cutting edge must be treated until the diameter is about 1/64 inch larger than the standard. Having completed this work, the reamer is now retempered and brought to final size by *grinding.* This is usually accomplisht by placing the reamer in a Universal precision grinding machine.

Before grinding the reamer, its center should be carefully cleaned of any dirt or other foreign matter that may have adhered to it. A point scraper made from a three-cornered file answers well for this purpose. After scraping the centers it is usually necessary to lap them. For this process we *chuck* a short brass rod in the lathe and turn the end to the shape of the lathe centers. Having smeared this conical end with fine emery and oil, the reamer is placed on the center of the lathe and started at the greatest speed attainable. The reamer center is lapt by alternately forcing it against and releasing it from the revolving brass. This is done by light pressure with the tail spindle, and for each time that the reamer is prest against the brass it should be revolved slightly. By thus revolving it, we distribute the emery and counteract the tendency of the lap to scratch rings in the center. It is sometimes necessary to return the lap before finishing one reamer; but a skillful workman can do this in ten minutes or less. Instead of having to chuck the lap each time it is used, it would be better to make one to fit the hole in the lathe spindle directly.

[*In the next installment the subject of adjustable reamers and grinding of reamers will be discust—Editor.*]



A Shell Reamer. An Arbor or Shaft Supports the Reamer When in Use. They Are Held by a Key on the Shaft and Are Made With Straight or Spiral Flutes.

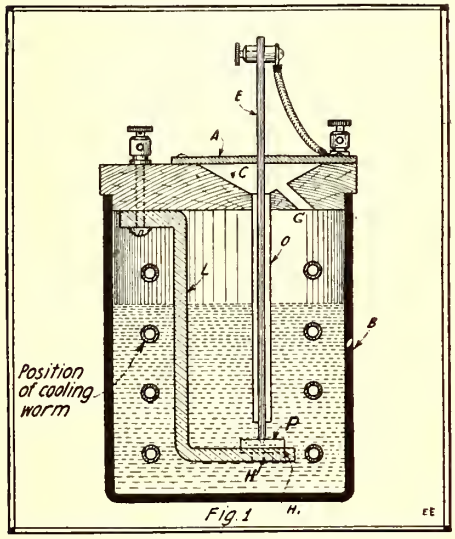
HOW-TO-MAKE-IT

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.

Automatic Electrolytic Interrupter

FIRST PRIZE, $3.00

After having experienced considerable trouble in devising a satisfactory electrolytic

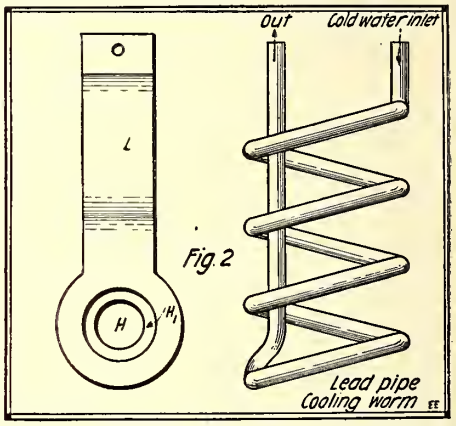


A Really Good Design of Home-made Electrolytic Interrupter.

interrupter, I succeeded in constructing the one described herewith in which most of the faults of its predecessors are eliminated. The greatest of these faults was the dropping of the rod electrode, thus short-circuiting the device. The materials required outside of the battery jar and wooden top, which must be boiled in paraffin to render it impervious to moisture, are: One-half pound of lead, about five inches of glass tubing, having an internal diameter of one-sixteenth inch, three binding posts, a small strip of brass and a small porcelain cup (used for mixing water colors).

The lead electrode is cast in the shape shown in Fig. 2. A hole somewhat smaller than the cup is bored in the large end. A rabbet, H^1, is cut around the edge of this hole so that the cup will fit into it. The lead electrode is now completed and fastened to the top with a machine screw and binding post. The top has a cup-shaped cavity reamed out as shown at C, Fig. 1, which is as deep as one-half the thickness of the top. A hole is bored in the center to receive the end of the glass tube, which should fit tight. The bottom of the tube is about three-sixteenths of an inch above the porcelain cup. The cavity also has a small hole G, Fig. 1, in one side to furnish an outlet for the solution which rises in the tube. A brass strip about one-quarter of an inch wide is fastened across the top of the cavity with a wood screw, binding post and a small screw. This strip has a small hole in the center for the rod electrode to pass thru. The rod is best made of phosphor bronze, and should fit the tube loosely. It has a binding post on top to serve as a weight and for connections. The interrupter is now complete, and should be filled to within an inch and a half of the top with a 10 per cent. solution of sulfuric acid.

The action of this interrupter is as follows: As the rod is worn away by the action of the solution, it is impelled downward by the weight on top, the porcelain cup preventing it from going too far. In case it



Detail of Lead Electrode and Lead Cooling Worm for Home-made Electrolytic Interrupter.

is desired to operate this interrupter continually for any length of time, it may be cooled by immersing in a large jar of water, or else by inserting a cold water cooling worm in the solution, after the design here pictured.

Contributed by SCOTT E. VANCE.

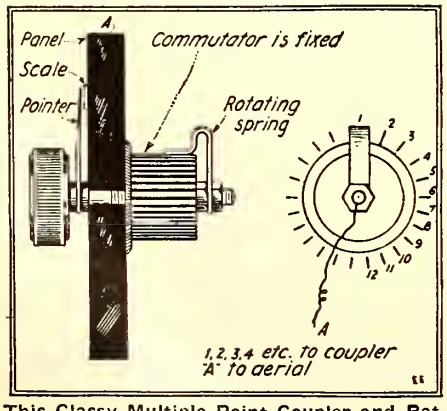
Clever Multiple Switch

SECOND PRIZE, $2.00

I submit herewith an idea for using a motor commutator as a rotary multiple point switch. This sort of switch is useful where it is desirable to economize on space, as on the secondary of a loose coupler.

This switch is, moreover, thoroly dust proof, as it is always on the inside of the cabinet.

Contributed by R. C. SMOLLEN.



This Classy Multiple Point Coupler and Battery Switch Is Constructed From a Small Commutator.

Send us some of your good ideas. We pay for all articles publisht. Address the Editor How-To-Make-It Dept.

THE PHONOGRAPH AS A TEACHER.

Many amateurs object to the use of a phonograph for learning wireless telegraphy because of the fact that the sound coming from the phonograph is in no way similar to the actual wireless message.

Close the doors of the machine and place a telephone transmitter on the inside. Or, better still, place the transmitter directly on the end of the tone arm. This latter method can be used with any make of phonograph. Then connect a telephone receiver (or a number of telephone receivers in parallel) in series with the transmitter and a few batteries.

This method overcomes all objections to the phonograph method and is much better than the omnigraph method since the phonograph records can be made to represent two stations of a different pitch sending at the same time, interference, etc. When you tire of listening to radio signals put on an ordinary record and have a "wireless" concert. What?

Contributed by PAUL G. EDWARDS

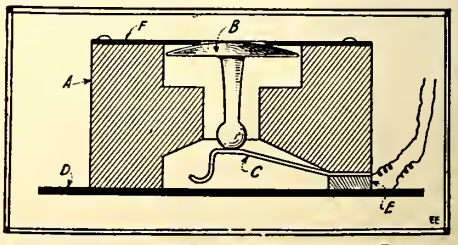
"Collar Button" Push Button

THIRD PRIZE, $1.00

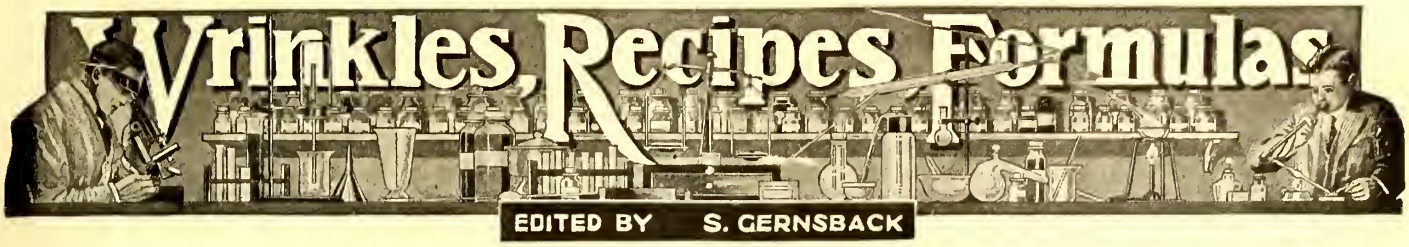
Here is a push button designed to use up all your waste material and make you buy more collar buttons. Bore the holes as shown in a two by one-half inch block of wood, screw on the metal plate D, with the brass spring C insulated from it by the wood or fiber E, slip in your collar button B, glue on the thin piece of wood F, and Eureka! there you have it!

I know my friends will surely bless me for this valuable contribution to Science in the Home. Pa can rest his mind hereafter —when the shirt button drops, he will know it's gone to help the cause of true Science.

Contributed by RAY BILLINGTON.



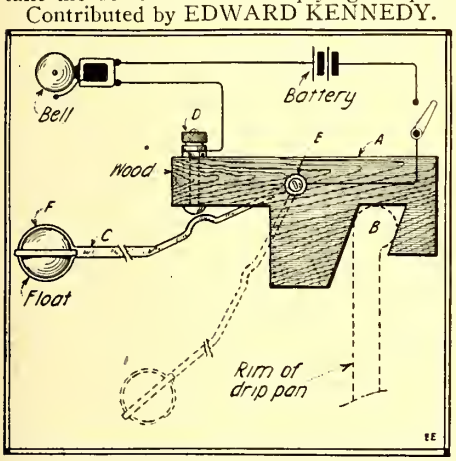
At Last! The "Collar Button" Push Button. Papa Will Never Find His Collar Buttons Now, When They Roll Away Under the Bed. Little "Willie" Will See to That!



TELL-TALE FOR REFRIGERATOR DRIP PAN.

This tell-tale for an ice box drip-pan consists of a piece of hard wood or fiber cut into the form (A). A piece of No. 14 copper wire is bent into the form (C). This form is allowed to turn on pivot (E), which is a current carrying part of the circuit. When the pan is full of water, the form (C) floats up by means of a piece of wood (cork is good) attached to the end. The copper wire makes contact with (D), and the bell rings, indicating that the pan is full. The notch (B) makes it possible to take the device off when emptying the pan.

Contributed by EDWARD KENNEDY.



Simplicity Is Stamped All Over This Home-made Refrigerator Drip-pan Alarm. It Costs But a Few Cents to Make and Will Save Your Carpets and Hard-wood Floors.

HINTS ON LABORATORY APPARATUS.

By Eugene McGowan

To most experimenters chemistry undoubtedly proves a most interesting study. However the chief fault lies in the fact that things mess up so easily. The following is intended to overcome this difficulty.

First of all the laboratory should be arranged so that the one who uses the room may be able to find everything he wants.

A gross of empty wooden boxes, 12 inches x 8 inches x 4 inches, will be found convenient for keeping dry reagents in.

Labels should be used freely, and all unlabelled bottles washed out. Paper labels on bottles may be protected by a coating of paraffin wax varnish or shellac. But most bottles should have some label in the substance of the glass. These are made in two forms. Enamel labels are melted on the glass. They last well, but white enamel is not always distinct when white crystals are in the bottle. Sand-blast labels are made by roughening the surface of the glass with a jet of sand driven by a blast of air. They are apt to be indistinct when wet, if not made with a really rough surface. They can be made more distinct by rubbing over with crayon or chalk. Sand blast labels cost only about half as much as enamel labels.

Retort stands should be firm and substantial. The sliding collars for the rings should be slotted at the sides, so as to move easily; and a good clamp should be chosen with well-made screw threads.

Deflagrating spoons can be cleaned by holding the cup in the Bunsen flame for a few seconds.

Bunsen burners occasionally get blocked by some molten substance falling into the inner tube. They may be cleaned by washing with water. After washing blow thru the burner to remove any drop of water which may clog the exit. The revolving tube or ring should be frequently turned, so as to keep it in order; otherwise they get jammed and it is impossible to change quickly from a yellow to a blue flame.

Balances should turn with much less than a centigram. Balances with steel knife-edges, if protected from the air of the laboratory, will remain serviceable for years. Those with agate edges set in steel are more durable, but are more expensive. Weights less than a centigram are needless, and cause trouble to beginners. More exact weighing can always be done by watching the pointer, if the weights are accurate.

Management of mercury. Mercury is difficult to manage, on account of its weight and the ease with which it picks up impurities. Stone-ware mortars are better for holding mercury than glass beakers, which easily crack when set down. All operations with mercury should be conducted over a tray or on a table with a groove around the edge.

Dust on the surface of mercury may be removed by allowing the mercury to run thru a dry filter paper in which a few pin holes have been made. Or the mercury may be washed in a current of water, and then past thru a separating funnel. The little moisture on the surface may be removed with a blotting paper. Many metals easily dissolve in mercury; and a very little tin or zinc will spoil its fluidity. They are best removed by shaking the mercury in a bottle with a little nitric acid; the tin or zinc will then dissolve, leaving the mercury pure.

A few words of caution concerning the care of reagent bottles are in place here. A good reagent bottle must have its stopper ground to fit it, and this stopper will not fit any other bottle you may have. Consequently the stoppers should never be interchanged. Again, the stoppers of all reagent bottles, excepting sulfuric acid, should be paraffined, otherwise they are apt to stick.

Do not lay down the cork of a reagent bottle while pouring out a solution, as the stoppers may become changed. Again, no solution but the one corresponding to the name on the bottle should ever be placed in the bottle.

Another important item is that each bottle shall have its own particular place on the shelf, and always be put in its place; thus the amateur chemist will know exactly where to find the proper reagent, just as a printer knows where to find the letters in his case, by prearrangement.

USE FOR AN ATOMIZER.

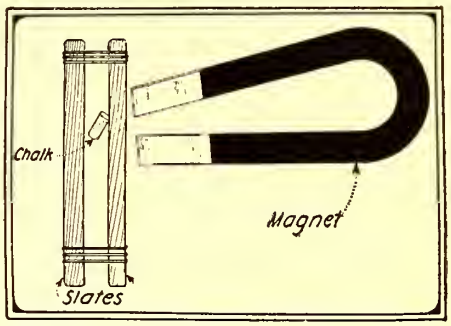
An atomizer is a handy appliance to furnish a draft of air when drying precipitates or evaporating solvents like ether or chloroform. The drying of precipitates and crystals can best be carried out when same is placed on a blotter to help absorb the liquid.

"SPIRIT" SLATE-WRITING.

Two thin slates are brought forth and offered for examination by the audience. The operator then places in between the two plates a small piece of chalk and hands the two slates to some-one (it does not matter whom) to tie with a string or seal all around with scaling-wax. After a few minutes or so, the slates are taken apart and Presto! there is found a message from the "spirit world" written with the chalk, which was placed in there by the "Medium."

The way it's done is this:

The chalk is of special formation; it is made of chalk dust mixed with iron-filings and a little glue. A strong (need not be very big) magnet is used to make the chalk move and write the message. The "Medium" located the chalk by tipping the slates to one corner and placing the magnet under it.



"Spirit" Slate Writing May Be Performed With This Simple Apparatus. The Chalk Container Could Very Well Be a Small Perforated Ball Filled With Powdered Chalk. The Slates Should Be Held Horizontally.

This works better in the dark for the simple reason that the people will not notice the magnet and its use. The darker the better.

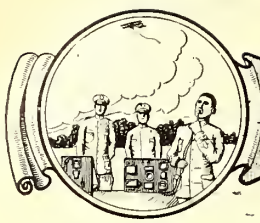
Contributed by GEORGE PASTO.

MAKING THE MOST OF A LITTLE SPACE.

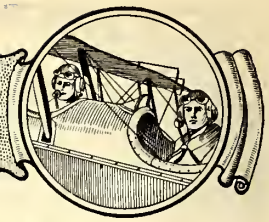
It is most discouraging to have to spend half-an-hour finding tools and impedimenta before starting an hour's work in the evening. The remedy is to have a place for everything, and keep everything in its place. Also, keep them as compactly as possible. A good deal of extra room can be got out of an ordinary cupboard by the exercise of a little ingenuity. Things not often required should be kept on the top shelf. Perhaps there is still some space to spare. Then tack a piece of cloth or a large handkerchief inside the top of the cupboard, and screw in a couple of brass screw hooks a few inches from the ends. Sew a brass ring to each of the free corners of the cloth and you have a sort of cradle in which many odd things may be suspended by slipping the rings over the hooks.

A dozen wooden soap or sugar boxes, stood one above another in a corner of the room, preferably in a recess, will do duty for a cupboard. Capital shelves can be made inside the boxes, using wood from the lids, while the whole structure can be effectually disguised during the daytime by covering it with a piece of dark colored material. Extra room can be made by fixing hooks to the outside edges of the boxes for things that can be hung up, while other odds and ends can be dropt into cocoa tins and the like tacked to the sides of the boxes.

Contributed by H. J. GRAY.



RADIO DEPARTMENT



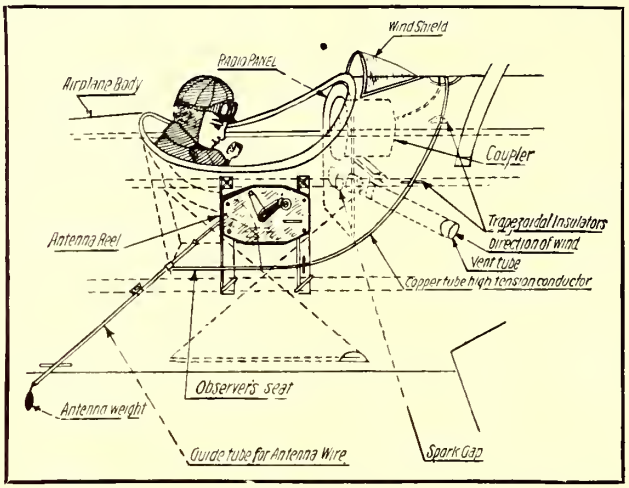
Airplane Antenna Reels

By LESTER F. RYAN

ONE of the most important parts of the antenna system in connection with airplane radio work is the *antenna reel*. Electrically, the antenna system of a radio transmitter consists of a single trailing wire and a counterpoise. The antenna wire is lowered from the airplane during flight by a hand reel and trails out to a distance of about 300 feet, at an angle of 20 degrees to the fuselage.

The antenna reel, as illustrated in Fig. 1, is so designed in order to stand all mechanical and electrical stresses under difficult service conditions.

It is constructed entirely of the highest grade insulating material and will therefore stand the high antenna voltages which are developed by the high power of the transmitter without leakage and danger to the operator.



Arrangement of Airplane Antenna Reel On Outside of Cockpit. The Reel Is Self-locking and Also Indicates At a Glance How Many Feet of Aërial Cable the Aviator Has Let Out. The Cable Runs Thru a Guide Tube As Shown. Thousands of Sets Like Those Shown Were Used During the War.

The drum of the reel will hold 600 feet of stranded phosfor bronze or other antenna cable, i.e., if one antenna of 300 feet of wire is lost, an additional antenna of 300 feet is still available. It is provided with a revolution counter as shown in figure which indicates the number of turns or feet of antenna wire in use.

It is also fitted with a *brake* or locking device, which is used to lock the drum when the reel is not in use. This brake may also be used to control the speed of the unwinding. The antenna wire is of tinned copper, and has a breaking strength of 400 pounds.

To prevent chafing and breakage of the antenna wire near the weight when the antenna is reeled in, due to the swinging of the weight, a stiff phosfor bronze wire is connected between the antenna wire and the swivel hook. A swivel hook is placed at the end of the tail wire to prevent spinning of the weight during flight. The weight is of lead, and weighs 1¾ pounds. It is of stream-line form to reduce wind resistance to a minimum.

The insulators used are of trapezoidal shape and serve the purpose of insulating the guide tube from the airplane. The flattened end of the trapezoid is made fast to the copper tube; the opposite base is made fast to the airplane fuselage.

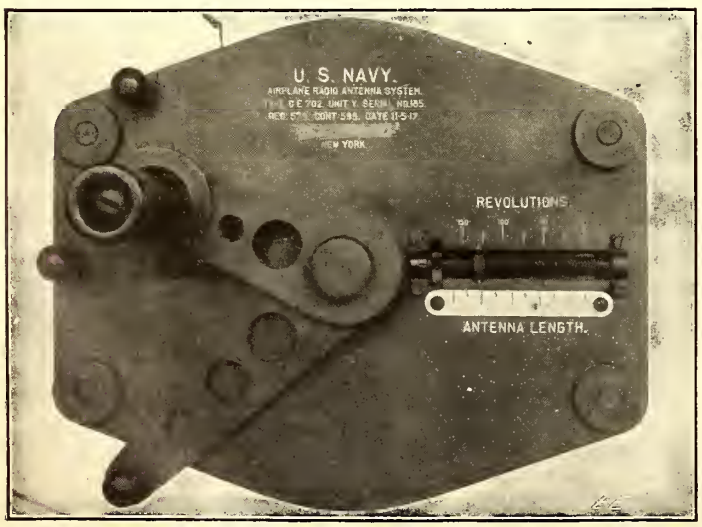
To prevent *sparking* or *grounding* of the antenna to the cowl a *cowl insulator* is used. It is made of bakelized canvas, six inches in diameter, with holes near its perifery for lashing to the cowl.

When installing the antenna system on a 'plane, great care must be taken to provide sufficient insulation against the high voltages developed by the transmitter. As a rule, the antenna reel is mounted outside of the fuselage on the right-hand side of the plane, as here shown. It is attached to two vertical pieces of wood which are lashed to the upper main and seat *longerons*. These pieces contain holes corresponding to the four attachment legs of the reels, and thru which these legs extend to the inside of the fuselage. The circular bakelite nuts, as shown in figure, secure the reel posts to these uprights. The copper guide tube thru which the antenna cable slides after leaving the reel is supported beneath and rearward from the antenna reel at an angle of about 20 degrees to the fuselage. It extends 6 inches beneath the fuselage, and is separated by insulators.

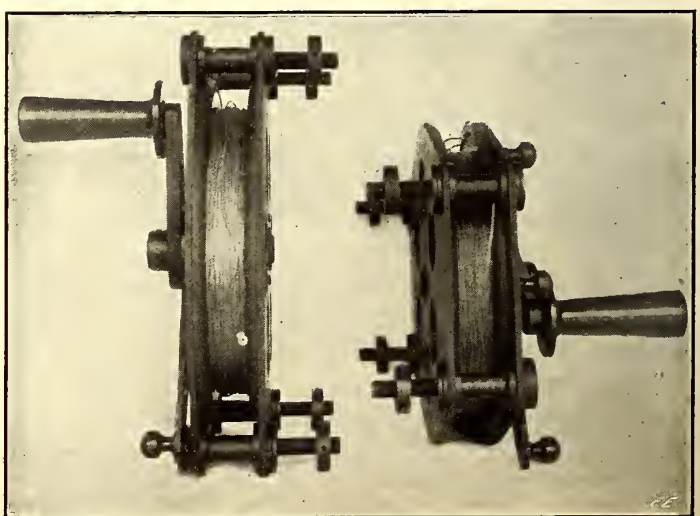
The connection between the antenna helix on the set and the antenna guide tube is as follows: The antenna helix is connected to the lower end of the cowl insulator as shown in figure by rubber-covered cable. The cowl insulator is connected with the antenna guide tube by means of a six-foot length of 0.180-inch copper tubing. The antenna wire is connected to the antenna reel by means of a hole thru the bakelite shaft on which the handle is fastened.

When properly installed, the antenna system should cause no trouble. The antenna reel may safely be operated while sending and is without doubt one of the most ingenious and novel features developed in airplane radio transmitters. This type of antenna reel is used in conjunction with the airplane transmitter described in the July issue of the *Radio Amateur News*.

The modern practise in airplane radiotelegraphy and telephony calls for the use of two antenna cables, let out from either side of the airplane. These cables have weights as usual.



View of Indicator Panel of Antenna Reel Device Fitted On Airplanes. The Length of Aërial Let Out Is Read Off Directly.



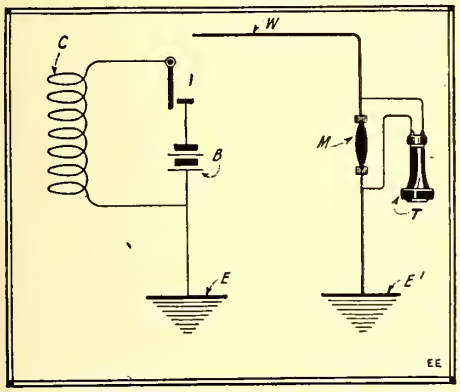
Two Sizes of Airplane Antenna Reels Are Here Illustrated. Note the Heavy Insulating Support Studs by Which the Device Is Supported.

How I Invented the Crystal Detector

By GREENLEAF WHITTIER PICKARD

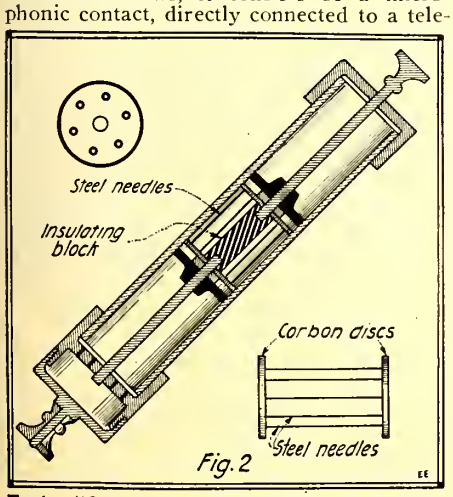
SPECIALLY WRITTEN FOR THE "ELECTRICAL EXPERIMENTER"

IN 1874 Prof. Ferdinand Braun discovered *unilateral conductivity* in a number of the natural metallic sulfids, such as pyrite, galena and chalcopyrite His observations were limited to the application of battery current to metallic contacts on the minerals, and he noted that a materially larger current would flow in one direction than in the other. Five years later, in 1879, Prof. D. E. Hughes, while experimenting with a carbon microphone, discovered that it was affected by a distant spark discharge, altho there was no wire connection between the circuits. Altho Prof. Hughes did not publish an account of his experiments until 1899, he exhibited his apparatus in operation, over distances as great as 1,500 feet, to many of the prominent English physicists, including Preece, Crookes, Stokes and Dewar. A glance at the circuit employed by Prof. Hughes in 1879 will show that he had the principal elements of the



Hughes 1879 Detector System. B Is the Transmitting Battery, C an Inductance Coil, 1 a Mechanically Operated Interrupter and E a Ground Connection. W is the Receiving Aerial, M a Carbon Microphone, T a Telephone Receiver and E¹ a Ground Connection. Hughes Discovered that the Carbon Microphone Was Affected by a Distant Spark Discharge. Fig. 1.

system re-discovered by Marconi in 1895. Undoubtedly, if Prof. Hughes had had proper encouragement at the time, he would not only have anticipated Hertz in the discovery of electric waves, but also Marconi, in their wonderful application to Radio-telegraphy, and so have altered considerably the course of scientific history. Our immediate interest in Prof. Hughes' work is, however, his detector. As my illustration shows, it consists of a microphonic contact, directly connected to a telephone receiver, and without local battery. It is the germ of the crystal detector.



Early "Carbon-Steel" Microphone Detector Used by the Author in 1902 at the Cape May, N. J., Wireless Station.

Dr. Greenleaf Whittier Pickard, Inventor of the Crystal Rectifying Detector. He is Well-known as an Electrical, Telephone, and Radio Engineer and Has Taken Out Numerous Wireless and Other Patents. He Has Tested 31,250 Crystal Detector Combinations.

The Coherer

In 1898, when my work in Radio-communication began, there was but one detector—the coherer. To the early workers in this field, the coherer was the *bête noir* of radio-telegraphy; the principal obstacle to assured and speedy communication without wires. Despite its unpleasant idiosyncrasies, the coherer had our deep respect, first because it was the only thing then known which worked, and second because of its *supposed* extreme sensitiveness to electrical oscillations. In the absence of any quantitative measurements, it was generally assumed that the received energy in radio-communication was so infinitesimal as to absolutely preclude its measurement or even detection by ordinary means, such as galvanometers or telephones, even if by some means it could be converted into a form suitable for these instruments. Altho in some of the early laboratory work with electrical waves various forms of thermo-couples and bolometers were used, the practical workers never considered these as possibilities in actual radio-telegraphy, because of the supposed extremely minute character of the received currents, to which such a device as the coherer could alone respond. In common with the other workers at that time, I held the same view of radio reception, and spent much time in attempts to improve the coherer as to regularity of action.

FEW inventions in radio have been made which proved of such tremendous importance to the young art than the Crystal Detector, invented by Dr. Greenleaf Whittier Pickard. In the olden days of the coherer, when we were still groping in the dark, only comparatively small distances could be bridged. The invention of the Crystal Detector may be said to have opened up an entirely new era in radio, for with the coming of this detector great distances were easily bridged and almost perfect communication was possible at all times. "Wireless" had arrived.

But you will want to read the story of how Dr. Pickard invented the Crystal Detector yourself. It is a historical classic. We promise you twenty minutes of most unusual as well as instructive reading.—EDITOR.

The Microphone Detector.

Much of the trouble in coherer working arose from the adjustments of the coherer adjuncts, the relay-tapper-recorder trio. Realizing this, in the latter part of 1899 I began experiments with a *single contact coherer,* in series with a battery and telephone receiver. I soon found, as several others did at about the same time, that a simple carbon steel microphone consisting of a sewing needle resting lightly against a carbon block, in series with a cell or two of dry battery and a telephone receiver, formed a most effective detector, exceeding the coherer in sensitiveness, speed of working and reliability. And, best of all, I found that this combination permitted a considerable degree of discrimination between Morse signals and static, which was not possest at all by the coherer-relay-tapper-recorder combination. All was fish that came to the coherer net, and the recorder wrote down dot and dash combinations quite impartially for legitimate signals, static disturbances, a slipping trolley several blocks away and even the turning on and off of electric lights in the building. Translation of the tape frequently required a brilliant "imagination!"

Altho the *microphone detector* was a

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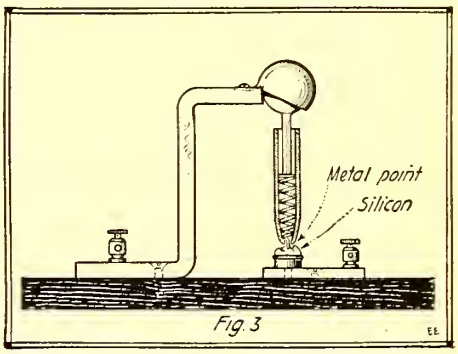
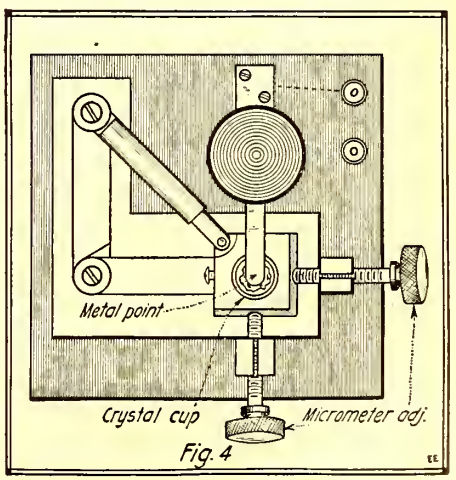


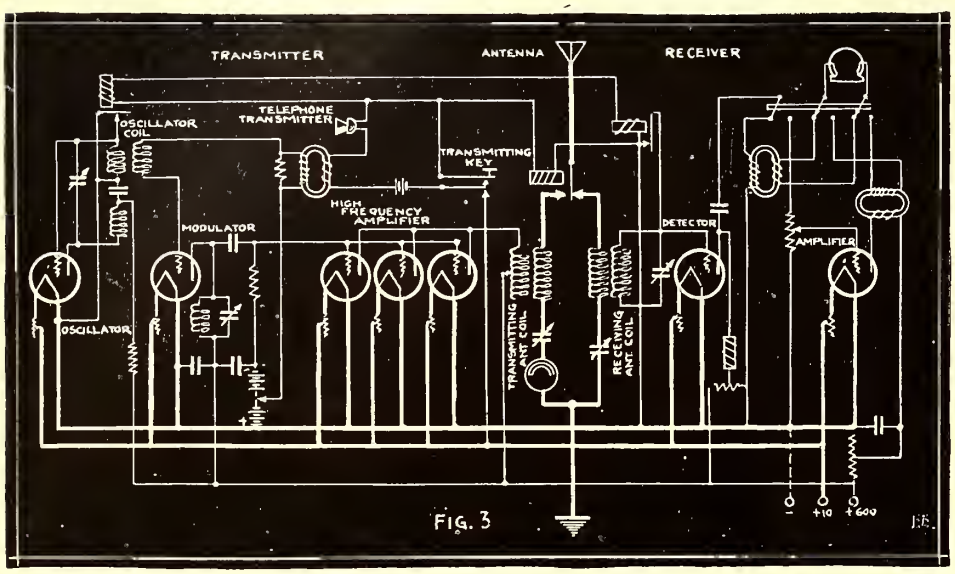
The "Silicon" Detector—A Good Old Standby of All Radio Operators. Invented by Dr. Pickard at an Early Date. It Involved a Sharp Metal Point in Spring Contact With a Piece of Fused Silicon.



Dr. Pickard's "Micrometer Adjustment" Detector. Can be Used With Any Crystal and the Cup Adjusted With Precision in Any Direction While in Use.

A Review of Radio-Telephony

RADIO-TELEPHONY has been before the public so frequently of late that an article describing the modern scientific apparatus that has made it possible would not go amiss, it is believed. No one man can claim the credit for *discovering* "radio-telephony," but electromagnetic waves of so-called "radio" frequency were first intentionally produced and studied by Hertz who was guided by the electromagnetic equations deducced by Maxwell, constructed some twenty years earlier. The first radio telegraphic outfit was produced by Hertz, and improved by the discovery of the coherer by Brown, and of the invention of the present form of antennae first by Tesla, followed by Marconi, which allows the radiation of large power by long waves.



Battleship Radio-telephone Set—Schematic Circuit Diagram. Showing Microphone Modulator Circuit, Talking Key, etc. Note How the Vacuum Bulbs are Connected on Parallel.

At an early date it was realized that a crystal detector in combination with a telephone would produce in the telephone, currents whose amplitudes varied approximately as the amplitudes of the received high frequency wave, and consequently if the amplitude of this wave could be varied at the transmitting station in accordance with speech, radio telephony would be possible.

The receiving apparatus was therefore in existence and all that was necessary was a means of *varying the amplitude* of the transmitting wave. In regular wire telephony, the amplitude is so varied by *microphones*, and of course this device was at once applied to radio-telephony. The great trouble lay, however, in the fact that microphones, even when especially designed, cannot easily be made to carry large currents and still function properly. Because of this handicap, numerous voice-operated resistance-varying devices appeared. Using methods of this kind, considerable success was obtained, and in 1912 Vanni succeeded in telephoning 1,000 kilometers.

During the years of 1912 to 1914, a great deal of research work was carried on in connection with the use of the audion in radio-telephony, and in 1914 it was decided that the apparatus was sufficiently developed to warrant an attempt at long range wireless telephony. These tests were so successful, that the Navy Department erected an experimental station at Arlington, Va. The type of power bulb used is shown in Fig. 1. The current, by which the filaments were heated, was supplied by a local power company and brought by underground cable to the station.

Alternating current was used for heating the filament and any possibility of the superposition of a 60 or 120 cycle note, due to the frequency of this current, was eliminated by the use of a special scheme of connections. Between the plate and the filament of the power tube a constant voltage of about 500 volts was imprest. It was obtained from one of the motor generators used by the Navy in operating the large Poulsen arc, with which they were then transmitting to Darien and other remote points.

The immense racks containing the power tubes are shown in Fig. 2. At the left in this figure is the remote control for operating the motor generator set in the main Navy radio station at Arlington, and also for metering the currents used for lighting the plant and other such auxiliary purposes.

The first opportunity to demonstrate the use of wireless telephony in war was presented early in 1916. After several trials and experiments, the first radio telephone set installed on a battleship was placed on the U. S. S. *New Hampshire*. This set differed from the one in Arlington only in size. The set was installed on the lower bridge deck, and the telephone transmitter and receiver were mounted on the bridge itself. This allowed the captain, while on the bridge, to converse without leaving his post.

After many successful trials, it was decided to install two experimental sets on other battleships and give the operating staff an opportunity to investigate and criticize them. These sets were installed on the battleships *Arkansas* and *Florida* at Guantanamo, Cuba, the first part of February, 1916. It was found entirely practicable to hold a two-way conversation between vessels over 30 miles apart. There is no reason to think that this was the limit of communication as some of these conversations were overheard in Jamaica, a distance of 175 miles. No attempt was made for range as that was not the object in building these sets.

Each set consisted of a transmitting and receiving set complete with motor-generators. An extension circuit was provided so as to allow placing a hand set in the captain's cabin. The normal position of the antennae was connected to the receiving set in order to hear incoming signals. When it was desired to talk, a push button operated a solenoid switch which connected the antennae to the transmitting set and started the motor-generator. This operation consumed only a fraction of a second. The wave length range of this set was from 600 to 1,200 meters. The complete circuit is shown in Fig. 3.

The greatest success with radio-telephony has been accomplisht in connection with military work in the air. On May 22, 1917, Major General Squier, Chief Signal Officer of the Army, called a conference at Washington to consider the feasibility of intercommunication between airplanes while in flight by means of radio-telephony. There were present at this conference, besides General Squier, Colonel Rees, of the Royal Flying Crops of Great Britain, Captain, now Colonel, C. C. Culver, of the Signal Corps, and Major, later Lieut. Colonel, F. B. Jewett, and Captain, later Major, E. B. Craft, who had been assigned

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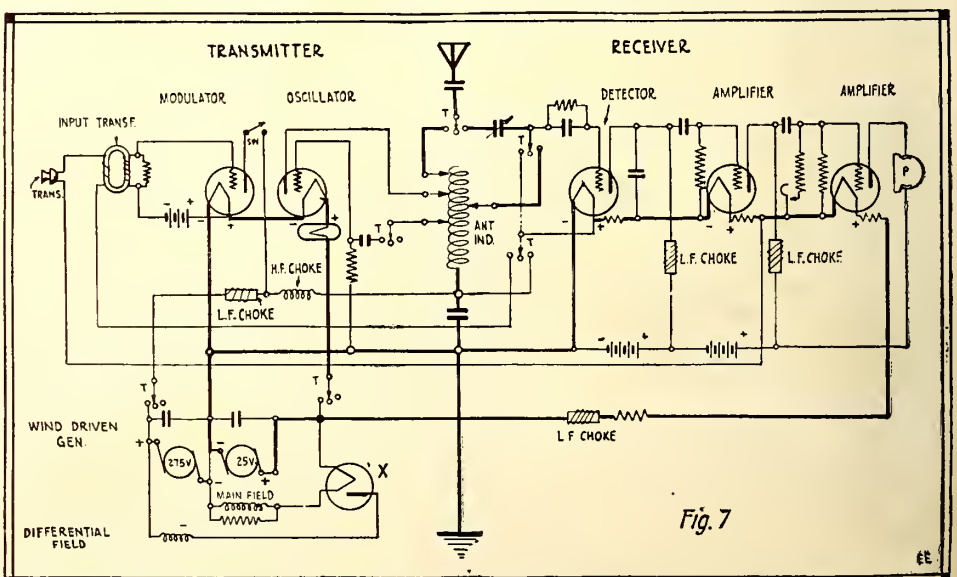
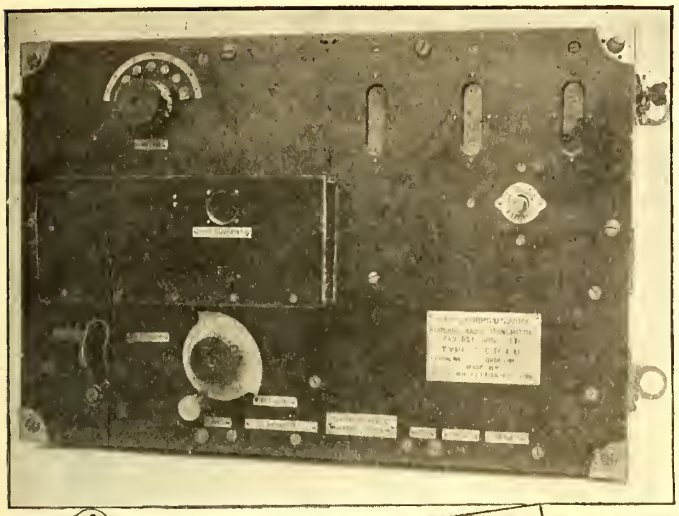
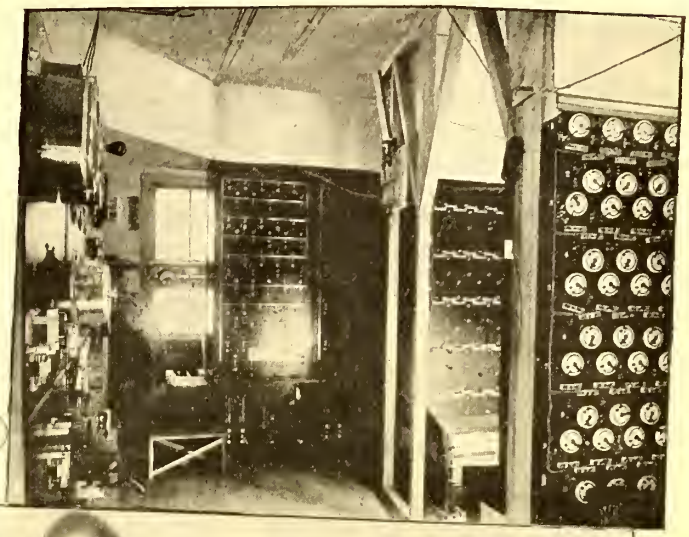
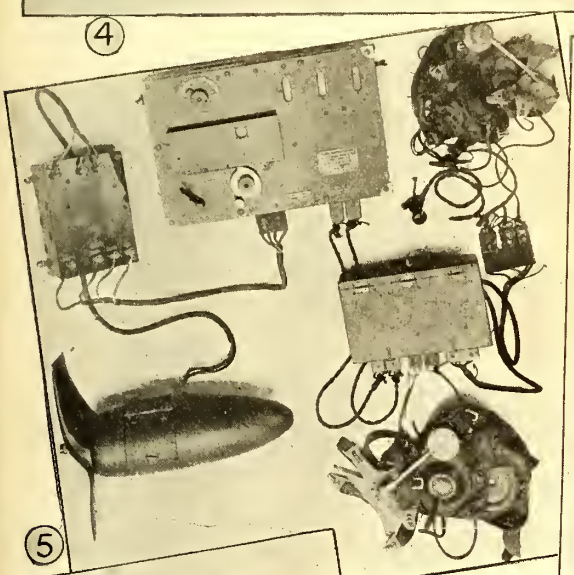


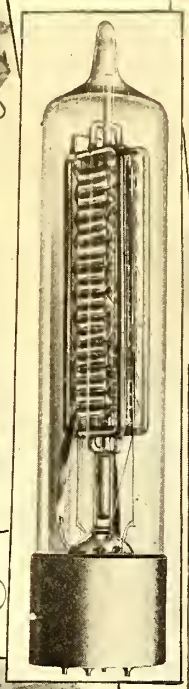
Schematic Circuit—Airplane Wireless Telephone Set, U. S. Signal Corps—Type SCR-68. Transmitting and Receiving Circuits Are Shown. "X" Indicates the Clever Vacuum Bulb Regulator for Maintaining the Dynamo Voltage Constant.

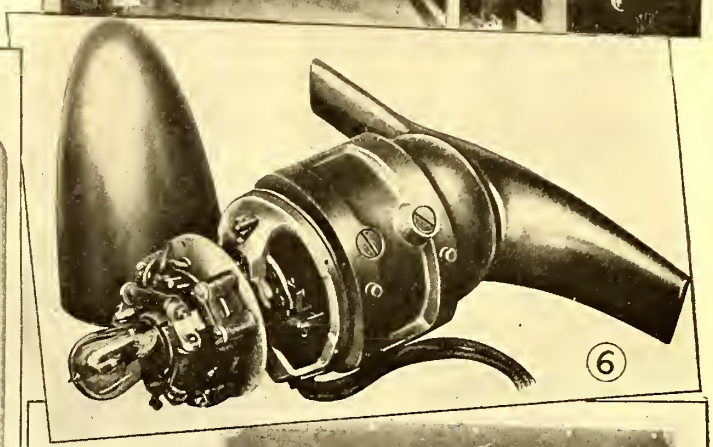
American Radio-Telephone Apparatus

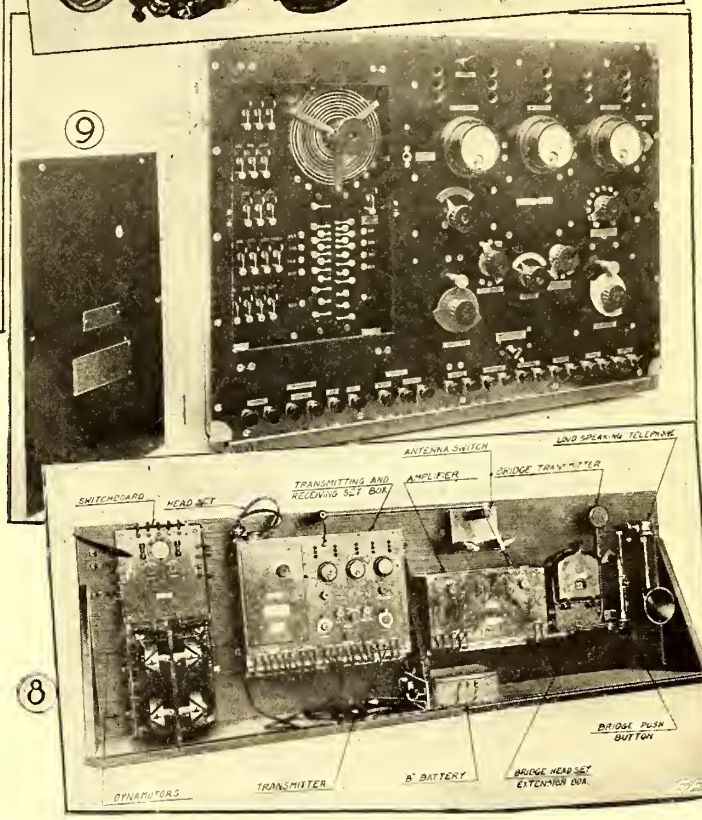


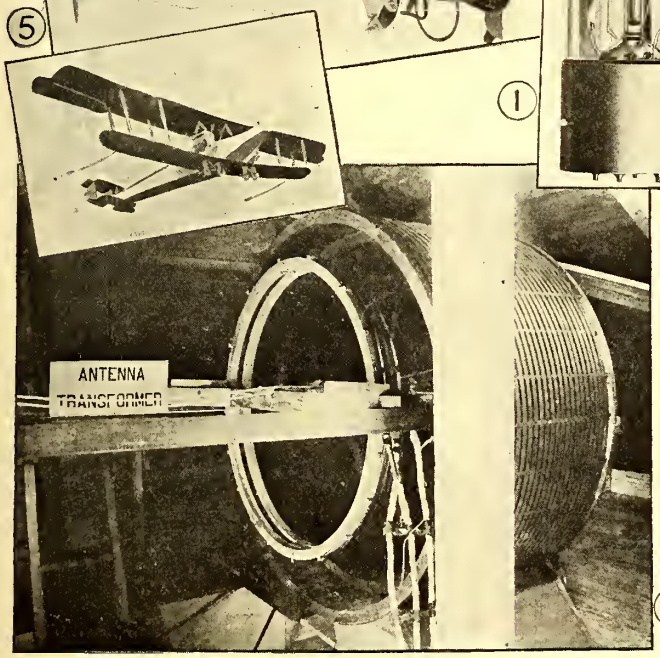












AMERICAN WIRELESS TELEPHONE APPARATUS DEVELOPED AND USED DURING THE WAR.

Fig. 1—Type of Vacuum Tube Oscillator Used in Long Distance Radio Telephone Work. Fig 2—Remarkable View Showing the Vacuum Tube Rack in the Radio Experimental Station at Arlington, Va. Note the Large Number of Rheostat Regulators for Controlling the Filament Currents of the Various Tubes. Several Hundred Tubes Were Available in This Laboratory, Any One or All of Which Could Be Used at One Time. Fig. 4—Front View of Transmitting and Receiving Set Used for Wireless Telephony by the U. S. Signal Corps. The Vacuum Tubes Are Safely Enclosed Within the Cabinet, and Their Degree of Luminosity Is Visible Thru the Oval Glass Windows in the Upper Right Hand Corner in the Panel. Fig. 5—This Shows the Complete Radio Telephone Equipment for Two-Place Airplane Service. Note the Two Helmets Fitted With Wireless Receivers and the Breast-Plate Transmitters, Specially Designed to Shut Out Noises From the Engine. The Wind-Driven Generator Is Shown at the Left. Fig. 6—View of Wind-Driven Radio-Telephone Generator with Stream-line Cover Removed, Showing Vacuum Tube Which Regulates the Voltage and Keeps It Constant at All Speeds,—an Extremely Clever Invention Due to an American Engineer. Fig. 8—An Assembled View of Various Apparata That Go to Make Up a Standard "Submarine Chaser" Radiophone Equipment. A Loud-Speaking Receiver Is Connected to a Three-Stage Vacuum Tube Amplifier. Fig. 9—This View Shows the "Submarine Chaser" Type of Transmitting and Receiving Set for Radiophony. Fig. 10—Shows One of the Gigantic Antenna Tuning Transformers at the Radio Experimental Station, Arlington, Va. The Secondary of the Tuning Transformer Is Moved In and Out of the Primary, by Means of Cables Which Run to Control Wheels in the Apparata Room. Some of the Most Important Radio-Telephone and Telegraph Researches Carried Out During the War Were Performed at This High Power Government Wireless Station.

Concentrated or Loop Aërials

By Prof. Lloyd M. Knoll, A. M.

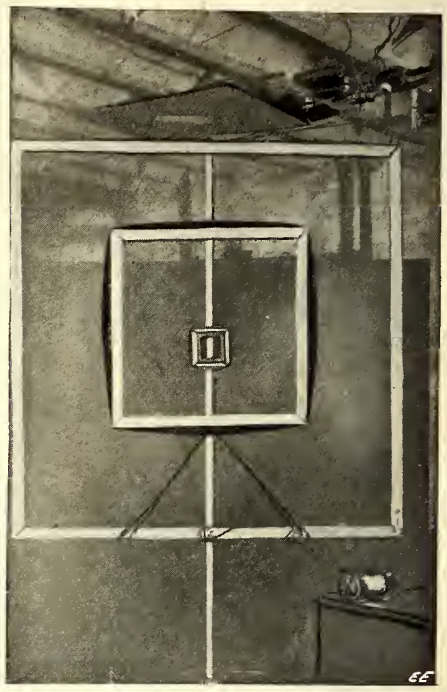
SEVERAL freaks and dreams of radio experimenters before the war have been realized in a device developed by the writer, in connection with the 4th Naval District. Not only does the device eliminate a large amount of interference from other stations of the same wave length, but like the Rogers underground system, eliminates

The Author and One of His Loop Aërial Radio Receiving Sets.

static as well, and being in a highly concentrated form it brings the outfit within the reach of the Radio Amateur. It is specially useful for the city wireless "Bug" who has limited space or a fussy landlord to contend with. It is no longer necessary to put poles on some high building, string aërials over large areas of ground nor even to tap an old 'phone line. The dream of the experimenter that some day he might put a nail in a flower pot for a ground and run a wire to a nail on the wall of his room is eclipsed and now the camper or tourist can pack a grip and be sure of always being in radio touch with the world.

Many operators will recall how it was easier to get certain stations when the aërial was disconnected from the set. This freak (?) set the writer and his friend, Mr. T. Appleby, to work to solve the problem of receiving regularly without an aërial and their results were put at the disposal of the government with the declaration of hostilities, and is only now being made public. Mr. (now Lieut.) Appleby discovered that the device had a strong *directional effect*. Later the writer concentrated the apparatus and discovered the way to eliminate static as well.

The extreme simplicity of the outfit is one of its most striking features. In fact the amateur has all the parts needed and early systems employed very much the same features but on a large scale. A loop of wire of proper proportions, a detector (a vacuum tube is most sensitive but not necessary), a pair of 'phones, the proper connections, and there you are. In the photograph may be seen a set in operation receiving on 2,500 meters wave length. Fig. 2 shows the receiving hook-up employed. As stated before there is a decided *directional effect* and if the loop is mounted in a vertical plane and rotated around a vertical axis, a remarkable fact is noticed. For example, suppose Fig. 5 to be taken as the circle described by the loop. Now if the signal is coming from a point along a line 210° from North, then if the end of the loop connected to the



Some of the Author's Loop Antennae. A Small Aërial of This Type Has Picked Up Messages From Stations 200 Miles Away.

grid of the audion or v. t. moves from A to B, there will be an increase and then a decrease in the intensity of the signal;

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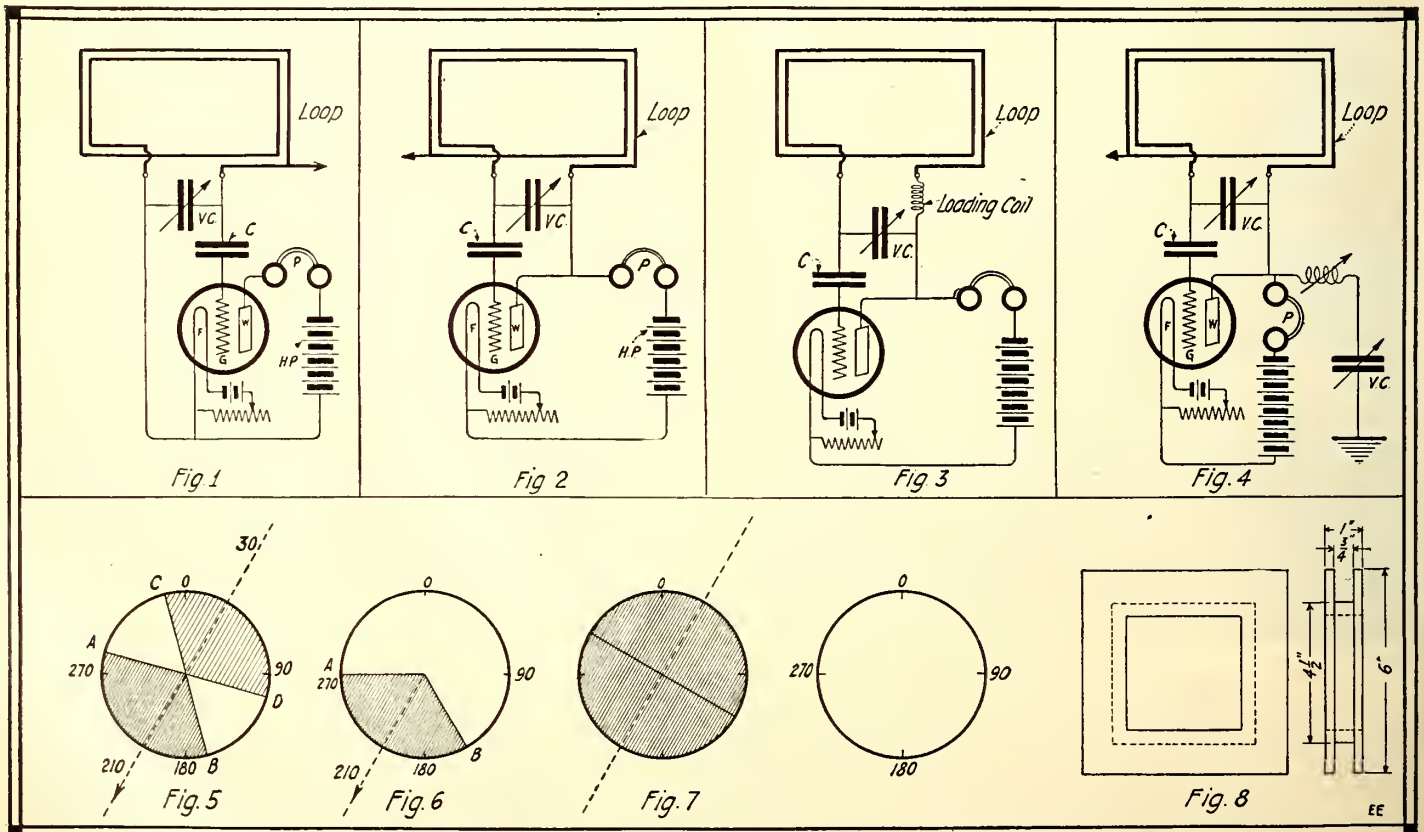


Various Hook-ups of Prof. Knoll's Radio Receiving Apparatus Involving Loop Antennae. The Lower Circle Diagrams Show the Relative Activities of the Loop Antennae.

To War on an American Destroyer

A Radio Operator's Experience Chasing the U-Boats

By A. H. WHEDON

TO begin with, let it be known that the author spent sixteen long, weary months with the United States Destroyer flotilla based in Queenstown, Ireland, and therefore feels competent to write the following few remarks.

The American destroyers arrived in Queenstown, Ireland, on the fourth day of May, 1917, after a ten-day trip across the Atlantic, during which time our radio transmitting apparatus was not used more than three or four times. You see, when we left the States we had no idea of what we were going into. Our idea of the German submarine question had been entirely derived from reading the newspapers. Consequently, we imagined that we would see a *dozen or so a day,* and that when a merchantship used her radio, several submarines got her position by a direction-finder, and sallied forth to attack her. Naturally, we were very quiet with our own radio instruments, and were terribly disappointed when we reached port without seeing a single "sub."

A "Lime-juicer" (English Sailor) Radio Operator Trying to Decipher What the Blankty-Blank the Yank's Code Message Means.

Don't Look at this Scene too Long or You'll Get Seasick. It Represents What the Radio Room on a "Destroyer" Looks Like In a Heavy Sea.

The Radio Room on the "Destroyer" Had a Leaky Ventilator in the Roof. What Didn't Happen in Those Two Awful Days Off Brest, France,—COULDN'T.

When we reached Queenstown, the British Admiralty Authorities came aboard to look us over and to hold a conference with our officers. One of the results of the conference was the determination to use the British method of radio-communication. They called it W/T (Wireless Telegraph). Of course, the code was the same, but there the resemblance between the two systems ended. And perhaps you think it was easy to forget, after years of thoro training, the things that came as second nature to us and to substitute absolutely new stuff—it was not very simple.

And when it came to working with the "Limy" (British) ships and stations—my, my! They sent at the terrific speed of sixteen to twenty words per minute. Twenty words was their high speed limit. The American operators who first went over there were all picked men, and their speed varied from twenty-seven to thirty-four, and to come down to sweet sixteen, once again meant hard work!

But gradually, as we operated with them, their receiving speed increased, and likewise did their transmitting speed, and again our troubles were increased. Very few of you, probably, have ever heard a "Limy" spark in action, but most of you are fairly familiar with the sound of a low frequency buzz-saw, and believe one who knows, there is not enough difference between them to be happy about. And then, when they started to speed up on a spark like that—can you imagine it?

Another trifling (?) detail (?) that bothered us was the fact that everybody and everything dashed off on the one wave length—600 meters. And altho there was an order out to the effect that radio work was to be reduced to a minimum, very few people ever took any notice of it. Consequently, in the Irish Sea there was an awful mixup, for on the English coast there are Liverpool, Fishguard and Land's End. Opposite them, a few miles away on the Irish coast, there are Belfast, Dublin and Queenstown, and when all of these stations are trying to work on the same wave length, to say nothing of all the ships in the Irish Sea, there is, to say the least, a *little* interference. But as the English boats are not equipt with an efficient wave changer, as are all our boats, nothing was ever done about it. Gradually the problem resolved itself into the equation: "The guy with the most power wins," for nobody would ever keep quiet long enough to let the other fellow work. There was a time when I, personally, had a message to send to Liverpool. It took 5 K. W. for 100 miles.

The English are not renowned for their quick perception. We found that fact out to our sorrow. Altho "playing flats" (unauthorized conversation) is not permitted in either Navy, there are times when it is necessary to talk to the other fellow about a message, or on similar subjects. Of course, such conversation must necessarily be as short as possible. In the U. S. Navy every word is abbreviated in this unofficial conversation. For instance, one operator wants to ask another "What is the check on message number one?" It would be transmitted: "Wht ck msg one." After the answer would come "Tks" for "Thanks."

There was an occasion when my ship, the U. S. S. *Conyngham* was in company with the H. M. S. *Snowdrop,* a boat of the "sloop" type, developed during the war. My sending set wasn't working any too well, but as I had a long message to send him, I decided to make a try at it. So I opened up and started. Very shortly I began to miss sparks, so I signalled over "ST BI 5 TRANS BRKN DWN," meaning "Stand by for five minutes. My transmitter is broken down." There was complete silence for a few seconds, while he tried to puzzle it out. Then he came back with a great big question mark. I thought it possible that I had been a trifle speedy for him, so I made a hasty connection and sent it again, more slowly. More silence. Then more question marks. By that time I had fixt my set up, and was just about to start in on friend "lime-juicer" with the message, when he came across with the conventional signal for "Your Morse is unreadable. Put a competent W/T operator on watch." That was all the thanks I got for trying to tell him to wait a minute.

There may be some of you who think that radio in the Navy is a soft job. Well, it is—on a decent sized ship that knows enough not to roll and pitch *all* the time.

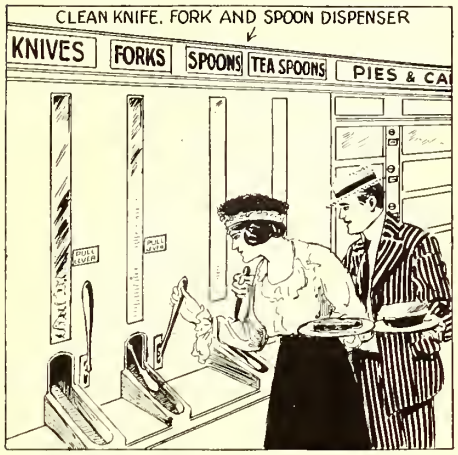
(*Continued on page* 367)

How to Develop Your Inventive Ability

By JAY G. HOBSON

(Author of "How to Finance and Manufacture a Patent")

AFTER many years of careful research into the mysteries of the human mind psychologists have concluded that every normal person is an inventor by nature, having inventive faculties to a certain degree.



The Automatic Restaurant Is a Clean Place To Eat, Isn't It? But Why Must We Allow People With Dirty Hands To Fumble Around In the Spoon, Knife and Fork Receptacle? Why Not Invent a "Dispenser" for the "Eating Tools?"

Many have developed these talents further than others, but the fact that we are all inventors naturally is of great importance to every one aspiring to create something of value to mankind and themselves. While we are assured that each individual is capable of creating, improving and originating new and useful things, yet most of us find considerable difficulty in deciding upon the best and surest course to pursue in order to develop our inventive qualities to a point of efficiency necessary to cash our ideas for their full worth.

Inventive ability is simply the power of close observation, scrutiny, imagination and analyzation of material things as they exist with the way they might be made to exist, if constructed in a different form. All things have at some time or other been the result of some dreamer's or some thinker's imagination and—observation crystallized into a mental picture, then developed until it has merged into actual form, a complete, improved article of practical worth.

The practise of observation, imagination,

Why Can't We Go to the Theatre and Find a Clothes Compartment in the Back of the Seat That Disappears Into the Basement When You Sit Down? Nobody Ever Thought of It!

constructive investigation and analyzation will develop this inventive ability and in time make it both perfect and prolific. But there are certain proven ways that help this development more than others. Idle curiosity over things will not promote the inventive training and is not constructive observation or investigation. Investigation, observation and analyzation must be done systematically and with a sincere aim in view. There must be a serious desire for betterment and improvement in mind to find that improvement or invention worth while.

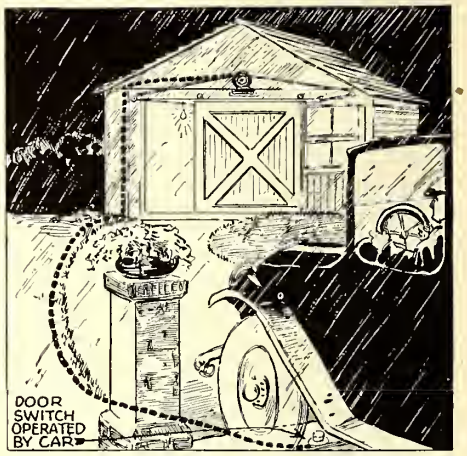
The great revolutionary inventions are few and far between, but when they do appear it is evident that some sincere mind has striven to create a working device of his mental picture which was undoubtedly conceived by a fervent desire to produce an improvement over unsatisfactory conditions as they were in the time of the conception. Or probably it was the aspiration to give the world a device that would save unnecessary labor, prolong life, or improve commercial intercourse for big business. However, it is establisht that to originate or create improvements of value, one must train his mind and imagination to picture things as they should be and then stick to his mental idea until it successfully matures into a practical device of certain operation.

There are numerous examples of inventive development but for illustration we will consider only a few. Elias Howe first observed the pressing need for a machine to do the tedious labor of sewing that in his day was entirely done by hand. After observation came investigation of his idea, then a mental picture or imagination of a machine capable of producing the desired result, then came analyzation of mechanical movements necessary to replace the human hand, and finally after years of discouraging effort he succeeded in designing and perfecting a model that not only did what the human hand would do but did it in one-fifth the time. It took Howe years to perfect his first machine mainly because in those days the art of mechanics was only in its infancy, which necessitated his working out of every mechanical detail. Today it is far easier for the inventor. He can conceive the idea, sketch plain plans and drawings and secure assistance to perfect the mechanical details. There are more and greater opportunities to become inventors today than ever. There is more money to be made and quicker. Elias Howe did not labor in vain as his invention made nearly two million dollars in royalties.

The incident of the hair pin and how its inventor observed his wife bending a straight hair pin to prevent it from coming out of the hair is a much hackneyed experience. But only recently an alert young man in Chicago conceived the idea of placing a hump in the neck of the old-fashioned hair pin to prevent it from coming out of the hair. A patent was obtained upon this extremely simple idea, they were offered to the feminine public in attractive packages and now sell by the millions. To date the inventor has made hundreds of thousands out of his simple little improvement, which only goes to prove that nothing is too small or too simple for our consideration and observation, if we would become successful inventors.

The simple ideas are, as a rule, more prolific and prevent infringement to a greater degree. After an idea is received the inventor should strive to picture it in the simplest possible form. *Simplicity in invention is the secret of patent success.*

There are five distinct ways in which the mind receives inventive ideas, namely thru the five human or physical senses; sight, taste, smell, feeling and hearing. A



Why Not Invent a Simple and Reliable Garage Door Opener? Thousands of Autoists Everywhere Will Not Only Bless You for It, But Will Buy Them by the Hundred. But It Must Be Cheap in First Cost and Maintenance.

person may see an improvement and patent it, or taste a flavor and create a better one, or smell an odor and design a device to eradicate it, or hear a situation and replace it with a different one.

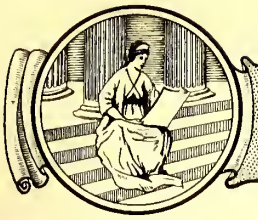
All inventions have entered the inventor's mind thru one or more of these five ideas-carrying channels before materializing into completed form. The mind is the oven or incubator for hatching these inventive germs and forming them into practical articles for earthly use. Therefore to develop one's inventive faculties it is necessary to develop both the five human senses and also the mind that controls them.

For the purpose of suggesting an effective method of development I will now ask the reader to join me on a little inventive expedition up among the clouds of creation.

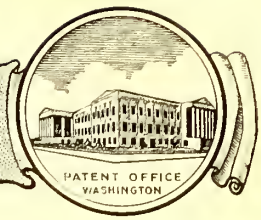
Our first imaginative stop will be in the office of a modern business man who is branch manager for a large eastern corporation. It is noon time and our friend decides to go out to lunch. We follow him down the avenue to a cafeteria. He en-

(Continued on page 338)

Can You Identify Yourself In a Strange City? You Could Do So With the Simple Pocket Case Here Shown, Containing Your Photo, Signature and a Cancelled Check Endorsed By You.



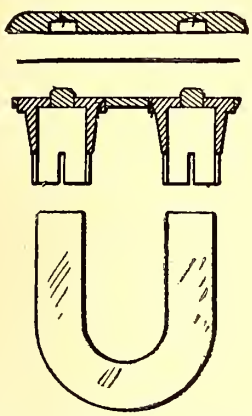
LATEST PATENTS



Magnetic Razor.

(No. 1,299,096, issued to Butler Ames.)

A very ingenious idea is this magnetic razor, which makes the cleaning of safety razors a very simple

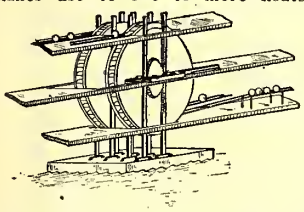


process, as the retaining cap over the razor blade may be instantly removed by pulling it off the magnet cores. The cap and blade members of the razor are adapted to be held in position by a guard member, by magnetic flux passing from one pole of the bi-polar magnet to the other pole, thru the blade and cap, which members are made of steel or other magnetic material.

Tidal-Power Motor.

No. 1,304,238, issued to Judson E. Wright.)

In this tide-motor the inventor makes use of one or more floats,

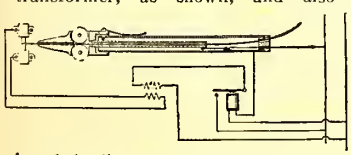


which rise and fall with the tide. The alternate up-and-down movements are made use of thru a pair of gear racks, acting alternately on a pinion or gear wheel as shown. One of the racks acts on the "upward" motion and the other on the "downward" motion, thus preserving a continuous rotary motion in the power wheel. When the action of the tide is low or nil, the power is maintained by a series of spherical weights acting on a bucket wheel connected with an auxiliary power member. These weights are carried to a higher level by the regular tidal motor thru a bucket conveyor.

Electric Soldering Device.

(No. 1,304,545, issued to Frederick A. Costello.)

This soldering device comprises a tubular holder resembling a pencil or pen holder, thru which the wire or strip solder is applied to the work to be united. This holder also carries a circuit-closing switch for the primary of a step-down transformer, as shown, and also

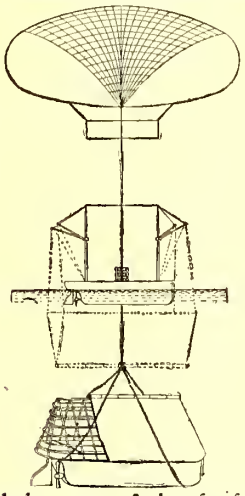


knurled "solder feeding" wheels. The electricity is used only in actually heating the solder when the same is placed in contact with the work to be united by this clever arrangement. A relay serves to open and close the primary circuit of the transformer in the manner evident.

Raising Submarine Vessels.

(No. 1,303,912, issued to Hideo Katayama.)

A clever idea for raising sunken

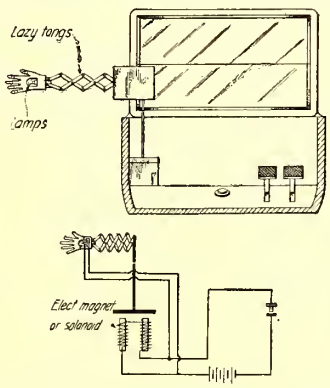


vessels by means of aircraft of the balloon or other type. In the first place, the surface of the upper deck portion of the sunken vessel is covered with a wedge of special pyramidal structure, so that when the balloon or other aircraft is connected with the wreck, as by means of slings, the buoyancy of the balloon may be utilized to greatest advantage. The slanting roof structure reduces the resistance of the body as it is lifted up thru the water.

Electric Semaphore for Autos.

(No. 1,299,361, issued to Hyman Lieberman.)

An electromagnetically operated semaphore for automobile signaling, two of which may be used on the car, one on the right and left, respectively. The device works by

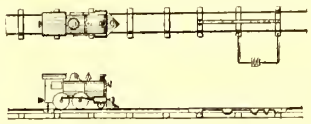


means of a lazy-tongs arrangement connected up to an electromagnet or solenoid. The driver has simply to close the electromagnet circuit with a foot-controlled push-button, when the electromagnet, becoming excited, causes the lazy-tongs to act, thus projecting the hand about two feet. At night the hand may be illuminated by an electric lamp in the palm, which can be seen from either front or rear, and also the fingers can be illuminated by a small electric light placed on each finger.

Electric Whistle for Toy Railroads.

(No. 1,303,117, issued to William C. Roe.)

This invention covers a design for a small electric whistle simulator,

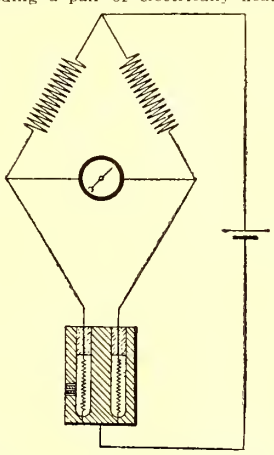


for electric toy railroads. A special circuit controller in the form of an auxiliary track member is provided, in the design here illustrated and described, so that as the locomotive and train pass over this auxiliary contact placed between the rails the whistle simulator circuit will be closed and the device actuated. The instrument is constructed in the form of a buzzer so as to give a high, shrill note, similar to a whistle.

Electric Gas Detector.

(No. 1,304,208, issued to Gilbert A. Shakespear.)

The definite rate of loss of heat from a body exposed to the gaseous mixture is employed as the detecting and measuring agency. A Wheatstone bridge circuit is utilized, including a pair of electrically heated

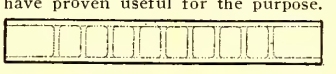


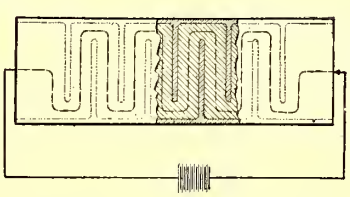
wires, one of which is surrounded by the gas to be tested, while the other is surrounded either by air or by any other gas, which can serve as a "standard" for comparison. A galvanometer is used to adjust the Wheatstone circuits to a state of balance.

Zigzag Carbon Resister.

(No. 1,298,421, issued to John Thomson.)

The present resister device renders the carbon element of the resister immune to oxidization, thus restoring the slotted member so as to maintain its original resistance at all times. To do this the slots of the resister are filled with a material having coefficient of expansion and contraction nearly identical to that of the carbon forming the resister. Fuzed aluminum oxid and silicon carbid in its crystalline form have proven useful for the purpose.

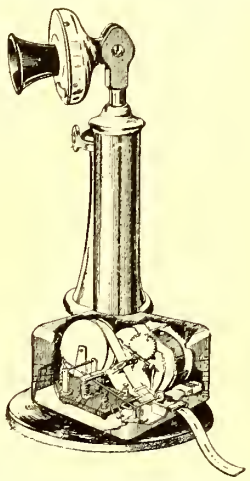




Telephone Call Recorder.

(No. 1,299,154, issued to Arthur Engelberg.)

This invention relates to an electromechanical device comprising a spring motor which will unreel a paper tape, and at the same time, by means of an electromagnet, cause to be recorded on the tape any telephone numbers of parties which may have called while the owner was absent. This device would seem to

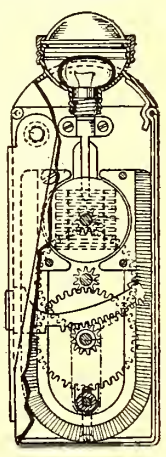


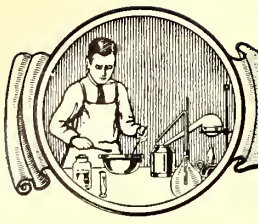
have considerable promise, and if taken up by the telephone companies should prove of great value as a time saver. The spring motor and electromagnetic recording device is controlled from the telephone exchange by "Central." Many times people call a party, only to find "that the line is busy" or else that "they do not answer," all of which wastes a good deal of time in the busy man's day. If the number calling was recorded in the office of the absent party, then upon their return they could call back the number in question.

Magneto Pocket Lamp.

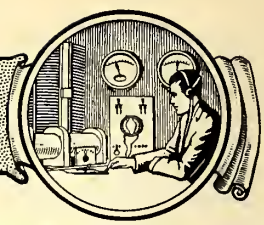
(No. 1,301,595, issued to Marc A. Pattay and Eugène Jaquemont.)

This is a clever idea in magneto electric pocket lamps, and represents several improvements over those heretofore proposed. Not only is it provided with a mechanism for spinning the armature of a small magneto generator, which develops the necessary current for lighting the lamp, by means of a reciprocating rocker arm, but it is also provided with a continuous circular movement crank operated independently and whenever desired by means of a change-over attachment. The device is ingeniously worked out, so that for ordinary lighting purposes it is but necessary to squeeze on the flexible casing of the pocket lamp, which causes the armature of the dynamo to be spun rapidly. No batteries are necessary, and by the arrangement of the mechanism in this lamp it would appear that the light should be practically continuous.





WITH the AMATEURS



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 each month for the best photos. Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $3.00 PRIZE WINNER—H. C. SMITH

I PRESENT herewith two photos of my laboratory and one of myself. My chemical laboratory has over 150 solid chemicals and about 100 different solutions. The glassware consists of beakers, Erhlenmeyer flasks, funnels, condensers, burettes, hydrometers, evaporating dishes, crucibles, graduates and retorts. It also includes a "French" microscope, a balance, and many other apparata too numerous to mention here. My "Electrical Laboratory" consists of various motors, generators, condensers, wireless transmitting and receiving apparata now in construction, also a switchboard under construction, ½ K.W. transformer coil and a two-inch spark coil. Unfortunately all of my "Electrical Laboratory" did not get into the picture.—H. C. Smith, 3816 S. Honore St., Chicago, Ill.

HONORABLE MENTION (One Year's Subscription to the ELECTRICAL EXPERIMENTER)—ROBERT NIESSNER and ROBERT BOHATY

HEREWITH are several flash-light photographs of the electrical laboratory and experimental machine shop of Robert Niessner and myself. In this laboratory we do all kinds of experimental and research work in chemistry, electricity, high frequency and wireless. This laboratory was started in 1917, and it is still growing very rapidly.

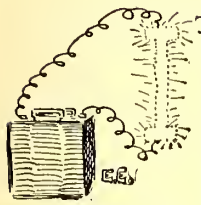
One of the photos (left) shows Robert Niessner, and the other (right) shows myself. Another shows a corner of our "office," where we do all the figuring and correspondence. One of the views illustrates our electrical testing bench and switchboard, and part of our chemical bench. We possess a large screw-cutting lathe on which we do all kinds of machine work. We have had this lathe only a short time and it has turned out quite a few dollars worth of work for us.

These photographs show only a small part of our equipment. We have all kinds of electrical motors, dynamos, generators, gasoline engines, steam engines, electrical testing apparata and a complete set of wood and metal working tools.

Among the magazines that we have in our "office" there is the ELECTRICAL EXPERIMENTER, which is of great value to us in our work. We also have many books pertaining to chemistry, electricity, steam and gasoline engines, et cetera.—Robert Bohaty, 434 East 77th St., New York City, N. Y.

Science in Slang

By EMERSON EASTERLING



IT was an Italian car, the chauffeur was an Italian, and he was delivering long accented discourses in galloping Italian. To be concise, the ignition system had gone on the "fritz" and the wop was "cussin" over the layout. Jazz Stokes and party, we, sat in the tonneau while the driver fingered and swore and smoked Turkish cigarettes.

"The name 'storage battery' is a misnomer," commented Jazz. "The juice is not stored as commonly conceded, but is generated or caused to circulate by the chemical action set up in the plates of the cell."

"How did the storage battery or secondary

Camille Alphonse Faure, Who Pasted Us a Hot One When He Handed Us the First and Original Pasted Gridplate.

cell come about?" asked "Rat" Morehouse, the bow-legged boy from Berkeley, California.

"Volta and Galvani started the ball in that direction when they got to monkeying around in the dynamic field, but the original storage cell was developed by a bird by the name of Planté. Gautherot got to shooting juice thru platinum wires in water and other electrolytes and observed that the little contraption was capable of kicking back a light current when the juice was cut off. The fact of the case was that he stumbled onto the accumulator idea when he was only trying to jerk the H_2O into O and a couple of packages of H. Electrolysis, that was his game. You remember, a lot of the scientists thought that ions was as far down as matter could be boiled—electrolysis did that. Like a lot of other things, the secondary cell was a secondary discovery—the inventor was not fishing for the cell.

"Two years after Gautherot's stunt, in 1803, Ritter constructed a secondary pile much like Volta's. By charging for a few moments with a strong galvanic current the pile would give quite a kick. The plates were copper disks separated by cloths moistened in sal ammoniac.

"Count Volta, Bequerel and a stack of other researchers became aware of the fact that gold, silver and platinum and some other nice metals would give secondary currents when subjected to electrolytic action in certain solutions.

"In 1842 Grove slipt us his celebrated gas (no, not mustard) battery. The big idea was the difference in polarity in the two gases, oxygen and hydrogen.

"Mike Faraday had the idea in his hand but did not close up on it when he found that peroxide of lead at the negative pole had a relative high conductivity. The old boy makes note of the fact in his *Researches.*

What Makes the Storage Battery Store?

"Until 1860, when Gaston (without the assistance of dear Alfonso) Planté threw a bunch of coiled lead plates together into a jar of solution, the old-timers never had the pleasure of seeing a *real* secondary cell. Gaston, with his plates of lead, lead peroxide and spongy lead, and finally lead sulphate in the sulphuric acid electrolyte, was able to run his battery down to where she took the count and then give her a shot of electric hop and watch her hump again. Metzger, Brush and some of the other highbrows boosted the Planté idea along until they had a fairly decent battery out of it."

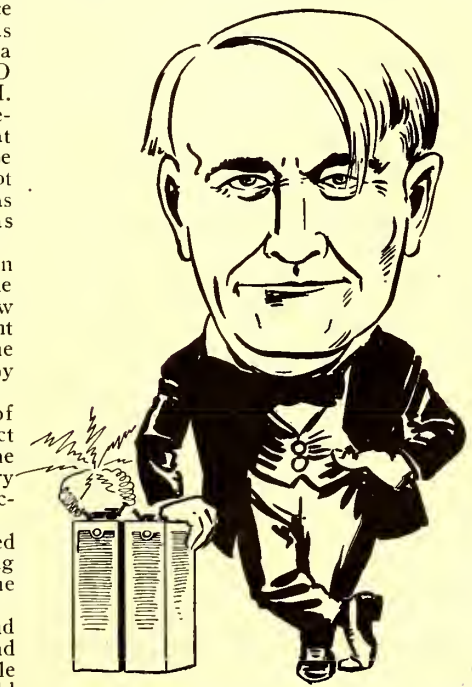
"What do you mean by lead, lead peroxide and spongy lead, and finally lead sulphate?" inquired Fred Cochran.

"To begin with, the plates are lead, unless the makers build up the plates from lead oxide and sulphates. The charging current turns the positive plate to peroxide of lead. The negative plate of lead sulphate is converted to spongy lead. The electrolyte is about 23 per cent. sulphuric acid in water. When I said that 'finally lead sulphate,' I was referring to the state that means curtains for the cell. A sulphated cell is like a car without gas or a ship on the rocks. Get the idea?"

"What chemical action goes on in the cell during charge and discharge?" asked Velt.

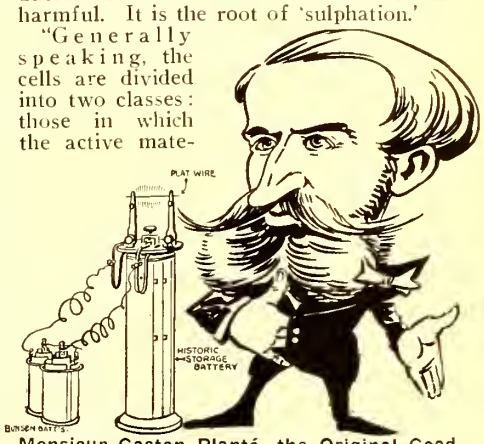
"It is like this," returned Stokes. "When the juice is sent through the cell, entering at the positive plate, the water is changed to its components, hydrogen and oxygen. The oxygen combines with the positive plate, forming lead oxide or peroxide. The hydrogen forms at the negative plate.

"On disconnecting the source and again closing the circuit, the water is again decomposed. The oxygen uniting with the hydrogen collected at the negative plate and with the plate itself, and the hydrogen uniting with the oxygen of the oxide of lead at the positive plate, causes a current to flow in the circuit that is closed. That is the simple explanation of the operation. There are minor and subsequent actions and reactions that take place, but the only one that makes any difference is the white insoluble sulphate formed by the red or yellow sulphates with the litharge. This formation is a non-conductor and otherwise bothersome and harmful. It is the root of 'sulphation.'



Tommy Edison Stept Off the Lead and Sulphuric Trail and Handed Us the Nickel-Iron Storage Battery.

"Generally speaking, the cells are divided into two classes: those in which the active material is formed by chemical or electro-chemical action, and those in which some easily reducible salt of lead is applied mechanically. Planté types are examples of the former and Faure types of the latter. The Gould batteries are made from the slow former process. The Willard batteries are also of the Planté type, while the Exide cells are of the Faure. The Faure type has a little better output for the weight, but the other has it over on them in sturdiness.



Monsieur Gaston Planté, the Original Goodness-to-Honest Storage Battery Kid.

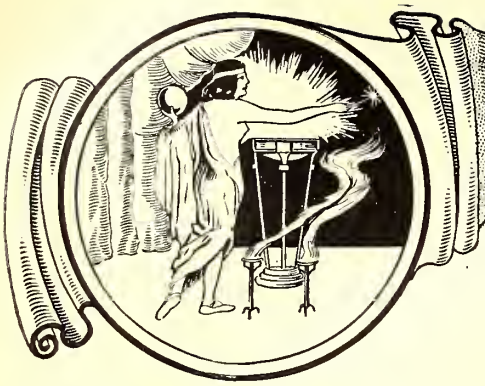
"Tommy Edison stept off the lead and sulphuric solution train of thought and handed us a new one with nickel and steel and iron plates and a twenty per cent. solution of caustic potash (omiting Perlmutter) for the electrolyte. The electromotive force is not as great as the lead type, but the ampere hours per pound is about half—the bulk being the same, practically, as the old line of cells. Upon discharging, the Edison cell shoves as high as three volts and higher onto the line, but decreases after the load sits on her. You are aware of the fact that the old lead accumulator gives out about two and four-tenths volts at the beginning of the discharge—if you did not know of it before, you do now. The old heavy type has it over on the Edison for constancy of current, but the selling point for the Edison is the lightness and mechanical robustness.

"There are other secondary cells that employ plates of bimetallical composition. The most satisfactory are the *zinc-lead, copper-lead,* and the *copper-zinc,* besides the Edison *nickel-iron* cell.

"Sacramento! Puerco! Blankety Blanko!" And a string of other stuff ending up with the statement that the *"automobile no bono"* and *"a infierno con todos!"* The wop broke in on our discussion—of Jazz's.

"I guess I will see what is the matter with the motor," said Stokes as he walked around the hood. "I've got a date with a blind man for a game of craps to-night."

In less than five minutes the Italian was saying *"gracias, signor"* and we were leaving a cloud of dust behind us.



THE ORACLE

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:

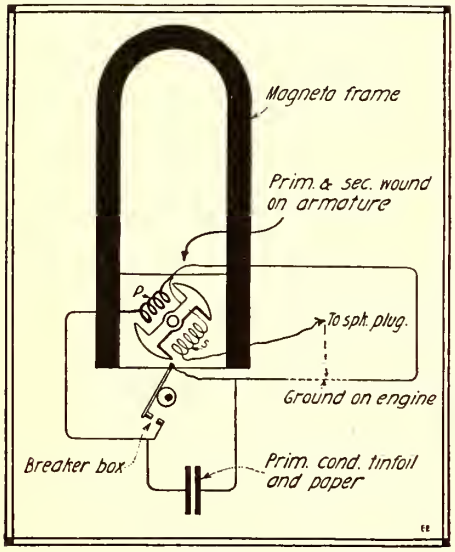
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail 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.

MAKING HIGH TENSION MAGNETO FROM LOW TENSION TYPE.

(1016) J. G. Whitfield, Goldsboro, N. C., inquires:

Q. 1. How can I change a low tension magneto into a high tension type?

A. 1. It is rather difficult to change a low tension magneto of the ordinary type into a high tension magneto unless you are quite familiar with the make-up and appa-



How a "Low Tension" Magneto May Be Converted into a "High Tension" Type.

ratus of the latest type machine. We are pleased to give you herewith diagram showing how most of these high tension magnetos operate.

In one of the modern high tension magnetos there are no revolving coils or commutators of any kind, but simply a rotating mass of iron, which is so formed as to cut the magnetic flux in the field many times per second. In this machine the primary and secondary windings are stationary, and undoubtedly you can obtain some information on this machine, as well as other high tension types, which may be of interest to you, by communicating with the various high tension magneto manufacturers.

RADIO ANTENNA QUERY.

(1017) Rolf Carbo, Minneapolis, Minn., asks:

Q. 1. For data on a radio antenna for amateur requirements.

A. 1. Regarding the type of receiving aerial which would be best, should be about 125 feet long, 75 feet high, and at least 4 to 6 wires spaced about three feet apart, which will prove very satisfactory for average long-distance reception and commercial wave lengths.

If you intend receiving amateur wave lengths it will be necessary for you to interpose a variable condenser in your ground circuit.

About the best thing for an all-around set, we advise a small coupler and audion, adapted to a great many ranges of wave lengths. Unless you intend to build a set to receive only undamped wave stations, we would suggest a very large loose coupler.

We refer to our September, 1915, issue of the ELECTRICAL EXPERIMENTER for excellent data on loose couplers.

To Our "Oracle" Friends

Do you realize that not one day passes when we do not receive from 150 to 250 letters addrest to "The Oracle"? If we were to publish all the questions and their answers we would require a monthly magazine five or six times the size of the ELECTRICAL EXPERIMENTER, with no other matter but questions and answers. Of late the influx of letters has become so heavy that several of our associates have been forced to discontinue important editorial work, in order to answer the mail. This we are certain you do not wish. You do not want your magazine to lower its present high standard. You want the best, the very best, and you know we never have failed you yet.

Moreover the multitude of letters are wholly unnecessary. Most of the questions Readers ask every day have been answered before in "The Oracle." Therefore, ere you sit down to write us, look over your back numbers, and nine times out of ten you will find the answer.

We strive hard to publish only such matter as has not appeared before in our columns, and for that reason, only a small fraction of the queries received by us are actually publisht.

Your magazine is steadily coming to the fore as the greatest publication in the scientific world. To keep up its present high standard and to make it a better and bigger magazine requires a tremendous amount of untiring effort on the part of the Editors. Therefore, in the future, we CANNOT in your own interest, answer questions by mail, free of charge.

For questions requiring an immediate answer our fee is 25 cents for the first three ordinary questions, and 25 cents for each additional question. We will gladly advise fee for special questions entailing considerable research work or calculations.

Stamped and addrest envelope should be enclosed with the queries, and moreover, any sketches accompanying them should be drawn in ink on separate sheets. Write plain and, PLEASE, PLEASE BE BRIEF.

Editor of "The Oracle."

STORAGE BATTERY QUERY.

(1018) B. W. Dresser, Homedale, Idaho, asks:—

Q. 1. Several queries on storage batteries, etc.

A. 1. Answering your first question, would advise that water for storage batteries should be distilled and kept in glass containers, as no matter what form of metal you might use, it is only natural that minute particles of the container will mix with the water. It is absolutely necessary for storage batteries, to secure perfect satisfaction from the same, to use pure distilled water absolutely free from any elements which might contain iron or any other metals.

The difference between the current and voltage for static machines and high-tension transformers does not vary very greatly, the designs of the machines and transformers having much to do with their outputs, tho the currents are about practically the same.

It is unnecessary to insulate the conductors of a rotor in a squirrel cage induction rotor. In the usual cases bare solid conductors are merely wedged in the slots of the rotor.

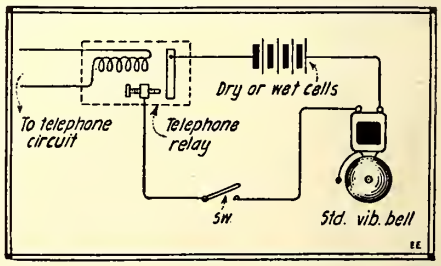
RINGING ALARM BELL FROM TELEPHONE CIRCUIT.

(1019) Theodore Mucha, Terlingua, Tex., writes:

Q. 1. How can I hook up an alarm bell to a regular telephone circuit?

A. 1. With reference to an alarm device for waking up a sleeping person, and to be connected to a telephone circuit, would say that several years ago the Editor installed a very successful form of alarm which will wake the dead.

In order to work this alarm, as the accompanying diagram shows, you will require a telephone relay. This can be pro-



Scheme for Ringing Extension Call Bell from Telephone Station by Means of a Telephone Relay. The Latter Instrument Can Be Obtained from Your Local Telephone Exchange or Supply House.

cured from any supply house at a cost of about $1.00.

The telephone relay is connected directly across the telephone line so that when the current is sent over the circuit, the relay will close the secondary circuit, in which you can connect batteries, electric horn or alarm bell, etc. You can also obtain, if you so desire, a large 6- to 8-inch telephone extension bell, which may be connected across the telephone line.

Solving the Transportation Problem

(*Continued from page* 303)

two main tracks, while a revolving pinion engaged with this rail rack. The train derived its energy from an electric third rail and shoe which operated the electric motor; this in turn worked the pinion.

In Fig. 3 is shown a later type of hydraulic shoe also operated under the water pressure and water suction plan. With this shoe very little water is lost.

100 Miles Per Hour—Safely.

From what has appeared, it will be seen that being that there is no friction, enormous speeds can be obtained with such railways. As a matter of fact one hundred miles an hour is a conservative figure. Nor is it dangerous to run such wheelless gliding trains at such speeds for two reasons. One is that there is no friction. There is no wear and tear of material, and if the flat rail with its guard rails (see Fig. 2) is constructed right, it will be impossible for the shoes to jump the track. And now we come to the most important point as far as the speed is concerned.

These trains it was found could be stopt almost instantly, and *very simply by cutting off the water pressure.* This maneuver brings the hydraulic shoe in direct contact with the rail and an enormous friction sets in. No brakes are needed to stop such a train. *The train is its own brake.* Nor is that all. Such trains can be stopt where *the rails dip at an incline of* 40%, a thing unheard of on regular railways with wheels. You see in a train of this kind there is nothing to roll and the minute the water pressure is taken off, the train must stop at once even at the worst incline. Inversely if the right tractive method is used to propel the train, it will run up almost impossible inclines at angles no regular railroad would ever think of attaining. Furthermore, in view of what has appeared, it will be realized that the cars do not have to be of such ponderous weight as are the present day ones. They can be constructed of aluminum alloy and could weigh one-quarter of the weight of the ordinary car and still be safe.

Former Disadvantages.

There was only one real disadvantage on a railway of this sort. During the winter the formation of ice and snow on the rails tended to put the entire road out of business because no means could be found to do away with the forming ice and its consequent unevenness or roughness of the track. This, however, would not worry our present day engineers for the simple reason that our trains would probably carry some electric heater in front of it, each train thus melting the ice as fast as it formed.

New Ideas by Mr. Gernsback.

We have today a means for propelling the gliding railroad, which is as simple as it is efficient. Our cover illustration as well as Fig. 5 show the means proposed. Fig. 6 also depicts the various methods used. The writer proposes the use of a single track, each car having two hydraulic shoes of the kind shown in Fig. 3. The car is held upright by means of the gyroscope shown. This gyroscope is to be driven by an electric motor and the energy is to be taken from a third rail running alongside the track. This also furnishes the power for the electric lighting system of the train and for the motors which drive the compressors as well as supply the power for the suction pipes. The propulsion of the train is accomplisht as follows:

Electro-Magnets Pull Trains.

The entire track must be supplied with *power (tractive) electro-magnets* sunk or led into the rail which latter should be of some non-magnetic material such as brass or bronze. The power electro-magnets are placed about six inches or so apart and run thru the entire length of the track. Normally these electro-magnets are not energized as will be seen by referring to Fig. 6. When it is desired to start the train, the conductor moves his *magnet-control lever* inside of the car. This lever at the lower end has a contact shoe, which when sliding over the contacts as shown, energizes its particular electro-magnet. In Fig. 6 it will be seen that two of these contact shoes are used. This is done so as not to have any dead points, as otherwise the train could not start. In this figure it will be seen that the rear magnet contact shoe has just closed its contacts, and the rear hydraulic shoe comes now under the influence of the energized magnet. This will tend to pull the rear shoe over the energized magnet. But the instant the pull starts, the train moves along as well and the contact is broken.

The momentum of the train, however, is sufficient to carry it along, and by this time the forward contact shoe will have energized the electro-magnet at the extreme right, shown at Fig. 6. The forward hydraulic shoe now comes under the influence of the energized electro-magnet and the train is pulled forward again. This play is repeated constantly and of course very quickly; within a few seconds the train has obtained a terrific speed. This speed increase can be regulated simply by an arrangement which lifts the electric contact shoe away from the contact rail, and by this means the speed of the train can be

(*Continued on page* 338)

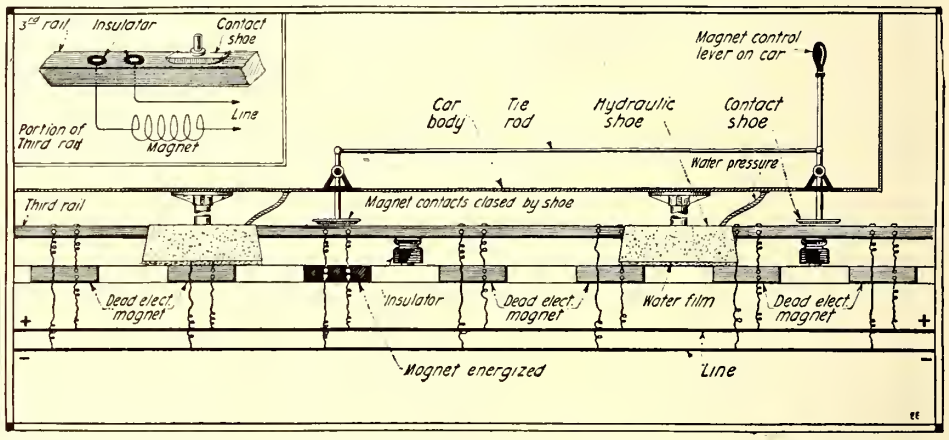


Fig. 6. Showing Mr. Gernsback's Arrangement for Propelling the Train by Means of Electro-Magnets. As the Train Moves One Electro-Magnet Is Energized at a Time, Which Exerts Its Traction on One of the Shoes, Thus Pulling the Train Along. Insert Shows Method of Making Contact with Power-Magnets.

Solving the Transportation Problem

By H. Gernsback

(*Continued from page* 336)

regulated to a nicety. In order to overcome the difficulty of starting the train with a bad jerk, it is in the power of the conductor to move the contact shoe forward or back, for a few inches. Thus the hydraulic shoes can be brought under the gradual pull of the electro-magnets by being a greater distance away from the energized magnets as shown in Fig. 6. For, the further the hydraulic shoe is away from the electro-magnet, the less the tractive effect will be.

In the writer's system, the train is stopt the same as by the French method, simply by withdrawing the water pressure. The hydraulic shoe then comes into contact with the track and the train stops almost immediately.

System Not Expensive

It will be argued that this magnet arrangement is a very expensive method, but this is not the case. These railroads are not intended for great distances, but will be mostly used in cities where first cost is of no consequence. Witness for instance the truly enormous cost of subway construction where the cost per mile frequently runs into millions of dollars. In the electro-magnet tractive scheme, like in all other railroads, it is only the first cost that counts, and it is very much doubted if the idea advanced here will make this railroad cost even one-quarter as much per mile as an ordinary elevated railway.

Another important plan which the writer advances, and which is shown impressively on our cover illustration, is that this railway is not intended to run thru the streets, *but rather over the house tops.* This is quite practical with such a railroad for the following reasons: Firstly, the single track will take away practically no light where it crosses over the streets. The track can be very light because the cars themselves are light. Also, there is but a single track, and consequently the structure that carries it can be exceedingly light. Secondly, there is no noise whatsoever. You cannot hear the coming or going of the gliding wheelless trains. They make absolutely no noise and *there is moreover no vibration.* The pillars supporting the track can be placed on two adjoining house walls as shown in our cover illustration; therefore no foundations are required. Stations can be located on the roof tops if desired, where they will not be as unsightly as at present. Elevators will take the passengers up and down.

Being that these railroads can be run safely at a speed double or triple the present day ones, it should be possible to provide a seat for everyone, no matter what the increase of the population will be. We cannot transport in the future many more people than our present day transportation facilities provide. Airplanes are out of the question for obvious reasons and so are airships for the reason that they cannot be operated quickly enough, and also they cannot carry enough passengers no matter what their size. Take for instance a New York Subway car when packed full will accommodate often as many as two hundred passengers, while a ten car train carries two thousand souls. From this it can be seen that neither the airplanes nor the airship can ever hope to compete with the wheelless trains as outlined above.

How to Develop Your Inventive Ability

By Jay G. Hobson

(*Continued from page* 330)

ters, steps in line, picks up his tray and proceeds to obtain his knife, fork, spoon and paper napkin. Directly ahead of him is a man with dirty face and hands who also fumbles around among the silverware probably touching our friend's knife and fork as well as his own. Our friend notices this and frowns, but sees nothing of importance about it other than the unsanitary annoyance for the time being.

At five-thirty P. M. we return to our friend's office and find him all prepared to drive home in his eight cylinder flyer; so feeling the need of fresh air we invite ourselves to go along. We haven't gone far until it begins to rain in torrents, but we don't bother as the top is up. Arriving home our friend turns into the driveway and as he nears the garage observes both doors tightly closed which means that he must get out into the wet to open them and that's no joke. He simply jumps out, gets wet and mutters things we can't record here.

Our friend's wife meets him at the door with the usual welcome and he feels greatly relieved amid the comforts of his cozy little home. Supper is served with our friend enjoying a good meal. During dessert his wife expresses her great desire to see a certain good play at the opera. Husband frowns inwardly for it is his preference to keep within the shelter of his home this wet evening. But observing his wife's earnest desire for additional amusement he strives to show some enthusiasm over the suggestion. They leave for the show about seven-thirty.

Arriving at the theater thirty minutes later they enter, taking their wraps with them to their seats. Past experience with the check room service has convinced them of this wisdom. The theater is crowded, every seat is occupied. There is no empty seat near them to lay their hot wraps on. Our friend must hold the collection upon his lap which doesn't add to his comfort. Along about the third act when the exciting part of the play makes everyone sit rigid with expectation, our friend is simply sweltering under the many woolen garments over his knees but he just sits there and suffers without one idea concerning the uncomfortable situation.

Returning home after the show our friend finds a telegram waiting for him. It is from headquarters instructing him to make a special business trip up-state to a city that he has never visited before. He prepares for the trip and leaves the following morning. But before leaving he acknowledges the company's wire and at the same time requests them to send him an expense check.

While en route to his destination he takes the hotel directory from the Pullman Library and selects what appears to be the best hotel in the city. He proceeds to this hotel and registers as usual. The following day the company's check arrives

(*Continued on page* 340)

Cigarettes made to meet your taste!

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CAMELS are offered you as a cigarette entirely out of the ordinary—a flavor and smoothness never before attained. To best realize their quality *compare Camels with any cigarette in the world at any price!*

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R. J. REYNOLDS TOBACCO CO., Winston-Salem, N. C.

Camel CIGARETTES

How to Develop Your Inventive Ability

By Jay G. Hobson

(*Continued from page* 338)

as requested. Being a total stranger in the city he asks the hotel manager to kindly cash said check, explaining who he is and the integrity of his superiors.

The manager very diplomatically explains that he has often heard of his fine company and would be pleased to accommodate him if he will just have some one identify him so that he can be sure our friend is the proper person. For it is possible, from the manager's point of view, that our friend could have found the check—that had happened before! Of course, the hotel does not mean to doubt our friend's honesty for one moment!

Turning around he rams the check deep into his pocket with a vow, to himself, that he will get that check cashed by the first bank he comes to.

Walking slowly down the main business street he runs into a friendly looking bank and he decides to try his luck in there. Approaching the cashier's window deliberately he shoves the check for a hundred toward the cashier with the remark that he would appreciate the favor. The cashier excuses himself for a minute and retires to one of the financial reference books for information about the company.

Promptly returning to his money cage the cashier politely informs our friend that he would be pleased to favor him if he will obtain additional identifications. Our friend is almost desperate by this time and requests the cashier to take him to the president of the bank. The president is courteous but assumes the same stand about further identification as the others. Our friend's spirits dropt very low from this last retort. But glancing down on the expensive mahogany desk of the president he accidentally observed the national emblem of an organization to which both he and the president belong and quickly makes this known. The president's face softened and after a few hand shakes the cashier is summoned with instructions to honor our friend's check which was accomplished among expressions of appreciation.

Now shifting our minds into reverse we will return to our friend's first experience in the cafeteria and see what, if any, improvement was suggested by things that transpired. This simple little test of observation will help to show how far your inventive abilities have been developed. The more observing mind would have received an idea of value after seeing that man with dirty hands mussing over the silverware. A mental picture of a sanitary dispensing machine for knives, forks and spoons would have appeared. A machine with levers to operate the dispensing of the silverware so that only one pair of hands would touch the silverware to be used by them. This would be an improvement of worth.

The incident at the garage should have suggested a device to automatically open the doors as soon as the automobile came near enough to put it into motion. Possibly a small electric motor attached to the doors with a bumper switch to come into contact with the front tires of the auto. After the small motor had propelled the doors sufficiently to allow the auto to enter, there would be a cut-off switch on the end of the door that would stop the motor.

Then at the theater our friend's discomfort should have suggested an improvement in seats. One with a clothes compartment in the back that would open when the seat was bent forward and close and disappear thru the floor when the seat was pushed backward.

Being check-bound away from home in a strange city without anyone to identify you is no joke, for I speak from experience.

The trained observer's mind would have pictured a device in the form of a small pocket case with his picture in one side and across the picture would be signed his official signature. In the other side would be secured a cancelled company's check bearing his signature, the stamps of the different banks and clearing houses it has past thru on its way back to the company; and on its face it is marked PAID. This old check would be compared to the new one. The signature on the picture and on the old check and on the hotel register would be compared together, which would be all the identity necessary to obtain the money needed.

A few months ago I was visiting friends in the evening. They owned a popular phonograph that they played for hours each evening and fully enjoyed every moment of it. This particular evening that I called they refrained from playing even as much as one short record, and I could not quite understand the unusual situation. Being by nature somewhat nosey about unusual conditions I inquired of the cause for their abstinence. The husband frankly confest that he had neglected to stop by the music store for a very important accessory necessary for proper playing of their instrument. This explained, I exprest my regret but immediately an idea flashed thru my mind that there was a great need for a small device to make this important accessory.

For weeks I kept turning that spark of an idea over in my mind trying to picture a machine that would be satisfactory for the purpose desired. Finally I pictured it in detail and soon constructed a working model that proved efficient. Then I applied for broad patents both in the U. S. A. and foreign countries. It is about ready for the market now, but in justice to the manufacturers it isn't possible to explain definitely all about the construction and origination until ready for public announcement. However in a later article I shall show several drawings and give a complete explanation of the invention.

Bomb Expert Eagan

(*Continued from page 296*)

use among the Italians. These bombs were made by Italians who had been employed in fireworks factories in Italy and in America. The cause for the placing of the bombs was feuds among the Italians. A section of the city became known as the "bomb centre."

While walking in a section of the east-side on a fair May day, in the neighborhood of East 11th and 12th Streets, I was stopped by a policeman from the East 5th Street Police Station House. "I was just up to the station house and sent a call for you," he said. "Why?" I queried. He answered, "We have located a big package down in 11th Street, which looks like a bomb, and the people in the house have left their apartments, fearing it will explode."

Upon arriving, I ordered all the children away from the place, and then started to operate upon the bundle. To my great surprise I came upon *two fulminate of mercury caps attached to two fuses, and twelve sticks of 40 per cent. dynamite put up in two separate packages!* To each six sticks of dynamite, a fulminate cap was attached. The bundle was surrounded on all sides with heavy pieces of iron, bolts and small pieces of slugs. It was then covered with burlap, which in turn was covered with newspaper and bound with

a heavy wire. In all, the bomb weighed about thirty pounds.

With the development and common knowledge of explosives of the nitro-cellulose group, chlorat and nitrat mixtures disappeared and the number of composite nitro-cellulose and nitro-glycerin bombs has increased and many ingenious combinations of the above mentioned methods of ignition have been devised, showing that much keener minds and men well trained in chemistry and the use of explosives have made these later type bombs.

Speaking of Large Bombs.

The first bomb of this type, the "Cunard Bomb," discovered in 1902, was the largest bomb I ever handled. This type was very rare then, but it is now "the usual garden variety." The Cunard bomb was of the nitro-glycerin class mechanically detonated. The bomb consisted of 100 lbs. of 60 per cent, dynamite, placed in two boxes, each containing 50 pounds. These boxes were set inside a larger box within which was set a *timing device* which would set off the fulminating caps and detonate the explosives. The timing device was set to explode when the ship had proceeded two hundred miles from the coast. The man who made the bomb was discovered in a tenement and was found to be insane.

The O. K. Bottling Works Bomb was of the nitro-cellulose type, mechanically and electrically operated, as was evident from the circumstances, weight and size of container, the express charge and the debris. On the morning of December 12th, 1913, a small pasteboard box was delivered by the Adams Express Company and was received by the stenographer, Miss Anna Amusewitz, who laid it aside until she had opened the mail. The bookkeeper who was in the office when the bomb exploded and who survived his injuries, stated that Miss Amusewitz cut the string, thereupon an explosion occurred. The office was wrecked, Miss Amusewitz was hurled into the corner and died within ten minutes. The perpetrator was never discovered.

The Herrara Bomb was of the nitro-glycerin group, chemically ignited. The circumstances were similar to those of the O. K. Bottling Works Bomb, which killed Miss Amusewitz. Mrs. Herrara was killed outright and her husband was totally blinded.

The Taylor Bomb, the second manufactured by Klotz, was of the same type and made by the same person. This bomb killed Mrs. Taylor under the same attendant circumstances as noted above.

My own fingers were blown off by a bomb of the same description and manufactured by the same man who sent it to a prominent man in New York City, (Judge Rosalsky), related Inspector Eagan.

Shortly after the third bomb, Herman Klotz, a draftsman and former employee of the City of New York, was mortally injured by a bomb he was making. Klotz confest to these outrages before his death in the Fordham Hospital.

Since the beginning of the European War, bombs have been of an improved type and are modelled along the lines of munitions used by the European Belligerents.

The Fay Bomb manufactured by Lieutenant Commander Fay, of the German Imperial Navy, was of the alkaline metallic nitrat and chlorat type, mechanically detonated. The bomb case was of steel plates welded together by 100 rivets, and a riveted cover with a water-tight gasket. The interior was filled with a chlorat, nitrat, sulfur and antimony mixture. There were two detonating devices, one within the steel case and the other one the exterior. The exterior mechanism was attached to the propeller shaft of the steamship and the rotation of the shaft tightened the spring on the interior me-

chanism so that when the spring automatically released, it tript the firing pin which exploded the percussion cap, thus detonating the chemical mixture.

The Recent "Gimbel Bros." Bomb.

The late nation-wide Post-Office Bombs were composite bombs of the nitro-glycerin, alkalin, metallic, chlorat type, manually, mechanically and chemically ignited, and were the work of a trained, experienced expert, who knew chemistry, explosives and the psychology of his victims. These nineteen bombs were similar in composition, but not in operation, to the bomb which killed Governor Steunenberg of Idaho. See photo of bomb.

The latest bomb outrages known as the "Anarchist Fighter's Bombs" were of the *high explosive* type. The details cannot be divulged at this time, but the destruction surrounding the residences where the bombs were set off tells the tale all too well.

There are many foolish bomb scares—from diamond studded wrist watches, sent without notice, to one of the Four Hundred's latest debutantes, to a piece of copper ore sent to a mining engineer or a new kind of cheese sent to a prominent patron of the Waldorf-Astoria, who is a connoisseur of famous cheeses, or it may

***INSPECTOR OWEN EAGAN** holds perhaps one of the most unique positions in the world. Mr. Eagan is the official bomb opener in New York City, where during the last decade more bomb outrages have been perpetrated than in any other community in the world. Mr. Eagan has consented to publish some of his experiences in the columns of the ELECTRICAL EXPERIMENTER, and we feel certain that every reader will be intensely interested in Mr. Eagan's experiences. Inspector Eagan has opened thousands of bombs in his past career, only once being injured, when he lost a finger of his left hand due to the premature explosion of a bomb.*

be a box of coals containing a ticking alarm clock which has been sent to the Italian barber in the corner barber shop. These jokes cause much worry and excitement and should never be perpetrated. In one case I found a woman in a serious condition, due to the receipt by messenger of a package the inner wrapper of which was decorated by skull and bones and a warning of death. Arriving there and removing this cover, I extracted a bottle of plain "Pluto Water"!

The latest bombs were not the only ones sent to prominent persons.

Carnegie Mansion at Ninety-first Street and 5th Avenue was the scene of a bomb discovery. Another bomb was discovered outside the offices of the Italian Consul at 212 Lafayette Street. These were of the nitro-glycerin class, manually ignited by the application of a match to the fuse.

The late Honorable Mayor Gaynor was the recipient of a similar bomb which was discovered outside his office window with three burnt matches, and a piece of Chinese lighting punk which showed evidence of having been ignited.

The wealthy and prominent persons of our city are not the only victims to have these unreliable and unexpected packages sent to them. Two bombs were placed in churches in this city. Two bombs were placed in moving picture houses on the East Side. One bomb tore away the stairway and gallery. Even tenements suffer as much as mansions and private residences.

Bomb-Making An Unhealthy Vocation.

The "bomb maker" is not particular where he manufactures his infernal ma-

chine. A cellar in an East Side tenement, the laboratory of a prominent hospital, an abandoned shack in the marshy sections of the suburbs, the servant's room of the mansion, a suite in the most modern apartment house, perhaps in the next apartment wherever you may be living. *Bombs, strange as it may seem, have been made by many types of men, in all degrees of education, wealth and state of life.*

In the bomb factory in the rear of a quiet and prosperous barber shop, the proprietor was killed by an explosion and upon the examination of his body, a little carelessness in placing a too highly reactive chemical in his pocket was found to have caused the end of his career. This rear room contained enough chemicals to stock a small drug store, sufficient dynamite to clear Long Island of tree stumps and enough modern fire arms and ammunition to make envious a "would-be" Jesse James.

The making or setting of bombs is not a safe and lucrative occupation or hobby, as many of these men meet destruction by their own bombs. The greatest death toll paid by bomb makers occurred in the top floor of a six-story apartment house on Lexington Avenue, between 102nd and 103rd Street. Three anarchists, Hansen, Carron and Berg were killed. A brother of Louis Berger, who used a fictitious name "Murphy," escaped death with severe injuries. The force of the explosion destroyed the three upper stories of this building.

During the war I was kept busy with the routine work of the Fire Department cooperating with the Police, Federal authorities, Defense authorities and in the instruction of agents who were assigned to the investigation of various enemy activities. The signing of the armistice brought its train of trouble with shells, rifle and hand grenades, fuses and every imaginable war relic which contained explosives. Many fingers were torn off by grenades exploding in the hands of children."

Mr. Eagan Only "Official Bomb Opener."

At this point we ventured the question: "How many men are engaged in this kind of work, Mr. Eagan?"

Mr. Eagan's answer is illuminating: "The only official bomb opener other than my own unique position, was the Imperial Chief Inspector of the late Czar of Russia, who held an exalted place in court circles and received a fabulous salary. I am one of the hard working, loyal American citizens in the Civil Service of this City, accepting an humble salary and have secured my position by long and trying experience, constant study and research."

To the question: "How did you engage in this mysterious and dangerous work?" Eagan's answer is to be found in the indomitable spirit of his race.

"As a boy, my Mother would relate to me the mysteries of Cleena, the Fairy Queen of County Cork, Ireland, whose invisible palace was on my great grandfather's estate near Fermoy. The spirit of delving into the occult and mysterious was early developed and not lacking the necessary nerve and grit, I went to it."

The telephone bell rang. "Another bomb," laconically said the inspector.

"Here's my card. Ring, if you get a package," were his last words as he dived into the express elevator. I looked at his card. This is what it says:

OWEN EAGAN.
BOMB EXPERT.
Fire Headquarters. Worth 4100.

U. S. S. TENNESSEE ELECTRIC DRIVEN.

The U. S. super-dreadnaught Tennessee is a sister ship of the California, now being built at the navy yard, Mare Island, Cal., and which is to be launched in the fall. The Tennessee is 624 feet long, 97 feet 5¾ inches in width, and has a draft of 30 feet 6 inches. She displaces 32,600 tons and has a speed of 21 knots. She has eight water tube boilers and a fuel capacity of 1,900 tons. Her armament will consist of twelve 14-inch guns, fourteen 5-inch guns, four 6-pounders, four anti-aircraft guns, and two torpedo tubes. She will be manned by a crew of 58 officers and 1,024 men. She will burn oil exclusively and will be equipt with electric drive.

Man's Greatest Curse--Infected Teeth

(*Continued from page* 301)

"Tooth infection is undoubtedly transmitted from person to person in the same family, from parents to children, by means of kissing, the use of common drinking and eating utensils, and many other ways. So, if one has infected teeth, he is not only dangerous to himself, *but may transmit this infection to other members of his family, especially his children,* and produce serious conditions which are difficult to explain. One is appalled at the condition of the first teeth of children, many of whom have to have their first teeth filled. Often the second teeth become infected from the first set and the child carries thru life the result of the neglect of the teeth, on the one hand, and the transmission of the parent's infection, in addition.

"Consequently, we feel justified in advocating radical measures in eliminating the infection from children as well as adults, and that means extracting all infected teeth, whether in children or adults, as soon as there is evidence of infection.

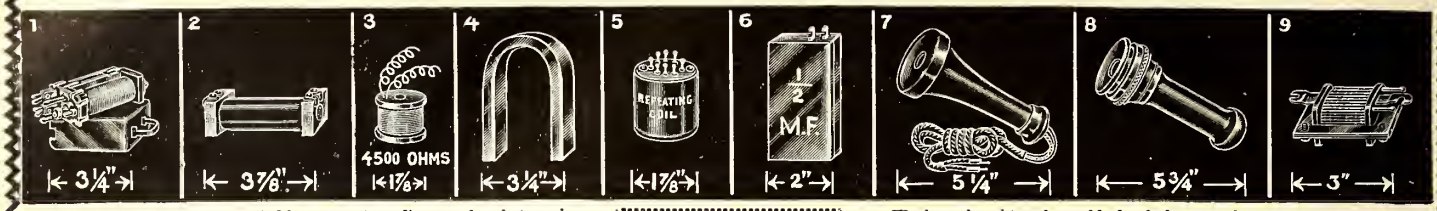
Conditions Resulting from Infected Teeth.

"As we give further attention to the subject of chronic infection of the teeth, we are finding more and more conditions resulting therefrom. At first, *the relation of infected teeth to rheumatism* was demonstrated by Hastings in 1914. This was a very important discovery, for this disease had baffled physicians who could find no definite cause for it and many fanciful theories were put forward to explain the cause. *Not only can rheumatism be prevented by intelligent care of the teeth,* as outlined above, *but in many cases it can be cured by the simple method of extracting infected teeth.* Possibly the most common ailment of people in general today is summed up in the general term 'stomach trouble,' and often this condition resists all attempts at eradication by the ordinary methods and may persist for years, causing the patient to drag out a miserable existence. In the majority of cases, infected teeth are at the root of the trouble, and if the condition has not progrest too far, extraction of those teeth, so fondly cherished for years, may clear up the chronic stomach trouble.

"We have proven conclusively that the infection of the teeth, after years, may spread to other organs of the body and cause disease in these remote regions, which disease has apparently no relation to the teeth, but, nevertheless, the infected teeth are directly responsible for the condition. The bacteria which grow and propagate

(*Continued on page* 347)

FOR EXPERIMENTERS ONLY!!



WE have in the past held many extraordinary sales, but we believe that the present one eclipses all by the wonderful values we are offering. The goods which we offer on this page are all standard telephone apparatus. Every piece we are offering is equipment that for one reason or another was discontinued by the telephone companies. If you wanted to buy any of the pieces which we offer herewith, from the manufacturers, the price would at least be ten times what we are asking for it. You can readily ascertain this for yourself by looking over our wonderful prices.

RUSH

Cut out and attach to your order. It will leave us within 24 Hours.

We have bought a large block of these goods and have a large quantity of every item on hand. Immediate shipment can be made on all of the goods in practically any quantity within reason. *Shipment within twenty-four hours* will be made if you use the adjoining coupon. This coupon saves you several days and your order will then be considered a rush order. We guarantee every piece to be as represented, and we will refund the money if goods are not exactly as claimed by us.

No. 1 TELEPHONE RELAY, 1500 ohms—has two silver-contact springs and is very sensitive. Can be used wherever a sensitive relay is needed. It is adjustable and can be used for a variety of purposes.
No. 1 Relay—shipping weight, 2 lbs. Price..... **$1.50**

NO. 2 STANDARD TELEPHONE Induction Coil, primary 1 ohm, secondary 55 ohms. Used wherever you need a good induction coil. Has primary and secondary and iron wire core; fibre heads.
No. 2 Induction Coil as described—shipping weight, 2 lbs. Price..... **$0.50**

NO. 3 STANDARD RESISTANCE wound with German silver wire—4,500 ohms, can be used as a choke or plain resistance, and has many other uses that readily suggest themselves to the experimenter.
No. 3 Standard Resistance as described—shipping weight, 4 oz. Price..... **$0.40**

NO. 4 HORSESHOE MAGNET, size 3¼ inches wide x 5 inches high. Will lift about 1 lb. Quality euch as used on magnetos, which means the best.
No. 4 Horseshoe Magnet — shipping weight, 2 lbs. Price..... **$0.30**

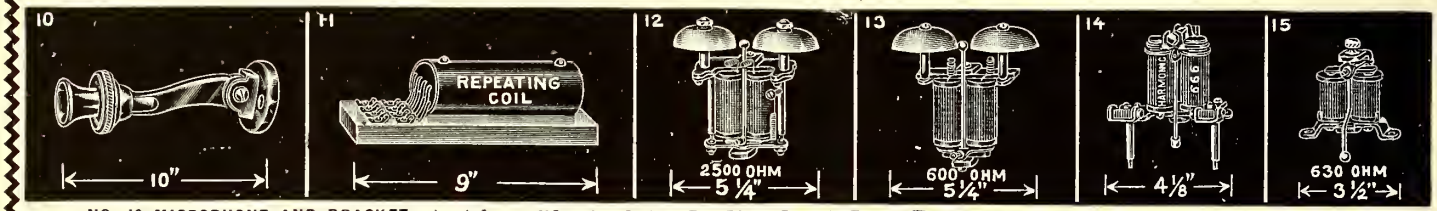
NO. 5 REPEATING COIL (Transformer). This is a standard small repeating coil and is used by all telephone companies. It has 4 different windings and eight contacts. Entirely enclosed in iron. The resistance being respectively 72 and 120 ohms, and 90 and 100 ohms. Diagram is furnished. Can be used for wireless, for boosting signals, etc.
No. 5 Repeating Coil—shipping weight, 2 lbs. Price..... **$0.50**

NO. 6 ½ M.F. CONDENSER. This is a standard telephone condenser and has ½ microfarads. Condenser comes in neat metal casing. This condenser is used in connection with spark coils to absorb the vibrator spark. Invaluable for test buzzers to absorb spark and make the sound of buzzer more steady. Is also used by every experimenter in connection with wireless where a fixed capacity is needed. Several of these condensers should be in every experimenter's laboratory.
No. 6 Condenser, ½ M.F.—shipping weight, 1 lb. Price..... **$0.50**

NO. 7 DOUBLE POLE BELL TELEPHONE RECEIVER—hard rubber casing with 4 ft. cord and tips. Standard 75 ohms—very powerful magnets. This receiver can be used in connection with any ordinary telephone work, and you will even find it sensitive enough for short distance wireless work.
No. 7 Bell Telephone Receiver—shipping weight, 3 lbs. Price..... **$0.80**

NO. 8 STANDARD TELEPHONE RECEIVER with Metal Head. This receiver is made by Stromberg Carlson Co., with genuine hard rubber handle and ear cap. A very good fool-proof as well as sensitive receiver that cannot be put out of order if you try. Used for the same purpose as No. 7 Telephone Receiver.
No. 8 Standard Telephone Receiver—shipping weight, 3 lbs. Price..... **$0.75**

No. 9 IMPEDANCE COIL (Close Core Transformer). This is a very fine little transformer and is used extensively in connection with telephone work. It is in reality an A.C. transformer for which you would pay $5.00 if you had it made to order. The primary has 0.15 ohms, secondary 2000 ohms. It can be used for a variety of purposes that will suggest themselves to every experimenter. Can be used successfully to boost wireless signals. Also in connection with audions, etc. An A-1 instrument. Size 3 x 3 inches.
No. 9 Impedance Coil—shipping weight, 2 lbs. Price..... **$0.65**



NO. 10 MICROPHONE AND BRACKET. An A-1 sensitive microphone of the carbon grain type. Has hard rubber mouthpiece and enamel steel bracket, the instrument being 10 inches long. This microphone, in connection with our No. 7 or 8 Receiver, will constitute a complete telephone outfit, good to speak 50 miles or more, at a remarkably low price.
No. 10 Microphone and Bracket—shipping weight, 5 lbs. Price..... **$1.00**

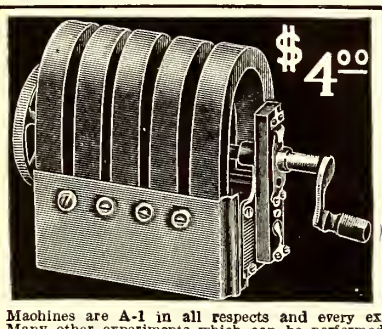
NO. 11 REPEATING COIL (Transformer). A standard repeating coil used for telephonic work. The coil windings are encased in an iron tube 2¼ inches in diameter. There are eight terminals for the four windings to connect to and the instrument is invaluable in connection with radio work to boost up eignals, audion work, etc. Many interesting uses will be found for this coil. Resistances are: 100, 120, 145, 175 ohms.
No. 11 Repeating Coil—shipping weight, 8 lbs. Price..... **$2.00**

NO. 12 POLARIZED RINGER with Bells. The resistance of the two coils is 1250 ohms each. The armature is perfectly adjustable. Bell will work on any magneto. We also furnish blue print with ringer showing how *a first class polarized relay* can be made by anyone using only a few pieces of metal and screws.
No. 12 Polarized Ringer with Bells—shipping weight, 2 lbs. Price..... **$1.50**

NO. 13 POLARIZED RINGER with Bells. This is the eame kind of ringer as the No. 12, except that it is not adjustable and that the resistance is less. First class in all respects. Blue print furnished with this to *make polarized relay* same as with No. 12. Solenoids on this ringer are worth more than the price we ask for the entire ringer, and do not forget a powerful magnet that goes with it.
No. 13 Polarized Ringer with Bells—shipping weight, 2 lbs. Price..... **$1.00**

NO. 14 HARMONIC RINGER. This ringer is also polarized and has a powerful magnet. It works on 66.6 cycles and any magneto will operate it if run at a certain speed. A very finely built instrument. Resistance of each coil being 200 ohme. Can be converted into a polarized relay by substituting a very fine leaf spring instead of the heavy one furnished. A most interesting instrument with which to experiment.
No. 14 Harmonic Ringer — shipping weight, 4 lbs. Price..... **$1.60**

NO. 15 RINGER without Bells—630 ohms. This also is a polarized ringer and has an adjustable armature. The adjustment is done by means of the top screw. A beautiful little instrument. With this instrument, too, we furnish a blue print showing how a *polarized relay can be built.* You should have several of these beautiful little instruments. They are worth their weight in gold; the powerful magnet alone being worth more than the price we ask for the entire instrument.
No. 15 Ringer—shipping weight, 2 lbs. Price..... **$0.80**



No. 55 5-bar magneto, 110 Volt A. C. Generator

This is one of the most powerful magnetos ever built, when manufacturers could afford to put good stuff into them; equipt with transmission, make and break, etc. Transmission wheels are all brass, crank handle furnished. This magncto, as well as the other ones listed below, will light a 110-volt lamp merely by turning the crank handle slowly. While this magneto gives alternating current only, it can be rewound so it will light up a number of four, six and 10-volt lamps, all depending upon the thickness of the wire you wind on the armature. As we furnish these magnetos, they will give a powerful alternating current and you will not be able to stand the current when grasping hold of the terminals. This makes an ideal shocking machine. All our generators can be transformed into a direct current machine by equipping it with a home-made commutator. Machines are **A-1** in all respects and every experimenter should have one of them in his shop. Many other experiments which can be performed with this machine will readily suggest themselves to any experimenter. The magnets furnished with these generators are very powerful, each one being able to lift one pound easily.

NO. 55 5-BAR MAGNETO GENERATOR as described—shipping weight, 25 lbs. Price..... **$4.00**

NO. 33 3-BAR GENERATOR, same as described above except that it has only 3 bars, and is somewhat emaller.
No. 33 3-bar Generator—shipping weight, 10 lbs. Price..... **$2.00**

NO. 44 4-BAR GENERATOR, same as No. 55 except that it has 4 bars, and is somewhat smaller.
No. 44 4-bar Generator—shipping weight, 15 lbs. Price..... **$3.00**

NO. 66 6-BAR GENERATOR, same as No. 55 except that it has one more magnet and the armature is somewhat larger and more powerful. This is the biggest type made and is extremely powerful.
No. 66 6-bar Generator—shipping weight, 30 lbs. Price..... **$4.50**

Complete Wall Set

This is a complete commercial telephone station. The cabinet is of polished oak, piano finish, within which is contained the powerful magneto, the 300 Ohm polarized ringer, and induction coil. The magneto is exceptionally efficient, being of the two bar type with brass gear transmission. The extra sensitive microphone, mouthpiece and two gongs are mounted on the front of the cabinet, giving the entire instrument that desirable appearance of compactness and efficiency. Guaranteed to work over 20 miles. The telephone receiver is a double poled one, and has a hard rubber case. Seven binding posts are provided for connections. The instrument is one which we can offer with pride to our patrons at a ridiculously low price. It is unobtainable anywhere else at less than $15.00 and is an instrument unequaled in value for the price we ask. Size over all 11" x 10" x 8". Shipping weight, 15 lbs.
No. 26 Long Distance Telephone Set..... **$8.00**

CARBON GRAIN TRANSMITTER

A special design of transmitter for long distance work. Is used on wireless telephone sets where a steady current of ¾ to 1 ampere is constantly required. Sizes over all 3¼ x 2½ inches. Shipping weight, 3 lbs. **No. 6080 Carbon Grain Transmitter as described..... $1.00**

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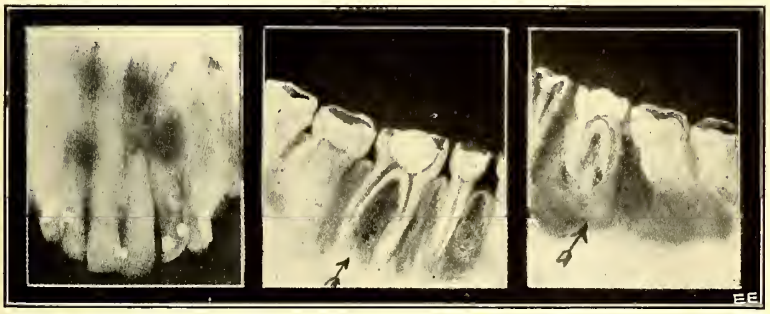
Man's Greatest Curse--Infected Teeth

(*Continued from page* 345)

at the roots of infected teeth must have an outlet, especially if the tooth has been crowned and all means of drainage from the upper part of the tooth is thereby cut off. *Then the bacteria filter thru the bone in which the teeth are embedded, which bone is microscopically porous, and from the organisms or bacteria gain access to the lymphatic system and migrate to other organs and set up a secondary focus of infection.* When this condition occurs, it is easy to understand that the mere extraction of the offending tooth will not clear up the condition but the infection must then be eradicated from this new focus.

"We have various methods of locating these secondary *foci* of infection. If the tonsils are infected as a result of infected teeth, *the teeth should first be extracted and then the tonsils removed.* If the stomach is infected, an examination of the contents will show the presence of this infection and it can be treated by means of vaccines, but always *after* the infected teeth are extracted. In the more serious conditions the *intestinal tract* may be the seat of the *secondary infection* and, by means of the X-ray certain things relating to the function of the intestines may be found and intelligent surgical aid may have to be invoked.



Three X-Ray Views of Infected Teeth. The Two Right-hand Radiographs Show Abscesses Indicated by Arrows: The Dark Patches In the Left-hand Radiograph Indicate Abscesses. This Photo Was Taken Down Thru the Top of the Mouth, the Patient Holding the Plate in the Mouth Between the Teeth.

"There can be no doubt that many unexplained diseases have their origin in infected teeth. Thus Barker, at the Johns Hopkins Hospital, has shown that many cases of *pernicious anemia* have recovered when the infected teeth are extracted. It has also been shown that *serious heart conditions, diseases of the kidneys*—commonly known as 'Bright's Disease'—*diseases of the gall bladder* and many other diseases may be the result, directly or indirectly, *of a focus of infection originating in the teeth.*

Nervous and Mental Diseases Due to Infection

"Finally, the most serious result of infected teeth is to be found in the relation of this infection to *nervous and mental conditions.* We have been for years groping in the dark, trying to find a cause for these unexplainable conditions. We have considered mental diseases as something apart from general diseases where such things as worry, grief, fear, overwork, and many other elements are usually given as the cause of disease of the mind. Since we have found at the State Hospital at Trenton *that many of the patients suffering from mental disease had also very serious chronic infections of the teeth, tonsils, and gastro-intestinal tract,* and that by **eliminating these infections our patients recovered,** we are justified in concluding *that these chronic infections play a very important role in the causation of the mental condition.* Of course, other factors, such as we have mentioned, have a profound effect in lowering the vitality and allowing a latent infection to become active.

"By recognizing the fact that mental diseases may be the result of infection and the toxemia or poisoning due to this infection, we have been able to restore many patients, who with our former methods of treatment, became chronic patients and remained in the hospital until the time of their death. *Thus we have been able to discharge 87 per cent. of the patients admitted to the hospital in the last nine months, whereas for a period of ten years, the proportion of discharges to admissions was only 43 per cent.* In other words, we have *doubled* the number of patients who leave the hospital as a direct result of our researches.

"As a prevention of mental diseases, then, it would seem that the proper care of the teeth is of the utmost importance, and we would emphasize the fact that the proper care is entirely different from what the usual dental examination reveals, *and that only by refusing to have devitalized teeth* (teeth in which the nerve has been destroyed), *crowned, or otherwise preserved, and insisting upon having these teeth extracted, can we hope for better teeth and prevent infection, which later will have serious consequences.* This is a matter which can be controlled by the individual and it is the public in general who can bring about a better state of affairs by insisting upon good dentistry, in the sense we have explained, and by not allowing the kind of dental work which preserves the teeth to the detriment of the patient's health. Such results as we are trying to obtain can only be brought about by educating the public in these matters, as well as the medical and dental profession. For this reason we believe that the widest publicity should be given to these facts and their importance emphasized both from the standpoint of prevention and cure.

CONCLUSIONS.

"We feel justified in summing up the results of modern scientific medical and dental investigations as follows:

1. That bad or infected teeth are extremely prevalent and because they cause no symptoms to the patient are often unrecognized.

2. That these same infected teeth may be the source of many serious and often fatal diseases, including nervous and mental diseases.

3. That the only known prevention of the effects of this infection is to have all devitalized teeth removed as well as the teeth known to be infected.

4. That one should not allow devitalized teeth to be capt or crowned nor pivot teeth to be placed on old roots but insist that these teeth be extracted.

5. That all persons should keep in mind the danger of transmitting this infection to other members of their families, especially children, and thus prevent serious trouble in after years.

6. That while the infection may originate in the teeth, in the course of years this infection will travel thru the lymphatic system and invade other organs, and eventually set up secondary foci of infection, which become more dangerous than the original focus in the teeth."

The "Torpedoplane" and "Sub" Spotter

By George Holmes

(*Continued from page* 306)

called because of its weakness for laying eggs in other people's nests—is one further testimony to British engineering ability and the resourcefulness of our navy.

Rear Admiral Bradley A. Fiske, U. S. N., conceived the idea of a torpedo-carrying airplane in the winter of 1910-1911 as a means of defending the Philippine Islands, and discust the idea with the General Board of the Navy. In April, 1912, he applied for patent on the torpedoplane, which was granted in July, 1912, by the U. S. Patent Office.

The Italians were the first to make experiments in dropping weights from an airplane, with a view to evolving a method of launching torpedoes. Captain Alessandro Guidoni, Royal Italian Navy, using a 1910 Farman biplane equipt with floats, made a number of experiments at an Italian naval base in 1912-1915.

Captain M. F. Sueter, who was then director of the air department of the British Admiralty, appreciated the value of the idea and in conformity with the practise of the British Navy, which provides that the name of the commanding officer shall appear on a patent application with the name of the author of the invention, a patent application was made in the joint names of Captain Sueter and Lieutenant Hyde Thomson, in March, 1914.

The sinking of a Turkish troopship while at anchor in the Sea of Marmora, in 1915, by a British torpedoplane, created a little more interest in the experiment, but no greater support was given to the work and the experiments were superficial in nature and dragged on slowly, due to lack of official interest.

In May, 1917, those who believed in the potentiality of the torpedoplane and hoped that the Allies would put this device into effect against the German Navy before Germany could build torpedoplanes, were made heartsick by the report that the British steamship *Gena* had been torpedoed by a *German torpedoplane*.

In connection with the above, it is stated by the Admiralty that this method of attack was first practised successfully in August, 1915, by R. N. A. S. pilots, who sank several ships in the Dardanelles by torpedoes from seaplanes.

How the Torpedoes Are Carried.

A sketch of one of the German seaplanes that participated in the attack against the *Gena*, showing the pontoon arrangement for holding the torpedo in the German seaplane, is exactly like the arrangement on Admiral Fiske's torpedoplane. The torpedo is held between the two pontoons of the seaplane with a bracing to keep the torpedo from moving while the seaplane is flying.

Some years ago I had occasion to discuss, first with Admiral Fiske and then with Allied officers, the advisability of using *automatic brakes* to check the velocity or fall of the torpedo. This discussion led to considering a number of methods, such as lowering the torpedo by means of a cable. But it was realized that while it would be feasible to lower the torpedo several hundred feet by means of a cable, and its direction could be maintained by means of vanes, and the possible swerving of the torpedo might also be checked by means of vanes, which would hold the torpedo steady excepting in case of sudden turns, the advantages to be gained were not readily apparent. The giant naval seaplane NC-4, which crost the Atlantic, could easily carry two full-size torpedoes.

One Hundred Miles an Hour Torpedo Boat!

Some of the transatlantic planes being designed at present are capable of covering 3,000 miles without stopping. These machines can be converted into torpedoplanes by merely attaching the torpedoes under their planes or at some other convenient place. And then they become flying torpedo boats, capable of cruising at a speed of 100 to 125 miles an hour or more. A crew of half a dozen men will be sufficient to operate such a torpedoplane. Imagine this marvellous combination of speed, potentiality and mobility! What better weapon can we find for the defense of our coasts and island possessions? An enemy fleet bent on attack or carrying an invading force would have to contend with large torpedoplanes before it could come within 1,000 miles of our shores and with smaller torpedoplanes launched from aerodrome ships, such as are recommended by Admiral Rodman.

Admiral Fiske's "Sub" Spotter.

A patent was recently issued to Admiral Fiske on a clever submarine localizer.

As the illustration shows the aircraft, plane or dirigible tows a super-sensitive sub-sea microphone thru the water by means of a float or else an armed boat, which may serve to give battle to the enemy, should he arise to the surface. Suspended from the boat is a sound-detecting microphone connected by circuit wires carried by a cable to a battery and telephone receiver in the car of the airship.

The operation is as follows: When a submarine is under water, power is supplied from her storage battery to an electric motor, whereby the submarine is driven. The continuous whirring sound made by the motor while in operation transmitted thru the water affects the microphone so that this sound is heard and recognized in the telephone receiver by an observer in the airship car, listening thereat.

Being thus apprised of the location of the submarine, the observer may transmit that information to a station ashore, or to a vessel afloat, by any known means—as, for example, by visible signals or by radiotelegraphy.

In order to enable the observer to convey information as to the speed and direction of the submarine, the sea area to be protected may be mapt in divisions of predetermined area, as 1, 2, 3, etc., of the detail drawing reproduced herewith. The observer knowing, for example, that he is over division 7 and hearing the submarine noise in his telephone, signals that fact to an observer at some central station. Afterward, being over division 5, *if he still hears the sound,* he communicates that further fact. The central station observer thus becomes informed that the position of the submarine is first in division 7, for example, and that its course is to a second position as in division 5, and, therefore, northeasterly, while the time elapsing between the signals will show approximately the speed of the submarine in going from the first to the second position.

The boat may be simply a float in boat shape, or it may be an armed motor-boat with crew on board. In the latter case, as soon as the observer in the airship signals the crew of the detection of a submarine sound, the cable may be detached from the boat, leaving the microphone suspended from the cable, and the boat free to watch for and attack the submarine, or to give warning to other vessels in the vicinity. Any suitable means of release may be provided.

By noting where the sounds in the telephone become louder or fainter, and by steering in such a direction that the sounds become louder or remain in the same intensity, the observer in the airship can move in a direction and at a speed approximately that of the submarine.

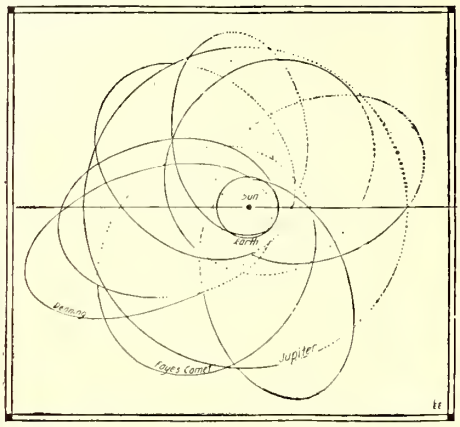
Popular Astronomy

THE NATURE OF COMETS

By Isabel M. Lewis

(Continued from page 313)

istic tail and peculiar cometary features are fully developed. As the comet again recedes from the sun after perihelion passage its speed slackens once more. It soon parts with all its spectacular features and fades rapidly away into oblivion.



This Diagram Shows How the Planet Jupiter Captures the Large Majority of the Comets. It Will Be Noted That Most of the Comets Are Grouped Around Jupiter's Orbit.

THE DISTINCTION BETWEEN STARS AND PLANETS.

THE chance enquirer into the mysteries of space usually is puzzled by the distinction that is to be drawn between stars and planets. All celestial objects except the sun, moon and a few chance comets he is apt to group together vaguely under the head of "stars" even to the "shooting stars."

The planets shine only by the *reflected light from the sun* around which they revolve, as does also the earth, which is one of the smaller planets. This light from the sun may be reflected from a rocky surface, as in the case of the moon, which is not a planet, to be sure, but a satellite *of* a planet, —the earth,—or it may be reflected by a cloudy atmosphere as in the case of Venus or from surface snow and clouds as in the case of Mars. The outer and larger planets Jupiter, Saturn, Uranus and Neptune, being chiefly in a gaseous condition, reflect sunlight from the gaseous vapors that envelope their central molten or gaseous cores.

Stars, on the contrary, are *suns* composed of intensely hot incandescent vapors of many chemical elements *emitting light and heat of their own.* The heat of the stars is inappreciable to us simply because they are so far away.

In size, the planets are conspicuously inferior to the sun and to the average star tho it is now known that there are some dwarf stars in existence that are as small as planets. The sharp distinction remains, however, that planets revolve around a central body that supplies them with the light and heat that they do not possess themselves, while the stars, however small they chance to be, shine by their own light and move thru space as independent bodies.

Not only is the distinction between stars and planets one of physical condition and, generally speaking, size. It is also one of relative distances.

The planets are all comparatively close to the earth. All are companion satellites of the same sun. The nearest Venus comes at times within twenty-six million miles of us and the farthest Neptune within twenty-seven hundred million, but the very nearest

(Continued on page 357)

READ THE CLASSIFIED ADS. ON PAGES 380—382

CARUSO CONCERTS TO AMATEURS BY WIRELESS 'PHONE.

Cleveland, Ohio, or that portion equipt with wireless receiving instruments, heard its first wireless telephone concert on the night of April 17th. And it is to become a permanent institution.

Every Thursday night between 8 and 10 o'clock the radio amateur or professional who "tunes" his instrument to receive wave lengths of 375 meters will be able to listen to strains from Caruso and Sousa's band interspersed with baseball scores and the latest news bulletins.

The concert will come from the plant of the Martin Company, air plant manufacturers and will be audible to wireless operators within 200 miles. It is estimated that 400 radio amateurs "listened in" on the first concert.

The wireless transmission of music is accomplished by use of the wireless telephones as developt by F. S. McCullough, wireless expert for the Martin Company. The same apparatus as is used in airplanes is employed and the music produced by a phonograph. The transmitting apparatus of the telephone replaces the phonograph horn. The baseball news and bulletins were announced by voice, so that no knowledge of "codes" were required to receive them.

Changing Nature's Face

(Continued from page 300)

copper wires extend from the blasting machine to one or more of the detonators. The ends of the two insulated wires inside the cap of the detonator are bridged by a very fine wire, which is soldered to the ends of the feed wires, and it is the heating of this fine bridge wire in the midst of the explosive charge, due to the passage thru it of the electric current transmitted from the dynamo, which ignites the cap explosive and in turn the main dynamite blasting charge. Electric blasting caps are made practically air-tight and water-tight, and are therefore safer to handle than the ordinary open-end blasting cap. It requires about 1½ to 2 amperes to melt the fine platinum bridge wire in the cap.

Connecting Wires

Owing to the small amount of current required, about 2 amperes, to melt the fuses in the electric detonators, and as these are invariably connected in series, a fairly small wire can be used to carry the current from its source to the location of the blast, as well as between the various charges, as shown in the accompanying diagram. No. 20 insulated copper wire is usually employed for connection between the dynamite charges in the holes. For the feed wires between the charges and the dynamo, a larger wire, such as No. 14 rubber covered copper conductor, is used. Several ways of connecting the charges in a group, as for instance in blasting a "ditch" or "brook," are illustrated in the accompanying diagrams, *A, B, C, D.* As will be seen, the various charges are connected in series. However, under some conditions the charges are connected in parallel. The series connection here shown is invariably used when a hand-operated *blasting machine* is employed to explode the charges. Parallel or series-parallel arrangements are used with dry or storage cells, or else an electric generator driven by a gasoline engine is used as the source of electricity for firing the blast. The standard blasting machines, fitted with magneto generators are designed in different sizes to fire from 1 to 200 charges, depending upon the type and size. The amount of current produced is about 3 amperes with this machine, while

the larger machines develop several hundred volts.

In some cases electric light or power circuits are tapt in order to furnish the necessary current for firing the charges. For example: if a circuit is supplying 250 volts and 10 amperes to a light or motor load beyond the point where the line is tapt, then this can be safely short-circuited and relied upon to fire 125 detonators in one series or five series of 625 detonators each. Such use of this current will not interfere with the operation of the motor or the lights, as connection is made for too short a time. Dry cells can be used for exploding electric blasting caps, but their rapid deterioration makes them unreliable. A storage battery will prove much more trustworthy.

How to Prepare the Blasting Charge.

The preparation of the load is accomplisht in several different ways and depends upon natural conditions where the blasting is to take place. Where ordinary wet ground such as in meadows or near a brook is to be blasted, in order to form another ditch or stream, it frequently happens that the necessary blasting holes may be drilled with a crow-bar. After the dynamite cartridge has been placed in the bottom of this hole with the electric detonating wires attached, the hole will in most cases fill with water, and this provides a satisfactory substitute for *tamping,* and will give very high efficiency when the blast takes place. It is interesting to mention in this particular instance, that in actual coal mining operations the drill hole is commonly filled with water instead of being tamped with coal dust, etc. Water being practically incompressible and possessing considerable inertia under the sudden bursting pressure of the charge, results in very high efficiency of the blast. Where a hole has been drilled in rock, or wherever it has been tamped or filled up with loam, the following proceeding is to be noted: To guard against danger of a prematurely detonating charge, the first five to eight inches of tamping over the dynamite cartridge should be *gently packed* by means of a tamping stick. When this amount of lightly tamped material has been placed, the rest of the tamping should be made as hard as possible, using a *wooden* tamping stick for the purpose. Moist clay free from gravel and clods makes good tamping material. Free running sand or moist loam is also effective. As pointed out in instruction books on the handling of explosives, it is not necessary to use any loam to tamp the drill holes, where the blasting is done in *watery ground,* or wherever the water will fill the hole to a depth of a foot or more. It is good practise, especially where heavy charges are used, to place two inches of paper or dried leaves immediately over the priming charge, so that they can be used as a safety marker, if the tamping has to be removed for any cause.

Purposes of Blasting.

The accompanying illustration shows three distinct purposes for the blasting operations carried on by agriculturists, and those desirous of cleaning up stump-strewn and rock-covered property. The method of using one, two or three lines of holes for blasting various widths of ditches is shown in the left-hand illustration. It is indeed surprising to learn that these ditches, in actual tests carried on before Government experts, have been blasted out with dynamite in the manner here shown. The bottom level of the ditch, when finished, was so nearly perfect *that not a shovel had to be touched to it.* In some cases, where specially deep ditches are desired, it sometimes becomes necessary to place another row of holes along the bottom of the first ditch blasted out, and then to blast this out.

The experts in charge of the blasting

usually drill a few holes and try several trial shots to ascertain the best depth and spacing for the holes. For ditches of three or three and one-half feet width, the depth of the holes will usually be 24 to 30 inches, and the spacing between the holes from 18 to 24 inches, altho it may be necessary to increase the depth and decrease the spacing in some cases. The test is usually begun with holes two feet deep and 18 inches apart. These are placed in lines and about 10 of them loaded with one dynamite cartridge each.

This loading, say the experts, should lift the soil at least 200 feet into the air and scatter it over the adjoining swamp for a distance of 150 feet, *leaving a clean ditch.* If such is not the case, then a different loading layout should be tried.

Blasting Stumps.

One of the principal uses of dynamite as utilized by agriculturists and by engineers in clearing up large areas containing obstructions is that of blasting out stumps. The lower illustration in the accompanying view shows how a large lateral stump is drilled, and how the electric blasting caps and dynamite cartridges are placed. The terminals of the blasting caps are connected in series, and the two wires run to the blasting machine which should be situated 250 to 300 feet away from the stump at least.

A new innovation in drilling the holes for stump blasting is the use of a portable electric drill or auger. One or more of these electric drills, as may be required, can be operated from a portable gasoline engine and dynamo outfit, or else from electric feed wires supplied by the local light and power company. Comprest air drills have also been used to some extent for this work and have proved very satisfactory. In all stump blasting it should be noted that the depth of the holes should reach to the sub-soil, not close up to or in contact with the wood. The best tools for making the holes are the crow-bar and the sub-soil punch.

Breaking Boulders.

There are three general forms of blasting applied to rocks, particularly those of the *boulder* class. *Blockholing* requires the smallest amount of explosives, altho more labor is involved with the drilling of a hole or series of holes directly into the boulder, as shown at the top of the right-hand illustration herewith.

Mudcapping, as depicted at the bottom of the right-hand illustration, requires the smallest amount of labor, but a considerably larger amount of explosives, while *snakeholing* is intermediate with respect to both labor and amount of explosives required. Each method has its own particular and special use.

Blockholing consists of drilling a hole into the boulder and charging it with a small amount of dynamite. It is the best and simplest method for breaking very hard or very large boulders, especially those of the "niggerhead" type, which are very difficult to break by other methods.

Snakeholing consists of punching a hole underneath but immediately against the bottom of the boulder, and placing a charge of explosives in as compact shape as the size of the boulder will permit. A boulder which has been snakeholed out of its resting place is shown in the accompanying right-hand illustration. As will be seen, the explosive, being confined on the under side of the boulder by the earth, can exert a powerful blow on the boulder and will force it out of its position or roll it out. If a sufficient charge is used, the boulder will be broken into fragments. The boulders should always be either pried out or snakeholed out of their resting places to the top of the ground, before attempting to break them by blockholing or a shattering blast of the type described above.

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.

Automatic Cut-Out Switch.

(334) Ben Waigand, Nampa, Idaho, states: "I am enclosing a print of a patent my brother and I took out some time ago. I would very much like to hear from you as to its worth in the electrical field. Also what we shall do with the patent.

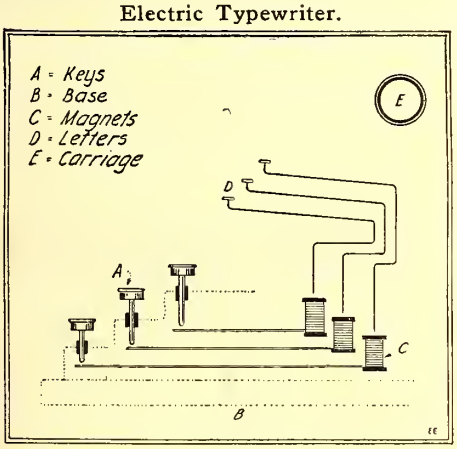
A. The invention relates to an automobile cut-out switch which is to produce a mechanically operated means, whereby, when a fuse in a three-phase circuit is blown, the switch connecting the circuits will be automatically thrown out of operation from the circuit. In three-phase circuits, one of the fuses may be blown, but this does not entirely break the circuit since it will continue to operate on a one-phase circuit, tending to overheat the motor or diminish the lights. By means of this invention, however, upon any of the fuses being blown, the switch is thrown open automatically. This seems to be a very good idea except for the fact that the fuse links which work this switch are exposed all around, which we believe is against the Fire Underwriter's ruling. Some device should be attachable whereby this objection is overcome. Otherwise, we think the patent is a good one. How successful it will be from a commercial standpoint we have no means of knowing. It all depends upon the owners of the patent who wish to exploit it.

Mechanical Converter.

(335) Herbert M. Hubs, Indianapolis, Ind., wishes to know if he could obtain a patent on a mechanical current converter which he designed. He claims that it will work with an efficiency of 80%.

A. It is impossible to say off-hand if a patent can be obtained on the idea as we do not know what it is about. We do not know the technical details; for that reason we cannot give any intelligent advice.

Electric Typewriter.



(336) Lucius M. Turner, Royston, Ga., writes as follows: "I have an idea which I think is entirely original concerning a typewriter that will work with electromagnets. My idea is as follows: Have each key used as a switch or, in other words, used like a telegraph key. As you are aware, each arm on which the letter is attached is shaped somewhat as shown in diagram. When the key is pressed the circuit of that particular magnet is closed. For instance, take the letter 'K.' Press the letter K and that closes the circuit of that certain magnet and the letter K is made. Magnets are located under each letter, as shown in illustration. IN THIS WAY ALL LETTERS WILL BE HIT WITH EQUAL FORCE. In reading letters and typewritten matter you often see some letters less plain or dimmer than others. This would be absolutely avoided. The magnets would be very small and therefore consume very little current. The current could be supplied with a few batteries located under the table or in the drawer, or in any other convenient place that is not needed. Please advise me as to whether it could be patented, and if it would be practicable. Also if it could be manufactured at a reasonable price (please give me some idea as to the price) and if I could find a ready market for same."

A. A very clever idea, and it seems it has the germ of a possible great future. Our present typewriters are operated on a very antiquated plan, and have not been improved since Remington built his first machine. What we refer to is the muscular energy it takes in operating a typewriter. It is rank foolishness in this age of invention and electricity to ask people to wear themselves out by pounding the keys. Electricity should be the mover. Mr. Turner in his invention has shown a very simple way of doing it. He uses the keys to establish the contact. Even the slightest touch will close the circuit. Then electricity, plus electromagnets, will do the rest. Each electromagnet will pull down its key. It thus should be possible to operate a typewriter with the very slightest touch, and each typewriter could be plugged into a light socket or otherwise, a battery or storage battery without any trouble whatever. Of course, the details will have to be worked out to make the device practical, but we certainly think that it is a coming thing. We believe also that such a typewriter could be marketed at a cost only slightly higher than the present-day machine.

We think a patent can be obtained on this invention without much trouble, and we would advise our correspondent to get in touch with a patent attorney at once.

Auto Tail Lamp.

(337) G. R. Smathers, Charlotte, N. C., says: "I have invented a combination auto tail lamp. It is a combination affair of two lamps in one, one being red, the other white. Either red or white bulbs can be used, or instead use red or white lens. It is electrically operated and is provided with extra "push" for white light, which is to be used in backing out of garage or "turning around" at night, in order to avoid "backing" into obstacles such as fences, ditches, etc. The white light, which is larger and brighter than the red one, serves the same purpose as do the front headlights. This device is also provided with the well-known license-plate bracket. The red light throws a white light on plate from under side."

A. From the description and drawings which we have inspected, we do not see anything fundamentally new in the device, and we doubt very much that a patent can be obtained on the combination. There are many similar devices on the market now.

Adjustable Book-Mark.

(338) N. Alpert, Sedalia, Mo., submits description and model of a new article of manufacture. In part he says: "Please advise me whether I can obtain a patent on an adjustable book-mark. It is to

be made of two strips of steel. The adjustable strip is so fastened that it is able to slide up and down or sideways. The stationary strip can move sideways in either direction. Near the end of this strip and on the underside, a clip is attached, by which the whole thing may be fastened to a page. I am sending a rough model with this letter. It will give you an idea of how the device will work.

A. This is a very clever idea, and we think there ought to be a market for it. It could possibly retail for five or ten cents, and for this reason five-and-ten-cent stores would probably be a good market to exploit the idea. We think a patent could be obtained.

Improved Fuse Plug.

(339) Thomas Sheehan, Duluth, Minn., wishes to have our opinion on an improved fuse-plug which works on the thermo-electric principle, similar to the *blinker contact* arrangements, that blink electric lights. This fuse is made similar to the regular fuse, except that in the interior it has a steel wire, which has a tendency to contract when a certain number of volts and amperes pass thru it. Naturally the wire must be of the gage that will not contract unless the voltage is over 110 volts. Our advice is asked on this invention.

A. While this is a very clever idea, and while no doubt it works and perhaps a patent can be obtained upon it, we doubt very much whether it would prove a success from a practical standpoint. We think the Fire Underwriters would not allow such a fuse plug to be put in use, for the reason that there probably would be bad arcing at times, and the heating effect therefrom would endanger fixtures, etc.

A gold palladium alloy which makes an acceptable substitute for the more expensive platinum iridium alloy used in chemists' utensils has been developed by metallurgists in California.

CREDIT CORRECTION NOTICE.

The story entitled "The Autograph of an Oyster," publisht in the July issue of the ELECTRICAL EXPERIMENTER, should have been credited to the courtesy of the *"New York Sunday American"* instead of the Star Company, who are the publishers.

How to Make Photo-Micrographs

(*Continued from page* 317)

will require a shorter exposure than dense objects or objects stained with carmine or picric acid. The experimenter should use his own judgment in regard to the length of exposure; some idea of the length of exposure may be obtained by examination of the photo-micrographs here shown.

No. 1. Scales from the wing of the moth of the grape-vine cut-worm, and are a good example of the scales which cover the wings of all moths and butterflies. This is the "dust" which comes off on the fingers when holding a butterfly or moth by the wings. Different shaped scales will be found on the same insect by taking scales from the various parts of it.

No. 2. Parenchyma of sunflower leaf; the specimen was obtained by stripping a small piece of the epidermis from the upper part of the leaf. The large pointed objects are hairs, the thin jagged lines mark the cell walls; the small objects shaped somewhat like coffee grains are the stomata by means of which the plant takes in CO_2, its principal food, from the air.

No. 3. Part of the surface of the under wing of the squash bug. The photo shows cells and the opening of glands which exude moisture, keeping the wing from becoming brittle. The dark line is part of a vein.

No. 4. Is a micro-photograph of the nitrogen fixing organisms from a nodule on the root of a pea. These micro-organisms have the property of fixing nitrogen from the air.

No. 5. Tip of antenna of May beetle; the short sharp bristles are the sensory organs, probably the sense of smell.

No. 6. Tip of the wing of the crane fly, showing covering of fine hairs.

For the average experimenter a microscope having a magnification from 15 to 250 times is sufficient, and with it photographs of pollen, mould, mildew, et cetera, can readily be made.

Popular Astronomy

By Isabel M. Lewis

(*Continued from page* 350)

of the stars is twenty-six trillion miles away. An inconceivable great abyss separates the sun and his planet family from the stars.

It is because they are so near that planets appear disk-like in the telescope, just as the sun and moon appear disk-like without the telescope. Even in the most powerful telescope in existence the stars appear as points of light simply because they are so distant.

Since the planets are so near, they appear to wander thru the sky from day to day and from year to year, the result of the earth's motion around the sun as well as their own motion. As a result of these two motions their apparent motion thru the sky is very complicated and the nearer the planet is to the earth the greater the rate at which it appears to move thru the sky from day to day. The stars, on the contrary, are apparently immovable for many hundreds of years, tho in reality they are in rapid motion thru space.

The continual change of position of the planets is confusing to the beginner who desires to learn to know the grouping of the stars into constellations. It is quite disconcerting to find an unknown bright star where none is indicated on the map. Perchance the observer may think he has discovered a brilliant *Nova*, but Novae, especially brilliant ones, are extremely rare. Gradually the fact is brought home that the unknown object is simply one of the five planets visible to the naked eye.

Uranus at the limit of visibility and Neptune far beyond it we need not consider.

Venus and Jupiter one soon learns to recognize by their unusual brilliancy which far surpasses that of the brightest stars. They are distinguished from each other by their distinctive colors and relative brightness. Venus is always a clear sparkling white and considerably brighter than Jupiter who glows unflickeringly with a slightly yellowish tinge .

Mercury, "The Elusive One," as the ancients called him, is rarely seen as he is always so near the sun. When it is possible to catch a glimpse of him in spring or fall when the ecliptic rises most sharply from the horizon, one marvels at his beauty and brilliancy as he twinkles in the twilight with the splendor of a first magnitude star.

Mars, "The Ruddy One," always glows with a deep red tinge but changes very greatly in brightness. When far away from us Mars is very like Antares, the deep red star glowing in the heart of the Scorpion low in the southern, summer sky. When comparatively near to the earth, however, Mars is one of the most strikingly beautiful objects in the sky and surpasses all stars in brilliancy.

Saturn, never particularly interesting without the telescope, is dull leaden colored and, in brightness, resembles a number of first magnitude stars. It is, therefore, more easily mistaken for a star than any of the other planets. It is easy to keep track of this planet when it is once found, however, as it takes nearly thirty years to make one trip around the sun and therefore moves eastward among the stars about twelve degrees a year.

During July and August the splendor of Venus will attract the attention of even chance observers of the heavens. It will be "Evening Star" during these months, as it has been during the spring and early summer and will reach its greatest brilliancy on August seventh. After that date it will draw rapidly nearer the sun.

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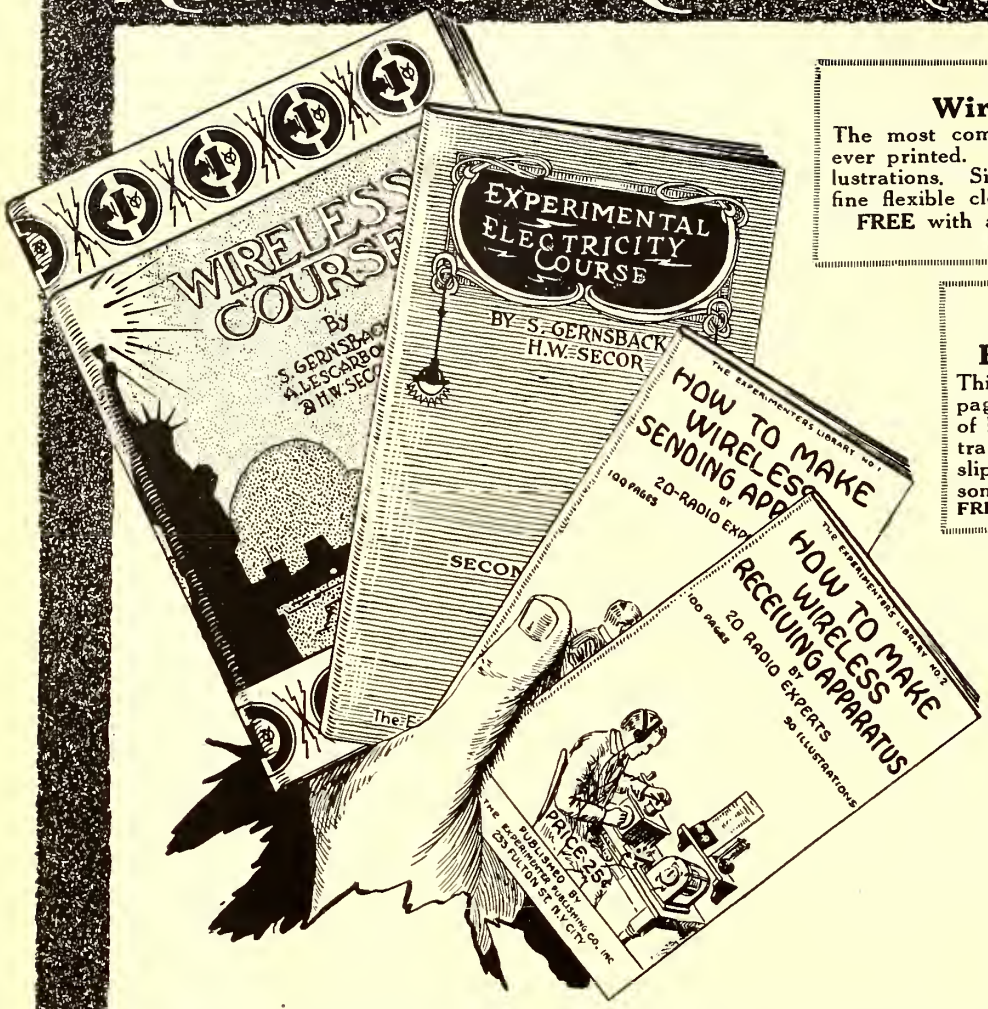

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Inside a U-Boat

(*Continued from page 309*)

captured enemy craft, the U-117, U-140, UB-148, UB-88 and the UC-97. The views here reproduced were taken on board the surrendered submarine U-105, and the machinery shown is typical of the other German craft of this type.

Under a U-boat's Deck.

The submarine UC-97 was a smaller craft than some of the others, but proved to be one of the most troublesome craft possest by the enemy during the war. This boat was designed to serve as a mine layer, as well as being fitted for carrying torpedoes, and provided with a 4.1 inch deck gun. She was propelled by oil-burning Diesel engines, each rated at 300 h.p. for travel on the surface. Propulsion when submerged was accomplisht by means of four compound-wound interpole generator-motors, mounted in pairs on the same shaft and coupled to the engine by means of a clutch. Each generator-motor unit developed 100 kilowatts capacity, or 130 h.p., when running as a motor at full load. These machines were artificially cooled. When these units are driven by the Diesel engines, while cruising on the surface, they operate as dynamos and charge the storage batteries. When submerged the engine clutches are thrown over, and the generators are now operated as motors by the electric current supplied from the storage batteries. A motor-driven air compressor supplied the necessary compresst air for discharging the torpedoes, emptying submerging tanks, et cetera. The electrical control and switchboard rooms on the UC-97 are situated forward of the engine room, from which all electrical apparatus is controlled. The hull is divided off into water-tight compartments which can be sealed off individually by close-fitting doors. The control room is directly below the conning tower. In this control room we find apparatus for steering the vessel, firing the torpedoes, planting the mines, also for filling or emptying the submerging tanks. Much of this part of the control equipment is installed in duplicate, so that if one set is disarranged the other set may be instantly put into service. The U-boat is steered by electric motors, provided in duplicate. One motor is placed aft and one forward, thus reducing the chances of becoming totally disabled to a minimum. It is possible to maintain the U-boat within two feet of any specified depth below the surface by discharging from or letting in water to the submerging tanks. There are provided elaborate and carefully calibrated depth gages on all submarines which indicate at any instant the exact depth at which the submarine is submerged. One of the accompanying photographs shows these depth gages.

Collapsible Motor-Operated Periscope.

The periscope is a collapsible affair which can be quickly elevated, thanks to the ubiquitous electric motor, for the purpose of taking a "sighting" and then quickly lowered. Two periscopes are invariably provided, in the event that one should become fouled or shot away. The periscope measures approximately four inches at the base and two inches at the top, thus reducing the visible portion and its accompanying "wake" to the smallest possible dimensions. This is highly important as the "wake", if very broad, can be easily seen by a sharp enemy look-out. Aiming at the head of this wake, the eagle-eyed gunner can make things highly unpleasant for the submersible.

In the forward part of the submersible are located the officers' quarters and the radio operating room, as well as the sub-sea telephone apparatus, by means of which the sounds of the propellers and engines of ships can be heard several miles away.

The Under-water "Ears" of the U-boat.

No wonder the surreptitious U-boats popt up in the least suspected places, for they could detect an enemy merchantman one to two hours' sail away. By carefully listening to the sounds picked up by the microphones mounted in the shell of the vessel, a steamer or warship could be trailed or maneuvered around for miles. U-boats have been known to dodge the Allied destroyers for periods of three and four hours; "blind-man's buff" you might call it, but he who laughs last laughs best, for the destroyers carried a better under-water sound detector than the "Heinies" and every move along his tortuous course was closely checked up. Periodically, depth charges were "let go" and many times, more than the Germans care to admit, the final crunching sound of a vanquished U-boat, as the depth bomb spelled its doom, came to the ears of the destroyers' officers via the sensitive hydrophone. The U-boats could be trailed just as accurately finally, as if they had been maneuvering on the surface of the sea.

Life on these craft was not to be craved for, especially when a U-boat got cornered and had to lay on the bed of some sound or harbor, for 10 to 15 hours. Electric cooking utensils were supplied, the same as on all of the Allied submarines.

The larger U-boats measured 300 feet and more in length, and had a capacity of 20 or more torpedoes and 45 mines. Craft of this type are propelled by two powerful Diesel engines, developing 1,200 h.p. each, for cruising awash, charging the storage batteries, etc., and when submerged propulsion is effected by a set of four 500 h.p. electric motors. The motors are operated as generators while awash, when it becomes necessary to charge the batteries. These large sub-sea craft often had a cruising range as great as 7,000 miles. The speed of this type of craft on the surface is about 19 knots and submerged about 10 knots. They carry two disappearing deck guns of 4 to 6 inch caliber. The torpedo tubes are four in number at the bow, while two are provided at the stern. At the bow of the U-boat the Germans mounted a cleverly contrived saw for cutting thru sub-aqueous nets. Even so, the nets placed in the waters about the English coasts enmeshed many of them, from which they endeavored to struggle loose in vain, as the official Admiralty reports prove. It may be said in closing that, contrary to the usual expectations, inspection showed the workmanship on the machinery of these U-boats to be very plain and ordinary.

Go to Church by Telephone

Holding church services by telephone was one result of the influenza epidemic. This was done by one church in Muncie, Ind., which arranged that at 10:30 o'clock, thru the coöperation of the local telephone company management, the telephones of all subscribers who wished should be connected with the telephone in the church, to which a special microphone was attached. The church organist also played a few numbers, which were thoroly enjoyed by the listeners.

How I Invented the Crystal Detector

By Dr. G. W. PICKARD

(*Continued from page* 325)

great improvement over the coherer, I soon found that it, also, had defects. Severe static or nearby sending would usually cause a partial or complete paralysis of the contact, curable only by the hit-or-miss process of repeatedly jarring the detector so that new contact points were formed, or the old ones unwelded. Even in the absence of severe electrical disturbances, the contacts gradually became, as it were, fatigued, and the signals weakened toward inaudibility, unless periodically restored by jars. Then, also, the microphone detector lived up to its name by acting as a microphone, picking up any slight sound or vibration in a most annoying way. Finally, even if the detector was screened from sounds and jars, it was prone to develop a hissing or frying sound, which overlaid faint signals to their obliteration.

The Contact Detector Is Invented.

In the first part of the year 1902, the American Wireless Telegraph and Telephone Company erected stations at Atlantic City and Cape May, N. J., about 40 miles apart, and also equipt the schooner *Pleiades* as a floating experimental station. On May 29, 1902, I was in the Cape May station, experimenting with a new system of tuning, and receiving signals from the *Pleiades*, then about two miles off Cape May. The detector I was using consisted of several fine sewing needles, laid lightly across a pair of carbon blocks, and in series with three cells of dry battery and a telephone receiver. Becoming annoyed at the microphonic "fry" of my detector, I attempted to check this by, as I thought, cutting out of circuit two of the three dry cells. The frying ceased, and the signals, tho much weakened, became materially clearer thru being freed of their former background of microphonic noise. Glancing over the circuit, I discovered to my great surprise that instead of cutting out two of the three cells, **I had cut out all three**, so, therefore, the telephone diafram was being operated **solely by the energy of the receiver signals.** A contact detector, operating without local battery, seemed to me so extraordinary, so contrary to all my previous experience, that altho I did not then know the reasons for its operation, I appreciated its possible great value to the art, and resolved at once to thoroly investigate the phenomenon at the earliest possible moment. This entirely accidental discovery was the foundation of my invention of the crystal detector.

Silicon and Other Detectors Invented.

During the summer of 1902, I was concerned with the development of a system of radio-telephony, conducting this work in the Boston laboratory of the American (Bell) Telephone and Telegraph Company. As one of the essential elements of this system was a detector which would respond quantitatively to telephonically modulated electrical waves, I at once began a series of tests, first with the form of the carbon-steel microphone I had used at Cape May, and then with other contact materials. Discovering that such detectors responded quantitatively to musical spark signals up to at least 2000 sparks per second, and were therefore capable of receiving speech, I devoted my energies for the time to the transmitting end of the system, finally discovering, in the fall of 1902, an effective means of telephonically modulating a stream of electrical waves. Returning to the detector development, I found that the Telephone Company had in their laboratory a large quantity of magnetite ($FeO.Fe_2O_3$) crystals, which had been procured as a possible material for loading coil cores. I broke one of these crystals apart, exposing a fresh fracture face, made a small area contact thereon with a brass point, and found that this crystal, like the carbon steel detector, operated well without local battery, but, unlike the carbon-steel contact, did not require a light or microphonic contact for best operation. In the period 1902 to 1906, I tested many different minerals and combinations, including magnetite, pyrite, galena, molybdenite, silicon and zincite. Much development was also required on holders for these minerals. Perhaps one of the greatest early stumbling blocks in such development was the old coherer idea that extremely light pressure contacts were necessary. With the carbon-steel microphone, this was still true, but I can remember my surprise when I found that many of the minerals worked best with quite high pressure contacts.

31,250 Crystal Detectors Invented.

A list of the several thousand materials I have tested would make dry reading. *Suffice it to say that I have found some two hundred and fifty minerals and furnace products which make operative detectors, either against metallic contacts, or in combination with other minerals. The possible combinations of these two hundred and fifty substances, amounting to some* 31,250 *pairs, have all been tested by me, or by my assistants, and many hundred useful pairs have been found.*

Oscillating Crystal Detectors.

The last word on crystal detectors and their uses has yet to be written. **For example, it may be of interest to know that they can be made to OSCILLATE, under proper circuit conditions, and I have found it possible to receive intelligible signals from UNDAMPED wave stations across the Atlantic, on a simple contact between a fragment of galena and a fine wire.**

MOTHER SHIPTON TOLD OF AVIATION IN 1488.

The following, which is known as "Mother Shipton's Prophecy," was first published in 1488, republished in 1641 and again in 1875. It will be noticed that all the events predicted in it except the last two lines have come to pass:

Carriages without horses shall go;
And accidents fill the world with woe.
Around the world thoughts shall fly,
In the twinkling of an eye;
Water shall yet more wonders do;
How strange, yet shall be true.
The world upside down shall be,
And gold be found at root of tree.
Through hills men shall ride,
And no horse or ass be at his side.
Under water men shall walk,
Shall ride, shall sleep, shall talk.
In the air men shall be seen,
In white, in black, in green.
Iron in water shall float
As easy as a wooden boat.
Gold shall be found, and shown
In a land that is not known.
Fire and water shall wonders do,
England shall at last admit a Jew.
The world to an end shall come
In eighteen hundred and eighty-one.

(It is curious to note that only the last two lines—WHICH DO NOT RHYME—have failed to come true. All the others that do rhyme did come about as prophesied!—Editor.)

E. F. W. Alexanderson Wins "I. R. E." Gold Medal

At the May meeting of the Institute of Radio Engineers held in New York City, May 7th, E. F. W. Alexanderson, consulting engineer of the General Electric Company, was awarded the gold medal of the institute in recognition of his original research and inventions in the radio field.

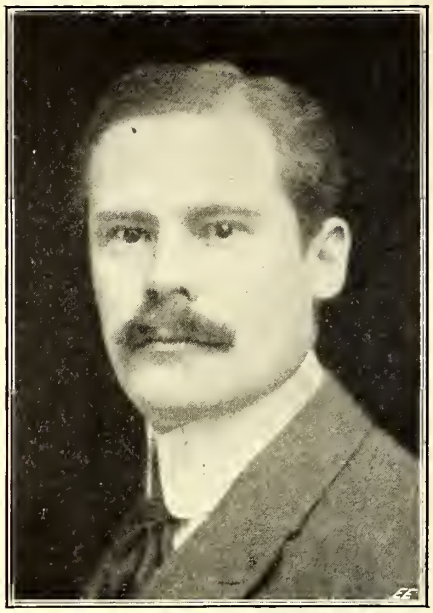
In accepting the gold medal, Mr. Alexanderson said:

Such great strides have been made in all fields of science and engineering during the emergency of our late war that I feel it a specially high honor to receive the Radio institute medal at this time.

"The radio art has drawn its talents from almost every profession. Broadly speaking, radio men may be classified as radio physicists, radio engineers and radio amateurs. In a sense we are all amateurs and we shall never know who was the first amateur. We do know, however, that the first radio physicist was Hertz who discovered and determined in his laboratory the laws of electromagnetic radiation. We also know that the first radio engineer was Marconi, who made the first use of electromagnetic waves for practical communication and developed the wonderful system which for the last 20 years has made the high seas safe for navigation.

"Fessenden conceived the possibility of bringing radio engineering within the realm of power engineering, and it was my privilege, due to connection with the General Electric Company, to develop the first radio frequency alternator. Indeed it was thru the work which this Company was requested to do for Fessenden that my interest in radio communication was first excited, and this has resulted in the contributions which I have had the opportunity to make to the radio communication of today.

"Radio telephony is a by-product of the development of sustained radio waves as a method of alternating current power transmission. With the previous system of spark telegraphy it was no more possible to transmit the modulation of the human voice than it would in land telegraphy to reproduce speech from the dots and dashes of the Morse code. But with the sustained energy of the continuous wave, it has become possible to put a dynamo electric machine behind the wave and vary the flow of power in correspondence with the modulations of the human voice, thus making long distance radio telephony possible.



E. F. W. Alexanderson, Well-known Radio and Electrical Engineer, Awarded the "I. R. E." Gold Medal.

"Mr. President and members of the institute, it has been a privilege to be connected with the great development in radio in the last years and I wish to express my deeply felt appreciation of the recognition represented by this beautiful medal. I thank you."

Concentrated or Loop Aërials

(*Continued from page* 328)

from B to D no sound, and then from D to C another rise and fall of intensity, the maximum in each case occurring when the plane of the loop is along 30-210° line but the signals in A B sector are about twice as loud as in C D sector; this gives the direction of signal in direction of arrow. If however the connections of Fig. 4, are used then the result will be as shown in Fig. 6. The signals will be much louder and will be heard only in the A B sector, thus making it strictly *undirectional.* If the loop be grounded on the grid side, then Fig. 7 shows the result, i. e., *loud signals but NO directional effect whatever.*

Fig. 3 shows the connections when it is desired to receive on other than the wave length of the loop. In practice it will be found to be simpler to have several loops of proper wave lengths rather than be bothered with a tuner.

As many navy and army operators know, the loop eliminates a lot of interference and also static. However, if it is desired to eliminate static more effectively, then it is necessary to take the loop and outfit into the cellar or under ground. Signals will be found to come in just as loud as tho an elevated aërial were used, but the static will be absent, *even in the midst of a thunder-storm* when an ordinary aërial "spits fire."

The loop shown in the photo and diagram Fig. 8, consists of 240 turns of No. 22 S. C. C. and with a 43 plate variable condenser has a range of from 2,000 to over 3,000 meters. Larger loops can be made if it is remembered that the same length of wire is required. The inductance is determined by the area turns, and hence a small loop will act about as well as a large one. If several loops are operated simultaneously from known points, but separated some distance, the exact location of the sending station can quickly be determined. And further if the circuit of Fig. 4, is used a very large amount of interference on the same wave length can be eliminated, since only such stations as lie in the region from 150° to 270° will be heard at all, while receiving from 210° and as the outfit tunes sharp much of this is cut out. By carefully adjusting the apparatus as good receiving can be done on the loop as with the ordinary aërial, and all other features will be additional. *Stations 200 miles away can be located to a pin point on the map.* Thus the Radio Amateur has opened to him a wide field that will make possible better work with less bother.

RADIO TELEPHONE BETWEEN ROME AND TRIPOLI.

Wireless telephone communication is maintained between Rome and Tripoli, 600 miles apart, mainly over water.

Radio-Planes Watch Forests and Ranches

(*Continued from page* 295)

stations erected about the ranch. The installation and maintenance cost of these stations is relatively small in any case. They have also been so greatly simplified during the war that practically anyone can be instructed in handling the talking and receiving apparatus in a short time. Some of these sets work as simply as the ordinary telephone.

Airplanes and Radio Serve to Protect Nation's Forests.

Recently the use of *airplanes* to patrol the forests and watch for incipient forest fires was extended by the Government and now the *wireless telephone* has been installed for an experimental trial. If found to be practicable the wireless will be extended to cover the great woods with an invisible net of communication.

The wireless is expected to be an improvement upon wires or cables for one very important reason. In the past great difficulty has been experienced in maintaining wire communication in the forests because of the interruption to the service caused by falling timber, especially in the stormy season. Snowslides have been another source of destruction to the wires. The use of wireless, of course, obviates all such difficulties.

For the purposes of the present experiment the Signal Corps of the Army has lent to the Forest Service four combination sets of transmitting and receiving apparatus. One set of the equipment is to be installed on Mount Hood at an elevation of about 13,000 feet, and another at the nearest forest ranger station, about twelve miles away. Two other sets are to be placed in the Clearwater Forest region of Idaho, which is a very heavy wilderness country.

All of the wireless stations will be establisht at *look-out points,* where watch is kept for forest fires, and will supplement the regular service, which not so long ago was augmented by the addition of airplanes for patrol. Now two additional airplane routes for that purpose have been mapt out, both operated from Mather Field, near Sacramento, Cal. The other two routes of the airplane service are operated from March Field, near Riverside, Cal.

The first route from Mather Field will cover the northern parts of the Eldorado and Tahoe forests on the valley side of the Sierras. The planes will start from Mather Field each morning and proceed to Oroville by way of Placerville, Colfax, Nevada City and Strawberry Valley. A landing will be made at Oroville, where a suitable field has been provided. The return trip will be made in the afternoon.

The second route from Mather Field will cover the southern parts of the Eldorado and Stanislaus forests. Starting from Mather Field, the route runs to Placerville, Grizzly Flat, Big Trees, and to a landing near Sonora or Tuolumne. In this case also the return trip will be made in the afternoon. Each of the Mather Field routes has a round-trip length of about 150 miles.

Forest Service reports tell of a successful trial patrol undertaken recently under test conditions. No difficulty was experienced in detecting fires in heavy timber at elevations of from 6,000 to 10,000 feet.

Peculiar interest attaches to the movement for conservation as affecting North Carolina, Tennessee and Kentucky because of the potentialities involved.

NEW SUBSTITUTE FOR PLATINUM.

The question of substitutes for platinum has received almost world-wide attention, many nations having been obliged to devise something. Most of the platinum came from Russia before the war. Germany was no exception. Some of the recent substitutes are enumerated in a German paper. The most important seems to be that suggested by Gotthold Fuchs, of Berlin, consisting of a wolfram-gold-nickel alloy which can be cast, forged and rolled, is of light color and polishes brightly, which platinum does not. Another substitute is an alloy of silver, wolfram and nickel. Both these alloys are stated to be acid resisting. A nickel-iron alloy, known as platinit, is said to be serviceable as a substitute for platinum in glow lamps, its coefficient of extension being similar to that of glass. For laboratory purposes an alloy of nickel and chromium affords a platinum substitute for wire and sheets, but cobalt alloys, such as cobalt-iron and cobalt-chromium are as serviceable, especially for acid-resisting purposes.

Peacetime Uses for War Inventions

By H. Winfield Secor

(*Continued from page* 298)

The illustration in Fig. 7 shows two applications out of many for the once busy *U-boats*. America and the other Allied countries can make use of all the superfluous U-boats without a doubt. For exploring the *flora* and *fauna* of the undersea regions they are ideal. They can be fitted with powerful electric projectors, observations lenses and windows, when not only can visual observations of the deep sea life be studied, but even motion pictures can be taken. And for pleasure trips at the seaside resorts—I would hate to have the job of figuring up how many five dollar bills one could rake in, in a single Saturday afternoon, with one of these pleasure submarines at Coney Island, not to mention the Beach at Coronado, Calif., and who would not like to explore the secrets of the Great Lakes? We have heard of the chap who endeavored to dash over Niagara Falls in a rowboat, and no doubt we shall soon hear of the enterprising fun-promoter, who will, for a consideration of $25.00 or so, invite you for a trip over Niagara in one of the former Kaiser's plush upholstered U-boats. Plush upholstered is right, and we would like to have it about nine feet thick.

In order to attract the sea and lake fishes for the edification of the passengers aboard, we can imagine that some genius will roll up his sleeves and get busy developing a "food gun" which can be attached to the torpedo tube. Presto! Push the button and out flies a perfect barrage of fishsome dainties for our piscatorial neighbors, when they will come bounding forward in great flocks, much to the delight of the submarine's guests, snapping their teeth gladly and otherwise showing how delighted they are.

The *Submarine Detector,* which is shown in Fig. 8, and which was wonderfully perfected during the World War, should find many peacetime applications, particularly on all ocean-going and inland lake vessels for the purpose of locating other vessels in a fog or at night, and also for accurately locating the presence of icebergs and reefs. The submarine detector, of which several different types were developt during the war, operates on one general principle, that of *sound wave transmission thru the water.* The sound produced by the propeller and driving motors or en-

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Faradic Currents—How To Apply Them

(*Continued from page* 318)

eight minutes or at the outside fifteen minutes is long enough for a treatment. The exceptions to this rule are in the treatment of some chronic diseases, as chronic articular rheumatism, etc., and in general electrizations, where a little longer time might be allowed.

No definite rule holds as to the frequency of sitting, as much depends upon the nature of the disease, the sex, age and habits of the patient. Some acute cases require daily sittings, seldom more than that. In chronic cases from two to four times a week may be enough.

Constipation

Connect the rectum electrode to the *negative* pole of the battery and place it in the anus. At the same time the *positive* over the stomach, liver and bowels. Use the *secondary* current. A small internal dose of cascara sagrada will sometimes prove beneficial. However, the use of cathartics, as a rule, is not advisable, and the above treatment is much better without them. Eat good plain digestible food. A dish of oatmeal and milk eaten in the morning will help to regulate the bowels.

Corns.

Place the foot upon the foot plate, it being attached to the *negative* pole of the battery and apply the *positive* pole directly to the corn, using a small piece of sponge fastened to the ear electrode. Treatment should last about ten minutes daily. Use the *primary* current.

Canker.

This is caused by indigestion. Let the patient live upon a light milk diet for a few days. Thoroly wash the mouth and throat frequently with borax or boracic acid diluted with water. Electrical treatment: Place the *positive* at the nape of the neck on the spine and apply the *negative* to the stomach. This treatment should last about ten minutes. Use *secondary* current. Another treatment is to place the tongue electrode in the mouth having previously attached it to the *positive* pole of the battery and apply the *negative* to the neck and throat. Use *primary* current. A general tonic treatment two or three times a week will be beneficial.

Diabetes.

Diabetes seems to be a nervous disease, and for that reason we recommend what is called *Central Faradization*. The object is to bring the whole central nervous system under the influence of the primary current. Place the *negative* pole at the pit of the stomach and pass the *positive* over the head and forehead, down the back of the neck and along the whole length of the spine. Use a very light current about the head and increase gradually. Do not apply the current to the head more than one or two minutes at a time. The spine will stand a much stronger current than the head. The back may be treated about five or six minutes. After this give tonic or general treatment for ten minutes, with the *secondary* current.

Death—Apparent.

People who have to all appearances been dead, have been restored to life by electricity. The test is as follows: Place the sponge electrode (*positive* pole) to the back of the neck, and apply the *negative* to the body over the lungs and heart. A mild *secondary* current is first used, gradually increasing it until the patient shows signs of life. Keep this treatment up for about five minutes, also apply the *negative* electrode to the arms, wrists and hands. Now sponge the whole body with the *nega-*

(*Continued on page* 371)

DESTROYER FLOTILLA NAVIGATED 1,100 MILES BY DIRECTIONAL WIRELESS.

Seven links in the chain of naval destroyers stretched across the Atlantic by the United States Navy for its transoceanic flight reached their Newfoundland base after traveling from New York enveloped in fog from Fire Island to Trepassey Bay, thus navigating 1,100 miles entirely by directional wireless, with which the Transatlantic seaplanes were equipt. The trip was said by Captain Arthur Crenshaw, base commander, to have been one of the severest tests this means of navigation ever had. The destroyer Philip became separated from the flotilla in the fog, but she entered the harbor soon after her companions.

To War On An American Destroyer

By A. H. Whedon

(Continued from page 329)

Of course, a certain amount of roll and pitch is to be expected—but a destroyer of a very nervous disposition just can't be still at all!

The largest roll that we made while I was on the *Conyngham* was seventy-two degrees to starboard and sixty-eight to port. That is in the ship's log, and signed by the Captain. And, friends and fellow citizens, I maintain that *that* was sure *some roll.* Try it once and see. A destroyer is always rolling at sea, and in a storm she is one great "dance artist."

The *radio shack* is mounted either way forward or way aft, in the place most calculated to get the benefit of the rolling and pitching. Of course, it is superfluous to mention the fact that everybody from the oldest salt down to the newest rookie gets sea-sick on the first trip to sea on a destroyer. The rookies come aboard expecting to be sick. But when a "gob" wise in the ways of ships (big ones) comes aboard, he proclaims for all to hear that he has been going to sea too long to get sea-sick. The day comes when we go to sea. The next day friend "gob" fails to rise for breakfast—not that he is sea-sick or anything like that, y' understand, but simply that last night's chow must have disagreed with him. By noon time he joins the rest of the gang at the lee rail, actively engaged in the sport technically known as "feeding the fishes." Yea, verily, 'tis a great life until you get used to it. And nine-tenths of the sailors get so that the more she rolls, the better they like it.

But now consider the case of the poor radio man, who is forced to sit for at least four hours before his set, never getting up from his chair and never taking his receivers off. Every time the ship takes a big roll he rolls with it, unless his chair is screwed to the deck—but they never are—and there is a wild scramble to hold on to pencils, pads, code books, and other loose articles that have a tendency to hide under power transformers, switchboards, or any other place where it is deuced hard to recover them.

At the first calm spot, the "op" nervously attempts to readjust his detector, and succeeds in making things worse. So he shifts over to the audion and thinks his troubles are over. So they are until he discovers that the filament battery is run down and needs recharging. Then follows a choice line of briny "cuss" words. About this time the boat decides to take another roll, and the show starts all over again.

In between times, the "op," if he is new on a destroyer, realizes that he really isn't feeling well. Then he begins to wonder why he ever joined the Navy anyway. Of course, he can't leave his post to join

his friends at the lee rail, but he must do something—quickly!! Ah—he grabs somebody's tin pail that is lying around, which is used to wash in. But friend "op" is not standing on ceremony, he wants action, and quick action—and he gets it!

The radio shack on the *Conyngham* was an inside room, and had no port-holes or other openings on deck. In order to provide for good ventilation, a small air vent was installed in the overhead of the radio room, leading out on deck. It was put in hastily, and was far from being watertight. When we hit a storm and the waves broke over the deck, lo! much "moisture" used to descend into the radio shack. In vain I pleaded with the ship's carpenter, and with tears in my eyes I begged him to fix that "gadget." But he was always doing something else. So I tried to see what I could do to it. When I got thru, it didn't leak, it poured! I had completely broken it. But I was triumphant. Now it would *have* to be fixt.

But we put to sea with the blame thing still busticated. It was the middle of December, 1917, and, for a change, the sea was unusually calm. Everything was all ski for two days, till we met the U. S. S. *George Washington* and the U. S. S. *Huron* to be convoyed into Brest. (This was before the *George Washington* became the Presidential ferryboat. Then, suddenly, all the furies of the sea and heavens turned loose. Everyone who was at sea in that part of the ocean will remember that storm to their dying day. For two days and nights we headed into it and gained but forty miles! Ordinarily the destroyers would have ridden it out with the storm instead of against it. But we had fifteen thousand U. S. soldiers to guard, and we stuck—! At last, even the troop-ships could stand it no longer, and we got a signal from the *George Washington* to "countermarch." That is, turn around and go with the storm. All that night we just drifted, taking things easy, and the next morning the storm had subsided enough for us to try to make port. There were times during those awful two days and nights when even the captain on the bridge remarked that we would never live thru it. And in the face of his belief, he refused to leave the troop-ships to the tender mercies of a stray submarine, for while no "sub" could work during the storm, there was bound to be a calm spell afterward when we would be needed. So we stuck—!

We finally reached port, but what a mess our division was! Of course, everything was absolutely swept clear of the decks. One destroyer even had a smoke-stack carried away, and another one had her main mast broken off. The *George Washington* had lost most of her life boats, and eight men had been washed overboard. The *Conyngham* escaped with very little damage. All our compartments were flooded, and of course there was nothing left on our deck in the way of sea chests, the carpenter's bench, etc. AND the radio shack! Just drift back a few lines to where I mentioned the broken ventilator and then on down further where I mentioned the storm. Two and two never made six—so you can imagine what our radio shack looked like. I had a young Atlantic Ocean in there—six inches of water rushing all over the deck and having a fine time playing with the power transformers and the Leyden jars, with *ye scribe* perched up on the desk, soaking wet and wondering who started this war.

And so it goes—as someone once remarked—"If we had some ham, we'd have some ham and eggs—if we had the eggs, ——etc." For those that like it the Navy is sure a fine playground, but personally I am better satisfied to sit here writing this short reminiscence in order to win a few extra pennies for a new pair of shoes for the baby!

A Review of Radio-Telephony

(Continued from page 326)

from the Western Electric Company Engineering Organization to engage in this work. At this time plans were in the making for the tremendous aircraft program which was later undertaken by the Army, and it was clear to all that a successful means of communication between battle planes when flying in squadrons would be of inestimable value and would greatly increase the efficiency with which these squadrons could be maneuvered. The early work had shown such promise that there was justification for assuring the Signal Corps that this means of communication could be worked out successfully and applied to aircraft of various types. As a result of this conference, orders were issued by the Signal Corps for the Western Electric Company to undertake the development of a wireless telephone system for the purpose.

The problem now was to produce sets of minimum size and weight, physical structures which would withstand the extreme vibrations and jars encountered in flying, especially in landing, the most convenient disposition of control elements, suitable sources of power for both high and low voltage, and a form of antenna which would not interfere with the evolutions of a plane in squadron formation.

It was realized that the solution of the last mentioned problem would consume more time than was at our disposal, and while work was immediately started in the field on antenna measurements and study, the design of the sets proceeded on the basis of using a trailing wire antenna.

The working out of a practical helmet design proved to be more difficult than the success of the earlier experiments indicated. It was found that the degree of interference experienced changed very rapidly with slight imperfections in fit. The problem was also complicated by the necessity of providing means for using oxygen at high altitudes, and of providing for the comfort of the wearer over a period of several hours. It was found that a very slight amount of pressure on certain portions of the ear caused excessive pains and headaches after a very short period, and the final design was a compromise between comfort and efficiency as to sound insulation.

The problem of power supply was an interesting one. It was required that the weight should be reduced to a minimum, which precluded the possibility of employing storage batteries. There are obvious objections, also, to attaching any form of generating device to the propelling engine. Consideration of all the factors led to the adoption of a wind-driven generator for the purpose. This generator of about 100 watts direct current output was required to produce a potential of 300 volts for the plate circuits of the vacuum tubes, and a potential of 25 volts for the filament circuits. It is necessary, to insure most efficient operation, that the filament current be kept constant, and the fact that the specifications called for operation with airplane speeds varying from 40 to 160 miles per hour made the problem of voltage regulation loom large. Ordinary forms of electro-mechanical regulating devices did not prove to be successful, and while it was probable that something of this type would eventually have been developed, the problem was solved by a very ingenious arrangement proposed by Mr. H. M. Stoller, in which the vacuum tube is the essential element. The voltage of the generator is held approximately constant by means of a vacuum tube regulator, which controls the field flux. Two field windings are pro-

vided, the main field, which is in series with the filament of the regulator tube, and a differential field which is in series with the plate circuit. At minimum speed the differential field is inactive and the generator behaves like an ordinary shunt machine, except that the main field has a small resistance in series due to the regulator tube filament. This filament is so designed that the main field current heats it to a temperature which gives a small electron current. This current flows thru the differential field and reduces the resultant flux. At minimum speed, the differential current is small, but as the speed increases, the main field current tends to rise (as in any shunt generator) and this increases the temperature of the regulator tube filament. The electron current is, therefore, considerably increased, which current, flowing thru the differential field, reduces the generator flux and thus restricts the rise in voltage. Due to the fact that the electron current of the regulator tube increases very rapidly with increase in filament current, the voltage is held practically constant between 4,000 and 12,000 revolutions per minute. The 1.5-ohm resistance units are provided so that the regulator may be set to give different voltages by cutting them in or out of the main field. The 100 ohms shunt resistance is used to prevent hunting.

Upon the completion of the next set of models, field tests were resumed and on August 20th the first two-way telephone conversation between two planes in the air was successfully accomplisht. After this first trial, Major Bartholf and Lieutenant Stevens, of the Signal Corps, held two-way conversation between planes with very satisfactory results.

Late in 1917, the type of airplane set shown in Figs. 4 and 5 was installed on our airplanes. The various parts are arranged so that they can be mounted in any available space in the machine. The switch box shown in the diagram is to provide for communication between pilot and observer by means of the same microphones and helmets used in radio-telegraphy. The transmitting and receiving set proper is shown in Fig. 4. This set is 17x10x7 inches and weighs but twenty-one pounds. The generator is of the wind-driven type, and is shown in Fig. 6 with the tail cover removed giving a view of the vacuum tube regulating device. The complete weight of the entire outfit is about fifty-eight pounds. Fig. 7 shows a simplified form of the circuits.

The last distinctive type of radio-telephone outfit is the short wave set installed on submarine chasers and destroyers during the war. These sets are shown in Figs. 9 and 10. The circuits of these sets are practically the same as for the airplane sets, except that the power for them is obtained from small dynamotors run on a 30-volt storage battery. The complete transmitter and receiver, together with the amplifier and extension set, are shown in Fig. 8 and the transmitter receiver itself is shown in Fig. 9.

The set is installed in the radio room with the amplifier for the loud-talker. An extension set consisting of a telephone transmitter and receiver, together with the loud speaker, is mounted in the pilot house. By means of a switch in the radio room, the operator can cut in the extension set while the conversation is being carried on by the captain. It is also possible to use either the head receivers or the loud-speaker for receiving.

This equipment has an effective range of from 5 to 10 miles and can be used in four wave lengths ranging from 250 to 600 meters.—*From a paper by E. B. Craft and E. H. Colpitts, entitled "Radio-Telephony," read before the American Institute of Electrical Engineers, Feb.* 21, 1919. *Photos courtesy Western Electric Co.*

Faradic Currents—How To Apply Them

(Continued from page 366)

tive while the *positive* electrode is at the base of the spine. The room should be well aired, and the patient's feet and hands should be kept warm with hot water and bags.

Headache.

The treatment of headaches depends upon the cause. If caused by disordered stomach or bowels, what is called a sick headache, place the *positive* electrode at the base of the brain and apply the *negative* over the stomach, liver and bowels, using a *mild secondary* current. General tonic treatment of the whole body with *secondary* current will cure or help some patients, while central faradization (as described in treatment of diabetes) will help others.

Indigestion.

Place the *positive* at the back of the neck and sponge the region of the stomach and bowels with the *negative*. Another method is to place the *positive* electrode on the tongue and the *negative* at the pit of the stomach. Use *secondary* current. If the patient is debilitated give general tonic treatment of the whole body.

Neuralgia.

If properly treated, neuralgia is one of the diseases that yield most readily to electrization. There is one difficulty in the treatment of neuralgia by electricity and that is the intensity of the pain. Often the first few treatments aggravate the pain, especially if the current is too strong or the treatment is continued too long. Not over one treatment a day should be given. Give a general tonic treatment of the whole body every other day. For local treatment, where there is no swelling, apply the *negative* to the painful parts, and the *positive* at the hands or feet. If there is swelling apply the *positive* to the disease, and the *negative* at the hands or feet, using a *secondary* current.

Rheumatism—Inflammatory and Acute.

Either of the above kinds of rheumatism may be treated with the *positive* electrode. If the trouble is about the head, neck, arms or shoulders, hold the *negative* in the hands and apply the *positive* to the painful parts. If the pain is below the arms, apply the *negative* electrode to the feet and the *positive* to the affected parts. Drink freely of lemonade. Avoid alcoholic liquors, meats and fatty food. A rigid diet for a few days is to be recommended.

Rheumatism—Chronic.

Chronic rheumatism is much more obstinate and resists a cure more than the acute kind. Very often the general tonic treatment will give relief. For local treatment, treat with the *negative* electrode instead of the *positive* as in the acute form. Also use the primary and secondary currents alternately. If the joints are enlarged treat with the *positive* electrode, using the primary current. Keep the body warm and the feet warm and dry. Do not allow the patient to expose himself to any dampness. The electric bath is to be recommended.

Sunstroke.

In most cases of sunstroke, electricity is a valuable agent in restoring persons who have been overcome with the heat. General tonic treatment should be given, also central galvanization as described in the treatment of diabetes. Local treatment to the head may be given and a *very light secondary* current should be used, *positive* electrode at the head and *negative* at the base of the spine. In all cases have the attention of a good physician.

WIRELESS CONTROL IN THE PEACE TREATY.

Wireless: During a period of three months after the peace German high power wireless stations at Nauen, Hanover, and Berlin will not be permitted to send any messages except for commercial purposes, and under supervision of the allied and associated Governments, nor may any more be constructed.

Cables: Germany renounces all title to specified cables, the value of such as were privately owned being credited to her against reparation indebtedness.

Germany will be allowed to repair German submarine cables which have been cut, but are not being utilized by the allied powers, and also portions of cables which, after having been cut, have been removed, or are at any rate not being utilized by anyone of the allied and associated powers. In such cases the cables, or portions of cables, removed or utilized remain the property of the allied and associated powers, and accordingly fourteen cables, or parts of cables, are specified which will not be restored to Germany.

Air: The armed forces of Germany must not include any military or naval air forces except for not over 100 unarmed seaplanes to be retained till Oct. 1 to search for sumbarine mines. No dirigible shall be kept. The entire air personnel is to be demobilized within two months, except for 1,000 officers and men retained till October. No aviation grounds or dirigible sheds are to be allowed within 150 kilometers of the Rhine, or the eastern or southern frontiers, existing installations within these limits to be destroyed. The manufacture of aircraft and parts of aircraft is forbidden for six months. All military and naval aeronautical material under a most exhaustive definition must be surrendered within three months, except for the 100 seaplanes already specified.

POCKET WIRELESS SOON, PREDICTS MARCONI OFFICIAL.

Godfrey Issacs says the English Marconi company, of which he is managing director, expects to have a commercial service of wireless telephones in operation in New York and London early next year.

The company hopes to make arrangements with New York and London telephone companies so that eventually the British and American wireless 'phone subscribers will be able to sit at their desks and "Hello, London" or "Hello, New York."

Isaacs foresees the day, not far distant, when pocket wireless telephones will be in wide use. A business man's secretary, walking along the street, Isaacs says, will hear a bell ring in his pocket, will put a receiver to his ear and hear "his master's voice" give him instructions, probably from an airplane hundreds of miles away.

The Daily Mail says that the British government probably will compel all commercial airplanes and airships to carry wireless telephone or telegraph equipment. Larger machines of both types may be compelled to carry both.

BULLARD ONCE AGAIN RADIO DIRECTOR.

Navy orders were issued April 9th, reappointing Rear Admiral William H. G. Bullard as Director of Naval Communications, a position he held at the time the United States entered the world war, but from which he was detached for service overseas.

Rear Admiral Bullard is an honorary member in the Radio League of America, as our readers will remember.

Heat Engines

By John J. Furia

(*Continued from page* 320)

utes at the beginning of the day and the steam pressure is controlled automatically. Kerosene is used as the fuel which is considerably less expensive than gasoline. No shifting of gears is necessary. A turn of the throttle will give enough steam to climb any hill or to slow down to a crawl. No fussing with carburetor or ignition systems. The spent steam is condensed and led back to the boiler so that a much smaller water supply tank is used. No cooling system is necessary. A pilot light using up a negligible amount of fuel keeps enough steam pressure all day, so that one can make an immediate start. All gages operating on the fuel and steam are automatic, thus eliminating all danger. Why is it then that we do not see many of these steam cars. Two reasons—it takes a long time to educate the public—steam cars cannot be kept in the present public garages, since the open flame of the pilot light is liable to ignite the gasoline vapors present in all garages and cause fire. No doubt the steam car has a great future (provided the oil companies do not boost the price of kerosene).

The Hot Air Engine.

The *hot air* engine uses neither gasoline nor steam but plain ordinary air and that is pretty cheap. Let us examine the principles of its operation. Figure 3 shows an ideal engine consisting of a cylinder, piston, connecting rod, and fly-wheel. Heat is applied to the lower end of the cylinder as in A, the cylinder being composed of non-conducting material, except the bottom which is a good conductor. The heat will cause the air in the cylinder under the piston to develop great pressure and *eventually to expand,* forcing the piston *upward.* If the heat is suddenly removed and replaced by cold, when the piston reaches the top of its upward motion, then the air under the piston will *contract* and the piston will move *downward,* due to two causes: (1) the suction under the piston and (2) the pressure from above the piston, since the air above the piston was comprest when the piston moved up. This then would constitute the complete cycle and if repeated indefinitely our engine would continue to run. Let us look at Fig. 2 again. If the inlet were connected to a tank of air and the air heated, the air would expand, enter the cylinder and move the piston; if then new air were admitted and heated, this on expanding and entering the cylinder from the other side, because of the action of the slide valve, would cause the piston to move back again, giving us a motion similar to that of the steam engine.

The ideal hot air engine described above and this steam engine operated as a hot air engine, illustrate the two types of hot air engines in existence. The first typifies the *closed cycle* engine which operates continuously with the same mass of air (a fresh charge being occasionally admited to compensate for leakage). The second typifies the *open cycle* in which a new charge of air is admitted and exhausted at each stroke. The closed cycle engine is analogous to the new type of steam engine employing a condenser for the spent steam, while the open cycle is analogous to the old type non-condensing steam engine. Therefore it is readily seen that the closed cycle engine is more efficient than the open cycle, none of the fuel being wasted on the exhausted air. In all types of *hot air* engines, the power is secured by the pressure of the air produced by heat transferred by a separating metal wall. The air is admitted to the cylinder at a high temperature and pressure, it is allowed to do mechanical work on the piston as a result of which the pressure and temperature fall off.

There are two heating systems employed in hot air engines—the *regenerative* and the *non-regenerative.* A regenerative system is one which uses a device for absorbing the heat from the air as it passes in one direction and supplying it again on passing in the opposite direction. A non-regenerative system does not employ such a device. One of the best of the hot air engines is the Stirling engine which has been actually used commercially, tho without much success. It is of the closed cycle type working with a constant volume of air, and requires about 2 lbs. of coal per hour horsepower (i. e., more efficient than the steam engine). Its chief objection was that the heating plate, which takes the place of the boiler of the steam engine, burned out rapidly. Figure 4 is a sketch of the essential parts of the Stirling engine. C is the brick foundation of the engine, B the fire box, A the draft, H is the working cylinder, E the displacer acting in opposition to the working piston, D the air-box, F metal gauze, and G coils of pipe thru which cold water flows. The total volume of the air contained in the air-box, the working cylinder and the connecting pipe *remains constant.* The lower end of D is a plate pierced with holes, thru which the air flows when the displacer E moves downward. The upper part of D, thru which the coils G pass, is known as the *refrigerator.* The fire heats the air in the air box D. As the engine is started the displacer E moves downward, forcing the hot air thru the regenerator gauze F. Heat is absorbed by F and the air cooled. It is further cooled by the refrigerating pipes G. The pressure in H is therefore diminished and the piston moves downward. This forces the air back thru F into D, gaining heat from F and forcing the displacer upward. The heat gained from F, in addition to that gained from the fire, causes the air to *expand,* raising the piston in H. This completes the cycle. The inertia of the fly-wheel causes the fly-wheel to push down the displacer E and the cycle is repeated.

Steinmetz's Own Shorthand

(*Continued from page* 314)

"It is my opinion that every college student should learn some good accurate system of shorthand, so that he can follow the lectures and make notes without effort."

The system of shorthand that Dr. Steinmetz has evolved as the best adapted for writing on electrical subjects is based upon the "Arends" system of stenography as taught in Europe. Words are written as they are pronounced without regard to their spelling; that is, they are written phonetically. The word "height" is written h-i-t, but in this case the long "I" is used.

One of the most interesting features in connection with this system of shorthand is the fact that French and even Latin and Greek words and names can be perfectly written and read without the slightest hesitation.

With his own hand, Dr. Steinmetz has written down the rules, or it might be said, the "code" of his system, so as to assist those persons with whom he is working in a translation of his reports and various articles.

With a view of affording every reader of this article, especially those attending college, some knowledge of Dr. Steinmetz's system, a reproduction is given of the alphabet, written out by the famous electrical wizard himself.

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Contents of August Issue:

X-Ray Experiments

(*Continued from page* 319)

zation. This statement is not altogether accurate. Barkla has observed that when a pencil of rays enter an object which scatters them, the scattering is more marked in a direction parallel to the stream of cathode particles. The greatest objection has been advanced by Bragg. He reasons as follows: If a stream of cathode rays striking a target set up some sort of rays which it has been found instigate new cathode particles when they enter some body, it is reasonable to suppose that these rays merely serve as a means of transferring energy from one electron to another. He suggested that they might consist of neutral doublets made up of a *positive* and *negative* charge, which is broken up when the rays strike some object. This theory might explain why only a few and not all of the molecules in a gas are ionized, for as the doublet moved thru the gas only a few of the molecules would come into contact with it and be charged. Later, however, this theory was disproved.

The most important property of the rays is their power of making objects transparent and affecting a photographic plate. Procure about a 5 x 7 plate and carefully wrap it in black paper. Care should be taken that the *film side is placed upward* as the *glass* cuts off a good deal of the radiations. The bulb should be placed about six inches above the plate and the objects to be photographed laid directly upon it. The arrangement is clearly shown in one of the accompanying illustrations, Fig. 4. The bulb may be procured from several leading supply houses. The one shown is not provided with a third electrode. The coil is connected direct to the bulb, no condenser or spark gap being used. When the connections are properly made *the lower half of the bulb will glow a bright green.* If the polarity of the current is wrong, only a *ring of light* will show. The polarity may be corrected by a pole-changer in the primary circuit of the coil.

Radiographs, while once a comparative novelty, are now fairly common—especially since the war. Many interesting skiagrams have been returned from the front showing the invaluable work X-rays have accomplisht. The Customs House has made a novel use of their penetrating power. In order to see if anything such as bombs were concealed in bales of cotton or other apparently innocent objects, the bale would be placed before a powerful X-ray bulb and a man standing on the other side would examine it with a fluoroscope. Of course a small bulb operating on about a 2-inch coil does not possess very great penetrating power, but the reader should experience no difficulty in seeing thru the thick part of the arm. An X-ray picture taken with such apparatus is reproduced herewith. See figure. As was said above, the amount of penetration is proportional to the density, decreasing as the density increases. Use has been made of this fact in determining the atomic weight of unknown elements by measuring their transparency to X-rays. Benoist determined the atomic weight of indium by this process.

Another important property, and the one which gives us the readiest means of measuring their intensity, is their *ionizing* power. This may be easily illustrated by hanging a grounded plate above an electroscope of the ordinary flask type. The arrangement is shown in Fig. 2. *If the intervening air is exposed to x-rays the electroscope will be discharged.*

Another interesting experiment is to take an ordinary hydrometer and remove the float. Fill the bulb and about a third of the tube with water. Put your finger over the end to prevent the air from escaping and squeeze the bulb. It will be noticed that a cloud is formed. This is due to the moisture condensing around the dust particles in the air. After this has been repeated several times all the dust particles will be drawn down into the water and *no cloud will form.* Now, if when this condition has been reached, the apparatus is exposed to X-rays, a dense cloud will be formed. *This is caused by the moisture condensing around the ions, due to the X-rays.* This phenomenon forms the basis of the rain-making apparatus described in the February, 1919, issue of this journal as developed and patented by the Australian inventor and engineer, Balsillie.

Röntgen rays also possess the remarkable property of exciting *secondary rays* in substances which they strike. As this is a rather complicated phenomenon and as there are no experiments in connection with it which the average reader may repeat, it will not be discust here, except to mention that the secondary rays resemble the original cathode rays, only they travel at a slightly slower speed, which is dependent on the hardness of the primary rays. Recently X-rays have found a new application in the analysis of *crystal structure.* It was found that X-rays might be defracted by the cleavage surface of crystals. Using X-rays, it has not only been possible to determine the exact shapes of crystals, but also to actually show the arrangement of the atoms as well as the distance between them.

"Christmas Bullet" Plane to Fly the Atlantic

Another attempt to cross the Atlantic was announced recently by the Cantilever Aero Company, makers of the "Christmas Bullet" airplane.

In the company's plant at Amityville, L. I., assembling has begun on a huge airplane which is expected to start from New York and land within thirty-five hours at Queenstown, London or Brest.

It will have a wing measurement from tip to tip of 180 feet and will be equipt with four 800-horse power motors, giving a speed of 115 miles per hour. These motors are connected in such a way that should one be put out of commission the operation of the machine will not be affected. The engineer will also be able, if necessary, to overhaul any of the motors, clean the spark plugs and make adjustments while the plane is in flight.

The body of the machine will be 14 feet in diameter, insuring comfort and proper housing for the crew, who will not at any time be exposed to the elements.

There will be two three-bladed propellers in front of the machine. Each will be 21 feet in diameter, capable of making 600 revolutions per minute. The weight of the machine with full flying rig is 30 tons. It will be controlled thruout by electricity.

Two pilots will be seated in separate compartments, working alternately, each taking the machine for a certain length of time.

The construction and design of this airplane has been under consideration by the Cantilever Aero. experts for six years and every detail has been tested and approved by the designer and inventor, Dr. William Whitney Christmas, it is stated by the builders.

Thunderstorm Electricity

By Rogers D. Rusk, M. A.

(*Continued from page* 307)

ly called *thunder-caps,* or *thunder-heads,* and often the clouds will grow so thickly together that to an observer on the earth they appear as a huge dark rolling-cloud extending across the sky, the tops being obscured except to aërial observers several thousand feet in the air. It is while such clouds as these are forming that the electrical forces are at work which build up enormous charges in a manner which will now be described.

How Rain-Drops Form.

Experiments show that *ions* are nearly always present in the air. Sometimes these are *charged dust particles,* sometimes they are *charged atoms of the gases* of which the air is composed. Experiment further shows that rain-drops condense about *negative ions* much more quickly and easily than about *positive ions.* The earth itself is a very highly charged *negative* body, its charge being estimated at 600,000,000 volts, but the rain that falls is *positively* charged almost as often as it is *negatively,* which may be accounted for by the fact that the *positive* drops, forming more slowly, are larger and heavier and are not retarded so much at times by upward currents of air. It is these upward currents of air in the clouds themselves that produce the charges within the clouds. The *negatively* charged drops being smaller and lighter are carried to the top of the cloud, very often forming a heavy *negative* charge. In a similar manner the heavier *positively* charged drops will fall to the bottom of the cloud forming a strong *positive* charge. In addition the wind may break up the drops into smaller droplets and when this is the case, it is found that the smaller droplets are nearly always *negatively* charged. By these processes of division and formation of charged drops and their separation in the cloud, enormous charges are generated, and the thunder-cloud is seen to be really a huge electrical generator as shown in Fig. 3. And when the charges become sufficiently great the lightning discharge results. This may take place from top to base of cloud which is usually a distance of about a mile, or it frequently takes place between the base of the cloud and the earth which is often a much shorter distance. From cloud to cloud the lightning may flash a distance of *ten or twenty miles,* and at such a time the discharge exercises a powerful *inductive* effect on all nearby clouds, which may cause flashes to occur in rapid succession.

When a *negatively* charged cloud approaches the earth, the *inductive* effect of the earth's charge may cause it to suddenly reverse its charge to *positive,* and the potential become so great that a discharge to the earth follows. Sixty per cent of these discharges to the earth carry *negative* electricity to the earth, while the remaining forty per cent carry *positive* electricity. This shows that sixty per cent of the discharges were from clouds which had built up a higher *negative* charge than the earth itself.

The phenomena of thunder-storm electricity cannot be said to be the product of any one particular cause, or of always exactly the same combination of causes. One thing, however, is certain. All of the above mentioned factors act together and atmospheric conditions are so variable and in such a continual state of change that a definite formula for their operation would be beyond the limits of possibility. The theories of thirty years ago which tried to explain lightning by means of atmospheric friction and other such causes have sunk into oblivion.

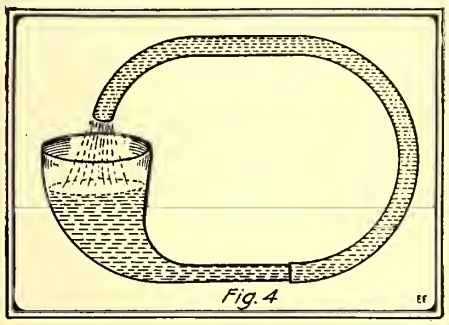
Experiments in Physics

PERPETUAL MOTION

By John J. Furia

(*Continued from page* 315)

See Fig. 6. In Electrostatics we learn that the sharper the point of a conductor, the greater the density of the charge present. Because of the great density, the charge leaves the conductor at the sharp points. If by some means we continually charge a conductor having a shape like that in Fig. 1, then the reaction will cause it to move as indicated by the arrows. The source of the charging can be a static machine (Whimshurst or other type). Why not belt the conductor so as to run our static machine; and sidetrack some of the electricity from the machine to be used for other purposes? One has but to look at the small weight of the conductor and the slow speed



"Perpetual Motion" de Luxe. The Atmospheric Pressure on the Water in the Bowl Will (Theoretically) Force the Water Up Thru the Circular Pipe and Out of Its Open End. Thus the Water Will Circulate Around and Around—Yes It Will—NOT!!!

at which it runs and compare it with the large heavy static machine and the large force required to cause it to give a spark, in order to perceive at once the folly of such an absurd scheme.

Another idea along somewhat similar lines is the following: A screw fits tightly in a cylinder at the top of which is an ordinary rotary lawn sprinkler. As the screw is turned the right way, the water rises in the cylinder. When the water reaches the level of the sprinkler, it comes out from the nozzles and the reaction causes the sprinkler to turn. Once this machine is started it should operate forever, for as it turns, water rises to the sprinkler—while as the sprinkler operates, it turns and causes water to rise in the cylinder. It takes considerable force to cause the sprinkler to rotate due to the reaction; it would require still more force if the sprinkler had to in addition do the work of lifting the water up the cylinder. The reaction due to the water coming out from the level of the sprinkler *with no force behind it* is very small, and not ever sufficient to cause the sprinkler to budge. See Fig. 2.

Fig. 3 represents the cross-section of a cylinder containing grooved curved spokes. Marbles or lead balls rest in the grooves. It will be seen that the marbles at the left are further from the center than those at the right. Consequently because the rotational moment on the left is greater than that on the right (the marble being of the same size and weight) not only will the machine move perpetually and do work, but it will even start itself? By putting a belt around the cylinder, machinery can be driven continually, perhaps?!X! It is true that the moment on the left is greater than that on the right and therefore there is *apparently* a tendency to cause rotation opposite to the rotation of the hands of a clock, but if rotation is to take place the top marbles near the center vertical axis will have to be raised over the bend in the spoke, and the machine having no means of doing this, the scheme fails miserably.

The following is a good example of perpetual motion proposed by one ignorant of the simplest fundamentals of hydrostatics. If a pipe having a very large bowl is connected to a piece of tubing of small diameter, and curled in the shape shown in Fig. 4, when water is placed in the bowl, it should come out from the end of the tubing, thus filling the pipe bowl again and the passage of water from the pipe bowl out thru the stem and tubing back to the pipe again *will be continuous?* This will operate as long as the amount of water in the bowl is large compared with that in the stem and tubing, for then the weight in the bowl will be greater than that in the stem and tubing, and the weight in the bowl will force the water thru the stem and tubing, said early philosophers. This explanation, of course, ignores the fact that it is the pressure in the liquid that counts and not its weight, and since both ends (the bowl and the tubing) are exposed to the atmosphere, they are at atmospheric pressure and hence the liquid will stay at the same level in both.

(NEXT ARTICLE—STAGE TRICKS AND ILLUSIONS)

Jeweled Portal Welcomes N. Y. Fighters

(*Continued from page* 311)

altar on the farther side, making a total width of 110 feet. The bejeweled obelisks rise to a height of eighty feet and are surrounded by great jeweled forms in the shape of sunbursts which are each twelve feet wide and twenty feet in length.

Lighting of the portal was effected by two banks of twelve 18-inch searchlights at Fifty-eighth Street and Sixty-second Street, respectively, which threw shafts both up and down town. This effect of *more than a million candlepower* reflected by the 31,000 jewels, defies description, and New York held its breath and watched the fairy spectacle.

Cut glass jewels, cut scientifically to imitate diamonds, rubies, emeralds and sapphires, are mounted in such a manner as to be kept in motion by the breeze. All the colors of the spectrum gleam from these jewels as the screened lights search out the portal and the tower tops sparkle in veritable glory above.

While the Victory Arch, and the Court of Heroic Dead attracted many thousands of persons, the dazzling effect of the "Jeweled Portal" set the vast crowds astirring, backward and forward in order to obtain a better or different view of the wonderful illumination.

The "Jeweled Portal" cost $40,000 to erect, and after being lighted for the first time was acclaimed the greatest thing New York had ever seen.

Architecturally, the portal is an achievement and an innovation praised without stint by the architects of New York, and reflecting great credit upon Mr. Ryan and Captain Gosling, in whose minds the entire scheme was born.—*Photo Courtesy General Electric Co.*

Peacetime Uses for War Inventions

By H. Winfield Secor

(Continued from page 365)

gines of the distant vessel is picked up by a sound-sensitive electrical instrument, known as a *microphone*. By turning the microphone in different directions, and noting carefully the position where the maximum sound is heard in the receivers, the spot from which the sound originally emanated can readily be determined even to within a fraction of a degree, it is claimed. For locating icebergs or other obstructions, which of course do not produce any sound themselves, there is required a *sound producer* such as an under-water electric bell or siren. The sound waves radiate from this device, mounted between two microphones on a rotatable arm secured to the vessel, as the illustration shows, travel outward until they impinge against the iceberg or other impediment, when they are *reflected* as the arrows show. These reflections, or the "echoes," are listened for by the aid of microphones and sensitive telephone receivers connected with them. By swinging the bar supporting the microphones and siren in different directions, the position of the obstruction is at once determined. Its distance can also be ascertained with some of the more highly developed apparatus of this class, by direct reading instruments, or else by the relative strength of the sound heard in the receivers.

The *Radio Compass*, as it is called, has come greatly to the fore in the past three years. Prior to the World War it existed mostly in the laboratorial stage. But at the close of the war radio compass stations were to be found not only in the principal coastal regions in the vicinity of shipping activities, but they were also to be found on the great battlefields of Europe, where they were used for the purpose of accurately locating "enemy" radio stations. The radio compass should, we might almost say, find even a greater field of useful application in peacetime than it did during the war. It promises to become one of the most important scientific developments in wireless telegraphy, particularly for the navigation of aircraft. We were recently informed by a naval radio expert that the English Navy had the radio compass scheme worked out to wonderful perfection, and that during the war they were actually able to steer vessels up the entrance to the Liverpool Harbor, one of the most treacherous harbor entrances in the world, on the darkest and most foggy nights, without ever having a collision. See Fig. 9. To do this, a series of radio compass stations were situated on either shore at short intervals, and these stations sent out predetermined radio signals at successive intervals. This expert also mentioned that it was very easy for any Allied war vessel to instantly obtain her location and bearings if she was anywhere about the coast of England or Ireland, utilizing the service of the radio compass stations which dot these coasts. If the vessel wished to know her location, the radio code signal for interrogative "L" was sent out twenty times. This was the official notice to nearby radio compass stations that the ship calling wished to know her location. At least two land compass stations then took readings of her signals, and by triangulation and by means of wire or wireless communication between the two stations which had a fixt base line, the triangle was solved in a few minutes, and the exact location of the ship was transmitted to her radio officer from one of the land stations. The ship received her location figures in latitude and longitude about five minutes after sending out the call letter aforementioned.

Airplane Photography was pre-eminently one of the most highly developed sciences brought out by conditions imposed by the World War. Complete sections of the battlefront often had to be photographed in a single day's time, and by means of camera guns, and other extremely rapid photographic devices, thousands of pictures could be taken within a few hours in such a manner that when the films were developt and prints made, which took a short time with the perfected apparatus used by the Army in the field, these prints could be matched up by map experts so as to give a true composite photograph of an entire region. The work done by the Photographic Department of the Army in this respect was nothing short of miraculous. At a recent exhibit of this Department's work, one of the composite aërial photographs showed the entire city of Washington, D. C., and environs. The airplane flew over Washington in a certain prescribed course and took all of the photographs which composed the composite view in a little over *two hours!* The individual prints making up the composite view usually measured about three inches square. Imagine how easy it now becomes to obtain actual physical maps of such regions as the Rocky Mountains and other inaccessible and treacherous localities so that our geographies of tomorrow may indeed prove a marvelous revelation to the school students of today. Airplane photography in its modern aspect and with the high speed available should lend itself well to the requirements of mapping real estate, large farms, railroad sites and hundreds of other localities for many kindred purposes. See Fig. 10.

Gas Masks, as well as *Gas Detectors,* find many uses in our everyday life. The gas masks are useful to firemen and rescue squads and prove particularly efficacious for use in entering gas-filled mines and other subterranean passages. Gas detectors are not so well known to the general public, as these proved one of the extremely valuable keys to the success of the Allied soldiers. One ingenious form of electrical gas detector is illustrated in Fig. 11. This detector, which also permits of the measurement of the amount and strength of the gas present, comprises a pair of sensitive detecting wires, also a pair of resistance coils and a galvanometer, forming a Wheatstone bridge system, as the diagram shows. At the bottom of the apparatus is shown a metal block in which there are two cavities, each containing a gas detecting wire, and the gas reaches one of these wires thru a series of perforations placed in the external wall of the block. This clever patent has been granted to Gilbert A. Shakespear of Birmingham, England (U. S. patent number 1,304,208).

Depth Bombs apparently seem to be one of those peculiar inventions which follow the old adage—"killing two birds with one stone." Not only did they prove the undoing of the career of many U-boats, but they likewise show great promise of performing many useful peacetime tricks as well. Among other things, the depth bomb should prove uniquely successful in blasting ice jams in river gorges, etc. And as one of our naval officer friends recently told us, thousands of fish are stunned and killed every time a depth bomb is detonated on the water. See Fig. 12. Therefore, why fish with nets in the ocean, when by means of a few depth bombs detonated thirty to forty feet below the water you can stun or kill thousands of fish? Then by a simple suction arrangement pull them into the fishing smack so fast that it would take seventeen bookkeepers and three adding machines to keep account of the catch. Another practical use for depth bombs is the clearing away of derelicts or other obstructions in harbors, lakes or on the ocean.

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, dealers and amateurs 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 seven cents a word for each insertion. No advertisement for less than 50c 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. Objectionable or misleading advertisements not accepted. Advertisements for the September issue must reach us not later than July 22.

The Circulation of the Experimenter is over 115,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Automobile Accessories.

Battery Charging Pays Big Profits. City current or gas engine operates. Easy terms. Hobart Brothers, Troy, Ohio.

Lubricant Carbon Remover. Cleans your engine and keeps it clean. Results guaranteed, $1. Circular. Lewis Gilbert, Skaneateles, N. Y.

Fords run 34 miles per gallon with our 1919 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all motors. Runs slow high gear. Attach yourself. Big profits for agents. Money back guarantee, 30 days' trial. Air-Friction Carburetor Co., 270 Madison St., Dayton, O.

Auto Motors and Supplies. Buick, Hupp, Franklin, Michigan, Everett, Hudson, Chalmers. Both water and air cooled motors, $40 each and up. Bosch Magnetos, $15 each and up. Presto Tanks, $5. Coils, Carburetors, Head Lamps, Horns, Air Compressors, Generators, Starters. Write for bargain bulletin second-hand auto accessories. Johnston, West End, Pittsburgh, Pa.

Power Increased; Carbon Eliminated; results guaranteed; write for booklet. No-Leak-O Piston Ring Co., Baltimore, Md.

Agents Wanted.

Beginners. Complete "Mail Order System." C, Box 1005, Atlantic City.

Agents Wanted to sell these rubless washing bars. Save soap and money. Agents making good. Le Hunt, 756 23rd St., Newport News, Va.

Big Money Made every day selling our automobile accessories. Every autoist a customer. Most remarkable inventions in the accessory line. Demonstration proves every claim. Particulars free. Exclusive territory if you act quick. The Embee Co., Wilkinsburg, Pa.

$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.

Signs for store and office windows. $50 a week easily made. Chicago Sign System, G 326 River St., Chicago.

Wonderful Chance—Men's shirts and furnishings at wholesale rates, or make $10 daily starting real business. Goodell Co., Duratex Bldg., New York.

10 to $25 a day profit. Biggest summer seller. Concentrated fruit drinks. Just add water. Delicious drink in a jiffy. Six popular flavors. Bestever Products Co., 2426-SE-8 Polk St., Chicago.

Agents. Big returns, fast office sellers; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Insyde Tyres, inner armor for automobile tires, double mileage and prevent punctures and blow-out. Quickly applied. Costs little. Demand tremendous. Profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, O.

Help Wanted.

Auto Experts Wanted. $35 week. Learn easily while earning. Write immediately. Franklin Institute, Dept. H 806, Rochester, N. Y.

Detectives make big money. Travel; be your own boss. Either sex. We instruct, small cost. Write Johnson's Detective School, 232 Sheldon Ave., Grand Rapids, Mich., Dept. A.

U. S. Government wants Railway Mail Clerks. Hundreds needed. $1,100-$1,600 year. Examinations everywhere, Aug. 23. Sample questions free. Write immediately. Franklin Institute, Dept. H 26, Rochester, N. Y.

Agents 200% Profit. Wonderful little article. Something new; sells like wildfire. Carry right in pocket. Write at once for free sample. Albert Mills, Mgr., 1287 American Bldg., Cincinnati, Ohio.

Fishing.

Julian's Liquid Fishing Lure. Doubles your catch. By mail One Dollar. Circular for stamp. George Julian, Albany Bldg., Boston, Mass.

Postcards.

Five Prettiest Women Cards, hand colored, 25c. Chas. Durso, Dept. 41, 25 Mulberry St., New York City.

Stammering.

St-Stu-t-t-tering and Stammering cured at home. Instructive booklet free. Walter McDonnell, 105 Potomac Bank Bldg., Washington, D. C.

BUFFALO SHOE COMPANY
OUTDOOR FOOTWEAR

Seneca and Ellicott Streets

BUFFALO, NEW YORK, U. S. A.

142 Oxford Ave., Buffalo, N. Y.

The Experimenter Pub. Co.,
233 Fulton St., New York City.

Dear Sirs:

Find inclosed a bill for 98c and also money for same. Kindly send receipt. Please pardon me for not sending it sooner.

It was the best ad I ever had and if I ever have any other instrument to dispose of I will advertise in your columns. I received 24 answers inside of 4 days.

Yours for success,

(Address) J. Rife Barbusser,

Exchange Ads.

For Sale—Electro Importing Co. Loose Coupler $6. Never used. James Walker, Pontiac, Mich.

Sacrifice: Large Camera, large Scientific book. Want: Wireless Apparatus. Stamp for list. Weniger, Brownsdale, Minn.

Exchange, Buy, Sell. Wireless, electrical goods, etc. Large list 6c. State what you have and want. Zehrbach, Box 600, Hiram, O.

Boys' Books for chemical or electrical apparatus. Stamp for list. Homer Votaw, Raymond, Wash.

For Sale—One new bicycle motor. Makes your bicycle a motorcycle. Walter Van Schaick, Lake Benton, Minn.

For Sale—One pair Murdock phones with cord, "Regular" Headband, two thousand ohms. Second-hand, but very sensitive. Twelve "Electrose" Ball insulators. New Six "Electrose" strain insulators. New one six hundred volt ground switch, 6 lbs., new. Thirty feet high tension cable 7/16 inch diameter, twenty thousand volts discharge. New six lbs. Copper Clad Wire, 510 feet. Best and latest Wire, new. Cash. Twenty Dollars, or make offer on part of equipment. H. K. Tryon, Berlin, New York.

$5 Electrical Water Purifier; want Film camera. Prints—or offers. Clarence Skinner, Topeka, Kansas.

For Sale—Wireless and electrical apparatus, also other articles. Cheap. List free. Write quick. Atley Maurek, Box 157, Austin, Minn.

Cheap—Twenty-three dollar Omnigraph. Arnold and Murdock Couplers. Load. Detectors. Meeker, 1632 University Ave., N. Y.

Exchange pair 1,500 receivers, headband, 100 Amp. switch, 9-4" insulators, fixed condenser, 2 lbs. aluminum wire No. 14, spark gap, 15 ft. ground wire; for folding camera like Kodak, value $10 (2¼x3¼). Maron, 390 Highland Ave., Malden, Mass.

For Sale—Complete unused analytical and industrial I. C. S. Chemistry Course. First $20 takes it. Nicholas Michel, 217 South 4th St., St. Charles, Mo.

5 H.P. 2 cycle single cylinder air cooled engine. Coil ignition. New piston rings and spark plug, good carburetor. Guaranteed A-1. $25. Money with letter. James E. Walker, Box 63, Marfa, Tex.

For Sale—"Ranger Arch-Frame" bicycle; 22-inch, three-speed, clincher tires, nearly new, $43. Stamp for answer. Gerald Willard, Heron Lake, Minn.

Exchange Ads—Cont'd

For Sale—2 K.W., D.C. 110 V. Dynamo. Marble slab with 0-150 V. Meter field rheostat and switch attached. Price $100. Or part in wireless receiving apparatus. S. R. McClure, Helm, Ky.

Wanted—Everything. Motor-wheels, cyclecars, anything. R. Place, Sprague, Fall River, Mass.

Attention, Experimenter—Brand new books, "Radio Telephony," by Alfred Goldsmith, $1.25 (sells for $2.00). "Practical Wireless Telegraphy," by E. E. Bucher, $1.25. Arthur E. Reider, 348 E. 15th St., N. Y. C.

Your Opportunity to Save Money. I have Printing Outfit; cost $150; is almost new; will sell for $100 cash. Have lots of Electrical Wiring Supplies; will sell at my cost (wholesale prices). Paid $80 for Smith Motor Wheel; very good condition; will sell for $45 cash. Above statements and your complete satisfaction fully guaranteed. Privilege to return within 10 days. H. L. Baer, Van Wert, Ohio.

Bargain—1,200-mile Receiving set, includes loose coupler, loading coil, condenser, silicon detector, buzzer code. Mounted; for $7. Money Order. Merle Doan, Vera, Oklahoma.

For Sale or Exchange: Six copies of Hawkin's Guides, $3.90; 1 400-day clock in first class condition, $5; 1 1 K.W. Thordarson Transformer, $18.90; 1 ¼" Spark Coil, $1; 1 1-K.W. Tesla Coil, $15; 1 Crystaloi Detector, Type AA, $5; 1 E. I. Co. loose coupler, $2; 1 Navy Type loose coupler, $4. All in first class condition. Address Walter Franseen, Woodhull, Ill.

For Sale—$40 Cabinet Set. Receives any 1 K.W. set in States. Uses bulb detector. Two loading coils free. $20. $35 Rotospeed Duplicator and equipment, $20. No. 3 Box Brownie, $2. Any article C. O. D. upon 25% payment. No trades. J. C. Gilliland, Munhall, Pa.

For Sale—½ K.W. Wireless Transformer complete with rotary motor gap and one battery charging outfit; will charge 3 six-volt batteries at once. Will sell all of above for $75. A good bargain for someone. E. L. Forslund, Madrid, Iowa.

Sell—3 1-qt. size Wet batteries, 75c each; 2-plunge batteries, 75c; telegraph outfit, $1.00; Selenium cell outfit, $1.00; loose coupler, $3.00; 6 bar magneto 110 volt generator, $4.00; telephone set, $3.00; Structo Auto Builder, $4.50. Raymond Fiedler, 70 Sargent Street, Lawrence, Mass.

Sale—1" coil, $2.50; O. K. motor, $1.00; step-down Thordarson, $3.50; ¼ K.W. transformer, $5.00. Also wire, silicon steel, etc. R. P. Hanger, Sherwood Ave., Staunton, Va.

Motor Winders. See ad under "Blueprints." Charles Chittenden.

Motor Generator for Sale. 220 volt, 60 cycle, single phase motor, 30 ampere, 36 volt generator. Specially wound for battery charging; 1 to 24 batteries charged at one time. Used very short time; good as new. Price, including switchboard and 4 charging rheostats, $230. Earl Hotchkiss, Forestville, Conn.

For Sale—High grade regenerative receiver with phones. Will sell parts separately. Also have key, large oil condenser, half-inch coil, motor, etc. Write for prices and description. E. H. Hartnell, Salem, Wis.

For Sale—$8 Loose Coupler, $6; 2,000 Ohm receivers, $4; $4.50 Variable Condenser, $3.50; $3.50 Variable Condenser, $3; $1 Fixed Condenser, 60c; $4.50 Detector, $3; $2.25 Transformer Key, $1.50. All Murdock goods. 2" Spark Coil, $6; Gernsback Interrupter, $1.85; 2 ½-pt. Leyden Jars, $2; $5 Vacuum Bulb, $3; 6 Volts 6 Amp. Dynamo, $1. Guaranteed all new. Send money order. K. Jennings, 106 Blue Hill Ave., Mattapan, Mass.

For Sale—One I. C. S. Heavy Electric Fraction Course without bound volumes. Highest cash price takes. Elwood Little, Decatur, Ill.

Wanted—Wireless goods for 3¼x4¼ Premo Camera. G. Kostka, 2215 St. Louis Ave., Chicago.

Will trade I. C. S. Mechanical Engineering Course for Chemical Laboratory. Herbert Langlois, 2414 Cleveland Ave., Everett, Wash.

For Sale—Steel Radio Tower, 115 ft. high. A bargain. W. Turnor Lewis, Racine, Wis.

Sell. Set of Ford Spark Coils, $7.50. Extension Desk Phone, $6. 2000 ohm Receivers, $2. Phillip Stout, 1621 Riverside Drive, Knoxville, Tenn.

Business Opportunities.

Start a Profitable Business manufacturing "Puffed Crisp." Delicious confection. Whirlwind money-maker. Machine, Instructions complete $6.50. Samples 10c. Bestever Products Co., 2426-PE-8 Polk St., Chicago.

$30 a Week. Evenings I made it with a small Mail Order Business; continued my regular job daytime. Free Booklet Tells How, 2c postage. Albert W. Scott, Cohoes, N. Y.

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.

Anyone Interested in making $100.00 month in spare time at home? Send 25c. (coin). L. Stutz, Middletown, Md.

$1 Does It. Bank references furnished. Investigate us thoroughly, that's all we ask. Results count. Our plan $1 down, $2 monthly few months gives you Warranty Deed to land. May pay profits $200 or more monthly. Maps, reports, established facts free. Address Sourlake Texas Oil Co., 867 De Menil, St. Louis, Mo.

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.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89, New York.

Manufacturers of Electric Vibrators and Hairdryers are requested to send us price lists at once and conditions of payment and delivery. I. Calvete, Ltd., 46, Newman Street, Oxford Street, London, W. I. England.

We Write Ads. that pull. Send outline for advice. Sales Letter $2. Jacobus Advertising Service, 1073 Sanford Ave., Irvington, N. J.

Victory. Mechanical Toy Soldier window attraction. 30 inches high. Salutes, turns head, points with finger, etc., as set. Well made, nicely dressed officers, privates, Uncle Sam, etc. Electrically operated. Does some stunt every half minute or oftener as set and will salute soldier and pay no attention to other if desired. Representative wanted in each city and town. Write for prices. The John M. Biggs Co., Box 324, Chattanooga, Tenn.

We will start you in the cleaning and dyeing business; little capital needed; big profits. Write for booklet. The Ben-Vonde System, Dept. H, Charlotte, N. C.

Open for proposition. R. A. Holmes, 1934 Edmondson Avenue, Baltimore, Maryland.

Break Into the Newspaper Game as correspondent or city reporter. Our correspondence course indorsed by leading editors. We give instruction and actual experience in gathering and writing news. Write for details. American Institute of Journalism. "A Newspaper School Run by Newspapermen." Dept. E, 22 Hawley St., Boston.

Your Money Back within ten days if not satisfied. Only one dollar per share for undivided interest in Sinking Ship Saver Patent. Two full pages illustrated description on second and third pages, news section, in 1918 June issue Illustrated World and first full page July, 1918, Popular Mechanics Magazine. Send $10, $25, $50, $100, or $1000 for as many shares and copy of patent. Inspect them and if not satisfied return to me within ten days and get your money back. C. Stewart Henslee, Inventor and Patentee, Chattanooga, Tenn.

Money-Making Farms. 19 States. $10 to $100 acre. Stock, tools, crops, often included to settle quickly. Write for big illustrated catalog. E. A. Strout Farm Agency, 150 E C Nassau St., New York.

The Enricht Chemical Technical Laboratories at Farmingdale, N. Y., offer their services to Manufacturers in Research work to improve and cheapen their output. Terms moderate. Correspondence solicited. Results guaranteed or no charge.

"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 publishers. 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 W. 39th St., New York.

Blue Prints

236 A. C. Motor Connections, 2 to 12 poles, contains 54 single, 42 two phase, 50 three phase Star, 40 Delta, 12 Star-Delta. Appendix 38, changes of voltage, phases, speed, cycles, etc. Particulars and sample free. Charles L. Chittenden, 811 West 18th Street, Kansas City, Missouri.

Motors, Engines & Dynamos.

Gas Engines. Marine, stationary and cycle motors for bicycle attachment, rebuilt and guaranteed. Don't fail to get our price list before buying. Prices 50% lower than others. Write. United Motor Repair & Supply Company, 305-309 Broadway, New York.

Small Motors and Generators from bankruptcy and receivers' sales. Motors for all phases of current. Immediate delivery. Less than one-half regular prices. See display ad on page 259. Johnston, West End, Pittsburgh, Pa.

Gasoline Engine, marine or stationary, ¾ horse. Castings, $8. Speed Lathe complete, $2.75. Send 12c for blueprints. M. & J. Specialty Co., 252 Parke St., Pontiac, Mich.

Miscellaneous

For Sale. Choice Silver Black breeding foxes. Reid Bros., Bothwell, Ont., Canada.

Wanted. Small gasoline and steam engines, small lathes, drill presses and other light machinery. Will pay high cash prices for good material. Johnston, West End, Pittsburgh, Pa.

Here, Boys! Jersey Skeeter, flies 100 feet; see our ad page 344. Nifty Novelty & Toy Co., Newark, N. J.

Mansfield's Automatic water and oil finder a proved success, silver medal awarded. Particulars from Edwin A. Mansfield & Co., 94 Victoria Road, New Brighton, England.

Let me send you a harmless and agreeable recipe to stop the odor and relieve your sore feet for one dollar. Guaranteed or money refunded. Louis Burchard, 119 East Vermijo St., Colorado Springs, Colo.

Breed Canaries. Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

Motion Pictures.

Electric Arc Generator halves expense. Your engine operates. Easy terms. Hobart Brothers, Troy, Ohio.

Photoplays Wanted. Big prices paid. You can write them. We show you how. Free particulars. Rex Publishers, Box 175, E14, Chicago.

News Correspondents.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

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., 920 So. Michigan Ave., Room 265, Chicago, Ill.

Write the Words for a Song. We revise poems, write music and guarantee to secure publication. Submit poems on any subject. Broadway Studios, 197C Fitzgerald Bldg., New York.

Stamps & Coins.

Stamps—12 different from warring nations, 10c; 10 different foreign coins, 15c; 10 Uruguay stamps, 10c. Lists free. Toledo Stamp Co., Toledo, O.

California Gold. Quarter size, 27c.; Half dollar size, 53c.; dollar size, $1.10; large cent, 1820, and catalogue, 10c. Norman Shultz, Kings City, Mo.

1844 cent, 10c. 727 McClellan Ave., Detroit, Mich.

Stamps—61 All Different Free. Postage, 3c. Mention paper. Quaker Stamp Co., Toledo, O.

100 Different Stamps 12c.; 200, 27c. Michaels, 5600 Prairie, Chicago.

Lusitania Medals. Exact duplicates of German medal celebrating murder of innocents. Everlasting proof of Hun's damnable duplicity. 50c each; three for $1.00; $3.00 per dozen. C. E. Mahood, Warren, Pa.

Best One Cent Approvals in America. F. P. Hand, 1117 So. 60th St., Philadelphia, Pa.

Rare Coin Over 100 Years Old, 12c. Bohn, Crafton, Pa.

Approval Applicants, 65 different stamps Free. Reference—5 cents. Harland Burgett, 419 Spring St., Lima, Ohio.

Old Money Wanted.

We Buy and Sell Old Coins. $2 to $500 each paid. Keep All Old Money; you may have valuable coins. Send 10c. for New Illustrated Coin Value Book, 4 x 6. Guaranteed prices. Get posted. Clarke Coin Co., Box 110, Le Roy, N. Y.

Telegraphy.

Telegraphy (both Morse and wireless) and Railway Accounting taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and Largest School—est. 45 years. Catalog free. Dodges Institute, 7th St., Valparaiso, Ind.

Cameras, Supplies—Photo Developing.

Clean, Neat, Perfect Kodak Finishing at the lowest prices. Work returned the same day received. Send film for sample print and copy of catalogue on developing, printing, enlarging and hand coloring, also copy of Photo Craft Magazine, which will help you make better pictures. Photo Craft Co., Box 69, Ann Arbor, Mich

For 15c we will develop and furnish prints from one, six or eight exposure film or enlargement 8x10, your favorite negative, 20c to show quality and service. Associated Photo Company, Sta. A 12, Cincinnati, Ohio.

Mail us 15c with any size film for development and six velvet prints. Or send six negatives, any size, and 15c for six prints. Or send 35c for one 8 x 10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Co., 255 Bell Ave., Roanoke, Va.

Health.

Cigarette, pipe or chewing habit conquered. Nature's method. Guaranteed. Write for free brochure. Edw. J. Woods, TA-300, Station F, New York.

Tobacco or Snuff Habit Cured or no pay; $1 if cured. Remedy sent on trial. Superba Co., SA, Baltimore, Md.

Tobacco, Cigarette Habit Quickly Overcome. Eniram Remedy Co., Anderson, Ind.

Pyorrhea. H. E. Kelty, D.D.S., M.D., pyorrhea specialist for 15 years, has developed a successful home treatemnt for pyorrhea. Purifying, healing, preventative. Full month's treatment and booklet $1. Circular free. Dr. H. E. Kelty, 106 Gladwin Ave., Leonia, N. J.

Chemicals.

Chemicals in Sets, $13.50 to $54.25. Apparatus in sets, $11.75 to $55. Write for particulars. Ziegler Experimental Laboratory, Rochester, N.Y.

Chemicals. Special, 35 different chemicals, one ounce of each, including mercury, acids, etc. Sent express prepaid $2.50. Jos. Simpson, 3880 Windsor Place, St. Louis, Mo.

Amateurs and Experimenters—We can supply you with any chemicals and apparatus at the lowest prices. Write for our price list. Jos. Simpson, 3880 Windsor Pl., St. Louis, Mo.

Chemists. Send 75c for a complete set of 150 labels for your chemicals. Reginald Pitts, 103 Third St., Hanover, Pa.

Standard Chemicals and laboratory apparatus, cheap and reliable. July list and 10 formulae 6c. Frane, Eureka, Ill.

Potassium Sulphocyanide C. P. at 50c per oz., postpaid. Ziegler Experimental Laboratory, Rochester, N. Y.

Electrical Supplies & Appliances.

Castings, Blueprints, Engines—Gas and Steam, ⅛ H.P. up. Gears, Pulleys, Pumps, Fittings, Small Boilers. Complete circulars for stamp. Latest models. Universal Gas Motor Co., 364 Monadnock Block, Chicago.

Obtain a Vial of Radium to complete your outfit. Used for illuminating light bulbs, keyholes, watch dials, etc. Price 1.00. Address G. Raymond Laboratories, 298 Broadway, N. Y. C.

Motor Connections. See ad under "Blueprints." Charles Chittenden.

Magnets: Large Horseshoe Magnets. Will lift 12 lbs. Mail $1, stamps or Money Order. Parcel Post Prepaid to all parts of U. S. or Canada. West Side Novelty Co., Drawer No. 8 Wabash P. O., Pittsburgh, Pa.

Battery Charging pays big profits with HB Equipment. Electric Light Generators and Motors can also be furnished on easy payments. Full information free. Hobart Brothers, Troy, Ohio.

Storage Batteries charged by alternating current. Inexpensive, Simple and Efficient; Instructions and Print $1. K. & S. Engineering, Box 124, Sewickley, Pa.

Electrical Workers and all others who are interested in Electrical Work in the Reconstruction that is taking place. To send us their name and receive descriptive literature of our Modern Blue Print Chart Method of Electrical Wiring. Souvenir information card included. Electrical Wiring Diagram Co., Box C. 173, Altoona, Pa.

"Danditoy" Transformers, 2½-27½ volts, $2.98. Description sent. Eagleco, Darien, Conn.

For Sale—2,000 Standard Signal Corps Audion B. Batteries, Type BA-2, each 22 volts, 50c each while they last, postage extra, 1 lb. Herman Silber, 164 Ross St., Brooklyn, N. Y.

Lava Insulation is not molded but individually sawn, lathe turned, milled, drilled, threaded. No limitation on form, only on size. Kilned at two thousand degrees. Hard, strong, accurate, fire, acid proof. Ask for hook. American Lava Insulator Company, Chattanooga, Tenn.

Continued on page 382

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